Royal Government of Cambodia
Nation Religion King

NATIONAL POLICY, STRATEGY AND ACTION PLAN ON ENERGY EFFICIENCY IN CAMBODIA

The Ministry of Industry, Mines and Energy
16/05/2013

The National Policy, Strategy and Action Plan on Energy Efficiency in Cambodia has been developed by the EU Energy Initiative Partnership Dialogue Facility (EUEI PDF) and an expert team from INTEGRATION environment and energy in close cooperation with the team of MIME and other concerned institutions.

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Foreword to the CNEE

Since 1999, a rapid economic growth In the Kingdom of Cambodia has been recorded with annual growth rates of 6 to 10%. The real GDP per capita has more than tripled from 1999 until 2011 and the Economic Institute of Cambodia is expecting that this economic growth trend will continue in the coming years. In only 9 years, the electricity consumption multiplied by 4.5: From 2002 to 2011, the annual electricity demand growth rate in the country was 16.3%.

In 2009, the total primary energy demand amounted to 5.2 million tons of oil equivalent, of which 71.7% was biomass and 28.2% was imported oil. Only 0.1 % was hydropower.

In the same year, CO_2 emissions from energy consumption amounted to nearly 4 million tons of CO_2. Both, primary energy consumption as well as CO_2 emission, at least doubled over the past ten years, representing one major challenge for the national energy policy.

The other major challenge of the national energy policy is the national electrification which in 2009 increased to 34%. But with almost 100% of the urban households being electrified, only 14% of the rural households have access to grid electricity. About 50% have limited access to alternative off-grid electricity sources such as diesel generators or solar systems, and more than 30% have no access to electricity at all.

The National Census 2008 showed that 91% of households in Cambodia use biomass as their main cooking fuel: 84% firewood, 7% charcoal. LPG is used as the main cooking fuel by 7.9% of the households. Cambodia is still largely dependent on firewood in particular in rural areas,

Having recognized and prioritized energy and climate change as main tasks in the second phase of its **"Rectangular Strategy"** for growth, employment, equity and efficiency, the **Royal Government of Cambodia** has oriented its N**ational Energy Policy** towards the provision of reliable, affordable energy services to all end users in the most sustainable manner. By means of this policy, it is envisaged to:

- **Improve the living standard** of the population,
- **Increase the competitiveness** of the Cambodian economy,
- **Decrease the dependency on imported fuels** and
- **Protect the natural environment** of the country.

In 2008 a circular on the Implementation of Electricity Saving Measures has been issued by Samdach Prime Minister Hun Sen related to Energy Efficiency This circular required MIME to issue detailed guidelines on electricity saving and the Ministry of Information to cooperate with MIME to disseminate via radio, TV and newspapers widely to all electricity consumers appropriate methods of saving energy.

The **National Strategic Development Plan 2009-2013** enshrines the commitment of the Royal Government of Cambodia to mitigate adverse effects of energy consumption on the environment and the society by the implementation of energy projects while safeguarding economic efficiency and environmental sustainability of each project. NSDP 2009-2013 includes planned actions to implement the prioritized policies related to energy such as

- Developing a policy and a legal and regulatory framework for the energy sector in order to ensure efficient management and resources utilization for the economic development and improvement in livelihoods of the Cambodian people; and
- Encouraging the efficient use of energy with minimal impact on the environment.

As a result of this effort, the **National Climate Change Committee (NCCC)** has been established, having Samdach Prime Minister Hun Sen as honorary chairperson. With the NCCC, the government of Cambodia is aiming at reducing Greenhouse Gas emissions, the major threat for climate change, by implementing a number of projects in the fields of energy efficiency and renewable energies.

The Government's Rectangular Strategy Phase II and the National Strategic Development Plan (NSDP) provide a broad **Roadmap to Green Growth** by improved governance, increased public investments in rural areas and support to the economic development

The efficient and sustainable use of energy resources is probably the most effective way to make these visions a reality. Energy must be considered as a valuable resource for economic progress as well as for social development and should therefore be used in the most efficient way to improve industrial productivity and by consequence the competitiveness of Cambodian enterprises as well as the living and working conditions in particular of the rural poor by providing them adequate energy services at affordable prices.

The **concept of Energy Efficiency** does not mean to save energy by reducing economic activities and the overall comfort and well-being of the end users, but it aims at providing the same (or even better) energy services using less energy inputs. The Cambodian Ministry of Industry, Mines, and Energy has well identified the challenges ahead and is eager to increase energy efficiency as the most cost-effective strategy for economic and social development at reduced energy costs. It requested in July 2011 EUEI PDF for support in the development of a:

National Energy Efficiency Policy (definition of policy targets)
National Energy Efficiency Strategy (how to achieve the policy targets)
National Energy Efficiency Action Plan (how to implement the strategies proposed).

The project started with an inception phase in August 2012 and is being concluded in April 2013 by the final workshop, where the recommendations and conclusions as elaborated by the project team in this document are presented. It can be seen that the growth rate of the national energy demand can be slowed down and reduced by 20% up to 2035. The Government of the Kingdom of Cambodia is well aware of the challenges ahead and will provide the appropriate framework conditions and political guidance to make this national energy efficiency policy a reality.

I would like to thank EUEI-PDF for this most valuable support and the international expert team for their contributions to this important task.

Suy Sem

MINISTER

Acknowledgements

The energy sector is of strategic relevance to every country. The provision of reliable and affordable energy services to our population as well as our industries is a key success factor in the development of Cambodia's social and economic development.

In the last decade, the annual electricity demand growth rate in Cambodia was 16.3%, which means that our country's electricity consumption multiplied by 4.5 during the period of 2002 to 2011. This high rate of demand for energy services is likely to rather increase than decrease in the near future. At the same time, the installation of additional generation capacityand the import of electricity from neighboring countries have not been – and are not likely to be – able to keep up with the increased demand at a level that would satisfy the ever-rising demand adequately.

Against this background, the efficient use of energy is paramount to Cambodia's social and economic development and, not least, to the competitiveness of our private sector. With the development of the *National Energy Efficiency Policy, Strategy and Action Plan*, the Ministry of Industry, Mines and Energy is seeking to address the improvement of Cambodia's energy efficiency in order to cope with the increasing energy demands of our population and industry in a cost-efficient manner, while at the same time contributing to the reduction of greenhouse gas emissions which threaten all our very livelihoods through their negative effect of climate change.

The development of a National Energy Efficiency Policy, Strategy and Action Plan is a complex matter, involving the cooperation on multi-sectoral and multi-stakeholder levels. It is thanks to the constructive cooperation of stakeholders from ministries, government institutions, and representatives from the private sector, civil society and research as well as the team of international experts that this document was developed within a timeframe of only nine months, involving consultations with the above-mentioned stakeholders in various one-on-one interviews as well as two major consultation workshops.

In kind acknowledgement, on behalf of the Ministry of Industry, Mines and Energy and on my own behalf, I would like to express my profound gratitude to **H.E. SuySem,** Minister of Industry, Mines and Energy for his commitment and continuous support, advice, direction and coordination of the preparation of the National Energy Efficiency Policy, Strategy and Action Plan.

I would like to take this opportunity to extend my special gratitude to Mr. Toch Sovanna, Director of the Department of Energy Technique, General Department of Energy of the Ministry of Industry Mines and Energy and the Chairman of the Focal Point Group of on Energy Efficiency for his strong support and effective facilitation for the development of this National Energy Efficiency Policy, Strategy and Action Plan.

I wish to sincerely thank the European Union Energy Initiative Partnership Dialogue Facility (EUEI PDF)for providing financial and technical support for developing this National Energy Efficiency Policy, Strategy and Action Plan; as well as the international team of experts of INTEGRATION who have worked hard in order to accomplish our joint objectives in a very short timeframe.

My special thanks are also extended to other contributors including all stakeholders and line ministries for their invaluable assistance in preparing this Policy, Strategy and Action Plan. At the Inception Workshop in November 2012 and the Final Workshop in April 2013 at total of 70 and 150 representatives from government, private sector, civil society and research gathered to provide their input to the development of the documents. They also provided invaluable insights and advise individually to the sub-sector experts in face-to-face meetings during the course of the development of the respective chapters of this Policy, Strategy and Action Plan.

Furthermore, I would like to extend my profound thanks to Dr. P.K. Gupta of the Cambodia Cleaner Production Programme for his valuable information and experience on successful existing energy efficiency activities in some of our industry's sub-sectors.

Moreover, my deep thanks are also extended to the members of the newly formed Focal Point Group on Energy Efficiency, for their kind cooperation and contribution to produce this Policy, Strategy and Action Plan.

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Phnom Penh, Date…….. 2013

H.E. Tun Lean

Under Secretary of State in charge as

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Ministry of Industry, Mines and Energy

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List of Abbreviations

ASEAN	Association of South East Asian Nations
CFL	Compact FluorescentLamp
CNEE	The Cambodia National Strategy and Action Plan on Energy Efficiency
ECCJ	Energy Conservation Center Japan
EE	EnergyEfficieny
EEIRC	Energy Efficiency Information Resource Centre
EE&C	Energy Efficiency and Conservation
ESCO	Energy Service Company
GDP	Gross DomesticProduct
GWh	Giga Watt hour
HH	Household
HSI	Household Scale Industry
IEA	International Energy Agency
kWh	Kilo Watt hour
LPG	Liquified Petroleum Gas
NGO	Non-Governmental Organisation
NSDP	National Strategic Development Plan
OECD	Organisation for Economic Co-operation and Development
RGC	Royal GovernmentofCambodia
SME	Small and Medium Enterprises
SFM	Sustainable Forest Management

TOE	Ton of oil equivalent
TWh	Tera Watt hour
USD	US-Dollar

List of National Stakeholders

COMIN	COMIN Khmer
CRDT	Cambodian Rural Development Team
CSA	Cambodia Society of Architects
EAC	Electricity Authority of Cambodia
EdC	Electricite du Cambodge
FA	Forest Administration
FAC	Forest Administration Cantonment
GBC	Green Building Council
GERES	Groupe Energies Renouvelables, Environnement et Solidarités
ICoProDAC	Improved Cookstove Producers and Distribution Association of Cambodia
ISC	Institute of Standards of Cambodia
MAFF	Ministry of Agriculture, Forestry and Fisheries
MoC	Ministry of Commerce
MoEF	Ministry of Economy and Finance
MEYS	Ministry of Education, Youth and Sport
MENV	Ministry of Environment
MIME	Ministry of Industry, Mines and Energy
MINF	Ministry of Information
MLVT	Ministry of Labor and Vocational Training
MoLMUP&C	Ministry of Land Management, Urbanization and Construction
MoP	Ministry of Planning
MPWT	Ministry of Public Works and Transport
NCCC	National Climate Change Committee
NIS	National Institute of Statistics
NU	Norton University
RECOFTC	Regional Community Forestry Training Centre
REE	Rural Energy Entrepreneurs
REF	Rural Electrification Fund
RUFA	Royal University of Fine Arts
SGFE	Sustainable Green Fuel Enterprise
SME	SME Cambodia Renewable Energy
TUV	TUV Group Cambodia
WEWG	Wood Energy Working Group

List of Regional Stakeholders and Donors

ACE	ASEAN Center for Energy
ADB	Asian Development Bank
AJEEP	ASEAN-Japan Energy Efficiency Partnership
AUSAID	Australian Aid
ECCJ	Energy Conservation Center Japan
EEP	Energy and Environment Partnership Program (Finland)
EUEI PDF	EU Energy Initiative Partnership Dialogue Facility
GEF	Global Environment Fund
GIZ	German International Cooperation
LIRE	Lao Institute of Renewable Energy
NDF	Nordic Development Fund
KfW	KreditanstaltfürWiederaufbau (German Development Bank)
UNDP	United Nations Development Program
UNIDO	United Nations Industrial Development Organization
WB	World Bank

Part I

1. The Energy Efficiency Policy of Cambodia

1.1. Introduction

This document outlines the Royal Government of Cambodia's dedication in establishing Energy Efficiency as a major principle of the National Energy Policy in Cambodia. The rationale behind this decision is to provide more reliable and affordable energy services to all energy users in order to support the economic and social development of the country and to protect its natural resources. The electricity tariffs in Cambodia are among the highest in the region, and the rural electricity supply does not meet the needs of the rural population. The rural population is still heavily depending on biomass for cooking purposes, which is being used or produced (charcoal) in very inefficient ways.

In a close consultation process between MIME and EUEI-PDF that started in July 2011 it was concluded to launch a project supporting the RGC in the elaboration of a National Energy Efficiency Policy, Strategy and Action Plan. During the scoping mission in September 2011, the priority areas for the project interventions were determined and the terms of reference for the project been elaborated, focussing on the setting of targets for the national EE policy, the definition of strategic options to be pursued and the development of an action plan for each priority area. The project started with an inception phase in August 2012 and was concluded by a final workshop on 29 of April 2013, where the recommendations and conclusions of the project were presented and comments/suggestions from the participants were received and incorporated in this document.

The following chapter will outline the current energy situation and the energy related policies in Cambodia, followed by the Vision statement for Energy Efficiency and the National Energy Efficiency Policy Objectives. The overall National Energy Efficiency Potential will be assessed, based upon the specific analysis of the saving potentials of each sector.

Thereafter, the energy efficiency strategies for each sector are displayed. The document concludes with the Energy Efficiency Action Plans for each sector that details the proposed activities in terms of time frame, budget requirements, and stakeholders to be involved and potential sources of financing.

1.1.1. The Current Energy Situation in the Kingdom of Cambodia

GDP per capita multiplied by 3 from 1999 to 2011

From 2004 to 2007, the economy of Cambodia grew by more than 10% per year, contracted slightly in 2009 as a result of the global economic slowdown but climbed back up to 6% in 2010 and 6.9% in 2011, driven by tourism and renewed exports. From 1999 until 2011, the real GDP per capita has more than tripled and the Economic Institute of Cambodia expects that the economic growth trend will continue with the real GDP growing by 6.2% in 2012.

Electricity consumption multiplied by 4.5

While the economic growth tripled within 12 years, the electricity consumption multiplied by 4.5 in only 9 years: From 2002 to 2011, the annual electricity demand growth rate in the country was 16.3%. As the energy demand in Phnom Penh grew a bit faster with an average growth

from 2002 to 2011

rate of 17% during the same period, the share of the City of Phnom Penh in the total electricity demand was further increasing (multiplied by 4.8 since 2002) covering now at least 80% of the country's total electricity consumption.

Cambodia's power consumption is forecast to rise to 3.4TWh by the end of 2020, representing an average annual growth of 9.4% until 2020.[1]

Primary energy supply and CO_2 emissions doubled over 10 years

Total primary energy supply in 2009 amounted to 5.2 million tons of oil equivalent[2], of which 71.7% was biomass and 28.2% was imported oil. Only 0.1 % was hydropower.[3]

In the same year, CO_2 emissions from energy consumption amounted to 3.93 million tons of CO_2. Both figures primary energy consumption as well as CO_2 emission at least doubled over the past ten years.[4]

Power supply mainly depending on imports

In 2011, 45% of the total national electricity demand of 2,674 GWh was covered by imports from Thailand, Vietnam and Lao PDR. The country's own power generation is depending mainly on imported Heavy Fuel Oil (93%). Hydropower and coal contribute with a bit more than 3% each, while biomass contributes less than 1% to power generation.[5]

In the long term, it is expected that along with the increasing power demand, the fuel mix will change in a way which makes coal the main fuel for power generation, followed by hydropower.[6]

High electricity cost limiting economic development

Due to the high cost of imported diesel fuels and the fragmented power supply systems, energy prices in Cambodia are among the highest in the region. In summer 2011, electricity prices in Cambodia were:[7]

- Phnom Penh: 0.18 USD/kWh for households, 0.19 USD/kWh for businesses
- Other grid-connected towns and urban areas: 0.25 - 0.40 USD/kWh
- Rural areas (mostly diesel generators): 0.50 - 1 USD/kWh
- Battery (car batteries) charging stations (diesel - to be found in 35% of rural villages): up to 4 USD/kWh

The Royal Government recognises that the high cost of electricity and inadequate supply significantly limits economic growth and hinders the country from attracting investments and stimulating economic activities.[8]

Power grids concentrated on major cities

According to MIME/EdC, in 2011 the national electrification increased to 34%. The households in urban areas were almost 100% electrified, but only 14% of the rural households have access to grid electricity and about 50% have access to alternative off-grid electricity sources. Areas with no access to electricity still use candles and kerosene for lighting. [9]

1 Source: MIME National Stakeholder Workshop 2012 Phnom Penh
2 This figure is excluding power trading over the national borders.
3 Data source: OECD/IEA 2011
4 Data source: International Energy Statistics 2012published by the U.S. Energy Information Administration:
5 Compare: Poch, K. and S. Tuy (2012), 'Cambodia's Electricity Sector in the Context of Regional Electricity Market Integration' in Wu, Y., X. Shi, and F. Kimura (eds.), Energy Market Integration in East Asia: Theories, Electricity Sector and Subsidies, ERIA Research Project Report 2011-17, Jakarta: ERIA, pp.141-172.Data source: U.S. Energy Information Agency Country Report on Cambodia
6 Compare: Invest in Cambodia – Sector Report on Energy
7 Data source: Energypedia Country Report (https://energypedia.info/wiki/Category:Cambodia)
8 Source:Invest in Cambodia – Sector Report on Energy
9 Source: MIME National Stakeholder Workshop 2012 Phnom Penh

Firewood is the main cooking fuel

The National Census 2008 showed that 91% of households in Cambodia use biomass as their main cooking fuel: 84% firewood, 7% charcoal. LPG is used as the main cooking fuel by 7.9% of the households. Cambodia is still largely dependent on firewood in particular in rural areas, and the demand for firewood is rising due to population growth. While in the urban areas 25% of the households are using charcoal today, the use of charcoal in rural areas is not yet significant.

