



**RURAL ELECTRIFICATION WORKSHOP**  
**Bangkok, February 23-25, 2005**

# **Rural Electrification by Renewable Energy in Cambodia**

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## **BACKGROUND**

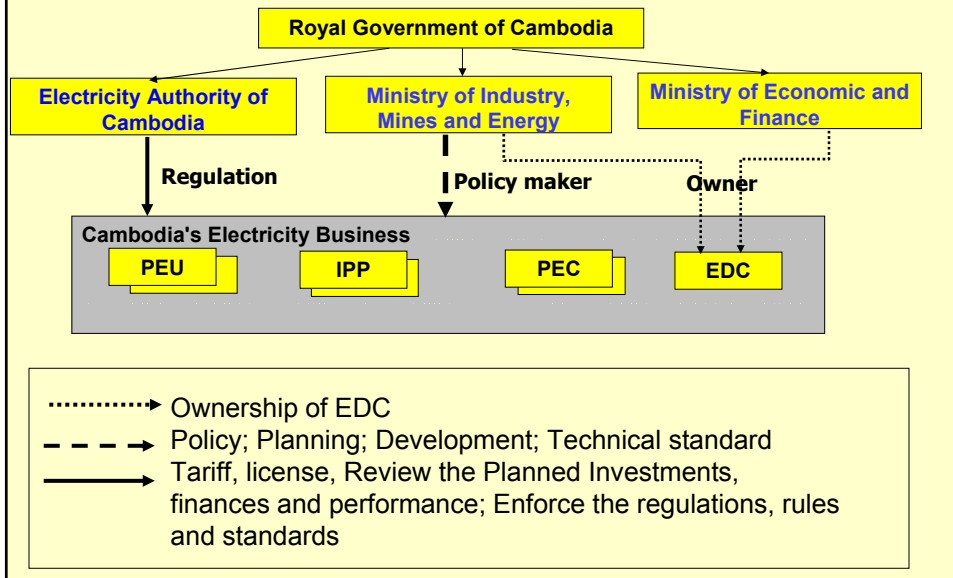
- **Territory: 181,035 sq. km**
- **Population: 13 million (85% in rural areas)**
- **GDP: US\$280 per capita**
- **Electrification rate : 17% (urban~54% and rural~13%)**
- **Energy consumption: 55 kWh per capita**
- **Electric energy price : US\$0.09-0.25 per kWh**
- **In rural area / using battery and diesel generator :  
US\$0.4-0.8 per kWh**
- **Generation in 2004 : 200MW and 1,000GWh**
- **Projection in 2015 : 750 MW and 3,000GWh**
- **Main generation source: Fuel Oil (DO and HFO)**
- **High potential of hydro source : more than 10,000MW**

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## **BACKGROUND (cont.)**

- **March 1996: Corporatisation of Electricité du Cambodge (EDC) as a limited liability state company to supply electricity to Phnom Penh and six provincial towns. In 2004 MIME transfers 7 more provincial towns to EDC. EDC manages about 80% of generation and distribution in the country and also is responsible for all transmission operation.**
- **Feb., 2001 : Promulgation of Electricity Law, setting a framework to regulate the electricity sector.**
- **Sep., 2001 : Establishment of Electricity Authority of Cambodia (EAC), as a regulatory body, which is responsible for licensing, tariff setting and enforcing the performance of the electricity supply industry.**
- **MIME : continues to be responsible for government policy, strategic planning and technical standards for the electricity sector.**
- **Other suppliers of electricity : Private Electricity Operators/Companies, including IPPs, Provincial Electricity Companies and Rural Electricity Enterprises, manage the remaining generation and distribution systems<sub>4</sub>**

## Current Structure of Electricity Sector



## Power Sector Development Policy

It was formulated in October, 1994:

- To provide an adequate supply of energy throughout Cambodia at reasonable and affordable price,
- To ensure a reliable and secured electricity supply at reasonable prices, which facilitates the investments in Cambodia and developments of the national economy,
- To encourage exploration and environmentally and socially acceptable development of energy resources needed for supply to all sectors of Cambodia economy,
- To encourage the efficient use of energy and to minimize the detrimental environmental effects resulted from energy supply and consumption.

## **Energy Sector Strategy**

With referring to the draft CPSS 1999-2016 (WB) & the draft revised 2004-2020, its focus on 3 mains components:

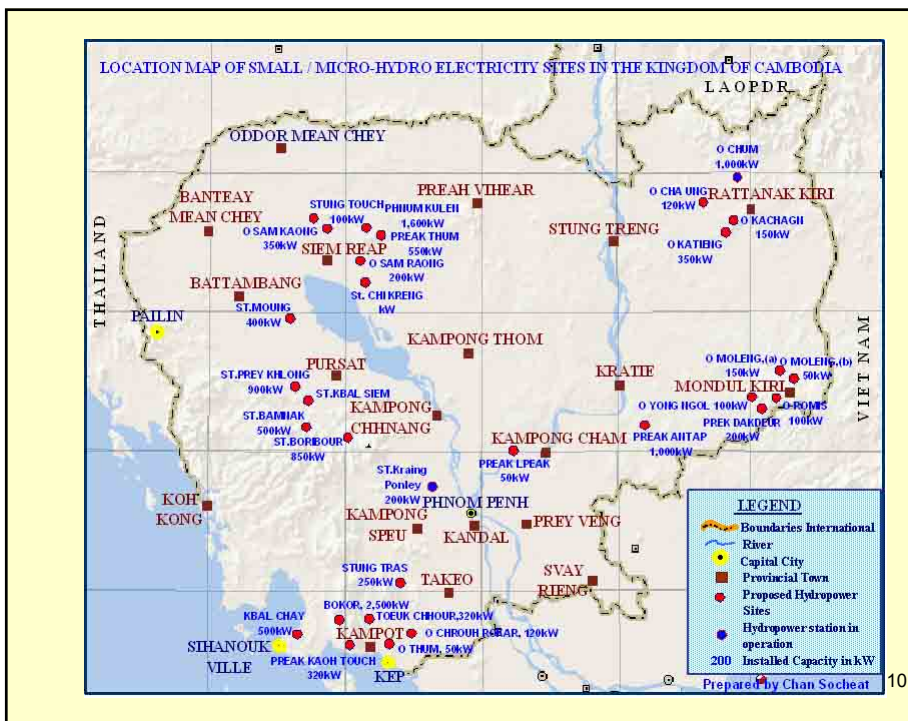
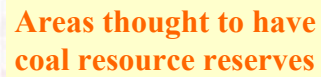
- 1- Generation Master Plan
- 2- Transmission Master Plan
- 3- Rural Electrification

