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Report on

Review on Cambodia's Key National Policies and Strategies and Current Status of National Climate MRV and M&E Activities and Initiatives

MARCH 2019

Department of Climate Change, the General Secretariat
of the National Council for Sustainable Development

ICAT INITIATIVE FOR Climate Action Transparency

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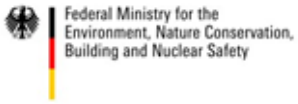

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Abbreviation

CMDGs	Cambodia Millennium Development Goals
CDM	Clean Development Mechanism
CCTT	Climate Change Technical Team
CIDP	Cambodia Industrial Development Policy
CPSS	Cambodia Power Sector Strategy
CCCO	Cambodian Climate Change Office
CCCSP	Cambodia Climate Change Strategic Plan
DNA	Designated National Authority
EAC	Electricity Authority of Cambodia
EDC	Electricité Du Cambodge
FSP	Fuel-wood Saving Project
GGGI	Global Green Growth Institute
GHGs	Green House Gases
GSSD	General Secretariat of the National Council for Sustainable Development
GDP	Gross Domestic Product
HV	High Voltage
IPPU	Industrial Process and Industrial Use
IPPs	Independent Power Providers
IPCC	Intergovernmental Panel on Climate Change
INC	Initial National Communication
IIED	International Institute for Environment and Development
JICA	Japan International Cooperation Agency
KP	Kyoto Protocol
LUCF	Land Use Change and Forestry
MV	Medium Voltage
MLMUPC	Ministry of Land Management, Urban Planning, and Construction
MIH	Ministry of Industry and Handicraft
MAFF	Ministry of Agriculture, Forestry and Fisheries
MME	Ministry of Mines and Energy
MoU	Memorandum of Understanding
NCDM	National Committee for Disaster Management
NSDP	National Strategic Development Plan

NCSD	National Council for Sustainable Development
NAMA	National Appropriate Mitigation Action
NAPA	National Adaptation Program of Action
NBP	National Bio-digester Program
NCCC	National Climate Change Committee
NFM&ECC	National Framework for M&E of Climate Change
NSPGG	National Strategic Plan on Green Growth
NGGR	National Green Growth Roadmap
PFERNA	Post-Flood Early Recovery Needs Assessment
REAP	Renewable Electricity Action Plan
REREP	Rural Electrification by Renewable Energy Policy
REEs	Rural Electricity Enterprises
REF	Rural Electrification Fund
RGC	Royal Government of Cambodia
SNC	Second National Communication
SRESB1	Special Report on Emissions Scenarios
SMEs	Small and Medium Enterprises
TFEC	Total Final Energy Consumption
TPES	Total Primary Energy Supply
TAMD	Tracking Adaptation and Measuring Development
UNTAC	United Nations Transitional Authority of Cambodia
UNFCCC	United Nations Framework Convention on Climate Change
VERs	Voluntary Emission Reductions
WCS	Wildlife Conservation Society

1. Introduction

This report presents the overview of key national policies and strategies, which can be proposed for the monitoring reporting and verification (MRV) system development under the support of the Initiative for Climate Action Transparency (ICAT). Current status of the national climate MRV and monitoring and evaluation (M&E) activities and initiatives in Cambodia will be reviewed and several meetings with different stakeholders will be organized to collect the data and information of the MRV and M&E system related policies and strategies. This study undertakes a nation-wide assessment of the renewable energy and energy efficiency related policies and strategies, existing climate change MRV and M&E system to evaluate whether it is effective and suitable for the country. It is also designed to identify the drivers, barriers, and opportunities so that the possible establishment of institutional arrangements for the MRV at the national level and piloting a sectoral guidance to improve the MRV development in the renewable energy sector for Cambodia.

The work is supported by the ICAT to strengthen national institutions to meet enhanced transparency requirements that focus on the MRV of climate change policies. It will be focused on review of the existing MRV and M&E policies, particularly the renewable energy, on the establishment of institutional arrangements, including design and implementation of legal frameworks, data collection, reporting and verification methodologies and procedures for the purpose of development of a robust and continuous national MRV system.

A significant portion of the overall work will be dedicated to hands-on capacity building through utilizing the ICAT transparency guidance in the energy sector, among other related guidance. The direct objective of the ICAT is to track GHG reductions achieved as a result of the application of the current renewable energy policy. With the MRV of climate policies, the ICAT will provide methodological inputs in the energy sector and enable to integrate it into the Cambodia's MRV system with the purpose to identify non-methodological barriers such as barriers related to institutions, laws, processes, data, and systems.