Definition of Energy Efficiency

Increasing the Energy Efficiency means, the same or even better energy services for lighting, cooling, processing and cooking can be provided by less input of energy resources. This includes the generation and distribution of electricity, the manufacturing of industrial products, and the processing of food, the air conditioning in buildings and the use of electrical appliances in households. If the same services can be provided and products be produced with less energy, this will boost the social and economic development and contribute to the protection of the natural environment of Cambodia by decreasing GHG emissions.

1.1.2. Review of the Energy Related Policies of the Royal Government of Cambodia

2006: The Royal Government of Cambodia establishes a policy for long term energy security

On January 27, 2006, the Royal Government of Cambodia firstly approved the National Strategic Development Plan which is known as NSDP 2006-2010 and includes strategies and actions on the Energy Sector and Electricity[10]. NSDP 2006-2010 envisages a long term energy security for the country and recommends the development of a 15-Year Cambodia Energy Strategy 2006-2020[11]. The medium term strategy for the energy sector in the NSDP 2006-2010 does not mention any strategy on energy efficiency except concerning energy supply and low cost considerations[12].

2008: Prime Minister Hun Se Establishes Energy Saving Measures in all ministries

In 2008 a circular on the Implementation of Electricity Saving Measures has been issued by Prime Minister Hun Sen related to Energy Efficiency[13]. The circular requires all ministries and public institutions at all levels to participate in a Program on Electricity Saving Consumption in order to save the national budget. The electricity saving measures are determined in the circular as follows:

- Air Conditionings shall be turned on at 25 degree Celsius,
- Air Conditionings shall be turned off 30 minutes prior to leaving the office,
- Fans can be turned on in rooms equipped with air conditioning only in case of necessity to avoid fading away cool air,
- Do not plug in computers, printers or copy machines without usages,
- Plug out all devices when stopping usage,
- Use sunlight from the window by all means, avoiding closure of window curtains and usage of electricity instead of sunlight,
- Use lamps efficiently which can save and consume electricity but

[10]The Royal Government of Cambodia, NSDP 2006-2010, point 4.65, p.64

[11]This document is not found while conducting this research

[12]Ibid, point 4.66, p.54

[13]Circular No 01/SR dated March 12, 2008 on the Implementation of Electricity Saving Measures

set the same bright/light,
- All public lighting except on national holidays shall use only one side of lamp or turn on only half of the lamps,
- All public lighting shall turn on and off at necessary time by avoiding lighting when it is not dark and in the morning that has sunlight but the public lighting is not yet turned off,
- Do not turn on electricity if not necessary.

The circular requires MIME to issue detailed guidelines on electricity saving and the Ministry of Information to cooperate with MIME to disseminate via radio, TV and newspapers widely to all electricity consumers appropriate methods of saving energy.

2010: Commitment to mitigate adverse effects of energy consumption on environment and society

NSDP 2006-2010 was updated by the RGC, adopted by the National Assembly, reviewed by the Senate and promulgated by the King on June 30, 2010 and became the Law on the Adoption of the National Strategic Development Plan NSDP 2009-2013[14]. NSDP 2009-2013 enshrines the commitment of the Royal Government of Cambodia to mitigate adverse effects of energy consumption on environment and society by the implementation of energy projects while safeguarding economic efficiency of each project. Attention will also be paid to capacity building and institutional reform in the Electricity Authority of Cambodia (EAC), Electricite du Cambodge (EdC) and other relevant ministries and agencies to improve management efficiency and the quality of electricity supply[15]. NSDP 2009-2013 also includes planned actions to implement the prioritized policies related to energy such as

- Developing a policy and a legal and regulatory framework for the energy sector in order to ensure efficient management and resources utilization for the economic development and improvement in livelihoods of the Cambodian people; and
- Encouraging the efficient use of energy with minimal impact on the environment[16]. In spite of the energy efficiency concept being included in NSDP 2009-2013, no specific sector is mentioned.

*2008-2013: The **Rectangular Strategy Phase II** has been reaffirmed as socio-economic policy agenda of the RGC, focusing on economic growth **and** environmental sustainability*

The RGC has **recognized and prioritized energy and climate change** as main tasks in the second phase of its *"***Rectangular Strategy"** for growth, employment, equity and efficiency, based on the **four pillars**:

- Enhancement of the agricultural sector
- Enforcement of the physical infrastructure
- Capacity building and human resource development and
- Generation of employment by private sector development.

The Government's Rectangular Strategy Phase II and the National Strategic Development Plan (NSDP) provide a broad **roadmap to Green Growth** by improved governance, increased public investments in rural areas and support to the economic development[17]

As a result of this effort, the National Climate Change Committee (NCCC)

[14]Royal kram N. NS/RKM/0610/012 dated June 30, 2012

[15]The Royal Government of Cambodia, NSDP 2009-2013, point 465, p.165

[16]Ibid, point B.468, p.165

[17] See: Green Growth Road Map, ESCAP/Ministry of Environment December 2009

has been established, having Prime Minister Hun Sen as honorary chairperson[18]. With the NCCC, the government of Cambodia is aiming at reducing Greenhouse Gas emissions, the major threat for climate change, by implementing a number of projects in the fields of energy efficiency and renewable energies. The sustainable economic development must take into consideration the protection of the natural environment and the sustainable management of the natural resources of the country.

1.2. Vision Statement

The national energy policy as formulated in October 1994 by the RGC assists to provide reliable, affordable energy services to all end users including the various economic sectors and social groups of the country in the most sustainable manner. By means of this policy, the RGC is aiming to:

- **Improve the living standard** of the population,
- **Increase the competitiveness** of the Cambodian economy,
- **Decrease the dependency on imported fuels** and
- **Protect the natural environment** of the country[19].

The efficient and sustainable use of national as well as imported energy resources is probably the most effective way to make these visions a reality. Energy must be considered as a valuable resource for economic progress as well as for social development and should therefore be used in the most efficient way to improve industrial productivity and by consequence the competitiveness of Cambodian enterprises as well as the living and working conditions in particular of the rural poor by providing them adequate energy services at affordable prices.

These considerations are also reflected in the latest revision of the national energy policy and strategy by the National Parliament concerning the implementation of RGC's policy and strategy during the fourth term of the National Parliament from 2008 to 2013.

The **concept of Energy Efficiency** does not mean to save energy by reducing the overall comfort and well-being of the end user, but it aims at providing the same (or even better) energy services using less energy inputs. The Cambodian Ministry of Industry, Mines, and Energy (MIME) has well identified the challenges ahead and is eager to increase energy efficiency as the most cost-effective strategy for economic and social developing at reduced energy consumption. It requested in July 2011 EUEI PDF for support in the development of a:

- **National Energy Efficiency Policy** (definition of policy targets)
- **Energy Efficiency Strategy** (how to achieve the policy targets)
- **Energy Efficiency Action Plan** (how to implement the strategies proposed).

1.2.1. The Core Values of Energy Efficiency

As mentioned above, Energy Efficiency contributes to the economic and social development as well as to the protection of the natural environment of Cambodia.

- The **economic value** of improved energy efficiency comprises efficiency increases in industrial production and, by consequence, higher competitiveness of Cambodian

[18] See: Speech of H.E. Suy Sem, Minister of Industry, Mines and Energy, for the launching of the workshop on "Climate change related technology transfer for Cambodia" on Feb. 14, 2013

[19] See: Assessment Report on Energy Efficiency Institutional Arrangements in Asia, UN-ESCAP 2010

enterprises in the regional market, increasing turnover and value added and lower prices of industrial products for end users.

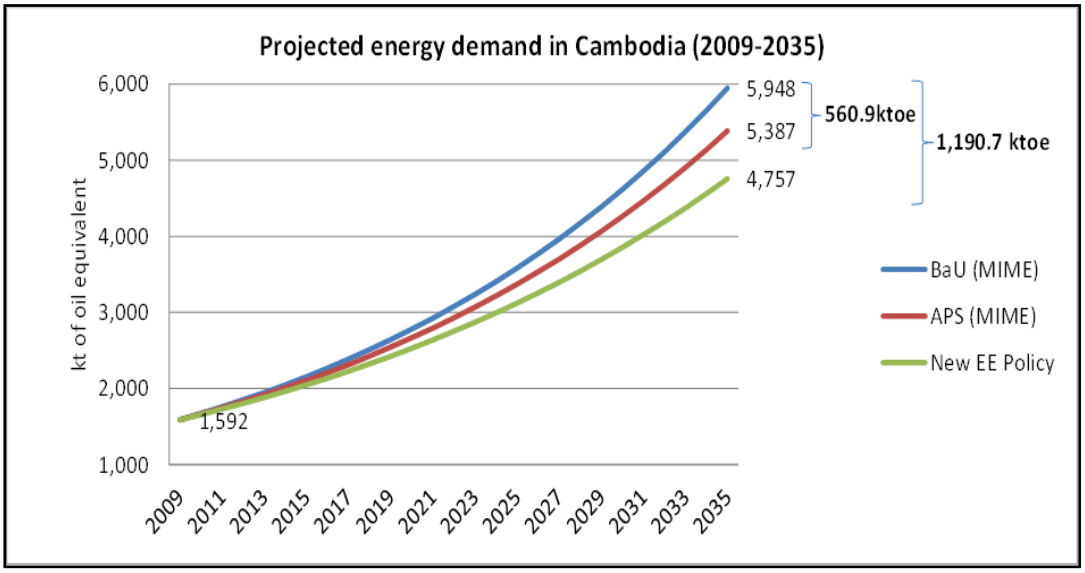
- The **social values** concern the improvement of living and working conditions of workers, students, families by providing reliable and affordable energy services such as efficient lighting, air conditioning and cooking facilities to factories, universities, schools and private households.
- The **environmental values** comprise the reduction of greenhouse gas emissions and dust emerging from all kinds of energy conversion and consumption such as electricity generation by thermal power plants, charcoal production and firewood consumption for industrial and domestic purposes. This has a severe impact on public health and on the regional and global climate. In addition the efficient use of firewood contributes to the protection of the natural forest resources of Cambodia.

1.3. Goals and Objectives

1.3.1. National Energy Saving Potential

As of today's "business as usual (BaU)" scenario (represented by the blue curve), Cambodia's total energy consumption is projected to grow at an average annual rate of 5.2% for the period 2009 to 2035 with an assumed total energy demand of 5,948ktoe in 2035.

Figure 1: Energy saving potential in Cambodia



According to MIME's "alternative policy scenario (APS)", the red curve, which takes into account the current national energy efficiency action plans, the projected growth rate of the total energy consumption can be reduced by 10% down to 4.8% per year, thus reducing the projected annual energy demand in 2035 by 560,9 ktoe down to 5,387 ktoe.[20]

According to the sectorial analysis, the national projected energy consumption annual growth rate can be further reduced down to 4.3%, representing an **overall reduction of future energy demand by 20% or 1,190,7 ktoe in 2035**, compared to the business as usual projections, thus reducing the projected annual energy demand in 2035 further down to 4,757 ktoe.

[20] Lieng Vuthy (MIME) - ERIA Analysis of Energy Saving Potential in East Asia Region 2011

This corresponds to an overall **reduction of the CO_2 emissions in 2035 by 23% or 3 million tons of CO_2.**

The total budget required to realize this objective will amount to about 9 million US$ (see chapter 2.6). Once the full plan of actions will be realized, the annual savings will presumably increase up to about 319 million US$ per year in 2035 (see calculation in the annex).

1.3.2. Overall Policy Goal for Energy Efficiency

The above calculated Saving Potentials form the basis of the National Energy Efficiency Policy objective:

- **Reduce the future National energy demand by 20% until 2035, compared to business as usual projections**
- **Reduce National CO2 emissions in 2035 by 3 million tons of CO2.**

To achieve these main objectives, MIME has defined the goals of energy development in the Kingdom as follows:

1- From the year of 2015, the national grid has sufficient capacity to support all kinds of demands of consumers already connected to the national grid and in 2018 the national grid will provide a 25% reserve capacity for the system.
2- In 2020 the high tension transmission line will cover all 24 cities and provinces of Cambodia. And these cities and provinces will have at least one sub-station each to receive electricity supply from the national grid.
3- In 2020, 80% of villages will be connected to the national grid and another 20% will be supplied by other energy sources such as electricity imported from neighbouring countries or single supply systems. In 2030, 95% of villages of the whole country will be connected to the national grid while another 5% of the villages will be connected to single supply systems with a quality of supply similar to the national grid.
4- In 2020, at least 50% of households in Cambodia will be grid-connected with the same quality of supply as those connected to the national grid and 70% of households will follow up to 2030.
5- In 2020, the gap of electricity selling prices between urban and rural areas will be reduced and the price difference should not exceed 15%.

These highly ambitious energy policy goals can only be achieved, if energy is used in the most efficient, cost effective and sustainable manner in all economic sectors as presented in the sectorial energy analysis hereafter.

To reach the overall energy efficiency objective, MIME's "Alternative Policy Scenario" was adjusted by the results of assumed energy efficiency improvements in the five sectors identified as **priority areas** for the national energy efficiency policy, strategy and action plan.

- Energy efficiency in **industry**
- Energy efficiency of **end-user products**
- Energy efficiency in **buildings**
- Energy Efficiency of **rural electricity generation and distribution**
- Efficient use of **biomass resources for residential and industrial purposes**.

In close collaboration with MIME, these priority areas were selected according to their share on the overall energy consumption and to their importance for the socio-economic development of the country. The residential sector is still the biggest energy consumer counting for 37% of the total energy consumption, followed by the commercial sector (including buildings) and the industrial sector. 75% of the national primary energy supply is covered by biomass, 25% by imported petroleum products.

In the process of identification of the 5 priority areas it was decided to leave out the **transport sector** for the time being because of the specific requirements concerning the collection of reliable data on fuel consumption by the various means of transport, which could not be met in the framework of this project. It is recommended to launch a study on its own on this sector.

The energy saving potentials in the various subsectors was assumed as follows:

- In the **INDUSTRY SECTOR**, saving potentials ranging from 20% (garment industry) to 70% (ice factories) have been identified, mainly depending on changes in behaviour and on the replacement of inefficient devices.
- Concerning the energy efficiency of **END USER PRODUCTS** in the residential sector**,** an energy saving potential of up to 50% was assumed according to international experiences by introducing energy efficiency labeling schemes for household appliances.
- In the **BUILDING SECTOR** energy saving potentials between 20 and 30% are assumed for new commercial buildings according to international benchmarks by making use of appropriate building materials and construction principles with special emphasis to be put on standardized wiring.
- The energy saving potential in **RURAL ELECTRICITY GENERATION AND DISTRIBUTION** is estimated at up to 80% corresponding to the reduction of the huge generation and distribution losses of the Rural Energy Enterprises (REE's).
- Concerning the **USE OF BIOMASS resources for residential and industrial purposes**, energy saving potentials between 30 and 50% can be achieved by introducing improved cook stoves, more efficient charcoal kilns and char briquettes, substituting fuel wood and charcoal.

1.4. Strategic Objectives

For the implementation of the above National Energy Efficiency Policy, strategic objectives have been developed in the National Energy Efficiency Strategy. The strategic objectives follow economic, social and technical rationales and define specific goals for each of the five sectors. These strategic objectives are also supporting the four priority strategies as developed by MIME for the period of 2013 to 2018 (see examples in brackets):

1- Develop alternative electricity sources and improve electrical transmission lines to satisfy the demand for electricity services under close consideration of safety, quality and security of supply aspects at reasonable costs (see 2.5.1 Energy Efficiency in Industry, objective 1, activity 3: Substitution of fossil fuel by biomass for co-generation in rice mills).

2- Attract private participation in energy infrastructure investment including production, transmission and distribution focusing strongly on modern technology, economic efficiency and on reducing negative social and environmental impacts (see 2.4.1 Cross-cutting Issues: Development of appropriate legal and financial framework conditions).

3- Improve overall electricity supply in particular for all villages not yet electrified and promote an equal level of electricity services in cities and rural areas of Cambodia (see 2.5.4 Energy Efficiency of Rural Electricity Generation and Distribution: Reduction of generation and distribution losses of REE's).
4- Continuous support to social affairs in rural electrification fund program of EDC by contribution of RGC's direct fund and business support of EDC.

The complete National Energy Efficiency Strategy is presented in Part II of this document.

In Part III the National Energy Efficiency Action Plan elaborates on the activities proposed to achieve this strategic objectives.This Action Plan includes also the principal measures set-up by MIME for the accomplishment of the overall energy policy goals.