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## **The Potential of Cambodia's Energy Resources**

- Petroleum & Natural Gas are under the responsibility of CNPA
- Coal
- Hydropower
- Renewable Energy ( solar, wind, mini-micro hydro, wood fuel, biomass, biogas, biofuel etc.. )

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| Micro-Hydropower Project |  |                        |                      |  |  |                 |                        |                                |                     |                     |          |                    |                   |                           |       |       |                 |  |
|--------------------------|--|------------------------|----------------------|--|--|-----------------|------------------------|--------------------------------|---------------------|---------------------|----------|--------------------|-------------------|---------------------------|-------|-------|-----------------|--|
| Site No.                 | Hydro Project Name                       | Province               | Map Ref Series 17018 | Distance from Demand Centre to Power House | Distance from Existing Transmission Line | Catchment Area  | Mean Annual Rainfall   | Mean Annual Evapotranspiration | Mean Annual Flow    | Power Flow          | Net Head | Installed Capacity | Annual Generation | Development Cost (USD/kV) |       |       | Production Cost |  |
|                          |  |                        |                      | km   | km                                       | km <sup>2</sup> | liters/km <sup>2</sup> | liters/km <sup>2</sup>         | m <sup>3</sup> /sec | m <sup>3</sup> /sec | m        | kV                 | kVhr/yr           | Hydro                     | Trans | Total | USD/kVhr        |  |
| 1                        | Kbal Chay                                | Sihanoukville          | 5737III              | 17.1                                       | 8.5                                      | 45              | 3,500                  | 1,100                          | 3.4                 | 3                   | 12.49    | 312                | 1,80,583          | 2,944                     | 144   | 2,988 | 0.097           |  |
| 2                        | Upper Kamchay                            | Kampot                 | 5830IV               | 26   | 13                                       | 243             | 3,500                  | 1,100                          | 18.5                | 10                  | 37.6     | 3,132              | 12,001,374        | 1,886                     | 46    | 1,932 | 0.061           |  |
| 3                        | Prek Toek Chhu                           | Kampot                 | 5830III              | 15.6                                       | 4.8                                      | 710             | 3,500                  | 1,100                          | 54.0                | 5                   | 18.28    | 762                | 5,139,974         | 3,391                     | 33    | 3,424 | 0.071           |  |
| 4                        | O Touroo Trao                            | Kampot                 | 5830III              | 13.1                                       | 2.7                                      | 20              | 3,500                  | 1,100                          | 1.5                 | 1                   | 134.73   | 1,122              | 5,488,956         | 1,629                     | 13    | 1,642 | 0.041           |  |
| 5                        | Snam Prampir                             | Kampot                 | 5830III              |  |  |                 |                        |                                |                     |                     |          |                    |                   |                           |       |       |                 |  |
| 6                        | Bokor Plateau                            | Kampot                 | 5830III              | 13.1                                       | 2.7                                      | 44              | 3,500                  | 1,100                          | 3.3                 | 3                   | 40       | 1,000              | 3,821,728         | 1,800                     | 44    | 1,844 | 0.07            |  |
| 7                        | Prek Kaoh Touch                          | Kampot                 | 5830UTM              |  |  |                 |                        |                                |                     |                     |          |                    |                   |                           |       |       |                 |  |
| 8                        | Turnup Koun Sav (O THUM)                 | Kampot                 | 5830UTM              |  |  |                 |                        |                                |                     |                     |          |                    |                   |                           |       |       |                 |  |
| 9                        | O Chruoh Rokar                           | Kampot                 | 5830UTM              |  |  |                 |                        |                                |                     |                     |          |                    |                   |                           |       |       |                 |  |
| 10                       | Stung Tras                               | Takeo-Kampot - Kg Speu | 5831UTM              |  |  |                 |                        |                                |                     |                     |          |                    |                   |                           |       |       |                 |  |
| 11                       | Phnum Bayang Koi (O Chhneung)            | Takeo                  | 5830UTM              | 40   | 40                                       | 5               | 1,451                  | 1,000                          | 0.1                 | 0.067               | 60       | 30                 | -                 | -                         | -     | -     | -               |  |
| 12                       | Stung Kring Ponleay                      | Kg Speu - Kg Chhnang   | 5832UTM              |  |  |                 |                        |                                |                     |                     |          |                    |                   |                           |       |       |                 |  |
| 13                       | Stung Sva Slab                           | Kampong Speu           | 5831IV               | 80   | 30                                       | 205             | 2,200                  | 1,000                          | 7.8                 | 8                   | 56.66    | 3,804              | 20,296,185        | 1,634                     | 54    | 1,688 | 0.055           |  |
| 14                       | Stung Boinbour                           | Kg Chhnang             | 5833UTM              |  |  |                 |                        |                                |                     |                     |          |                    |                   |                           |       |       |                 |  |
| 15                       | Stung Bannak                             | Kg Chhnang             | 5833UTM              |  |  |                 |                        |                                |                     |                     |          |                    |                   |                           |       |       |                 |  |
| 16                       | Stung Kbal Siem (St. Kampong La)         | Kg Chhnang             | 5833UTM              |  |  |                 |                        |                                |                     |                     |          |                    |                   |                           |       |       |                 |  |
| 17                       | Siem Reap No.1 (entg French)             | Siem Reap              | 5735I                | 15   | 11.9                                     | 600             | 1,200                  | 1,000                          | 3.8                 | 0                   | 0        | -                  | -                 | -                         | -     | -     | -               |  |
| 18                       | Siem Reap No.2 (Disused Irrigation Vst)  | Siem Reap              | 5735I                | 0  | 0.2                                      | 670             | 1,200                  | 1,000                          | 4.2                 | 0                   | 0        | -                  | -                 | -                         | -     | -     | -               |  |
| 19                       | Siem Reap No.3 (entg Western Irrigation) | Siem Reap              | 5735I                | 17.7                                       | 7.8                                      | 600             | 1,200                  | 1,000                          | 3.8                 | 0                   | 0        | -                  | -                 | -                         | -     | -     | -               |  |
| 20                       | Stung Siem Reap (2)                      | Siem Reap              | 5836III              | 47.9                                       | 44                                       | 115             | 1,600                  | 1,000                          | 2.2                 | 3                   | 69.25    | 1,732              | 6,639,554         | 2,120                     | 212   | 2,332 | 0.074           |  |
| 21                       | Upper Stung Siem Reap (3)                | Siem Reap              | 5836III              | 52.7                                       | 48.8                                     | 86              | 1,600                  | 1,000                          | 1.6                 | 3                   | 26.22    | 656                | 2,036,354         | 1,709                     | 88    | 1,797 | 0.055           |  |
| 22                       | Kbal Siem Waterfall                      | Siem Reap              | 5836UTM              |  |  |                 |                        |                                |                     |                     | 12       |                    |                   |                           |       |       |                 |  |