I.1. Objective

The objectives of this report are to:

1) Provide overview of Cambodia energy development;
2) Review energy related national legislation, policies, and strategies;
3) Review the existing climate change related MRV and M&E system in Cambodia; and
4) Propose the MRV and M&E framework in the renewable energy for Cambodia.

I.2. Scope of Work

The scope of the study includes the situational analysis of the power sector and related policies and institutional framework, review of exiting MRV and M&E system in Cambodia for climate change response, and inputs from the stakeholders to validate the finding.

2. Cambodia's Energy Overview

2.1. Total Energy Supply and Consumption

The total final energy supply (TFES) (Figure 1) has increased at an average rate of 9 percent annually– from 3,426 ktoe in 2006 to 7,575 ktoe in 2016 or it has increased more than two times over the last decade. The main energy supply in the country is from biomass wood, which is used significantly for household cooking and industrial thermal energy production in the form of steam and direct heating furnaces. After the biomass energy, the primary and secondary oil (mainly diesel, gasoline, heavy fuel) contributes also a big sum to the total energy supply mix.

This energy increase gradually with average of 8 percent per year from 1,009 ktoe in 2006 to 2,202 ktoe in 2016. The main use of the energy is in the transport sector. In terms of supply growth, hydro energy is fastest growing at the average rate of 123 percent per year from 4 ktoe in 2006 to 225 ktoe in 2016. Similar to hydro, coal supply is also growing fast from 0 ktoe in 2006 to 679 ktoe in 2016. The main use of coal is for power generation and industrial use mainly in the brick sector.

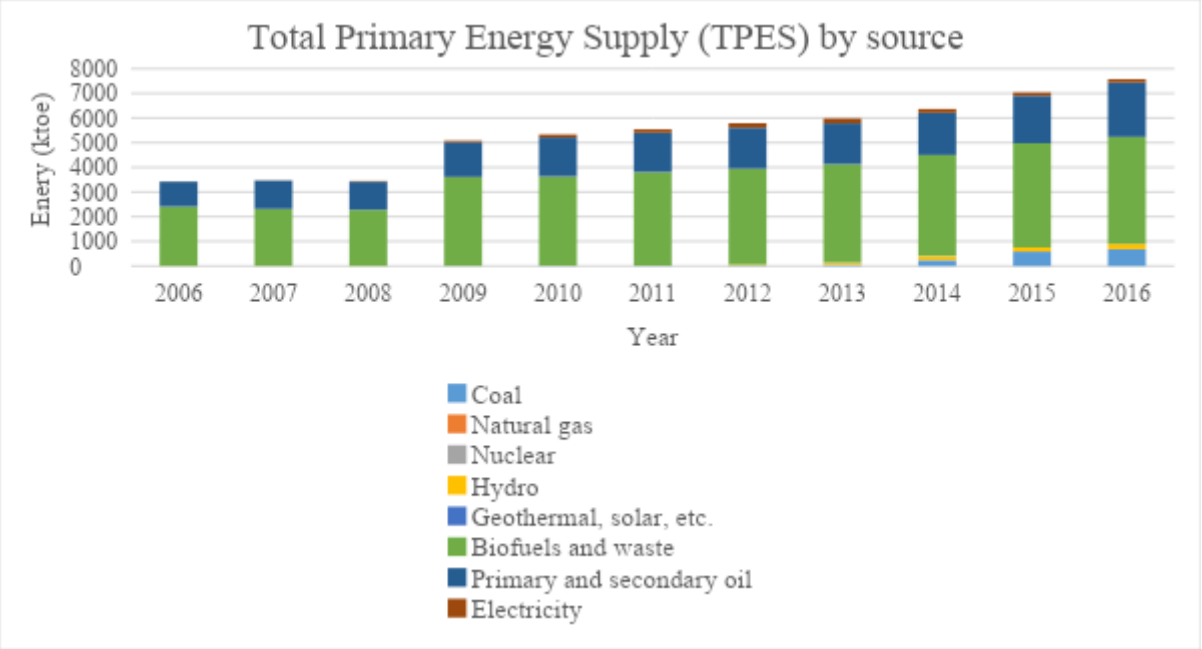


Figure 1: Total final energy supply of Cambodia (IEA, 2018)

The annual growth of the total final energy consumption (TFEC) (Figure 2) increased at an average rate of 9 percent per year from 2857 ktoe in 2010 to 6357 ktoe in 2016. In terms of consumption growth, coal is the fastest growth by 23 percent per year, and electricity is the second fastest growth at 19 percent per year. Biomass is main energy supply with its average share of 66 percent compared with the total final energy consumption during a decade ago followed by oil products in the form of diesel, gasoline, and HFO. The electricity consumption also increases due to grid network development and extension in the recent years.