1.5. Monitoring and Evaluation

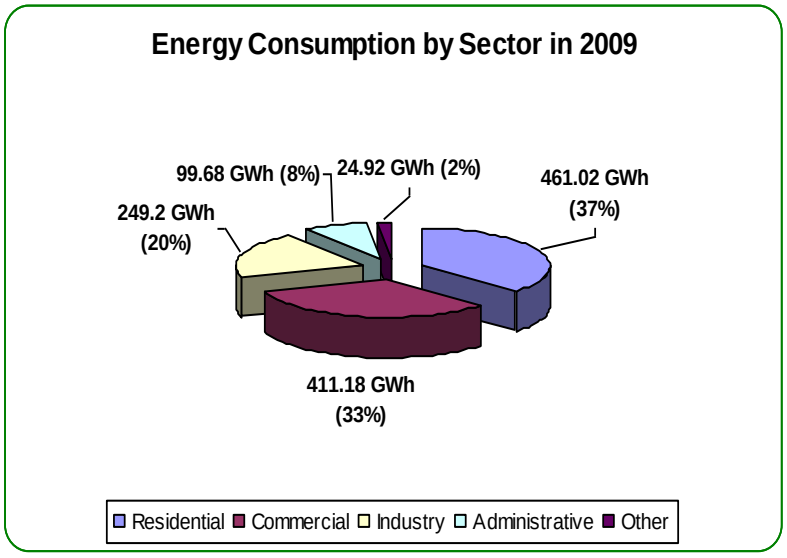
To regularly monitor and evaluate the process of the National Energy Efficiency Policy, a Plan-Do-Check-Act (PDCA) approach has been elaborated and integrated into the National Energy Efficiency Strategy (see Part II).

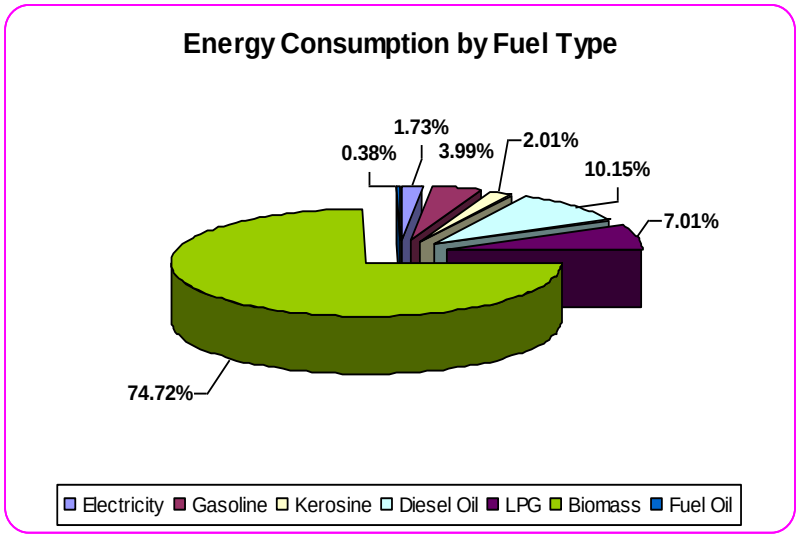
ANNEX

Calculation of the Energy Saving Potential

ENERGY SAVING POTENTIALS BY (SUB)SECTOR					
(Sub) Sector		**min**	**Max**	**average**	**Comments**
Rice mills	upto		70%	35%	Substitution of fossil fuels by rice husk gasification
Garment industry		20%	35%	28%	More efficient wood boilers Application of thermal insulation More efficient sewing machines
Ice factories				25%	Introduction of biomass gasifiers
Food industry		15%	20%	18%	Replacement of inefficient lights Replacement of inefficient air compression
Rubber factories				25%	Improvement of drying process, use of more efficient electrical motors
Brick factories	upto		70%	35%	Replacement of tunnel kilns by vertical shaft kilns Improvement of brick molding
Commercial buildings		20%	30%	25%	According to international benchmarks. No comprehensive data on energy consumption of buildings in Cambodia are available.
Charcoal production		30%	40%	35%	By making use of more efficient kilns such as the Yoshimura Kiln, tested by GERES
Domestic cooking	upto		50%	25%	By making use of improved stoves tested and introduced by GERES
REE	upto		80%	40%	Corresponding to the reduction of generation and distribution losses of REE's
Residential electricity for household appliances	upto		50%	25%	According to international labeling schemes for household appliances

CALCULATION OF THE EE POLICY TARGET					
	Average energy saving potential by sector	Weight on total energy consumption	Weighted energy saving potential by sector	Policy implementation/impact target	Impact (composition) of total energy saving target of 20% by 2035
Industry	28%	0,10	2,80%	0,80	2,24%
Buildings	25%	0,16	4,11%	0,40	1,65%
End user products	25%	0,16	3,88%	0,95	3,68%
Biomass	30%	0,53	15,90%	0,75	11,93%
REE	40%	0,02	0,94%	0,90	0,85%
		0,97	28%	0,76	**20,34%**





CALCULATION OF THE EE POLICY TARGET						
	Industry	Buildings	End userproducts	Biomass	REE	TOTAL
Average energy saving potential by sector	28%	25%	25%	30%	40%	
Weight on total energy consumption	0,10	0,16	0,16	0,53	0,02	0,97
Weighted energy saving potential by sector	2,80%	4,11%	3,88%	15,90%	0,94%	28%
Policy implementation/impacttarget	0,80	0,40	0,95	0,75	0,90	0,76
Impact (composition) of total energy saving target of 20% by 2035	2,24%	1,65%	3,68%	11,93%	0,85%	20,34%
ENERGY SAVED						
ktoe	130	108	221	680	51	1190
COMPOSITION OF SAVINGS PER FUEL						
Biomass				680		680
Electricity, generated by heavy fuel oil (ktoe)	29	80	221		0	330
Diesel	101	28	0		51	180

CALCULATION OF COST SAVING POTENTIAL

Fuel Type	Amount (ktoe)	World Market Price 2012 (US$/ton)[21]	Savings (thousand US$)
Heavy Fuel Oil (Electricity Generation)	330,00	560	184.800,00
Diesel	180,00	750	135.000,00
TOTAL	510,00		318.800,00

[21]Data source: IEA End-use petroleum product prices and average crude oil import costs (March 2013)

Part II

2. National Energy Efficiency Strategy

2.1. Introduction

In the National Energy Efficiency Policy, MIME declared its willingness to reduce energy demand by 20% until 2035. As a typical scenario consisting of a pressure to act, a limitation of resources and a variety of available options, it is of utmost importance to take a clear decision for a particular strategy on how to implement this policy.

With its vision statement and its recognition and prioritization of energy and climate change as main tasks in its Rectangular Strategy Phase II, the Royal Government has chosen effective guiding principles. On this basis, the National Energy Efficiency Strategy develops an overall strategic framework for the policy coordination and sets specific strategic objectives for the implementation in each sector.

2.2. Vision

The national energy policy as formulated in October 1994 by the RGC is aiming at providing reliable, affordable energy services to all end users including the various economic sectors and social groups of the country in the most sustainable manner. By means of this policy, it is envisaged to:

- **Improve the living standard** of the population,
- **Increase the competitiveness** of the Cambodian economy,
- **Decrease the dependency** on imported fuels and
- **Protect** the natural environment of the country.

The efficient and sustainable use of national as well as imported energy resources is probably the most effective way to make these visions a reality. Energy must be considered as a valuable resource for economic progress as well as for social development and should therefore be used in the most efficient way to improve industrial productivity and by consequence the competitiveness of Cambodian enterprises as well as the living and working conditions in particular of the rural poor by providing them adequate energy services at affordable prices.

2.3. Goals and Objectives

In the National Energy Efficiency Policy, MIME has formulated its will to

- Reduce the future National energy demand by 20% until 2035, compared to business as usual projections
- Reduce National CO2 emissions in 2035 by 3 million tons of CO2.

The way forward to reach this objective is manifested in MIME's "Alternative Policy Scenario", adjusted by the results of assumed energy efficiency improvements in the five sectors identified as priority areas for the national energy efficiency policy, strategy and action plan:

- Energy Efficiency in industry
- Energy Efficiency of end-user products
- Energy Efficiency in buildings
- Energy Efficiency of rural electricity generation and distribution
- Efficient use of biomass resources for residential and industrial purposes.

2.4. Strategic Framework

2.4.1. Strategic Analysis and Methodology

MIME appointed ***national coordinator*** *for EE in Cambodia*

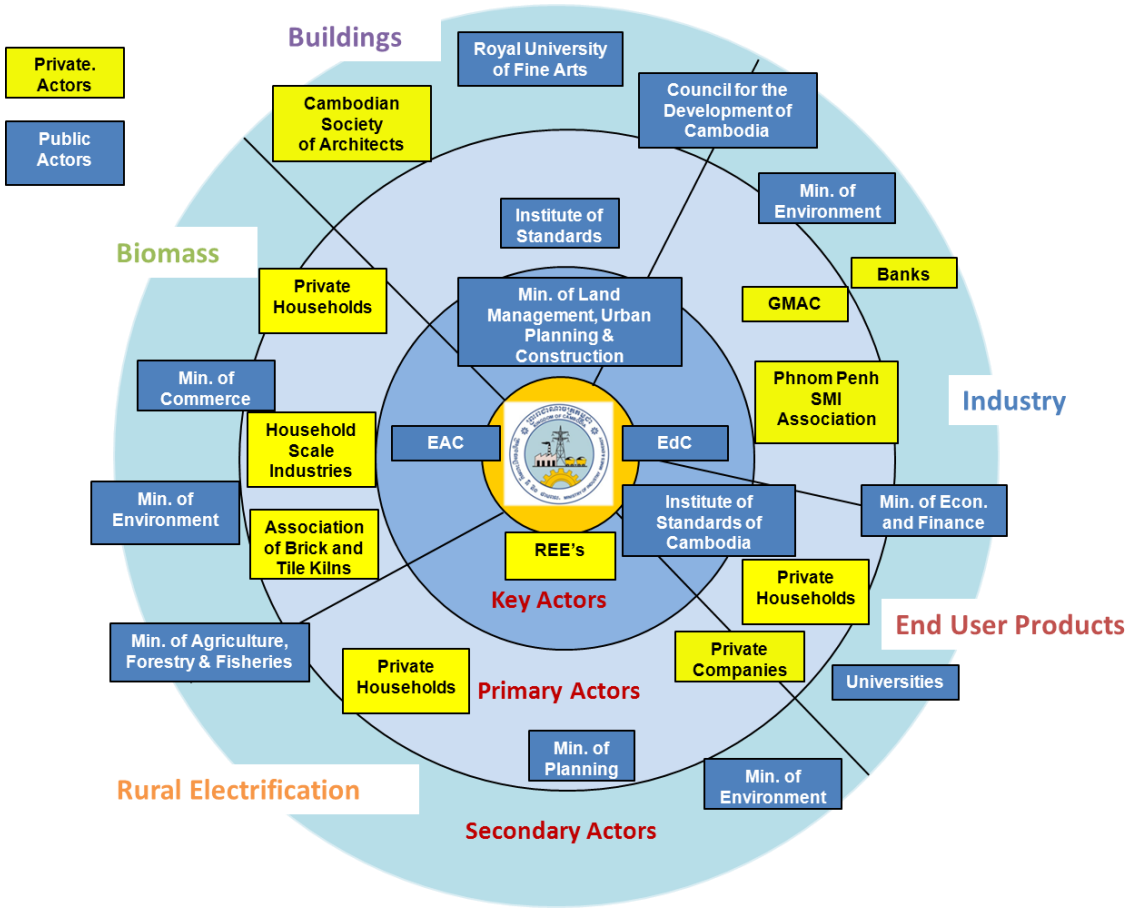
Focal points *are established*

It is essential to have one core institution responsible for the overall coordination of all EE activities in Cambodia. It is suggested that MIME will be the national coordinator of the Energy Efficiency Policy and Action Plan implementation.

MIME as the responsible ministry will establish a system of national, regional and sectorial focal points and appoint for each focal point a responsible chairperson with an appropriate mandate to coordinate the specific activities of this focal point and to be in constant exchange with the other focal points.

The focal points should be composed of representatives of the involved and affected stakeholder groups from the public, and the private sector. The most important stakeholders are presented exemplary in the figure below. Key Actors will include policy makers; Primary Actors consists of relevant beneficiaries and implementers; among Secondary Actors are stakeholders relevant for enforcement, consulting, academia and the banking sector. When it comes to establishing a network to support the working groups, the stakeholder list presented in the introductory section provides a more complete overview that can be used.

Figure 2: National Stakeholders



Capacity Needs Analysis

Upon the appointment of the focal points it is advisable to conduct with the support of donors and/or regional initiatives e.g. EUEI PDF and AJEEP, a capacity needs diagnosis in order to identify potential gaps and to provide the necessary training and capacity building to establish fully functional working groups.

***Capacity building** and **PDCA training** for focal points / working groups*

With this capacity building, the focal points / working groups, and eventually also the key contacts within MIME will be trained in the application of a Plan-Do-Check-Act (PDCA) cycle approach that helps to **constantly monitor, evaluate and adapt the specific energy efficiency activities** during their implementation:

PLAN – establish the objectives and processes necessary to deliver results in accordance with the expected output.

DO – Implement the planned approach with the necessary resources, operating processes and take measures as planned.

CHECK – Analyse the information gathered to determine whether the plan has achieved what was intended.

ACT – Ensure that the working group is achieving the results and take action to correct any deficiencies.

Pilot Phase	Once a working group is established and equipped with the appropriate responsibilities and mandates it shall start to **prioritize the actions** of the action plan. The first year will function as a pilot phase with a particular emphasis to establish an appropriate, well-functioning and effective working and cooperation framework for the working groups.
Cross Cutting Issues	For all five identified priority areas, some crucial cross cutting issues have been identified that are equally important for each sector and must be addressed by MIME and the focal points: ▸ Comprehensive energy data collection procedures and analysis systems ▸ Awareness raising, education and knowledge about energy efficiency ▸ Appropriate legal and financial framework conditions ▸ Inter-institutional and regional cooperation and networking ▸ Establishment of an "Energy Efficiency Information Resource Centre" at MIME

2.4.2. Cross Cutting Issues of the Energy Efficiency Strategy

The Figure 3 below visualizes the proposed structure of the National Energy Efficiency Strategy. It highlights again the importance of the **cross-cutting topics** for all sub-sectors and shall demonstrate how cross-sector cooperation on these topics is likely to create positive synergies (see also Action Plan Part III). The cooperation on these issues will be supervised by MIME and coordinated by the chairpersons of the focal points. It is advisable to have regular meetings on these topics to exchange experience amongst the groups but also with comparable regional initiatives.

In order to increase the **public awareness** and create a platform for **cooperation and networking,** it is proposed to establish an **"Energy Efficiency Information Resource Centre" (EEIRC)** at MIME. This EEIRC should comprise:

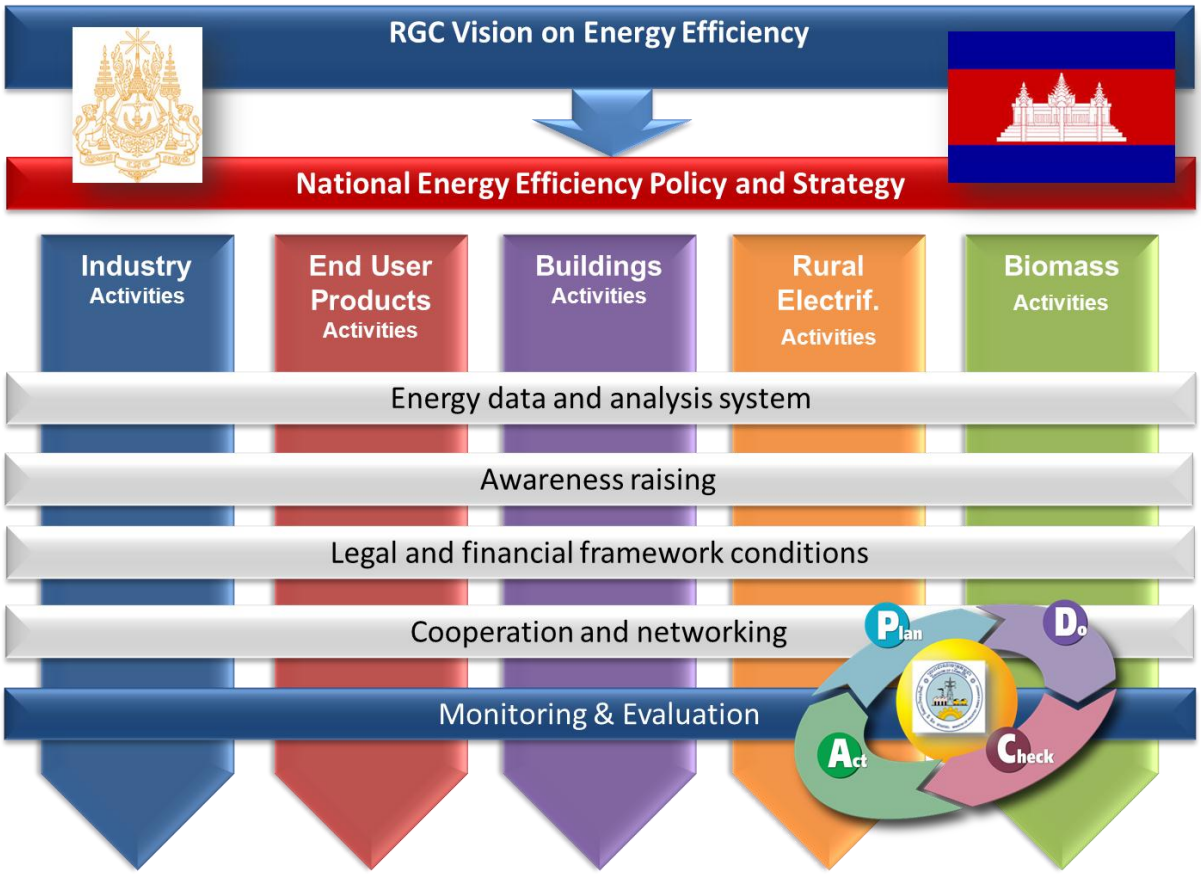
- A physical desk at MIME accessible by phone or in person and
- A web portal via internet offering information and services about EE products, regulations, standards, reports and governmental publications.