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|    |                                 |              |         |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
|----|---------------------------------|--------------|---------|------|------|-----|-------|-------|------|-----|--------|-------|------------|-------|-----|-------|-------|--|
| 23 | O Sam Raong                     | Siem Reap    | 5835UTM |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
| 24 | Stung Touch                     | Siem Reap    | 5736UTM |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
| 25 | O Sam Kaong                     | Siem Reap    | 5736UTM |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
| 26 | Stung Chi Kreng                 | Siem Reap    | 5835UTM |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
| 27 | Stung Muong No.1                | Battambang   | 5634III | 34   | 34   | 546 | 1,800 | 1,000 | 13.9 | 4   | 20     | 400   | -          | -     | -   | -     | -     |  |
| 28 | Stung Muong No.2                | Battambang   | 5634III | 18.8 | 18.8 | 550 | 1,800 | 1,000 | 14.0 | 13  | 4      | 400   | -          | -     | -   | -     | -     |  |
| 29 | Stung Pursat No.1               | Pursat       | 5733I   | 46   | 40   | 700 | 1,600 | 1,000 | 13.3 | 4   | 2      | 100   | -          | -     | -   | -     | -     |  |
| 30 | Stung Prey Klong                | Pursat       | 5733II  | 20   | 20   | 555 | 1,600 | 1,000 | 10.6 | 3   | 2      | 100   | -          | -     | -   | -     | -     |  |
| 31 | Prek Antap (Memut District)     | Kg Cham      | 6232 IV |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
| 32 | Prek Lpeak (Kg Siem District)   | Kg Cham      | 6033UTM |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
| 33 | O Chum 1                        | Ratanak Kiri | 6436V   | 8    | 3    | 0.3 | -     | 1,200 | 3.8  | 3.8 | 10     | 300   | -          | -     | -   | -     | -     |  |
| 34 | O Katieng                       | Ratanak Kiri | 6336II  | 10   | 10   | 44  | 3,000 | 1,000 | 2.8  | 3   | 43.05  | 1,076 | 4,025,338  | 2,593 | 90  | 2,683 | 0.087 |  |
| 35 | Prek Dal Deur (S)               | Mondul Kiri  | 6434III | 11.3 | 11.3 | 53  | 2,600 | 1,200 | 2.4  | 16  | 14.3   | 200   | 1,000,578  | 5,645 | 296 | 5,941 | 0.14  |  |
| 36 | O Phlai                         | Mondul Kiri  | 6433I   | 27   | 27   | 95  | 2,800 | 1,000 | 5.4  | 4.5 | 92.78  | 3,478 | 12,377,213 | 1,586 | 75  | 1,661 | 0.057 |  |
| 37 | Prek Por                        | Mondul Kiri  | 6434II  | 30   | 30   | 198 | 2,800 | 1,000 | 11.3 | 15  | 38.53  | 4,800 | 12,710,928 | 1,290 | 62  | 1,352 | 0.073 |  |
| 38 | Prek Dal Deur (Meitec site) (S) | Mondul Kiri  | 6434III | 13   | 13   | 102 | 2,800 | 1,000 | 5.8  | 5   | 17.52  | 721   | 2,408,226  | 2,510 | 115 | 2,625 | 0.095 |  |
| 39 | O Moleng1                       | Mondul Kiri  | 6433 IV |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
| 40 | O Moleng2                       | Mondul Kiri  | 6434 IV |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
| 41 | O Romiss                        | Mondul Kiri  | 6435 IV |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
| 42 | O Yong Ngol                     | Mondul Kiri  | 6436 IV |      |      |     |       |       |      |     |        |       |            |       |     |       |       |  |
| 43 | Kirolm III                      | Koh Kong     | 573III  | 140  | 40   | 98  | 2,500 | 1,000 | 4.7  | 5   | 250.36 | 8,342 | 38,792,449 | 1,344 | 48  | 1,392 | 0.039 |  |
| 44 | Phnom Batau Downstream          | Koh Kong     | 573III  | 140  | 44   | 105 | 2,500 | 1,000 | 5.0  | 5   | 100.78 | 4,197 | 21,302,049 | 1,188 | 100 | 1,288 | 0.031 |  |
| 45 | Phnom Tursang Upstream(3)       | Koh Kong     | 573III  | 140  | 2    | 32  | 2,500 | 1,000 | 1.5  | 2   | 188.66 | 3,143 | 15,853,167 | 1,406 | 6   | 1,412 | 0.054 |  |
| 46 | Phnom Tursang Downstream(3)     | Koh Kong     | 573III  | 140  | 7    | 53  | 2,500 | 1,000 | 2.5  | 4   | 90.11  | 3,002 | 14,356,893 | 1,704 | 21  | 1,725 | 0.071 |  |
| 47 | O Sla Upstream                  | Koh Kong     | 573III  | 140  | 3    | 54  | 2,800 | 1,000 | 3.1  | 3   | 78.15  | 1,953 | 10,208,534 | 1,682 | 14  | 1,676 | 0.058 |  |
| 48 | O Sla Downstream                | Koh Kong     | 573III  | 140  | 7    | 75  | 2,800 | 1,000 | 4.3  | 5   | 107.64 | 4,483 | 13,851,211 | 2,022 | 15  | 2,037 | 0.048 |  |