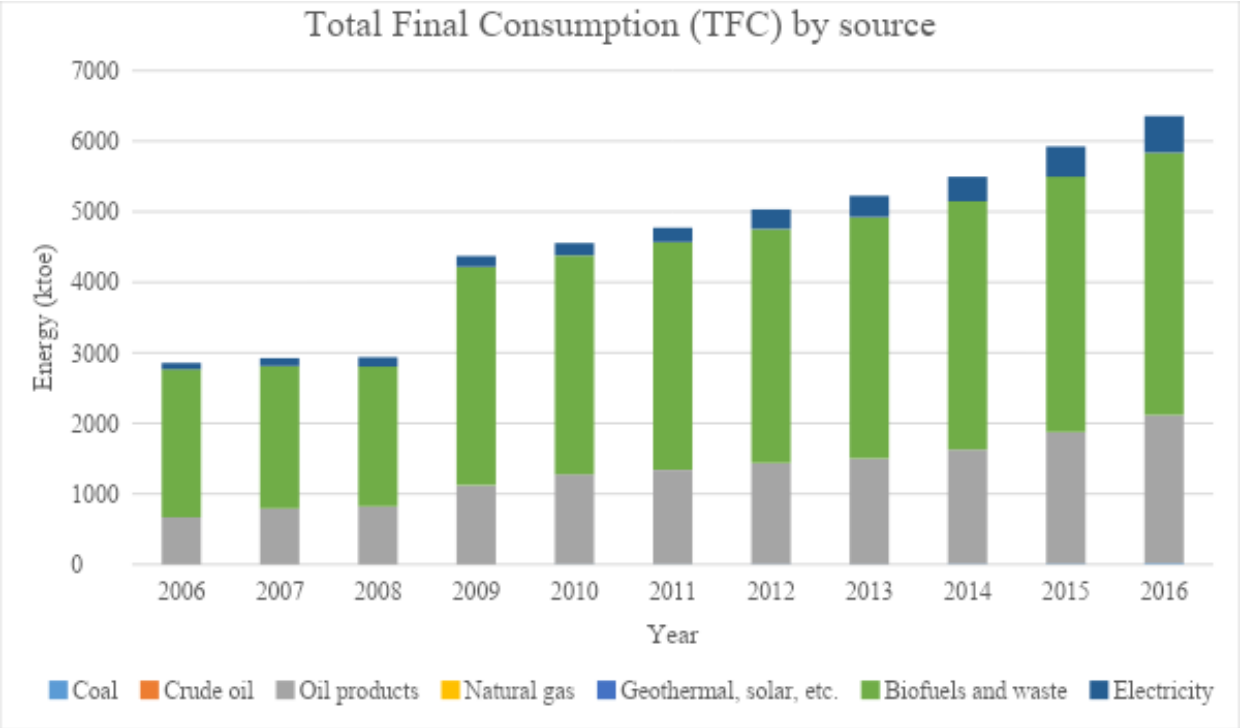


Figure 2: Total final energy consumption of Cambodia (IEA, 2018)

2.2. **Energy Development in Cambodia**

2.2.1. Electricity Generation Development

The installed capacity on a national level by type for the period from 2004 to 2014 is presented in Figure 3. This illustrates that until 2010 Cambodia's power generation depended heavily on HFO and Diesel, and its capability remained quite limited (of less than 400 MW). In this period, Cambodia also imported significant electricity from neighbouring countries, e.g. up to around 60 percent in 2010 (EAC, 2012). From 2011 to 2014, the total installed capacity has increased significantly and has become more diversified with hydro and coal projects playing roles in the capacity mix. By 2014, hydropower had become Cambodia's dominant generation technology, accounting for 62 percent of the total 1,511 MW of installed capacity. It is followed by diesel / heavy fuel oil (HFO) at 19 percent, coal-fired at 18 percent and biomass at 1 percent. However, compared with the total potential of renewable energy of 7,692 MW in Cambodia, the existing capacity is only around 20 percent, meaning that there are still opportunities for the government to fulfil the energy demand thanks to the RE.