The EEIRC should ensure:

- A pro-active communication approach
- A monitoring of the system use
- A continuous integration with schools, universities and other public institutions
- A system of fluid inter-active online monitoring (incl. collection of data; data base, visualization, communication & use), to allow in the long run even demand side management by online regulation of large consumers and selected end users.

For more details on EEIRC's scope of work see section 3.3 "Cross Cutting Activities" in Part III of the document.

Figure 3: National Energy Efficiency Strategy of the Kingdom of Cambodia



The monitoring, evaluation and the PDCA cycle are accentuated colour-wise, because their application is a crucial continuous process throughout the entire action plan implementation, across all sectors.

The different sectorial activities run in parallel. For each sector, the activities can and should be arranged according to their impact, the level of inputs needed and their effects on the time line (see Action Plan).

2.5. Strategic Objectives per Sector

2.5.1. Objectives for Energy Efficiency in the Industry

The industry sector in the Kingdom of Cambodia has shown a strong growth in the past decade. Among the energy consuming industries, the **garment sector** can be considered as the driving force, followed by the fabrication of clay bricks for **building construction**, the **rice mills** for processing paddy into polished rice, the **rubber production** and the **food sector** with a particular emphasis on the **fabrication office** for refrigeration.

It is assumed that the **industrial energy consumption totals to about 3.04 TWh/year**[22] and with its present growth rate of 5.7%[23] in terms of production, it can be expected that the energy consumption will grow steadily at an **annual growth rate of 14.7%**[24] **until 2030**.

Despite this low share in the national total energy consumption, the industrial sector as a whole **represents 21.9%**[25] **of the GDP and employs 15.9%**[26] **of the 8.8 million labor force**, out of the 14.31 million inhabitants of Cambodia. The export of industrial goods out of the country has reached 6.49 BUSD in 2011. All relevant sectors (garment, rubber production, brick kilns, food processing, ice making and rice mills) have at least 20% energy saving potentials and particularly brick kilns can potentially save up to 70%.

Based on the above findings the following strategic objectives are proposed:

#	Strategic Objective	Outcome	Rationale
1	**The Energy Efficiency of the industrial sector is improved**	The energy intensity per unit of production is reduced	By means of reducing the specific energy consumption of industrial production processes, the energy costs in industry can be reduced by at least 20% (garment industry) up to 70% (brick production), depending on changes in behaviour and on the replacement of inefficient equipment.
2	**Capacity building in the field of EE&C in industry is strengthened**	Owners and managers of factories are trained in energy management and apply its principles	Most managers and owners of factories are not aware that a substantial amount of energy and thus money can be saved at their plant. They need to be taught and shown how to achieve those savings. For achieving this, it is recommended to support the development of energy service companies (ESCO's), the technical training of engineers and technicians in the field of energy conservation for performing energy audits and implement energy saving solutions in the industry and the support of local development and manufacturing of energy efficient equipment.

[22] ERIA Analysis of Energy Saving Potential in East Asia Region 2011
[23] Wikipedia on Cambodia's Economy
[24] Assessment Report on Energy Efficiency Institutional Arrangements in Asia, UN-ESCAP 2010 - www.eeasia.unescap.org
[25] ERIA 2d East Asia Summit EE Conference, Phnom Penh, Aug 2012
[26] Wikipedia on Cambodia's Economy

3	**Attention of factory owners/managers about EE is raised**	The owners and managers of factories are interested in knowing more about energy conservation measures and are ready to implement energy saving solutions	It is recommended to establish a working group among Industrial Associations to facilitate the exchange of information and know how concerning energy efficiency in industrial processes. The activities to be implemented are awareness raising campaigns about EE&C, providing financial incentives for the implementation of energy efficient solutions and support, especially to SME industrial companies, for auditing of their facilities and implementation of energy saving solutions.

2.5.2. Objectives for Energy Efficiency of End User Products

With an estimated share of 37% of total energy consumption (equalling 461.02 GWh) in 2009, the residential sector in Cambodia is the largest energy consumer.

Electricity consumption in the residential sector is characterized by a large discrepancy between urban and rural households. Only about 20% of households, most of them in urban areas, have access to grid electricity. Off-grid users rely e.g. on expensive diesel generators/ car batteries, thus residential electricity consumption is very low. The main use for electricity is lighting, and energy efficient CFL bulbs are already in widespread use across urban and rural areas.

However, due to the high urbanization rate and improvements of income and living standard, more heavily consuming electrical appliances such as refrigerators, air conditioners, rice cookers, TV sets, radios and washing machines will be used in future, and the energy efficiency of these appliances as well as their efficient use become important issues.

Considering the high electricity prices in Cambodia, particularly in off-grid areas, the introduction of energy efficiency standards for appliances as well as appropriate education and awareness campaigns can be highly efficient. According to international experiences implementing and enforcing energy labels for end user products and their efficient use can result in energy savings of up to 50%.

Based on the above findings the following sector objectives are proposed:

#	Strategic Objective	Outcome	Rationale
1	**Energy efficiency of end-user products has increased and residential electricity consumption is reduced**	Energy efficiency of end user products is improved	At present there are no energy efficiency standards available in Cambodia and the end user does not get any information on the energy efficiency of household appliances available in the market. It is therefore recommended that the energy consumption of energy consuming household appliances is tested by certified testing laboratories and labelled according to an approved labelling system. According to the experiences in other ASEAN countries and in Europe, by means of these measures energy savings of up to 50% can be achieved in the residential energy consumption.
2	**The market share of energy efficient resid-ential appliances has increased**	End users select more energy efficient products and reduce their energy consumption accordingly	There is no information available from retailers concerning the specific energy consumption of household appliances. Once the labelling system is introduced, consumers must be informed about the advantages of energy efficient appliances by means of publicity campaigns and advertisements in public media.

3	**End users are aware of the concept of energy efficiency and behave accordingly**	End users change their behaviour and use their electrical appliances in a more efficient way	At present there is a lack of knowledge about energy efficiency on all levels. Education programs must therefore be developed and implemented into school curricula. Publicity campaigns must be broadcasted by radio and TV and be published in newspapers to inform the great public about the concept of energy efficiency and the saving potentials that can be realized by the appropriate utilisation of electrical appliances, avoiding any wasteful consumption of electricity.

2.5.3. Objectives for Energy Efficiency in Buildings

On a global scale, the building sector is responsible for 42% of world electricity consumption. In developing countries with a growing building sector the potential for savings is particularly large because sub-sectors which will experience future growth can be targeted. Cambodia is clearly in a growth mode so planned construction is very important when designing an energy efficiency policy.

Mega projects such as Camko city, Garden city by LYP group, and Diamond Island in Phnom Penh will greatly impact energy consumption in Cambodia and it will be crucial to assess here the individual buildings, as well as their impact at the urban planning scale.

International experience shows that 20% or more energy savings can be achieved in buildings by using energy efficient building materials, energy efficient equipment, and passive design principles.

Based on the above findings the following sector objectives are proposed:

#	Strategic Objective	Outcome	Rationale
1	**Energy efficiency of new buildings is improved**	An energy efficiency building code for new buildings is established	An energy efficiency building code is widely regarded as the most effective way to reduce energy consumption in buildings. There is relatively little or no cost to improve the design of new buildings, to make them inherently more energy efficient, before they are built. Once a building is built, changes become more difficult and expensive. An energy efficiency building code specifies these energy efficient designs.
2	**Energy efficiency in existing buildings is improved**	An Energy Manager Certification program is established	Energy efficiency of existing buildings can be improved in the most cost effective manner by careful attention to the operation of the building. An onsite energy manager can both monitor building equipment, such as air-conditioners and boilers, and manage the habits of building occupants e.g. turning off lights when not in use. Furthermore, the building energy manager can report energy data and energy saving strategies that are valuable for policy making.
3	**Energy efficiency in public buildings is improved**	A green standard is applied to all new public buildings	A green standard is chosen for government buildings because it is in government's power to subscribe to a higher standard than energy efficiency codes and lead the way for Cambodia. An added benefit is addressing wider environmental concerns, such as building waste in landfills and water consumption. Also, these standards are already written, such the LOTUS in Viet Nam, and thus can be implemented relatively quickly. A model program is the United States' Government Service Administration (GSA) which has made the Green Building Council's LEED green standard a requirement for all federal government buildings.

#	Strategic Objective	Outcome	Rationale
4	**Education and awareness of energy efficiency in buildings has increased**	Classes and information for building professionals and the public	Architecture students are provided the necessary fundamentals to understand energy efficiency issues when in professional practice. Professional architects have the training and information needed to improve energy efficiency in building designs. And the public becomes informed so that they demand energy efficient buildings as clients.

2.5.4. Objectives for Energy Efficiency of Rural Electricity Generation and Distribution

Even though Cambodia is a low income country, the cost of electricity is one of the highest in the world due to limited domestic energy resources. Even when available, rural households pay more for electricity than urban residents.

Currently, only 6 % of Cambodia's rural population has access to electricity, mostly from village grids which are often powered by inefficient diesel generators. On average, rural families spend about 10% of their income on fuel and electricity.

It is difficult to quantify energy efficiency in rural electrification because there are very few households in rural areas that have access to electricity, and even fewer with an official connection. This means that statistics regarding appliances and efficiency in distribution networks are lacking. Despite this, some key observations can be made:

- **Household consumption is relatively low** and correspondingly, the saving potential is low.
- Also, the **energy efficiency gains for small rural industries and the use of irrigation are limited** and can only be achieved via exchanging electrical equipment, which would be rather expensive.
- EdC has been slowly increasing the efficiency of their transmission system and grid losses decreased to around 10% by 2009, which would be approximately in line with international standards and offers little scope for improvement.
- **REE generation and distribution networks offer the greatest potential** for efficiency improvements by reducing losses (up to 80% electricity savings). This requires institutional capacity building and communication, training of REE staff and developing a better understanding of the benefits of electricity and its possible uses by the households.

Rural electrification is a rather untypical part of an energy efficiency policy and Cambodia is probably the only country that made this direct connection to energy efficiency in its policy. As such it can serve in the future as a good lessons learned case amongst the ASEAN countries.

Based on the above findings the following sector objectives are proposed:

#	Strategic Objective	Outcome	Rationale
1	**Rural energy entrepreneurs (REEs) operate more efficient businesses**	Rural energy entrepreneurs (REEs) can provide their energy services more efficiently and at lower costs	To improve energy efficiency of rural electricity supply, the two most urgent priorities are introducing and enforcing standards on electricity generation and distribution and training of REEs in operating their systems more effectively. Rural energy entrepreneurs (REEs) generate and/or distribute electricity across much of Cambodia. Although some guideline standards apply to licensed REEs, they are not properly enforced. On top of this, there are still a large number of unlicensed REEs in operation with electrical losses of up to 40%. These unlicensed REEs represent the greatest potential for efficiency savings in rural electrification and can be tackled through better training, stricter standards, and improved technology (including renewable energy). Increasing efficiency will lead to lower electricity costs for the end users.
2	**Increase knowledge around rural electrification efficiency**	Government, private organisations, and rural households are better informed and prepared to tackle energy efficiency in rural electrification.	In order to improve energy efficiency in the rural electricity supply, the knowledge at all levels from policy makers to consumers must be improved. This means that the RGC must understand the situation on the ground, commercial organisations and NGOs need appropriate capacity to provide more efficient services, and rural households must know about the various electrification options available.

2.5.5. Objectives for Energy Efficient Use of Biomass Resources for Domestic and Industrial Purposes

Biomass, in particular firewood is the main primary energy source in Cambodia (71% of total primary energy supply in 2009).[27] Total biomass consumption for cooking purposes accounted for 53% of the total energy consumption in the year 2008[28] and there is still a trend to an increasing consumption of biomass for cooking.

The average consumption of firewood for cooking in is approximated to 3.1 kg per household per day. For those households using charcoal for cooking, average consumption of charcoal amounts to 1.5 kg per household per day.

The use of Biomass is a rather untipical part of an energy efficiency policy and Cambodia is probably the only country that made this direct connection to energy efficiency in its policy. As such it can server in the future for a good lessons learned case amongst the ASEAN countries.

Potentials for the improvement of energy efficiency in the use of biomass for energy purposes in Cambodia are expected to be particularly high in the following areas:

- Domestic cooking (urban and rural)
- Household Scale Industries in rural areas
- Production of charcoal
- Production of char briquettes.

It is estimated that 30-50% energy savings can be achieved only by making use of improved cooking stoves and more efficient charcoal kilns.

[27] Data source: OECD/IEA 2011
[28] Most recent data included in the energy balance currently published by the IEA for Cambodia.

Based on the above findings the following sector objectives are proposed:

#	Strategic Objective	Outcome	Rationale
1	**The National forest resources are protected by the sustainable and efficient use of biomass**	Firewood and charcoal consumption is reduced by utilization of more efficient technologies. Community-based sustainable forest management is being implemented effectively within a context of province, district and commune level planning and delivering concrete benefits to local communities. A strong demand and supply chain of energy efficient cook stoves is established.	The most urgent issues as discussed in the working group on energy efficiency in biomass utilization concern the targeting of the sector with the largest efficiency potential, to make the improved technology competitive by smart and innovative mechanisms and to conduct public awareness campaigns about these technologies via mass media to raise public awareness, especially of biomass users on the availability of EE technologies in the market and their comparative advantages: "It is intended to strengthening the sustainable forest management and bio-energy markets to promote environmental sustainability and to reduce greenhouse gas emissions in Cambodia (Sustainable Forest Management - SFM)"
2	**Combustible solid biomass residues are utilized optimally to substitute firewood and/or charcoal.**	Forest resources are protected by reducing firewood and charcoal consumption. Sustainable Supply of Solid Biomass is achieved by disseminating improved Solid Biomass Fuel Technology.	In 2010, char-briquette, a new alternative cooking fuel, started to enter Phnom Penh market. The char-briquette is made of 100% waste - the bio char from a garment factory - which makes them an environmental friendly cooking fuel. Technically it has similar (and even better) quality as the traditional wood charcoal, it can also be used with the same cook stoves in the same way of operation (loading, igniting, reloading, etc. As the char-briquette is utilizing the underutilized material, it can be considered as an extension of energy utilization in different forms of energy.

2.6. Financial Resources Required

CALCULATION OF THE EE POLICY TARGET			
Priority Area	**Timing**	**Annual Saving Potential (% p.a.)**	**Financial Requirements (US$)**
Industry	Short Term Actions Medium Term Actions Long Term Actions	20-40% 10-70% 10-20%	1,450,000 2,010,000 2,120,000
Buildings	Short Term Actions Medium Term Actions Long Term Actions	20-30%% (S,M,L)	200,000 370,000
End User Products	Short Term Actions Medium Term Actions Long Term Actions	50% ofelectricity 10-20% (M,L)	90,000 1,150,000 40,000

Rural Electrification	Short Term Actions Medium Term Actions Long Term Actions	Up to 80% (S,M) by Reduction of Losses	475,000 450,000
Biomass	Short Term Actions Medium Term Actions Long Term Actions	20-35% offirewood 20% ofcharcoal	351,000 245,000
TOTAL	**Upto 2035**	**20%= 1,190 ktoe**	**8,951,000**

According to the sectorial analysis of the energy consumption in Cambodia, it can be assumed that more than half of these savings (about 680 ktoe) will be biomass based, about 330 ktoe are electricity savings generated from Heavy Fuel Oil, and 180 ktoe are Diesel savings.

The monetary value of the savings achieved depends on the future structure of the energy consumption in each sector, on the development of the world market prices of imported petroleum products and on the value to be attached to biomass fuels.

Based on 2012 fuel prices of 560 US$/ton of fuel oil and 750 US$/ton of diesel (see IEA: End-use petroleum product prices and average crude oil import costs, March 2013), a very first estimate results in annual savings of about 319 Million US$ in 2035.

In addition, the biomass savings and environmental impacts have to be taken into consideration as qualitative benefits of the national Energy Efficiency Policy, Strategy and Action Plan.

2.7. Monitoring and Evaluation

To regularly monitor and evaluate the implementation, a Plan-Do-Check-Act (PDCA) approach has been elaborated as presented in chapter 2.4.1.

Part III

3. National Energy Efficiency Action Plan

3.1. Background

In the National Energy Efficiency Policy, MIME declared its willingness to reduce energy demand by 20% until 2035 and has set energy and climate change as main tasks in its Rectangular Strategy Phase II. In this context, the National Energy Efficiency Strategy develops an overall strategic framework for the policy coordination and sets specific strategic objectives for the implementation in each sector for the next five years. This National Energy Efficiency Action Plan outlines the activities to be implemented for each sectors specific strategic objective, under the National Energy Efficiency Policy, using the methodology that was set up in the strategy.