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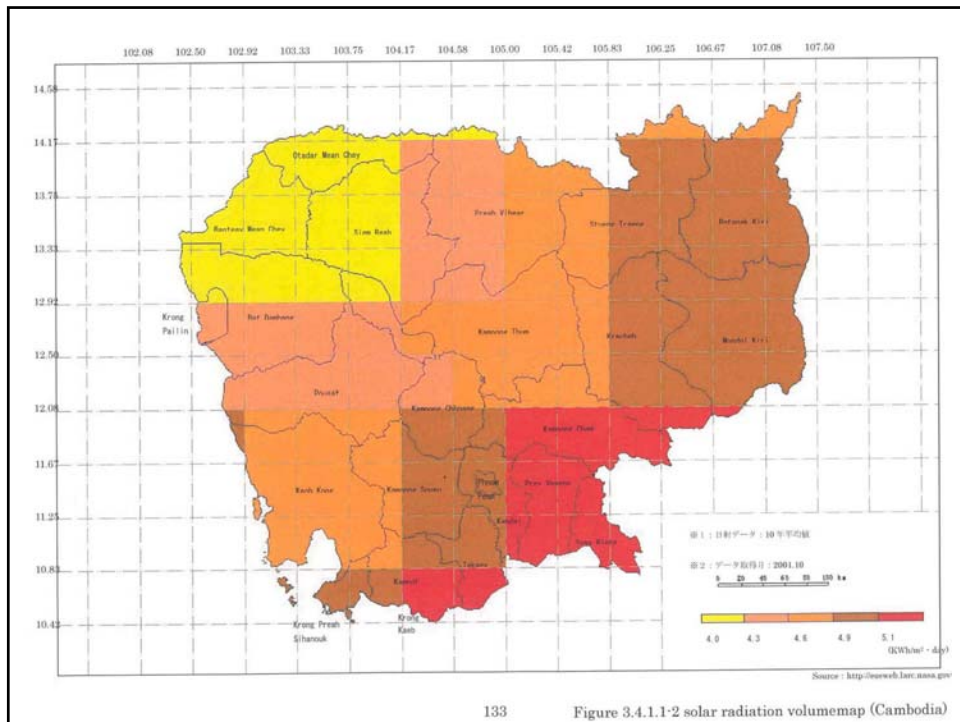
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|    |                          |                                  |         |        |            |        |       |       |       |        |      |               |      |       |      |      |         |        |
|----|--------------------------|----------------------------------|---------|--------|------------|--------|-------|-------|-------|--------|------|---------------|------|-------|------|------|---------|--------|
| 20 | Upper PREK TE            | MONDUL KIRI (REANG)              | 107 11' | 12 24' | Desk Study | 112    | 4.10  | -     | 26    | 685    | -    | 3.30          | 50   | 725   | 14.7 | 77   | -       | 57.6   |
|    |                          |                                  | -       | -      | -          | -      | -     | -     | 15    | 14     | 680  | 325           | 170  | 35    | 200  | 15   | -       | 10.20  |
|    |                          |                                  | -       | -      | -          | -      | -     | -     | 5.60  | 5      | 680  | -             | 0.50 | 35    | 200  | -    | -       | -      |
| 21 | STUNG SEN                | KOMPONG THOM (SAN THOUK)         | 105 15' | 13 17' | Desk Study | 10,500 | 530   | 3,660 | 2,890 | 43.50  | 19   | 145           | 38   | 2,700 | 38   | 201  | 130,000 | 80.40  |
| 22 | STUNG PURSAT 1           | PURSAT (KRAYANH)                 | 103 17' | 12 16' | Desk Study | 1,000  | 23    | -     | 123   | 200    | 125  | 10.10         | 15   | 200   | 3.5  | 9    | -       | 10.60  |
| 23 | STUNG PURSAT 2           | PURSAT (KRAYANH)                 | 103 37' | 12 17' | Desk Study | 2,880  | 283   | 335   | 130   | 45     | <15  | 9.70          | 28   | 250   | 17   | 715  | -       | 59.60  |
| 24 | PREK CHBAR               | MONDUL KIRI (KOHHEO)             | 107 03' | 13 04' | Desk Study | 1,220  | 70    | 355   | 238   | 144.60 | <4.8 | <26           | 30   | 3,000 | -    | -    | 26,000  | 8.50   |
| 25 | PREK SANTAI              | RATANAK KIRI (LOMPHAT)           | 107 18' | 13 32' | Desk Study | 350    | 14    | 56    | 46    | 140    | <5   | <6            | 25   | 1,600 | -    | -    | 6,000   | 3.30   |
| 26 | PREK DRANG               | RATANAK KIRI (VA DAR)            | 107 27' | 13 31' | Desk Study | 1,250  | 21    | 26    | 56    | 139    | <4   | 14            | 30   | 300   | -    | -    | 14,000  | 2.50   |
| 27 | PREK KRIENG              | KRATIE (SAMBOR)                  | 106 33' | 12 56' | Desk Study | 970    | 41    | 190   | 180   | 10     | <10  | 10            | 35   | 850   | -    | -    | 10,000  | 4.80   |
| 28 | PREK KAMPIE              | KRATIE (KRATIE)                  | 106 16' | 12 38' | Desk Study | 620    | 37    | 235   | 225   | 60     | <10  | 7             | 25   | 625   | -    | -    | 7,000   | 2.50   |
|    |                          |                                  | 106 45' | 12 40' |            | 985    | -     | 285   | 285   | 200    | <20  | 15.60         | 45   | 450   | -    | -    | -       | -      |
| 29 | Lower PREK TE            | MONDUL KIRI (Pich Roda/Keo Sema) | 106 52' | 12 38' | Desk Study | 445    | 105   | 170   | 160   | 120    | <10  | 3.10          | 30   | 900   | -    | -    | 30,000  | 11.10  |
|    |                          |                                  | 106 46' | 12 30' |            | 317    | -     | 70    | 90    | 143.50 | <7.5 | 4.40          | 25   | 750   | -    | -    | -       | -      |
|    |                          |                                  |         |        |            | 225    | -     | 27    | 22    | 80     | <2.5 | 1.80          | 25   | 800   | -    | -    | -       | -      |
| 30 | PREK CHLONG              | KRATIE (SMOUL)                   | 106 26' | 12 15' | Desk Study | 3,320  | 87    | 575   | 285   | 63.50  | <3.5 | 24            | 30   | 1,800 | -    | -    | 24,000  | 6.90   |
| 31 | STUNG STANG              | KAMPONG THOM (Pivut Baing)       | 105 46' | 13 15' | Desk Study | 1,500  | 144   | 590   | 550   | 55     | <10  | 20            | 25   | 3,000 | -    | -    | 20,000  | 10.00  |
| 32 | Lower STUNG RUSEI CHRUM  | KOH KONG (MONDUL SEMA)           | 103 06' | 11 47' | Desk Study | 1,020  | 140   | -     | 21    | 120    | 103  | 88.6          | 55   | 200   | 125  | 656  | -       | 123.80 |
| 33 | Middle STUNG RUSEI CHRUM | KOH KONG (MONDUL SEMA)           |         |        | Desk Study | -      | 28    | -     | 277   | -      | -    | 43.00         | 60   | 1,100 | 125  | 668  | -       | 274.60 |
| 34 | STUNG ATAY DIVERSION     | KOH KONG (THMOR BAING)           |         |        | Desk Study | -      | 48    | -     | 565   | -      | -    | 31.0          | 55   | 2,350 | 180  | 588  | -       | 156.40 |
| 35 | STUNG TATAY              | KOH KONG (THMOR BAING)           | 103 26' | 11 42' | Desk Study | 353    | 33    | 610   | 596   | 420    | 180  | 32.10         | 55   | 750   | 90   | 416  | -       | 214.80 |
| 36 | STUNG CHAY ARENG 3       | KOH KONG (THMOR BAING)           | 103 32' | 11 37' | Desk Study | 950    | 180   | 1,750 | 1,600 | 210    | 163  | 185.7         | 55   | 1,200 | 260  | 1358 | -       | 501.80 |
| 37 | KIRIPOM PLATEAU          | KOH KONG (SRE AMBOL)             | 103 43' | 11 15' | Desk Study | 105    | 4.30  | 40    | 38    | 395    | 283  | 3.50          | 40   | 300   | 13   | 70   | -       | 28.70  |
| 38 | STUNG PIPHOT             | KOH KONG (BOTUM SAKOR)           | 103 28' | 11 16' | Desk Study | 1,010  | 210   | 3,800 | 1,810 | 35     | 30   | 89.80         | 50   | 1,400 | 25   | 140  | 32,500  | 62.00  |
| 39 | PREK KAMPONG LED         | KOH KONG (SRE AMBOL)             | 103 55' | 11 07' | Desk Study | 580    | 57    | 240   | 220   | 22     | <4   | 7             | 27   | 650   | -    | -    | 12,000  | 6.70   |
| 40 | BOKOR PLATEAU            | KAMPOT (KAMPOT)                  | 104 03' | 10 40' | Desk Study | 21     | 4.10  | 27    | 25    | 950    | 885  | 2.32          | 45   | 900   | 28   | 147  | 1,500   | 63.80  |
| 41 | STUNG METEUK 1           | KOH KONG (MONDUL SEMA)           | 102 47' | 12 00' | Desk Study | 670    | 15.40 | 280   | 220   | 130    | 107  | 17.30         | 60   | 350   | 25   | 134  | -       | 76.20  |
| 42 | RIVER "A"                | KOH KONG (THMOR BAING)           | 103 12' | 11 47' | Desk Study | 955    | 6.70  | 93    | 81    | 400    | -    | 10.80         | 55   | 500   | -    | -    | -       | 7.10   |
| 43 | STUNG SALA MUTHUN        | KOH KONG (THMOR BAING)           | 103 16' | 11 45' | Desk Study | 103    | 6.30  | 66    | 61    | 480    | -    | 7.50          | 55   | 250   | -    | -    | -       | 8.50   |
| 44 | KIRIPOM EXTENSION        | KOH KONG (SRE AMBOL)             | 104 02' | 11 16' | Desk Study | 86     | 1.70  | 105   | 9     | 465    | -    | 0.48 to 0.60m | 35   | 265   | 13   | 6.2  | -       | 4.70   |
| 45 | STUNG KEP                | KAMPOT (KAMPOT)                  | 103 23' | 11 50' | Desk Study | 210    | n/a   | -     | -     | 480    | -    | -             | -    | -     | -    | -    | -       | 7.50   |