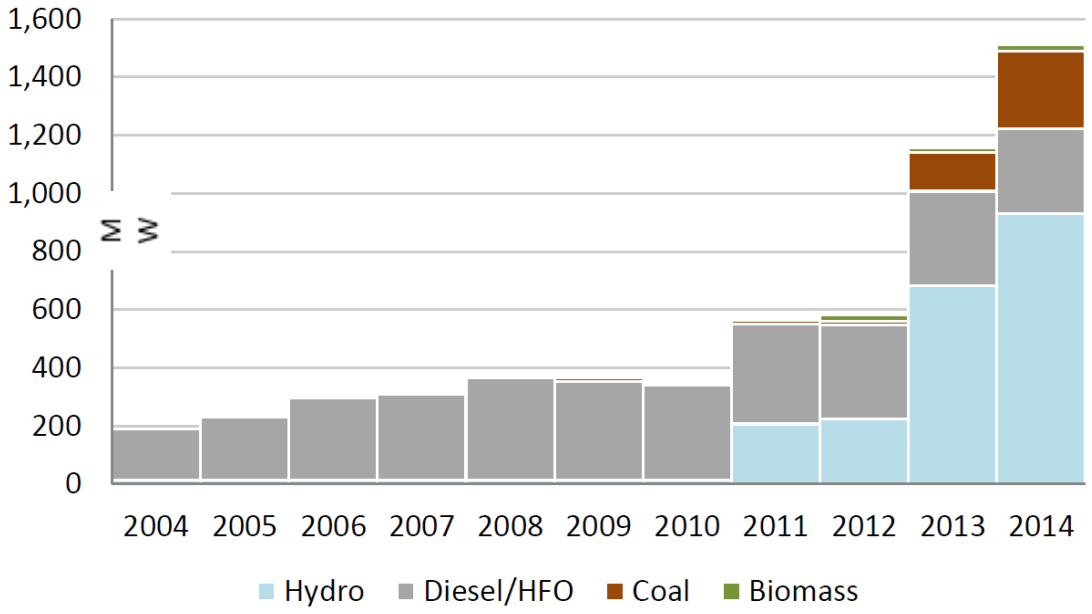


Figure 3: Cambodia Energy Generation evolution during the last decade [Adapted from (WWF, 2016) (EAC, 2015)]

Figure 3 shows that the capacity of electricity generation almost doubled in 2013 from less than 600 MW in 2012 to almost 1,200 MW in 2013 and increased to almost 1,500 MW in 2014. This is because hydropower plants went online during that period. It is noted that there is a supply of electricity from on grid solar power with the capacity of 10 MW in Bavet, Svay Rieng province which was commissioned in October 2017. Cambodia seems aware of its solar energy potential but solar power is not the focus of its energy plan because of the cost. As per the study of the Mekong Strategic Partnership in 2015 (Ferranti, Fullbrook, McGinley, & Higgins, 2016) the feasible cost of solar is $.12 per kWh, while the government can buy at a rate of $.07 or $.075 from hydropower. However, a current study by the UNDP and NCSD indicated that Cambodia has abundant solar resources with high solar potential at average of 5 kWh/m^2/day and average sunshine during of 6-9 hours per day. While technical solar potential is estimated at 8,100MW based on the estimated energy output of 14, 781 Gwh/year. The study also conducted a preliminary assessment of the most cost-effective public derisking measures to promote private sector investment of both off-grid (175 MW) and on-grid (350 MW) solar photovoltaic (PV) energy by 2030. This implied the possible energy contribution of solar PV sources of 350MW, which connect to the national grid by 2030.

2.2.2. Renewable Energy Development Plan

The government of Cambodia focuses mainly on hydropower on a big, medium and small scale. Since 2014, the contribution of hydropower has become significant and will continue to be more dominant in the energy supply mix in the next decade (Figure 4). As per the energy development planning of the Ministry of Mines and Energy (MME), hydropower will reach its peak at around 8,000 MW in 2027, and to meet the continuous demand of power the government has planned to add coal and gas.