3.2. Scope of Planning

The Royal Government of Cambodia is fully aware of the difficult challenge ahead that is to balance in between supplying Cambodia on a sustained and efficient basis with energy, increasing economic competitiveness and securing the financial viability of this undertaking. When implementing the CNEE Action Plan, it will thus always pay close attention to take an appropriate selection of activities according to their impact, feasibility and timing. The following matrix shall support this selection process accordingly. Further information on the used symbols can be found at the end of the matrix.

Overview and prioritization of activities						
Sect	Obj	No.	Activities	Impact	Feasi-bility	Timing
Industry	1	1	Improve energy data collection and processing in the industry	■	●	S
		2	Promotion of good energy management practice in industrial enterprises	■	●	S
		3	Promotion of biomass use for decentralized production of energy (thermal or electrical) through gasification or bio digestion	■	●	M
		4	Implementation of voluntary standards on energy efficiency in industrial enterprises consuming more than a certain amount (to be determined) of energy per year	■	●	S
		5	Implementation of energy efficiency/conservation laws/regulations on industrial energy use	■	●	M
	2	1	Support the development of energy service companies (ESCO's)	■	●	M/L

Overview and prioritization of activities						
Sect	Obj	No.	Activities	Impact	Feasi-bility	Timing
		2	Technical training for engineers and technicians in the field of energy efficiency, performing energy audits, establishing EMS and implementing energy saving measures in the industry	■	●	S/M
		3	Support the local development and manufacturing of energy efficient equipment	■	●	M/L
	3	1	Organize awareness raising campaigns about energy efficiency in industry	■	●	M
		2	Provide financial incentives to interested companies to implement energy efficiency strategies and measures	■	●	L
		3	Support, especially to small and medium industrial enterprises, for auditing of their facilities and implementation of energy efficient solutions	■	●	M
End User Products	1	1	A compulsory national energy efficiency labeling system for household appliances is being elaborated and introduced in Cambodia	■	●	S/M
		2	Electricity consumption of household appliances is measured/tested by certified institutions/ laboratories	■	●	M
		3	Energy efficiency standards, laws and regulations concerning energy efficiency of end-user appliances are being elaborated and promulgated by government	■	●	M/L
	2	1	Regular information campaigns on energy efficiency of appliances are organized in TV, radio and newspapers	■	●	M/L
		2	Ministries and other public institutions are demonstrating the usefulness of EE by applying EE minimum standards in the procurement of their energy consuming devices such as computers, AC, refrigerators, lights	■	●	M/L
	3	1	Education programs in energy efficient behaviour are performed in schools	■	●	M/L
		2	Publicity campaigns on energy efficient behaviour are published in the public media	■	●	M/L

Overview and prioritization of activities						
Sect	Obj	No.	Activities	Impact	Feasi-bility	Timing
Buildings	1	1	An energy efficiency building code for new buildings is established	■	🔴	M/L
		2	Energy efficiency building codes in other countries are evaluated	▪	🟢	S/M
		3	Energy efficiency building requirements are attached to large developments and luxury hotels	■	🟡	S
	2	1	Establish an energy manager program	■	🟡	M/L
		2	Establishment of an energy data base at MIME	■	🟢	M/L
		3	Energy managers are trained and certified	■	🟡	M
	3	1	Existing public buildings are held to a high energy efficiency performance standard	■	🟢	M
		2	Public buildings are designed according to an established green building standard	■	🟡	M
	4	1	Education of architecture students in energy efficiency (knowledge)	■	🟢	S/M
		2	Education of architects and planners in energy efficiency (basics)	■	🟢	S/M
		3	An Energy Efficiency Information Resource Center is established	■	🟢	S/M
		4	Study tours to selected examples of good practice of energy efficient buildings	■	🟢	S
		5	Public lectures by architects with expertise in energy efficient buildings	■	🟢	S
Rural Electrification	1	1	Pilot generation projects are installed and analyzed	■	🟢	S
		2	Establish and enforce distribution standards	■	🟢	M
		3	Training of REEs to improve operational efficiency	■	🟢	S
	2	1	Inventory of unlicensed REEs and electrification database	■	🟡	S
		2	Improve renewable energy system installation capacity and supply chain.	▪	🟡	M
		3	Increase consumer awareness of rural electrification options and energy efficiency	▪	🟢	M

Overview and prioritization of activities						
Sect	Obj	No.	Activities	Impact	Feasi-bility	Timing
Biomass	1	1	Promotion of improved and efficient cookstoves for rural households	■	●	S/M
		2	Promotion of sustainable forest management for biomass fuel supply	■	●	L
		3	Promotion of sustainable charcoal production applying improved charcoal kiln technologies	■	●	M
		4	Promotion of improved and efficient cookstoves for urban households	■	●	S/M
		5	Promotion of improved and efficient cookstoves for household scale industries in rural areas	■	●	S/M
	2	1	Promotion of production, distribution and utilization of char briquette as alternative cooking fuel for households and household scale industries in urban areas	■	●	S/M

Legend:

Impact		Feasibility		Timing	
High	■	Easy	●	Upto 1 year	S
Medium	■	Medium	●	2 to 3 years	M
Low	■	Not easy	●	> 3 years	L

3.3. Cross-cutting Activities

As outlined in the CNEE strategy, this section displays all cross-cutting issues, highlights the potential for synergies and shall facilitate the coordination of the below listed actions.

Action fields	Energy data collection and analysis system				
	EE in industry	EE of end-user products	EE in buildings	EE of rural electricity generation and distribution	Efficient use of biomass for residential and industrial purposes
Establish a working group comprising all relevant institutions	Industry EE&C working group: MIME, MoEF, National Institute of Statistics, EdC, Industry Ass.	MIME, MOC, ISC and representatives from the Industry and Consumer Associations	MIME develops a data collection template to be used by building energy managers	Working Group includes relevant institutions EAC, REF and EdC	WEWG to establish a National Biomass Energy Database (sub) Unit
Elaborate appropriate, regular data collection procedure	Large consumers report yearly consumption and volume of production to MIME	Data on the residential energy consumption are collected and processed regularly by NIS	MIME collects data from energy managers that use standards such as ASEAN Center for Energy	System and report on country wide data collection on unlicensed REEs	NIS of the MOP to set-up clear boundaries of biomass energy data fields
Create the legal prerequisites for the data collection process	Determine the level of consumption and the type of industry concerned	MOC, MIME should establish a legal framework for NIS to collect data from rural and urban HH	Create the prerequisite for data collection. See similar program in Malaysia	Legal prerequisites not required, though the RGC must understand and endorse the need for data collection	NIS of MOP establish a biomass energy database collection plan, including data format, scope, templates, etc.
Organize data collection in all sectors and regions	Data is prepared by energy managers. Comparison/benchmark on results carried out by AJEEP	Transparent and comprehensive exchange of data between Ministries and public is organized	MIME subject data to suitable treatment of subsectors such as hotels, shopping malls etc.	Editing and govern data in close work with local authorities and academic institutions	Relevant institutions and partners advised to mandatory share data in a pre-defined format
Process and compile the collected data according to international standards	Statistics are established per industrial sub-sector and categorized	Residential energy demand will be processed and published by NIS and incorporated in the National Energy Balance	Energy coaches interpret data and brainstorm methods to process data using recognized standards	Tabulation of data is set up in a comprehensive database and used to feed into performance metrics	Administer the collection, storing and management of the database related to biomass energy
Publish these data on a yearly basis	MIME concerned with EE&C yearly publishes the data and the Cambodia Statistical Yearbook with the help of NIS	National Energy Balance is being published annually with information on the cost-savings of changed behaviour	Data can be made available on MIME's website as part of a National Energy Efficiency Information Center	Annual reviews provide information on the impact and show progress in rural electrifiable energy efficiency	Incorporate the publication of biomass energy data in the Cambodia Year Book, soft copy (digital) and interactive (online)

Action fields	Awareness raising				
	EE in industry	EE of end-user products	EE in buildings	EE of rural electricity generation and distribution	Efficient use of biomass for residential and industrial purposes
Integrate the principles of energy efficiency in the curricular of schools and universities	Programs on the principles of EE&C and Energy Management Systems (EMS) to train energy auditors and energy managers	The energy consumption of household appliances and their efficient use serve as practical examples to demonstrate the saving potential for households	A pilot course on EE principals and technologies in a university architecture program	Energy efficiency teaching in rural primary schools. Focus should also be on the productive use of energy	Introducing basic principal of efficient heat generation and transfer by comparing traditional and improved cook stove to lower secondary school students
Launch appropriate training programs	Industrial professional associations propose training programs for auditors and managers		A vocational training course for building energy managers. A certificate course for architects on EE principles and technologies	Training for REEs covering energy efficiency and improved business practices	Adopt the initiatives implemented by the Sustainable Forest Management Project
Organize public awareness campaigns in urban and rural centers with appropriate media coverage	Messages, incentives and support available for audits and implementation of measures are disseminated through industrial associations	Public awareness campaigns concerning energy efficient end use devices (incl. biomass and buildings) and their efficient utilisation	Public lectures by architects designing projects demonstrating EE principals	Awareness campaigns for rural HHs covering energy efficiency, the productive use of energy and the range of services to be expected from local REEs	Publicity campaigns to promote improved cook stoves and other efficient biomass burning devices
Establish minimum standards and an energy labelling system	The Institute of Standards of Cambodia develops standards for industrial equipment both imported and built locally on their energy performance, using international standards and standards developed in ASEAN	The energy labelling system for energy consuming household appliances as part of the national EE policy and strategy and its potential impact on EE is a good example for the contribution of individual households to the reduction of the overall energy demand of the country	Rating building products such as windows (for solar heat gain coefficient)	Appliances are not a significant source of inefficiency in rural areas	Rating the improved cook stoves by considering the efficiency, cleanliness of the combustion, pollution level and safety based on field and laboratory tests that refer to an international standard protocol with necessary adoption to local contexts (climate, culture, cooking habit, etc…)

Action fields	Legal and financial framework conditions				
	EE in industry	EE of end-user products	EE in buildings	EE of rural electricity generation and distribution	Efficient use of biomass for residential and industrial purposes
Laws and regulations must be formulated, promulgated and enforced	Subject to control of power factor, energy performance indicators, limitation on peak, taxes, etc.	Laws and regulations concerning minimum standards must be integrated in the overall national EE policy	An EE building code developed by MOLMUP+C in cooperation with MIME	Minimum efficiency standards for licensed REEs must be more rigorously formulated and enforced	Regulation on Generic (general requirements of improved cook stove) and Specific Standard (specification of improved cook stove design)
Suitable credit/financing tools to facilitate energy efficiency investments such as co-generation must be developed	Low interest loans to finance all measures leading to energy savings: audits, energy management systems, EE equipment	Subsidies help EE appliances to stay competitive in the face of cheap products	Low cost loans for EE building projects	Financing to help REEs invest in more efficient technologies	Legal supports provided to the production and distribution of efficient cook stove in order to enable the enterprises to access specific finance supports (e.g. soft loan)
The import of energy efficient devices must be encouraged by tax-reliefs	Import taxes to be lowered on EE industrial equipment with criterions to be determined and upgraded yearly	Tax incentives for the import of energy efficient appliances	Reduction of import tax on EE building products such as low-e windows	Tax incentives should apply to all energy efficient electricity generation and distribution technology	Reduction of import tax for sheet metal (galvanized zinc) that is needed regularly by improved cook stove production (approx 5,000 pc per month) and other necessary component
Establish carbon credit fund and/or EE&C Fund to finance EE projects and interventions	A financing scheme (e.g. carbon credit fund) to boost industrial investment in EE. Locally available biomass resources reduces energy costs (e.g. for coal) and GHG emissions		Use for financing development of EE building code or a green standard	The current low price of carbon and small decentralised nature of projects mean scope for carbon credits is limited	Improved cook stove and other efficient biomass burning devices shall be privileged in accessing and managing the fund for scaling-up and funding the hard-to-fund activities (e.g. R&D, piloting, …)
Conferences with international donor agencies must be organized to get access to financing schemes	Target international donor organizations that support and fund pilot projects and training		Target international donor organizations that support and fund pilot projects and training	Target international donor organizations that support and fund pilot projects and training	WEWG team participates in selective regional and international networking to attract funding (grant, equity, loan, etc.)

Action fields	Cooperation and networking				
	EE in industry	EE of end-user products	EE in buildings	EE of rural electricity generation and distribution	Efficient use of biomass for residential and industrial purposes
Establish working groups under the guidance of MIME, comprising all relevant authorities and stakeholders	MoEF, MoEYS, MoLVT, ISC, EdC, industrial professional ass. of the priority sub-sectors banking sector representatives, TUV, international donors and agencies	Adaption of national survey of AJEEP to Cambodian context in close cooperation with AJEEP and ACE.	A working group for EE building code and data collection which includes MOLMUP+C and the building community	Local government authorities, local organisations (e.g. Picosol, Khmer Solar, SME Renewables, CRDT), academic institutions, national branches of international organisations (such as UNDP, UN Habitat, WB)	Revive and reactivate the Wood Energy Working Group that was established and endorsed by MIME (Prakas signed by Minister of MIME, Feb 2006)
Organize regular inter-ministerial meetings where the way forward will be discussed and decided	Involvement of MIME, MoEYS, MoLVT, MoAFF, MoEF, MoC,		MIME and MOLMUP+C to regularly meet to discuss development and updates of EE building code	Relevant stakeholders include EAC, REF, and EdC.	Forum established by implementation of "Sustainable Forest Management Project"
Perform regular workshops and conferences to inform the greater public about government decisions and recommendations	Decisions and recommen-dations are disseminated to the industrial enterprises through the industrial professional associations (GMAC, Brewery Association of Cambodia, etc.)		Workshops on the EE building code and data collection. Invite officials from neighbouring countries with established programs	Include representatives from rural communities and use their feedback to help shape policy decisions	The forum is managed by MIME & FA, funded by UNDP & GEF, operated by GERES and RECOFTC

To make the data and information collected available to all interested parties in order **to increase the public awareness** and create **a platform for cooperation and networking,** it is proposed to establish an **"Energy Efficiency Information Resource Centre"** at MIME. This **EEIRC** should be accessible as:

- A physical desk, i.e. a person assigned in MIME who is able to provide information and services by phone or in person and who is responsible for the continuous update (content) of the web-portal and as
- A web portal via internet offering information and services about EE products, regulations, standards, reports and governmental publications. Such a web-portal can be considered as an active communication tool with the users, as it is based upon
- A pro-active communication approach
- A monitoring of the system use
- A continuous integration with schools, universities and other public institutions

- A system of fluid inter-active online monitoring (incl. collection of data; data base, visualization, communication & use), to allow in the long run even demand side management by online regulation of large consumers and selected end users.

Such a web-portal should integrate social media to facilitate rapid communication. In this way, all sectors can be interlinked to optimize energy consumption in the most efficient manner. The Energy Efficiency Information Resource Centre could provide its services to all sectors, improving the inter linkage of the various decision makers and stakeholders.

In the following the specific action plans per strategic objective for all 5 sectors are elaborated.

3.4. Energy Efficiency Action Plan for the Industry

Industry Objective 1:	*The Energy Efficiency of the industrial sector is improved*
Activity 1:	**Improve energy data collection and processing in the industry**
Description of the measure:	• Data regarding energy consumption and production volumes across the country will be collected on a yearly basis in strategic industrial sectors and/or factories consuming more than a certain amount (to be defined) of energy per year. It is advised to start the data collection with the large consumers and progressively extend it to SME's, following a pre-defined schedule for that. • Those data are processed and compiled by MIME staff in a document reflecting the reality of energy consumption on a national level for all strategic sectors of industry • Energy benchmark indicators are established per type of industry • MIME staff is trained for these tasks of collecting, processing and editing those data.
Expected Results/Outputs:	Comparable data basis of the energy consumption in the industry for each sub-sector is obtained, which can be used to direct energy saving policy from local to national level.
Requirements:	• Data collection and measurement equipment is available and properly installed (e.g. National Energy Consumption Surveys by AJEEP) • It has to be made compulsory for all those industries to communicate their data to MIME every year. • Communication campaigns for the industry explaining the interest and need for those data must be organized.
Implementing Agency:	MIME
Stakeholders involved:	MIME, National Institute of Statistics, Industrial associations, experts in energy efficiency and statistics
Target Group:	Industrial enterprises
Saving Potential:	n/a
Budget Estimation:	220,000 US$ (training of staff at Ministry, communication to industrial companies, ITC hard- and software, measuring equipment)
Potential Source of Funding:	ADB, GEF, UNIDO
Time frame:	Short term, should be implemented and operational before end of 2015for the large consumers, then progressively be extended to the SME's. Priority in the program
Monitoring:	Random control by MIME staff or contracted energy auditors in selected factories using criterions such as energy bills, biomass consumption or meters in order to compare the data given by the factories with some actual information taken from the field.