Table lists the priority Hydropower Projects which need the private sector participation.

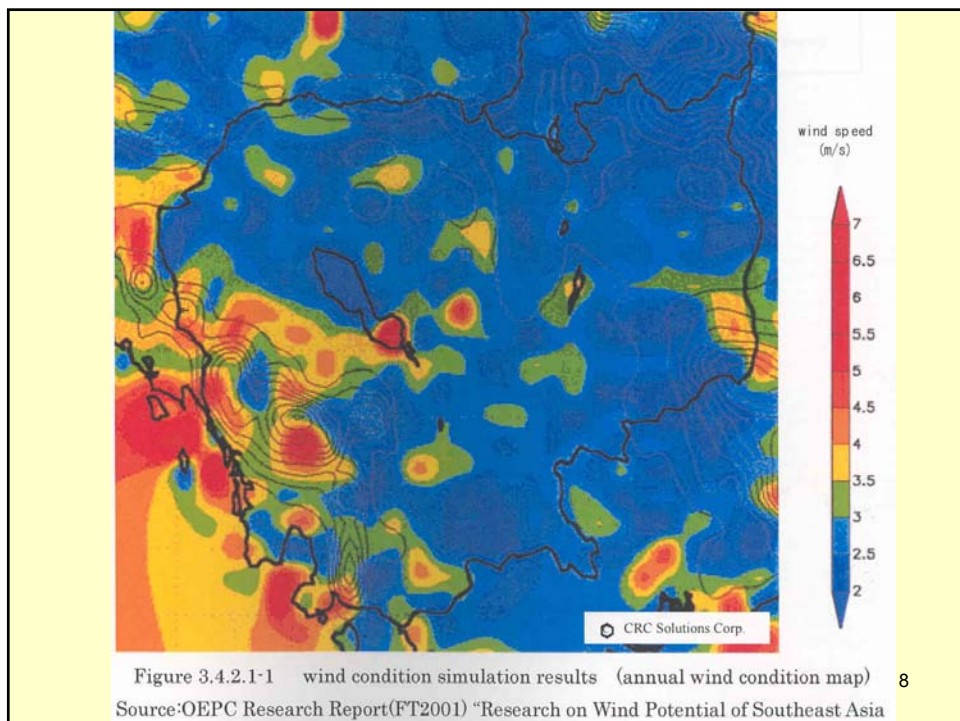
| No. | Project's Name            | Installed Capacity (MW) | Annual Energy (GWh) | Project's Cost in Mio. US\$ | Purposes                       | Remarks                |
|-----|---------------------------|-------------------------|---------------------|-----------------------------|--------------------------------|------------------------|
| 1   | Kamchay                   | 180                     | 558                 | 250                         | Power Generation or Irrigation | Prefeasibility Study   |
| 2   | Kirirum III               | 13                      | 70                  | 29                          | Power Generation               | Desk Study             |
| 3   | Battambang 2              | 36                      | 187                 | 65                          | Power Generation               | Desk Study             |
| 4   | Battambang 1              | 24                      | 120                 | 49                          | Power Generation or Irrigation | Desk Study             |
| 5   | Stung Atay                | 110                     | 588                 | 156                         | Power Generation or Irrigation | Desk Study             |
| 6   | Middle Stung Russey Chrum | 125                     | 668                 | 275                         | Power Generation               | Desk Study             |
| 7   | Lower Stung Russey Chrum  | 125                     | 656                 | 130                         | Power Generation               | Desk Study             |
| 8   | Upper Stung Russey Chrum  | 32                      | 211                 | 65                          | Power Generation               | Desk Study             |
| 9   | Stung Meteuk 2            | 210                     | 384                 | 290                         | Power Generation or Irrigation | Desk Study in Thailand |
| 10  | Stung Meteuk 1            | 175                     | 350                 | 320                         | Power Generation or Irrigation | Desk Study in Thailand |
| 11  | Stung Meteuk 3            | 50                      | 105                 | 190                         | Power Generation               | Desk Study             |
| 12  | Sambor                    | 467 or 3,300            | 2,800 or 14,870     | 700 or 3940                 | Power Generation or Irrigation | Desk Study             |
| 13  | Lower Sre Pok 2           | 222                     | 1,174               | 339                         | Power Generation               | Preliminary Study      |
| 14  | Lower Se San 2            | 207                     | 1,065               | 374                         | Power Generation               | Preliminary Study      |