Industry Objective 1:	*The Energy Efficiency of the industrial sector is improved*
Activity 2:	**Promotion of good energy management practice in industrial enterprises**
Description of the measure:	To promote good energy management practice, it is recommended to follow the standard ISO 50001 (EMS). This includes the following measures: • Make better use of existing energy consuming assets • Create transparency and facilitate communication on the management of energy resources • Promote energy management best practices and reinforce good energy management behaviours • Assist enterprises in evaluating and prioritizing the implementation of new energy-efficient technologies • Provide a framework for promoting energy efficiency throughout the supply chain of the factory • Allow integration with other organizational management systems such as quality (ISO 9001), Environmental (ISO14001), Occupational health and safety (OHSAS 18000).
Expected Results/Outputs:	Improved energy-related performance in industrial enterprises to realize untapped EE potential, to benefit from cost savings, make significant contribution to environmental and climate protection, e.g. reduction of CO2 emissions, meet legislative or self-imposed carbon targets and thereby enhance the entity's reputation as a socially responsible organization.
Requirements:	Management of industrial enterprises are aware of the benefits to implement Energy Management Systems (EMS) at their factories.
Implementing Agency:	UNIDO
Stakeholders involved:	MIME, industrial professional organizations (GMAC, Federation of Rice Miller Association, Rubber producers, Food industry, Phnom Penh SMI Association, Brewery Association of Cambodia)
Target Group:	Industrial enterprises
Saving Potential:	20-40% depending on the industrial sector
Budget Estimation:	160,000 US$
Potential Source of Funding:	GEF, UNIDO member countries
Time frame:	Short term
Monitoring:	Industrial energy audits to measure energy consumption and reduction on fossil fuels.

Industry Objective 1:	*The Energy Efficiency of the industrial sector is improved*
Activity 3:	**Promotion of biomass use for decentralized production of energy (thermal or electrical) through gasification or bio digestion** *(see also chapter 3.5)*
Description of the measure:	• Inventory of the biomass resources (rice husk, wood residues) available for energy purposes, • Inventory of the needs in the industrial sector, • Creation of efficient distribution patterns between supply and demand, minimizing the energy needs for transportation, • Technical and financial support to companies building locally biomass gasifiers and digesters • Develop programs of re-forestation/forest management to ensure sustainable supply of biomass on the long term.
Expected Results/Outputs:	Dependency on imported fossil fuels to run the industry and overall energy costs are reduced
Requirements:	• Sustainable supply of biomass through forest resource management programs and proper use of agricultural waste to ensure availability and low cost of the resource on the long term, • High quality of equipment (gasifiers, digesters) generating energy from biomass, • Agreed cooperation between MIME and the Ministry of Agriculture, Forestry and Fisheries (MAFF). • Certification of the origin of the biomass (e.g. for wood chips) would be desirable.
Implementing Agency:	UNIDO, NGO's
Stakeholders involved:	MIME, MAFF, enterprises involved in biomass gasifier construction/import, Ministry of Economy and Finance (MEF), NGO's
Target Group:	Industrial enterprises
Saving Potential:	This is more a measure of substitution rather than of savings. Here, we replace costly imported fossil fuel with locally produced low cost renewable energy source. Hence the energy costs can be reduced by up to 80%.
Budget Estimation:	650,000 US$
Potential Source of Funding:	GEF
Time frame:	Medium term
Monitoring:	Number of gasifiers/bio digesters installed per year, Quantity of fossil fuel saved per year.

Industry Objective 1:	*The Energy Efficiency of the industrial sector is improved*
Activity 4:	**Implementation of voluntary as well as of compulsory standards on energy efficiency in industrial enterprises consuming more than a certain amount (to be determined) of energy per year**.
Description of the measure:	• Promotion of standards in cooperation with industry associations based on ISO and in cooperation with ISC • Information to industry about costs and benefits of energy efficiency improvements according to the set standards • Dissemination of implementation progress and results
Expected Results/Outputs:	Industrial enterprises are optimizing their energy consumption according to the standards developed and can reduce their energy consumption accordingly.
Requirements:	Knowledge about international energy efficiency standards in industry
Implementing Agency:	Institute of Standards of Cambodia (ISC)
Stakeholders involved:	MIME, ISC, TUV, other auditing companies
Target Group:	Industrial enterpriseswith priority on the large consumers in a first phase and then dissemination to SME's in a second phase
Saving Potential:	15%
Budget Estimation:	320,000 US$
Potential Source of Funding:	ADB
Time frame:	Short to medium term (2014-2018)
Monitoring:	Regular review of the energy efficiency standards and their application in industrial enterprises by certified auditors.

Industry Objective 1:	*The Energy Efficiency of the industrial sector is improved*
Activity 5:	**Implementation of energy efficiency/conservation laws/regulations on industrial energy use**
Description of the measure:	• Control of power factor in large industrial facilities • Energy performance indicators will be set for each industrial sector (kWh or MJ per unit of product manufactured) for enterprises above a given minimum size • Enforcement of demand side management by limitation/control of peak loads in large industrial facilities connected to the grid • Implementation of Energy Management Systems in industrial enterprises consuming more than a certain amount of energy per year (to be determined), with designation of an energy manager to follow up on the EMS implementation • Increase import taxes on energy inefficient equipment and lowering import taxes on energy efficient industrial equipment to create an incentive for efficiency • Create tax incentives for energy efficient equipment produced in Cambodia.
Expected Results/Outputs	Owners/managers of industrial enterprises are taking actions to reduce their energy consumption according to the national laws and regulations.
Requirements:	Energy intensity of industrial facilities is being tested on a regular basis. Criteria for efficiency are determined by MIME.
Implementing Agency:	MIME
Stakeholders involved:	Ministry of Economy and Finance, EdC, EAC, ISC.
Target Group:	Energy managers, owners/managers of industrial enterprises
Saving Potential:	15%
Budget Estimation:	160,000 US$
Potential Source of Funding:	Government, co-financing by international donors such as EU
Time frame:	Medium term
Monitoring:	Regular inspection of enterprises concerning their compliance with laws and regulations Annual energy consumption to be recorded regularly to government services.

Industry Objective 2:	*Capacity building in the field of EE&C in industry is strengthened*
Activity 1:	**Support the development of energy service companies (ESCO's)**
Description of the measure:	• Launch an energy audit support program • Identify existing companies able/interested to offer such services • Train selected staff in energy conservation (auditing and implementation of energy conservation measures) • Certify ESCOs by MIME • Develop appropriate financing schemes for ESCO's • Campaigning about the availability of this type of service to the industry
Expected Results/Outputs:	A pool of qualified ESCO's is established and able to provide energy efficiency/conservation services to private and public customers.
Requirements:	• Appropriate training programmes and trainers in the field of energy conservation are available • Banks are willing to finance ESCO's
Implementing Agency:	TUV and other consulting companies from private sector
Stakeholders involved:	MIME, energy service companies, e.g. Comin Khmer etc.
Target Group:	Private energy service enterprises
Saving Potential:	10%
Budget Estimation:	300,000 US$
Potential Source of Funding:	GEF
Time frame:	Medium to long term
Monitoring:	Number of ESCO's registered per year, number of audits and implementation of energy saving measures achieved per year by this pool of ESCOs, quantity in toe and money of energy saved per year

Industry Objective 2:	*Capacity building in the field of EE&C in industry is strengthened*
Activity 2:	**Technical training for engineers and technicians in the field of energy efficiency, performing energy audits, establishing EMS and implementing energy saving measures in the industry**
Description of the measure:	• Implementing a curriculum at the National University in the engineering department to train energy auditors and managers for the industry • Training of MIME staff in charge of energy efficiency and energy conservation policies • Disseminate existing EMS manuals to priority industrial enterprises • Provide training courses for managers and technicians from factories • Training of industrial biomass gasifier builders and users in order to improve the efficiency of the gasifiers.
Expected Results/Outputs:	Trained managers and technicians are available and able to introduce principles of energy management in their enterprises and to trigger investments in energy saving measures and technologies, leading to the reduction of specific energy consumption per unit of production.
Requirements:	Training programs and trainers on energy auditing and energy management are available (e.g. ECCJ and ACE carried out ten audits) Training material is produced and disseminated.
Implementing Agency:	Ministry of Education, Youth and Sports (MoEYS) in collaboration with MIME
Stakeholders involved:	MoLVT, vocational training schools, engineering departments of universities
Target Group:	Engineers and technician from energy intensive industrial enterprises
Saving Potential:	15%
Budget Estimation:	750,000 US$
Potential Source of Funding:	Enterprises, co-financing by international donors
Time frame:	Short to medium term
Monitoring:	Number of technicians/engineers/professionals trained per year.

Industry Objective 2:	*Capacity building in the field of EE&C in industry is strengthened*
Activity 3:	**Support the local development and manufacturing of energy efficient equipment**
Description of the measure:	• Technical and financial assistance to local producers of industrial equipment in quality management • Training of technical staff in energy efficient technologies • Provide tax incentives for energy efficient devices produced locally
Expected Results/Outputs:	• Energy efficient equipment for the industry is available locally, produced at low cost and entailing to costs and energy savings. • Dissemination of skills for the manufacturing of energy efficient equipment
Requirements:	Commitment of the companies wanting to benefit from this program to produce energy efficient devices A minimum level of skills should already be present in the company.
Implementing Agency:	MIME
Stakeholders involved:	MoEF, MoLVT, vocational training schools
Target Group:	Companies building and selling industrial equipment
Saving Potential:	10%
Budget Estimation:	320,000 US$
Potential Source of Funding:	GEF
Time frame:	Medium to long term
Monitoring:	Number of technicians/engineers trained per year Turnover of energy efficient devices made in Cambodia

Industry Objective 3:	***Attention of factory owners/managers about EE is raised***
Activity 1:	**Organize awareness raising campaigns about energy efficiency in industry**
Description of the measure:	• Site visits of energy efficient factories inside and outside Cambodia. • Organization of workshops for pointing out to the managers and owners of production plants the solutions for saving energy/money at their premises. • Demonstration/pilot projects to be implemented in different types of industries in Cambodia • Creation of an Energy Resource Center for disseminating information related to EE&C, providing updated internet content, manuals and counsellors to inform owners and managers of industrial enterprises on EE&C potential, • Communication campaigns among managers and owners of factories at national level, especially through professional associations, in order to build a culture about EE&C in the industry on the long term, especially in SME's where it is definitely lacking at present..
Expected Results/Outputs:	Owners and managers of industrial enterprises are aware of the benefits of energy audits and energy conservation measures
Requirements:	Appropriate means and financing instruments to organize awareness raising campaigns are available
Implementing Agency:	MIME
Stakeholders involved:	Industrial professional associations (GMAC, Federation of Rice Miller Association, Rubber producers, Food Industry Association, Phnom Penh SMI Association, Brewery Association of Cambodia),
Target Group:	Owners and managers of factories
Saving Potential:	10%
Budget Estimation:	up to 900,000 US$
Potential Source of Funding:	GEF, UNIDO
Time frame:	Medium term
Monitoring:	Surveys in industry on the number of owners and managers of factories informed about EE&C and interested in implementing energy efficiency measures at their premises, number of awareness raising actions conducted per year

Industry Objective 3:	*Attention of factory owners/managers about EE is raised*
Activity 2:	**Provide financial incentives to interested companies to implement energy efficiency strategies and measures**
Description of the measure:	• Provide information on energy and money savings achievable by reducing energy consumption • Specify energy conservation measures according to their financial and organizational requirements (behavioural changes, small modifications/ changes in the production process, investment in more efficient appliances) • Elaborate financial instruments such as preferential credits, tax relieves, grants for energy efficiency measures, usage of carbon credits, establishment of Climate Change Trust Fund or similar • Define policy interventions for fiscal and economic incentives.
Expected Results/Outputs:	Companies, especially SME's, make increasingly use of the financial incentives to improve their energy efficiency.
Requirements:	Low interest loans for implementation of energy efficiency measures are available from banks; Other financial means are developed and accessible; Government is willing to support this initiative.
Implementing Agency:	Ministry of Economy and Finance
Stakeholders involved:	MIME, Banking System of Cambodia, ADB
Target Group:	Private companies, especially SME's
Saving Potential:	20%
Budget Estimation:	50 million US$ until 2020 for loans with a regular progression over the years, as energy efficiency programs develop in the country
Potential Source of Funding:	Banking system of Cambodia on private and public sides, KfW, ADB
Time frame:	Long term
Monitoring:	Number and amount of loans given per year, kind of solutions financed and energy saved by these measures.

Industry Objective 3:	*Attention of factory owners/managers about EE is raised*
Activity 3:	**Support, especially to small and medium industrial enterprises, for auditing of their facilities and implementation of energy efficient solutions**
Description of the measure:	• Definition of the criteria for the selection of the enterprises to be audited • Communication campaigns to the industrial sector concerning the auditing/implementation services offered • Selection of enterprises to be audited • Performance of the audits • Implementation of energy conservation measures. • Create financial incentives to facilitate the performance of audits and the implementation of EE measures, depending on the needs of the beneficiaries: SME's may need more support than the bigger industrial companies, especially on the energy audit side.
Expected Results/Outputs:	An increasing number of industrial enterprises and in particular of SME's is performing energy audits in their premises and implementing saving measures to reduce their energy demand
Requirements:	Motivation of the entrepreneurs to engage in energy efficiency
Implementing Agency:	UNIDO
Stakeholders involved:	MIME, industrial professional associations (GMAC, Federation of Rice Miller Association, Rubber producers, Food Industry Association, Phnom Penh SMI Association, Brewery Association of Cambodia),
Target Group:	Industrial enterprises and in particular SME's
Saving Potential:	15%
Budget Estimation:	1.8 million US$ for audits and implementation measures (for SME's)
Potential Source of Funding:	UNIDO, GEF
Time frame:	Medium to long term
Monitoring:	Surveys on the number of SME's participating in the program, energy efficiency measures put in place, energy and money saved per year.

3.5. Energy Efficiency Action Plan for End User Products

End-User Products Objective 1:	***Energy efficiency of end-user products has increased and residential electricity consumption is reduced***
Activity 1:	**A compulsory national energy efficiency labelling system for household appliances is being elaborated and introduced in Cambodia**
Description of the measure:	• Collection and evaluation of EE labelling systems from neighbouring countries and the EU • Decide upon the most appropriate labelling system for Cambodia • Set priorities concerning the appliances to be labelled • Put in place legal arrangements with importers/assemblers of electrical devices concerning the compulsory labelling of their products • Inform the public about the labels put in place by means of leaflets and publicity campaigns to be elaborated by local media experts.
Expected Results/Outputs:	• All electric appliances sold in Cambodia will be marked with the appropriate energy efficiency label. • Households know about energy efficient appliances and make increasingly use of them • Consumers select products based on reliable information on energy consumption • The market share of energy efficient appliances is increasing.
Requirements:	Government and the private sector must be willing to cooperate in introducing such a labelling scheme. End users must be informed.
Implementing Agency:	MIME in coordination with Ministry of Commerce
Stakeholders involved:	Institute of Standards of Cambodia, Ministry of Information
Target Group:	Producers and importers of electrical appliances, Industry Associations, EdC, Consumer Associations, Private households
Saving Potential:	Up to 50% of household electricity consumption
Budget Estimation:	Labelling scheme: 50,000 US$ plus Awareness campaigns: 40,000 US$ plus
Potential Source of Funding:	Government funding, co-financed by industry and international donors
Timeframe:	Short to medium term
Monitoring:	Surveys at retailer stores.

End-User Products Objective 1:	***Energy efficiency of end-user products has increased and residential electricity consumption is reduced***
Activity 2:	**Electricity consumption of household appliances is measured/tested by certified institutions/ laboratories**
Description of the measure:	• Visits of existing test laboratories in the region and discussion of means of cooperation • Define the requirements for a test laboratory to be established in Cambodia • Decide upon the Installation of a proper test laboratory in Cambodia • Set up the test laboratory, if appropriate • Train laboratory staff on how to perform the tests • Publish the test results in public media
Expected Results/Outputs:	The labelling of electrical appliances is based on objectively verifiable test results according to international standards.
Requirements:	Certified testing facilities to measure electricity consumption of products are available and can be utilized. They are either established in Cambodia, or Cambodian enterprises have access to testing facilities in neighbouring countries such as Thailand or Malaysia.
Implementing Agency:	Department of Energy Technique (DET) of General department of Energy (GDE), MIME in cooperation with ISC, MIME
Stakeholders involved:	Universities
Target Group:	Producers and importers of electrical appliances, Industry Associations
Saving Potential:	This activity provides only the necessary data, no direct savings can be quantified
Budget Estimation:	Testing facilities for: ○ Refrigerators: 250,000 US$ ○ Air Conditioners: 800,000 US$ ○ Lighting: 40,000 US$
Potential Source of Funding:	Government funding, co-financed by industry and international donors
Time frame:	Medium term
Monitoring:	Test reports to be published regularly

End-User Products Objective 1:	***Energy efficiency of end-user products has increased and residential electricity consumption is reduced***
Activity 3:	**Energy efficiency standards, laws and regulations concerning energy efficiency of end-user appliances are being elaborated and promulgated by government**
Description of the measure:	• The Institute of Standards of Cambodia is supported by EE experts in the elaboration of standards, laws and regulations. • Promulgation of laws and regulations concerning minimum standards by RGC • Information of Industry Associations • Adoption of import regulations according to minimum standards to be met
Expected Results/Outputs:	ISC is introducing EE standards, laws and regulations Only appliances above the set norms and standards are accepted to enter the market of Cambodia. Products which are not corresponding to the minimum efficiency standards are excluded from the market.
Requirements:	The ISC should closely cooperate with DET, MIME in establishing minimum standards for electrical appliances and with the Ministry of Commerce in regulating the import and assembling of these devices. Experiences from neighbouring countries such as Thailand in EE labelling are made available and are adopted. On the political level, the decision makers must be willing to impose energy efficiency standards by laws and regulations.
Implementing Agency:	ISC in collaboration with department of Energy Technique of GDE, MIME
Stakeholders involved:	Ministry of Commerce
Target Group:	Producers and importers of electrical appliances, Industry Associations,
Saving Potential:	Depends on the minimum standards to be set
Budget Estimation:	20,000 US$ for training of decision makers
Potential Source of Funding:	Government budget, International donors
Time frame:	Medium to long term
Monitoring:	Government bulletin, publishing laws and regulations

End-User Products ***Objective 2:***	***The market share of energy efficient residential appliances has increased***
Activity 1:	**Regular information campaigns on energy efficiency of appliances are organized in TV, radio and newspapers**
Description of the measure:	• Organizing press conferences and interviews with journalists on the subject of EE • Provide an internet platform for EE news, tools and information • Motivate radio and TV channels to publish information concerning the concept of EE and the savings achievable, e.g. by replacement of incandescent lamps by energy saving lamps etc.
Expected Results/Outputs:	The public is aware of the benefits of EE Consumers select more energy efficient devices
Requirements:	Government can convince the public media to participate in these campaigns
Implementing Agency:	Ministry of Information
Stakeholders involved:	TV and radio stations, newspapers
Target Group:	The public
Saving Potential:	Depends on the media coverage
Budget Estimation:	20,000 US$ to trigger the measures
Potential Source of Funding:	Government budget
Time frame:	Medium to long term
Monitoring:	Regular surveys on publications in the various media

End-User Products ***Objective 2:***	***The market share of energy efficient residential appliances has increased***
Activity 2:	**Ministries and other public institutions are demonstrating the usefulness of EE by applying EE minimum standards in the procurement of their energy consuming devices such as computers, AC, refrigerators, lights**
Description of the measure:	• Provision of information on energy consumption of office equipment to ministries • Include energy efficiency in all public tender documents as a priority prerequisite for orders • Providing incentives by organizing energy efficiency contests and publishing "best energy efficiency performances" Train and install staff responsible for the energy consumption of the institution
Expected Results/Outputs:	The good example of public authorities helps to convince employees in administration to select energy efficient devices for residential use
Requirements:	Cooperation of ministries and other public institutions
Implementing Agency:	MIME
Stakeholders involved:	Ministry of Public Works and Transport (MPWT)
Target Group:	All Ministries, public authorities and institutions
Saving Potential:	Depends on the present level of energy consumption in the public sector
Budget Estimation:	10,000 US$ plus for training and information
Potential Source of Funding:	Government budget
Time frame:	Medium to long term
Monitoring:	Regular surveys on energy consumption, published in the media.

End-User Products Objective 3:	***End user of residential appliances are aware of the concept of energy efficiency and behave accordingly***
Activity 1:	**Education programs in energy efficient behaviour are performed in schools**
Description of the measure:	• Energy efficiency is introduced in the curricula of primary and secondary schools • Development of a concept to pursue energy efficiency through school campaigns • Engage care takers/teachers with a special training program for targeted schools.
Expected Results/Outputs:	Changes in consumption behaviour of families
Requirements:	Good cooperation with MOEYS and schools Teachers are interested in the subject
Implementing Agency:	Ministry of Education, Youth and Sports (MOEYS)
Stakeholders involved:	MIME
Target Group:	Students at primary and secondary schools
Saving Potential:	10-20% of residential electricity consumption
Budget Estimation:	20,000 US$ for training of teachers by EE experts
Potential Source of Funding:	Government budget
Time frame:	Medium to long term
Monitoring:	Regular surveys at schools

End-User Products Objective 3:	***End user of residential appliances are aware of the concept of energy efficiency and behave accordingly***
Activity 2:	**Publicity campaigns on energy efficient behaviour are published in the public media**
Description of the measure:	• The principle of energy efficiency is explained in the media • Possible energy savings by energy efficient behaviour are published
Expected Results/Outputs:	Changes in energy consumption behaviour of end users
Requirements:	Good cooperation with the media
Implementing Agency:	Ministry of Information
Stakeholders involved:	MIME, newspapers, TV and radio channels
Target Group:	Private households
Saving Potential:	10% of residential electricity consumption
Budget Estimation:	30,000 US$ for publicity campaigns
Potential Source of Funding:	Government budget
Time frame:	Medium term
Monitoring:	Regular surveys on household level

3.6. Energy Efficiency Action Plan for Buildings

Buildings Objective 1:	***Energy efficiency of <u>new</u> buildings is improved***
Activity 1:	**An energy efficiency building code for new buildings is established.**
Description of the measure:	• An energy efficiency (EE) building code is being elaborated including a checklist of energy saving building techniques, such as sun shading and building orientation. It is a subset of a general building code and applies to new buildings and major additions • Building developers are required to achieve a passing score for approval of a building permit • The EE building code applies to all building types with air-conditioned floor area greater than 2,000 m^2, and connected to the public utility grid. Field inspection occurs during the issuing of a certificate of occupancy.
Expected Results/Outputs:	A stock of energy efficient buildings will be established in Cambodia over time.
Requirements:	• The Ministry of Land Management, Urban Planning and Construction (MOLMUP+C) completes the draft of a general building code. • Good cooperation between MOLMUP&C and MIME is established for the purpose of using data on existing buildings to update the energy efficiency building code. • An EE building code is written in consultation with MOLMUP+C and a steering committee of building professionals. • Field inspectors are trained.
Implementing Agency:	MOLMUP&C in coordination with MIME
Stakeholders involved:	Institute of Standards, Construction Association, Board of Architects, Ministry of Vocational Training
Target Group:	Developers of new buildings
Saving Potential:	At least 20% savings for the life of new buildings
Budget Estimation:	50,000 *US$* plus to hire an expert to help write the code 20,000*US$*plusexpert to work with MIME and MOLMUP&C staff 50,000*US$*plusto hire and train inspectors
Potential Source of Funding:	International energy agencies Building permit application fees
Time frame:	Medium to long term
Monitoring:	Regular surveys by MIME under the Energy Manager Program.

Buildings ***Objective 1:***	***Energy efficiency of new buildings is improved***
Activity 2:	**Energy efficiency building codes in other countries are evaluated**
Description of the measure:	A study of EE building codes in other countries in the region, particularly those in the same climate zone, is undertaken to provide a guideline for the content of Cambodia's code.
Expected Results/Outputs:	The EE building code to be developed for Cambodia (see activity 1) will incorporate experiences from other countries.
Requirements:	• Good cooperation with the respective authorities in neighbouring countries is established • Cooperation will continue to be important during updates of the code to find best practices.
Implementing Agency:	MIME in cooperation with MOLMUP&C
Stakeholders involved:	ASEAN Center for Energy
Target Group:	MoLMUP&C
Saving Potential:	See savings listed above for EE building codes.
Budget Estimation:	25,000*US$*plus
Potential Source of Funding:	International energy agencies
Time frame:	Short to medium term
Monitoring:	Evaluation report by MIME staff

Buildings ***Objective 1:***	***Energy efficiency of new buildings is improved***
Activity 3:	**Energy efficiency building requirements are attached to large developments and luxury hotels**
Description of the measure:	• The compliance with EE standards is made a prerequisite for tax reliefs applicable to large developments and luxury hotels in Cambodia. • The developer is encouraged to use energy efficiency standards from his home country if they are equivalent or better than those being developed in Cambodia.
Expected Results/Outputs:	The energy efficiency of large projects is improved.
Requirements:	Cooperation with the Council for the Development of Cambodia (CDC)
Implementing Agency:	MOLMUP&C and CDC
Stakeholders involved:	Foreign trade organizations, hotel associations
Target Group:	Foreign developers of large building projects
Saving Potential:	At least 20% energy savings in new buildings
Budget Estimation:	30,000*US$*plus
Potential Source of Funding:	International energy agencies Building permit application fees
Time frame:	Short term
Monitoring:	Regular reporting on EE measures applied in large developments and luxury hotels by MIME.

Buildings Objective 2:	***Energy efficiency in existing buildings is improved***
Activity 1:	**Establish an energy manager program**
Description of the measure:	• An energy manager (or person responsible for energy) is designated on the staff of large buildings with energy use above a certain number of kWh/year • A document containing energy use data and proposals for reducing energy consumption is periodically prepared by the energy manager • Initial energy audits are encouraged to establish a baseline for energy saving strategies and measures.
Expected Results/Outputs:	In all buildings above a given minimum energy consumption an energy manager is established.
Requirements:	Building owners are cooperative
Implementing Agency:	MIME
Stakeholders involved:	Electricite du Cambodge (EDC), Hotel Association, ASEAN Center for Energy
Target Group:	Building owners
Saving Potential:	20% or more
Budget Estimation:	75,000*US$*plus
Potential Source of Funding:	International energy agencies, government funding
Time frame:	Medium to long term
Monitoring:	Number of energy managers established.

Buildings Objective 2:	***Energy efficiency in existing buildings is improved***
Activity 2:	**Establishment of an energy data base at MIME**
Description of the measure:	• The energy consumption of buildings with an established energy management program is registered and regularly submitted to MIME • Templates for submission of data are established and agreed upon.
Expected Results/Outputs:	Statistics on energy consumption in buildings per type of energy and per end use category are available to policy makers.
Requirements:	MIME has the capacity to process and evaluate the data. Available on request are ten energy audits carried out by ECCJ and ACE
Implementing Agency:	MIME
Stakeholders involved:	EDC, Hotel Association
Target Group:	Building owners
Saving Potential:	20% or more (See Activity 1, above)
Budget Estimation:	50,000*US$*plus
Potential Source of Funding:	International energy agencies
Time frame:	Medium to long term (See Activity 1, above)
Monitoring:	MIME prepares annual reports on energy consumption in large buildings.

Buildings Objective 2:	***Energy efficiency in existing buildings is improved***
Activity 3:	**Energy managers are trained and certified.**
Description of the measure:	Energy managers (see Activity 1, above) are trained according to well established energy management programs such as ISO 50001 and certified by MIME.
Expected Results/Outputs:	A pool of trained energy managers with practical experience is established
Requirements:	Qualified trainers and appropriate training facilities are available
Implementing Agency:	MIME in coordination with MOLMUP&C
Stakeholders involved:	Ministry of Labour and Vocational Training
Target Group:	Building managers
Saving Potential:	20% or more (See Activity 1, above)
Budget Estimation:	75,000*US$*plus
Potential Source of Funding:	Government funding, International Energy Agencies
Time frame:	Medium term
Monitoring:	Surveys from training institutes on the number of trained energy managers per year

Buildings Objective 3:	***Energy efficiency in public buildings is improved***
Activity 1:	**Existing public buildings are held to a high energy efficiency performance standard**
Description of the measure:	A government directive outlines an energy efficiency standard for all large government buildings. It involves an energy audit and commitment to reduce metered energy consumption by a small percentage each year (e.g. 3%).
Expected Results/Outputs:	Existing public buildings become an example to lead the way to more energy efficient buildings in general in Cambodia
Requirements:	Assistance with how reductions in energy consumption can be made
Implementing Agency:	MIME
Stakeholders involved:	MOLUP+C
Target Group:	Government Ministries
Saving Potential:	50% or more over ten years
Budget Estimation:	50,000 US$ plus
Potential Source of Funding:	International energy, environmental, and climate change mitigation agencies
Time frame:	Medium term
Monitoring:	MIME

Buildings Objective 3:	***Energy efficiency in public buildings is improved***
Activity 2:	**New public buildings are designed with reference to an established green building standard**
Description of the measure:	• A green building standard, such as the LOTUS standard in Viet Nam, is used as a non-binding evaluation tool in the tenders for public buildings. • Green building standards address not only energy consumption, but also recycling (e.g. of discarded concrete into aggregate for new concrete), water issues (consumption savings and storm water runoff control), etc.
Expected Results/Outputs:	• New public buildings become an example to lead the way to more energy efficient buildings in general in Cambodia and encourage development beyond mere energy efficiency to sustainable, green building development. • This is in line with Cambodia's National Green Growth Roadmap (2009) which advocates environmental, economic, and social sustainability.
Requirements:	Green building standards from other countries are collected and evaluated. A standard could be developed specifically for Cambodia over time.
Implementing Agency:	Ministry of Economy and Finance
Stakeholders involved:	MIME, MOLUP+C, Green Building Council
Target Group:	Architects, project developers, building owners
Saving Potential:	20% or more
Budget Estimation:	60,000 US$ plus
Potential Source of Funding:	International energy, environmental, and climate change mitigation agencies
Time frame:	Medium term
Monitoring:	MIME

Buildings Objective 4:	***Education and awareness of energy efficiency in buildings has increased***
Activity 1:	**Education of architecture students in energy efficiency (knowledge)**
Description of the measure:	• Introduce into the curriculum knowledge of energy efficiency in buildings as a core competency for architecture students. • Perform a pilot project consisting of a two-term course on Environmental Control Systems co-taught by an outside expert and an existing faculty member in order to transfer knowledge to both faculty and students.
Expected Results/Outputs:	Students have the necessary background to be aware of and understand energy efficiency issues when in professional practice.
Requirements:	See for example the NAAB 2009 Conditions for Accreditation, page 23, item B.3.
Implementing Agency:	Ministry of Education, Youth and Sport (MOEYS) and the Royal University of Fine Arts (RUFA) or other university
Stakeholders involved:	Board of Architects, Cambodia Society of Architects, MIME
Target Group:	Architecture students
Saving Potential:	No immediate saving potential can be specified
Budget Estimation:	30,000 US$ for a 10 month pilot project
Potential Source of Funding:	International energy agencies
Time frame:	Short to medium term
Monitoring:	RUFA.

Buildings Objective 4:	***Education and awareness of energy efficiency in buildings has increased***
Activity 2:	**Education of architects and planners in energy efficiency (basics)**
Description of the measure:	• A certification course for architects and planners that addresses basic issues of energy efficiency in buildings is taught by an expert in evening- or weekend courses • Certificates are issued to improve the applicant's status in public tendering processes.
Expected Results/Outputs:	Energy efficiency in buildings becomes common knowledge among architects and is increasingly applied in the construction of new buildings.
Requirements:	• Qualified trainers and adequate training programs are available • Architects are willing and motivated to participate in the training courses and certification process
Implementing Agency:	Board of Architects of Cambodia
Stakeholders involved:	MIME, Universities
Target Group:	Architects and planners
Saving Potential:	No immediate saving potential can be specified
Budget Estimation:	15,000 US$ for an 8 week course
Potential Source of Funding:	International energy agencies
Time frame:	Short to medium term
Monitoring:	MIME and Board of Architects.

Buildings Objective 4:	*Education and awareness of energy efficiency in buildings has increased*
Activity 3:	**An Energy Efficiency Information Resource Center is established**
Description of the measure:	• A National Energy Information Center is established to promote energy efficiency in buildings. The Center is a division of MIME that is responsible for promoting energy efficiency awareness and information to building owners. It complements the Energy Manager Program by providing useful information to building managers • A portal on MIME's website offering technical manuals (e.g. the Guidelines on Energy Conservation for Commercial Buildings) and energy management information (e.g. Energy Management Handbook) in pdf format is created • A database of private service providers and products is included along with information on best practices for efficient buildings and factories • Staff provides assistance with energy audits and lends equipment such as data loggers. An example of such a program is Efficiency Vermont (http://www.efficiencyvermont.com/). • See also Cross-Cutting Activities for further information
Expected Results/Outputs:	Practical information on energy efficiency in buildings is made available to the public
Requirements:	MIME is taking the initiative to establish the Information Center and gets financial support from government and international donors.
Implementing Agency:	MIME
Stakeholders involved:	Ministry of Information
Target Group:	Building owners and managers
Saving Potential:	No immediate saving potential can be specified
Budget Estimation:	30,000 US$ plus
Potential Source of Funding:	Government, International energy agencies
Time frame:	Short to medium term
Monitoring:	MIME.

Buildings Objective 4:	*Education and awareness of energy efficiency in buildings has increased*
Activity 4:	**Study tours to selected examples of good practice of energy efficient buildings**
Description of the measure:	Study tours for architects and students to exemplary energy efficient buildings in the region are conducted. For example, a tour to Malaysia could be organized that includes the Diamond building, the Low Energy Office, and the Green Energy Office, all located in the Kuala Lumpur area. These buildings are well documented in terms of energy use and cost, and tours are available.
Expected Results/Outputs:	• Shows Cambodian officials and developers the practicality of energy efficient buildings • Fosters knowledge transfer between energy ministries in neighbouring countries on energy efficiency in buildings.
Requirements:	Scheduling
Implementing Agency:	MIME in cooperation with the Board of Architects and universities
Stakeholders involved:	MIME, MOLMUP&C, developers
Target Group:	Officials involved in writing the EE building code and building developers
Saving Potential:	Not available
Budget Estimation:	8,000 *US$ for* four people per tour
Potential Source of Funding:	International energy agencies
Time frame:	Short term
Monitoring:	Reports by the participants on the experiences gained.