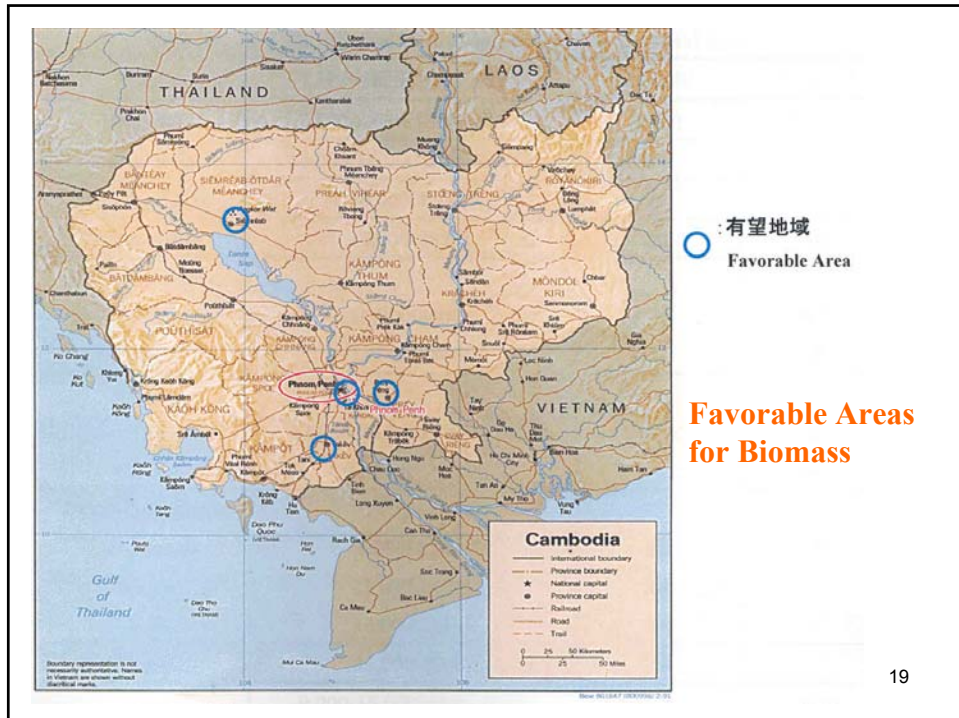




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Figure 3.4.1.1-2 solar radiation volumemap (Cambodia)





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# RURAL ELECTRIFICATION (RE)

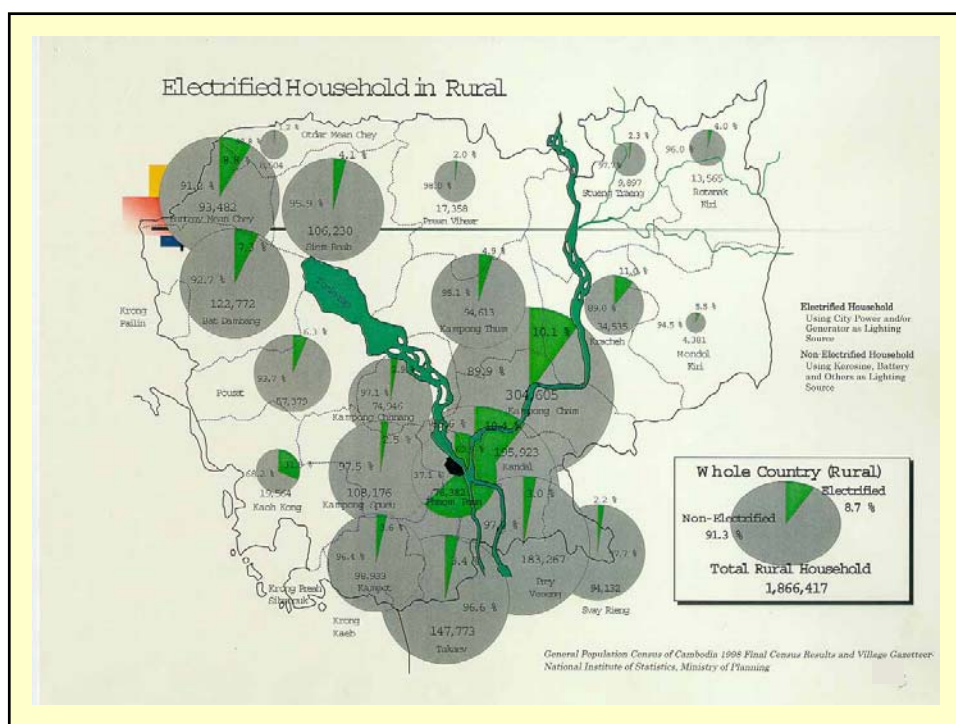


## Current Situation of Energy Use in Rural Area

Base on the survey of 2000 showed:

- Kerosene 92%
- L.a.Batteries 55%
- Dry Cell Batteries 24%
- Candles 11%
- REE 04%
- Small Genset 03%
- EDC Grid 02%

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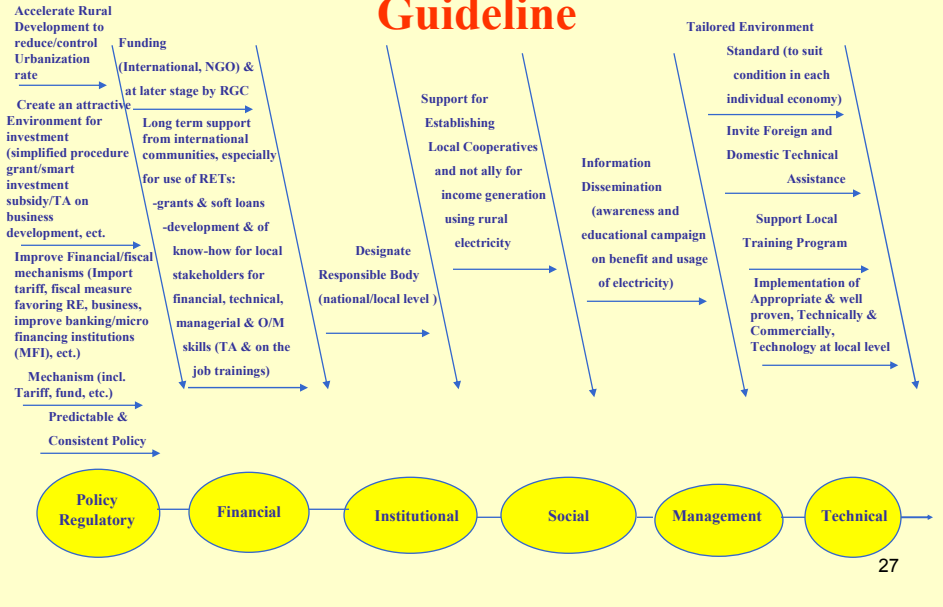




## **RE – STRATEGY COMPONENTS**

- Target to achieve 70% of RE by the year 2030 with grid quality.
- Main components of the Rural Electrification Strategy:
  1. **Grid expansion from the existing**
  2. **Diesel stand-alone, Mini-Utility Systems**
  3. **Cross-border Power Supply from neighboring countries (Thailand, Vietnam and Lao)**
  4. **Renewable Energy (Solar, Wind, mini-micro hydro, Biomass, Biogas, biofuel etc...)**

## Schematic Rural Electrification (RE) Guideline



## CONCEPT OF SUSTAINABLE RURAL ELECTRIFICATION AND ITSTARGET

Aims at:

- Non-electrified remote areas, which are far from national grid
- Developing the country
- Promoting local resources, such as Solar, Wind, Hidro, Biogas, Biomass, or Geothermal
- People participation.



## **KEY SUCCESS FACTORS OF SUSTAINABLE RURAL ELECTRIFICATION**

Are:

1. To provide sufficient Transfer of Practical Techniques to local staff,
2. To secure Sustainable Revenue at site for Implementation Activities, and
3. Public Participation and Consultation for Planning, Construction, Maintenance and Management.

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## **RURAL ELECTRIFICATION BY RENEWABLE ENERGY**

### **• National Policy on Renewable Energy**

The basis of the proposed policy is:

- Endeavor to provide access to reliable, safe and environmentally clean electricity services to rural areas, at an affordable cost to the national community;
- Act as a market enabler and encourage private sector participation in providing rural renewable electricity services;
- Provide effective legal and regulatory framework for enabling access to reliable, safe and clean electricity services to rural areas, at an affordable cost to the national community;

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## **National Policy on Renewable Energy (cont.)**

- Encourage the most efficient systems for generation, transmission and distribution of electricity from clean and renewable energy sources, to enable a rational electricity tariff policy through promotion of differentiated tariffs based on cost recovery principles;
- Promote renewable electricity systems for rural applications, as part of a national portfolio of grid and off-grid technologies, provided they are the least-cost option for the national communities; and
- Ensure adequate resources and appropriate institutional mechanisms to empower the poor, particularly those in rural areas.

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## **National Strategy on Renewable Energy**

The basic of the proposed strategy is :

- Widely expand the access for electricity services to the rural population through development of appropriate programs and action plans to promote the Renewable Energy Technologies (RET);
- Expand the supply base for renewable energy services by motivating and promoting the participation of private entrepreneurs so as to provide efficient and cost-effective services, which will benefit the whole community;
- Facilitate systematic market and institutional development in renewable electricity sector by creating a comprehensive legal and regulatory framework to enable effective participation of government, private and community based entities in providing electricity services to the rural consumers;

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## **National Strategy on Renewable Energy (cont.)**

- Ensure a wide and equitable access of electricity services to all sections of the rural population by developing appropriate tariff policies and instituting a rational tariff regime;
- Promote environmentally sustainable small power technologies including RET in on-grid and/or off-grid mode in order to create wide access for rural consumers to affordable electricity services; and
- Contribute to empowerment of the rural poor by creating economic opportunities and uplifting standards of living through electricity services, and through involving them in planning, operation, maintenance and management (OM&M) of programs providing those services.

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## **MASTER PLAN ON RENEWABLE ENERGY**

Purpose – To identify and evaluate the Renewable Energy Potential for the whole Kingdom of Cambodia

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## **RE MASTER PLAN BY RENEWABLE ENERGY**

- **GOAL** - To improve the current level of electrification and reduction poverty as well as enhancing education and medical treatment in the rural areas.
- **PURPOSES**- Study of policies to promote electrification in those areas not yet serviced
  - Introduction and development of Renewable Energy Technologies
  - Study of institution and organization for sustainable operation and maintenance supported by the appropriate business model, including the financial procurement plan.
- **TARGET** - To achieve 100% of Rural Villages by the year 2020.

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## **RENEWABLE ENERGY ACTION PLAN (REAP)**

- **REAP MISSION**
- **REAP GUIDING PRINCIPLE**
- **REAP LONG TERM TARGET**
- **IMPLEMENT THE 5 YEARS REAP**
- **FINANCIAL RESOURCES**

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# WHY

## RURAL ELECTRIFICATION BY RENEWABLE ENERGY IN CAMBODIA???

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## DUE TO THE FACTS THAT

- Some Renewable Energy Technologies (RET) still have some “weaknesses”, in terms of for example, reliability
- Invest cost of RET still high / very high investment cost
- Some RET still under Research & Development (R&D)
- There are no understanding on the RET usefulness & no RET support from policy makers and people
- There are weaknesses in financing, banking & incentive systems (e.g. no import tax, fiscal incentives etc...)

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## IN CASE OF CAMBODIA

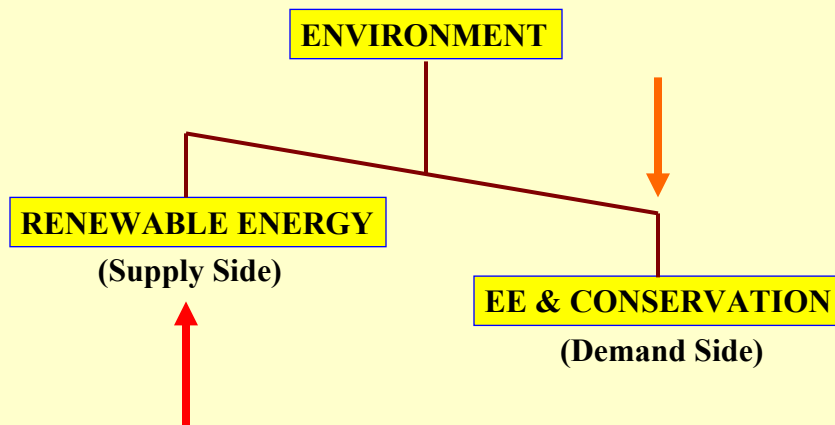
- Because the impact on the environment is one of the major problems facing this new century and the future period of the country, the region and the whole world.