Buildings Objective 4:	*Education and awareness of energy efficiency in buildings has increased*
Activity 5:	**Public lectures by architects with expertise in energy efficient buildings**
Description of the measure:	Public guest lectures at universities are given by architects involved in energy efficient buildings. For instance, architects of the Vattanac Capital building or the extension of the University of Phnom Penh Library are invited to present their work.
Expected Results/Outputs:	Increasing awareness in the architecture community and the public for green and energy efficient architecture.
Requirements:	Universities are interested in accommodating such lectures Advertising in public media
Implementing Agency:	Board of Architects of Cambodia in cooperation with universities
Stakeholders involved:	Society of Architects
Target Group:	Architects, developers, students
Saving Potential:	No direct saving potential can be specified
Budget Estimation:	200 US$ per lecture (up to 10 lectures)
Potential Source of Funding:	Participants and/or local companies
Time frame:	Short term
Monitoring:	Number of participants.

3.7. Energy Efficiency Action Plan for Rural Electrification

Rural Electrification Objective 1:	*Rural energy entrepreneurs (REEs) operate more efficient businesses*
Activity 1:	**Pilot generation projects are installed and analyzed**
Description of the measure:	• Selection of appropriate sites and technologies • Training of local staff • Installation of pilot projects
Expected Results/Outputs:	Renewable energy systems have the potential to efficiently provide electricity to more remote regions of the country. Operational pilot projects that can be used to showcase technology, monitored for efficacy, and used to leverage funding for further systems.
Requirements:	Installation capacity, necessary permissions, site identification, support from REEs.
Implementing Agency:	RE Enterprises
Stakeholders involved:	MIME, local private renewable energy organizations, unlicensed REE's.
Target Group:	Unlicensed REE's
Saving Potential:	The activity will contribute to the reduction of electricity generation and distribution losses of REE's by up to 80%.
Budget Estimation:	100,000US$
Potential Source of Funding:	International donors (private companies or grant organizations) targeting renewable energy systems. For example REEEP or Samsung
Time frame:	Short term
Monitoring:	System installation and operation should be monitored by local authorities and results reported to MIME for collation.

Rural Electrification Objective 1:	*Rural energy entrepreneurs (REEs) operate more efficient businesses*
Activity 2:	**Establish and enforce distribution standards**
Description of the measure:	• Analyze local distribution networks • Calculate distribution losses • Elaborate technical standards for the rural distribution network • Enforce the compliance of REE's with the standards
Expected Results/Outputs:	• Electricity losses in the distribution network are reduced • Maintenance costs will be reduced • System compatibility will be improved due to a more standardized network.
Requirements:	Technical knowledge of electricity distribution, legal framework to properly implement policy.
Implementing Agency:	EAC
Stakeholders involved:	MIME, EAC, EdC, ISC, private companies.
Target Group:	REE's
Saving Potential:	The activity will contribute to the reduction of electricity generation and distribution losses of REE's by up to 80%.
Budget Estimation:	200,000US$
Potential Source of Funding:	Government funds, AUSAID
Time frame:	Medium term
Monitoring:	Surveys by EAC among REE's to verify compliance with the new standards

Rural Electrification Objective 1:	*Rural energy entrepreneurs (REEs) operate more efficient businesses*
Activity 3:	**Training of REEs to improve operational efficiency.**
Description of the measure:	• Elaborate appropriate training programs • Select qualified trainers • Organize training courses for REE's.
Expected Results/Outputs:	• An appropriate training program will lead to a better understanding of energy efficiency measures and proper business techniques • This will improve operational and electrical efficiency and reduce costs and finally the tariffs for all customers.
Requirements:	Incentives to encourage REEs to attend training sessions should be provided.
Implementing Agency:	Cambodian Rural Development Team (CRDT) e.g. in cooperation with Lao Institute of Renewable Energy (LIRE)
Stakeholders involved:	MIME, LIRE, CRDT
Target Group:	REE's
Saving Potential:	The activity will contribute to the reduction of electricity generation and distribution losses of REE's by up to 80%.
Budget Estimation:	75,000 US$
Potential Source of Funding:	International donors targeting training programs, government funding
Time frame:	Short term
Monitoring:	Training programs should be monitored by local authorities and results reported to MIME for collation. MIME can monitor the efficacy of training programs through measured improvements in efficiency (see Activity 1 of Strategic Objective 2 below for more information on the required database to measure these improvements).

Rural Electrification Objective 2:	*Increase knowledge around rural electrification efficiency*
Activity 1:	**Inventory of unlicensed REEs and electrification database**
Description of the measure:	• Collect and evaluate information on the number of unlicensed REEs and on their efficiency by countrywide audits • Create a regularly updated database on rural electrification • Propose interventions to improve the quality of their services • Facilitate the licensing procedure for REE's.
Expected Results/Outputs:	• Efficiency targets are defined • A knowledge platform is established that can be used to quantify the benefits of new policies and monitor progress • Appropriate EE strategies can be implemented and the quality of the services be improved.
Requirements:	Appropriate knowledge of database management at MIME
Implementing Agency:	MIME, assisted by research institutions specialized on rural electrification
Stakeholders involved:	MIME, Local government
Target Group:	Unlicensed REE's
Saving Potential:	The activity will contribute to the reduction of electricity generation and distribution losses of REE's by up to 80%.
Budget Estimation:	300,000 US$
Potential Source of Funding:	Government funding, Research grants, International donors targeting knowledge management projects.
Time frame:	Short term
Monitoring:	Regular audits of REE's by MIME

Some remarks concerning unlicensed REE's:

- Unlicensed REE's are providing important services in remote rural areas, thus reducing the pressure on MIME and EdC to extend the grid to these areas at high costs.
- In many cases, the REE's were authorized by local authorities to do so.
- It might be difficult to set general license fees and to fix standardised electricity tariffs at an appropriate level due to the diversity in size (number of customers) and in technology used.
- However, they must be encouraged to improve the efficiency of power generation and distribution by appropriate incentives in order to be able to provide adequate energy services at acceptable costs.

- Such a commitment at government level, along with appropriate tariffs and efficiency requirements, could lead to increased private investment in this sector and to better quality of services for the rural population.

Rural Electrification Objective 2:	***Increase knowledge around rural electrification efficiency***
Activity 2:	**Improve renewable energy system installation capacity and supply chain.**
Description of the measure:	• Evaluate the actual know how of public and private organizations involved in renewable energy systems in Cambodia • Prepare appropriate training programs • Perform training courses for local organizations
Expected Results/Outputs:	• The technical knowledge of staff at organizations involved in renewable energy systems has improved • This expert knowledge will ensure that systems are properly designed and installed • Improving the supply chain for appropriate RE systems will also facilitate the selection and installation of more efficient technologies.
Requirements:	Local renewable energy organizations must be operational.
Implementing Agency:	RE enterprises
Stakeholders involved:	MIME, renewable energy system organizations in Cambodia
Target Group:	Local renewable energy organizations
Saving Potential:	The activity will contribute to the reduction of electricity generation and distribution losses of REE's by up to 80%.
Budget Estimation:	50,000 US$
Potential Source of Funding:	International donors funding capacity building, Public private partnerships on renewable energy projects.
Time frame:	Medium term
Monitoring:	Surveys on rural renewable energy systems by MIME.

Rural Electrification Objective 2:	*Increase knowledge around rural electrification efficiency*
Activity 3:	**Increase consumer awareness of rural electrification options and energy efficiency**.
Description of the measure:	Rural households currently have limited knowledge about energy efficiency, resulting in complacency over the cost of electricity from systems currently in use. To increase consumer awareness, it is proposed to ○ Elaborate information material ○ Identify appropriate means of dissemination of information ○ Organize awareness campaigns.
Expected Results/Outputs:	• REEs are forced to improve the efficiency of their systems • Rural households are well informed and will gain a greater understanding of alternative systems they could use such as solar lanterns or community owned energy systems • The costs of rural electricity supply will decrease.
Requirements:	NGO's are motivated to participate in this awareness campaign
Implementing Agency:	Cambodian Rural Development Team (CRDT), private sector
Stakeholders involved:	MIME, CRDT, private sector
Target Group:	Rural households
Saving Potential:	The activity will contribute to the reduction of electricity generation and distribution losses of REE's by up to 80%.
Budget Estimation:	200,000 US$
Potential Source of Funding:	International donors willing to fund public awareness programs in rural areas such as UN-Habitat or GEF.
Time frame:	Medium term
Monitoring:	By local authorities reporting to MIME for collation

3.8. Energy Efficiency Action Plan for Biomass

Biomass Objective 1:	***The National forest resources are protected by the sustainable and efficient use of biomass***
Activity 1:	**Promotion of improved and efficient cookstoves for rural households**
Description of the measure:	Business support to cook stove producers and cook stove distributors
Expected Results/Outputs:	Improved and efficient cookstoves are widely accepted by rural households
Requirements:	To promote the **efficient use of biomass**, a focal point should be set up at the General Directorate of Energy of MIME as coordinating body. This Focal Point should be assisted by a working group to tackle specific necessities and propose appropriate solutions. This requirement is also valid for all other activities in this sector.
Implementing Agency:	GERES Cambodia
Stakeholders involved:	MIME, Forestry Administration, Private cook stove producers and distributors
Target Group:	Rural households
Saving Potential:	Fuel wood consumption for cooking purposes in rural areas is reduced up to 20%
Budget Estimation: **(Activity 1, 4, 5)**	Start-up grants for establishment of 6 cook stove production centres (180,000 USD) Risk sharing loans from micro- finance institutions for 100 cook stove producers (24,000 USD)
Potential Source of Funding:	GEF, UNDP
Time frame:	Short to medium term
Monitoring:	Record of promotion means, series of promotion activities implemented to introduce improved cookstoves in rural areas including number of families involved.

Biomass Objective 1:	*The National forest resources are protected by the sustainable and efficient use of biomass*
Activity 2:	**Promotion of sustainable forest management for biomass fuel supply**
Description of the measure:	• Capacity Building and Policy Development Support (National and Local separated) • Capacity building to Community Forestry members on fostering and managing forests, sustainable harvesting techniques of biomass for energy (firewood, sustainable charcoal production), including integrated recording for monitoring purposes. • The limited choice of target groups is due to the consideration that this activity is implementing new approaches in managing and protecting the forest resources. At the initial stage (until early 2015), the project is aiming to build sufficient knowledge and expertise from a limited target group. The knowledge, good practices, lessons learnt and experiences obtained in this stage will be capitalized and implemented in the entire relevant forest areas in Cambodia.
Expected Results/Outputs:	Diversion of biomass extraction from natural forest to properly managed wood lots as sustainable sources of energy
Requirements:	Communities and FAC and MIME are familiar with sustainable wood biomass energy supply from CF (Community Forestry)
Implementing Agency:	GERES Cambodia
Stakeholders involved:	Forest Administration (FA), Regional Community Forestry Training Centre (RECOFTC)
Target Group:	Members of 5 forestry communities in the provinces of Kampong Speu, Kampong Chhnang, Pursat and Battambang;
Saving Potential:	No direct saving potential
Budget Estimation:	
Potential Source of Funding:	FAC Budget, GEF, UNDP
Time frame:	Long term
Monitoring:	• Baseline of forest standing stock, potential growth (annual yields), volume of harvested firewood within a certain period (week, month, quarter, …) and supply of the firewood to the users (direct users and/or sustainable charcoal production units) has to be done thoroughly, especially to monitor the supply-demand balance and pricing dynamics that will impact the economic development, raising of living costs and impact to the environment. • The monitoring shall be done by a collaboration of local FA offices (Forestry Administration Cantonment – FAC), the Provincial Department of MIME, the managements/administrators of respective Community Forestry

Biomass Objective 1:	*The National forest resources are protected by the sustainable and efficient use of biomass*
Activity 3:	**Promotion of sustainable charcoal production applying improved charcoal kiln technologies**
Description of the measure:	• Train Community Forestry members on technology of improved charcoal kiln – appropriate site selection, construction, operation (to produce charcoal), maintenance and management of the improved charcoal kiln production center • Train the operators (a management unit that responsible on operating and maintenance) of improved charcoal kiln production center on setting-up collaboration with Community Forestry to obtain sustainable wood supply • Piloting the promotion and sale of improved charcoal to the markets by highlighting the added value of the charcoal, and monitor the supply of improved charcoal made of sustainable wood.
Expected Results/Outputs:	Improved charcoal kiln technologies are widely used and reduce the wood consumption for charcoal production.
Requirements:	Good coordination between MIME, FA and charcoal producers
Implementing Agency:	GERES
Stakeholders involved:	MIME, FA
Target Group:	Traditional charcoal producers around selected community forestry areas in the four provinces of Kampong Speu, Kampong Chhnang, Pursat and Battambang
Saving Potential:	Wood consumption for charcoal production is reduced by 35%
Budget Estimation:	Risk sharing for loans from micro- finance institutions for 16 charcoal kilns (40,000 US$)
Potential Source of Funding:	GEF, UNDP
Time frame:	Medium term
Monitoring:	Record of the sale of improved charcoal production that is made of sustainable wood and the sale of improved charcoal.

Biomass Objective 1:	*The National forest resources are protected by the sustainable and efficient use of biomass*
Activity 4:	**Promotion of improved and efficient cookstoves for urban households**
Description of the measure:	Business support to cook stove producers, cook stove distributors
Expected Results/Outputs:	Improved and efficient cook stoves are widely accepted by urban households
Requirements:	Quality Assurance and Quality Control mechanisms are properly endorsed by Royal Government of Cambodia (Institute of Standards of Cambodia), and improved cookstove standards are promulgated.
Implementing Agency:	GERES Cambodia
Stakeholders involved:	MIME, Private cook stove producers and distributors
Target Group:	Urban households
Saving Potential:	Charcoal consumption for cooking purposes in urban areas is reduced up to 20%
Budget Estimation: **(Activity 1, 4, 5)**	• Support grant for Improved Cookstove Producers and Distributors Association of Cambodia (ICOPRODAC) – USD 50,000 • Loan for additional investment for scaling-up production and distribution from "ECONOMIC PILLARS" (a saving and credit cooperative that belongs to ICOPRODAC) – USD 7,250
Potential Source of Funding:	GERES, Economic Pillars, Improved cookstove producers and distributors
Time frame:	Short to medium term
Monitoring:	Production and sale of improved cookstove at producers' gate and limited tracking of the improved cookstoves from the producers to the users through the existing supply chain; Series of tests to obtain real fuel saving at users' level (households)

Biomass *Objective 1:*	*The National forest resources are protected by the sustainable and efficient use of biomass*
Activity 5:	**Promotion of improved and efficient cookstoves for household scale industries in rural areas**
Description of the measure:	Business and technical support to household scale industries that require heat energy as the main production process and consume biomass as the main fuel
Expected Results/Outputs:	Application of improved biomass burning device (more efficient, cleaner) in household scale industries for product quality improvement and higher energy efficiency.
Requirements:	• Improvement of standards of several household scale products (hygiene, safety, waste management, energy consumption & efficiency) • Detail data of household scale industries are gathered, analyzed, prioritized • Cooperation of HSI's in utilizing improved cook stoves.
Implementing Agency:	GERES Cambodia
Stakeholders involved:	MIME, Private improved burning device producers and distributors
Target Group:	Household Scale Industries in rural areas
Saving Potential:	Firewood consumption of small scale industries in rural areas is reduced up to 30%
Budget Estimation: **(Activity 1, 4, 5)**	Gathering data of household scale industries to have an integrated figures of biomass energy consumption, production quality and requirements, economic value of the production and improvement feasibility – approx USD 40,000 Development of the improved burning device prototype (for selected and prioritized limited industries) – USD 20,000 Select and train local private manufacturers to produce the improved and efficient burning device, and establish the production centers (including loan for start-up capital – when necessary) – USD 30,000
Potential Source of Funding:	GERES and possibly to obtain sufficient fund from donors
Time frame:	Short to medium term
Monitoring:	Series of tests to obtain real fuel saving at users' level (household scale industries)

Biomass Objective 2:	***Combustible solid biomass residues are utilized optimally to substitute firewood and/or charcoal***
Activity 1:	**Promotion of production, distribution and utilization of char briquette as alternative cooking fuel for households and household scale industries in urban areas.**
Description of the measure:	Char-briquettes are a new alternative cooking fuel substituting firewood and charcoal as domestic cooking fuel. The char-briquette is made of 100% waste - the bio char from a garment factory which makes them an environmental friendly cooking fuel.
Expected Results/Outputs:	Char briquettes are accepted as alternative fuel by urban households to replace charcoal.
Requirements:	Communities and FAC and MIME are familiar with sustainable wood biomass energy supply from Community Forestry.
Implementing Agency:	GERES Cambodia, Sustainable Green Fuel Enterprise (SGFE) – the leading producer of char-briquette in Cambodia
Stakeholders involved:	MIME, private char briquette producers, distributors & retailers
Target Group:	Urban households and household scale industries (mainly restaurants)
Saving Potential:	Production and utilization of char-briquette will substitute 1.25% of charcoal market share – approx. 2,400 ton per year.
Budget Estimation:	100,000 USD as spark fund to set-up new production facilities 100,000 USD to scale up at least 2 existing production facilities 5,000 USD Information and communication campaigns addressing the potential end-users (urban households and urban small scale family businesses/restaurants).
Potential Source of Funding:	Private investor, GERES, Carbon fund,
Time frame:	Short to medium term
Monitoring:	Production and sale are recorded for analyzing the economic, total energy efficiency (from production to the utilization) in comparison to wood charcoal.