So in this case:

- The Royal Government of Cambodia (RGC) has supported and ratified the Kyoto Protocol in the year 2002
- RGC is progressing from “support” to “concrete implementation” when feasible, notably in the energy field:
  - It promotes and encourages the development of renewable energy on the supply side, and
  - It promotes and encourages the efficient use of energy and the energy conservation, with the EE&EC programme on demand side.
  - Cambodia has indeed plenty of renewable energy resource, which can be converted into electricity, in particular for the supply of rural areas.

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## CONCEPT



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## Rural Electrification-Mechanism

To implement and to achieve the goals set by the policy, strategy and action plan, the RGC must first establish the **Rural Electrification Fund (REF)**

- REF is the creation of the Royal Government of Cambodia and the World Bank, with the goal of encouraging the private sector for investment in electricity supply to the rural population, with smart subsidies and Smart credit scheme for reason of social equity.
- Agreed electricity price sold to the rural population would be such that the rural entrepreneurs will still make project.
- Investment Fund will come from grants and loans with low interest rate and long term period from versions credit and financing institution.

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## EXAMPLE...

- **Financial Resources**

**From government budget through MIME.**

**The main funding sources will be the government loans from WB/IDA,**

**Other sources: grants from donors, private equity, etc.**

### **SUMMARY OF PROJECT COST**

| <i>Type</i>                             | <i>Local<br/>(US\$ M)</i> | <i>Foreign<br/>(US\$ M)</i> | <i>Total<br/>(US\$ M)</i> |
|---|---------------------------|-----------------------------|---------------------------|
| REE off-Grid Extension (45 000 HH)      | 1.82                      | 4.11                        | 5.93                      |
| Mini hydro (6.0 MW)                     | 2.81                      | 6.37                        | 9.18                      |
| SHS (12 000) (GEF US\$ M 1.2)           | 0.79                      | 3.19                        | 3.98                      |
| Village hydro (850 kW) (GEF US\$M 0.30) | 0.53                      | 1.25                        | 1.78                      |
| Sub-total REF Component                 | 5.95                      | 14.92                       | 20.87                     |

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## EXAMPLE...(Cont-e)

- Financing Grants

| <i>Type</i>                            | <i>Grant proposed, US\$<br/>per household<br/>connected</i> | <i>Estimated total<br/>cost/unit in US\$</i> |
|--|---|--|
| New household connected (diesel)       | 45 \$   | 150 \$                                       |
| Mini hydro<br>from 0.5 MW up to 5 MW   | 400\$/kW installed  | 1744\$/kW installed                          |
| Micro hydro<br>From 50 kW up to 500 kW | 400\$/kW installed  | 2700\$/kW installed                          |
| Solar Home System                      | 100\$/set   | 400\$/set of 40 Wp                           |

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## OTHERS...

- Promote and encourage Rural Electrification Entrepreneurs (REE) to participate by various supports, i.e. ideas, “subsidies”, training for awareness and understanding of renewable energy. The next step would be to reduce, even to spot using Diesel Generation sets and to replace these by Renewable Energy Technologies (RET).
- Create Community Business Associations or Organizations (CBA) in order to develop activities in villages and communes, particularly in remote areas, where private sector is not yet aware of or cannot yet reach.
- Necessity to create NGO, agents, associations, different centres in order to accelerate the development and to reach the targets set by the RGC in terms of RE:
  - 2020 all villages will be electrified by electricity from different forms
  - 2030 70% of rural households with grid quality electricity.

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# **BARRIERS**

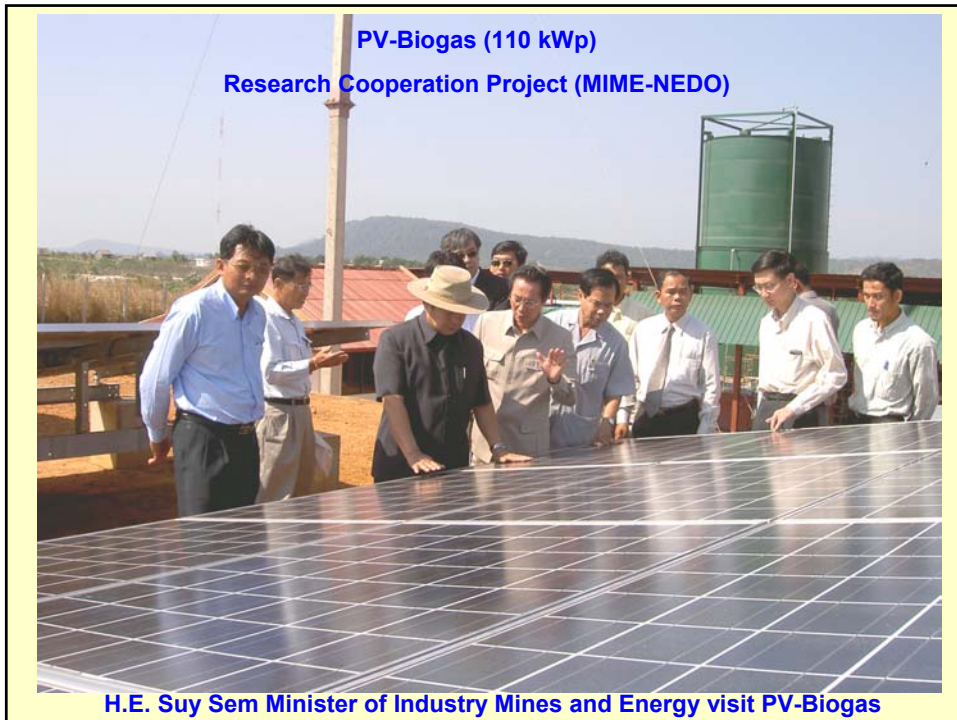
**In principle:**

- 1. Policy barrier**
- 2. Financial barrier**
- 3. Institutional barrier**
- 4. Social barrier**
- 5. Managerial barrier, and**
- 6. Technical barrier**

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**H.E. Samdech Prime Minister HUN SEN visit Solar Energy System**



**Thank you!**

**Any Question Please?**



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