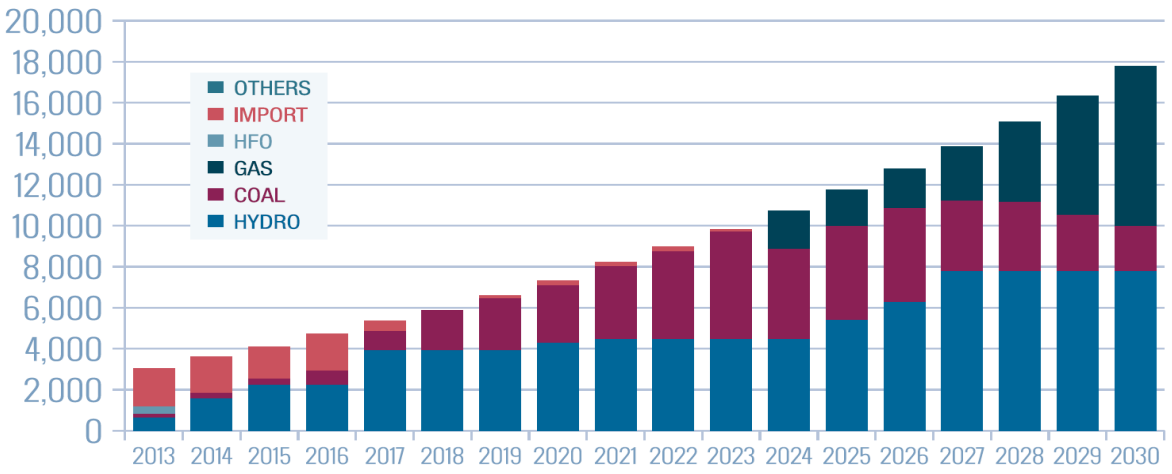


Figure 4: Cambodia Electricity Generation Plan from Different Fuels in MW [Adapted from (Ferranti, Fullbrook, McGinley, & Higgins, 2016)]

In 2015, WWF conducted a study on a sustainable energy scenario for Cambodia in which it relies 100% on renewable energy by 2050 (Figure 5 and Figure 6). The study suggested up to 45% of solar power in the energy mix by 2050. Remaining percentages of the mix included solar energy with battery system (22%), bioenergy (9%), hydropower (7%), off-grid (6%), concentrated solar power (6%), small scale hydro (run-of-the-river) (3%), and wind (2%). However, this is different from the government's plan (Figure 4). The main reason for not adopting the WWF's suggestions is cost. It can be noted that the EDC is a 100% state-owned company that purchases electricity from independent power producers to sell in country to different costumers, including industries, households, and rural electrification enterprises, etc. To maximize profit margins, the EDC prefers purchasing the electricity from independent producers at the lower price. In this case, it is important to note that the purchasing price of electricity for the main grid from hydropower is only $.07 or $.075 per kWh, which is 37% lower than the purchasing price of solar. However, the government is studying the possibility of the WWF findings (WWF, 2016).

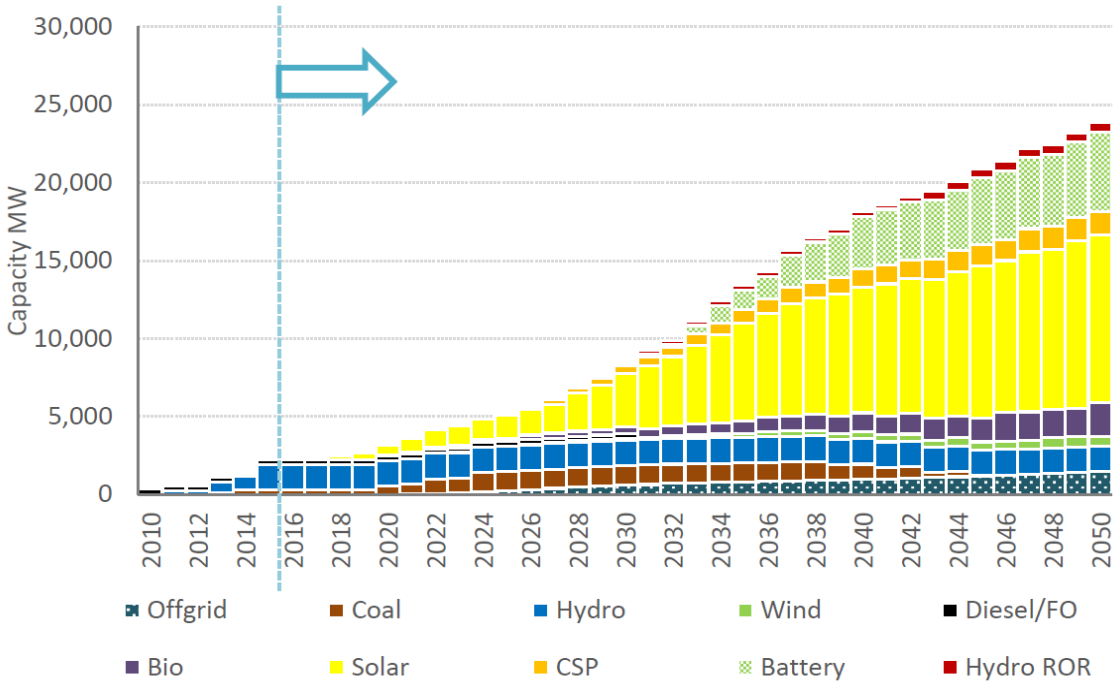


Figure 5: Proposed Energy Scenario by WWF for Cambodia by 2050 (WWF, 2016)

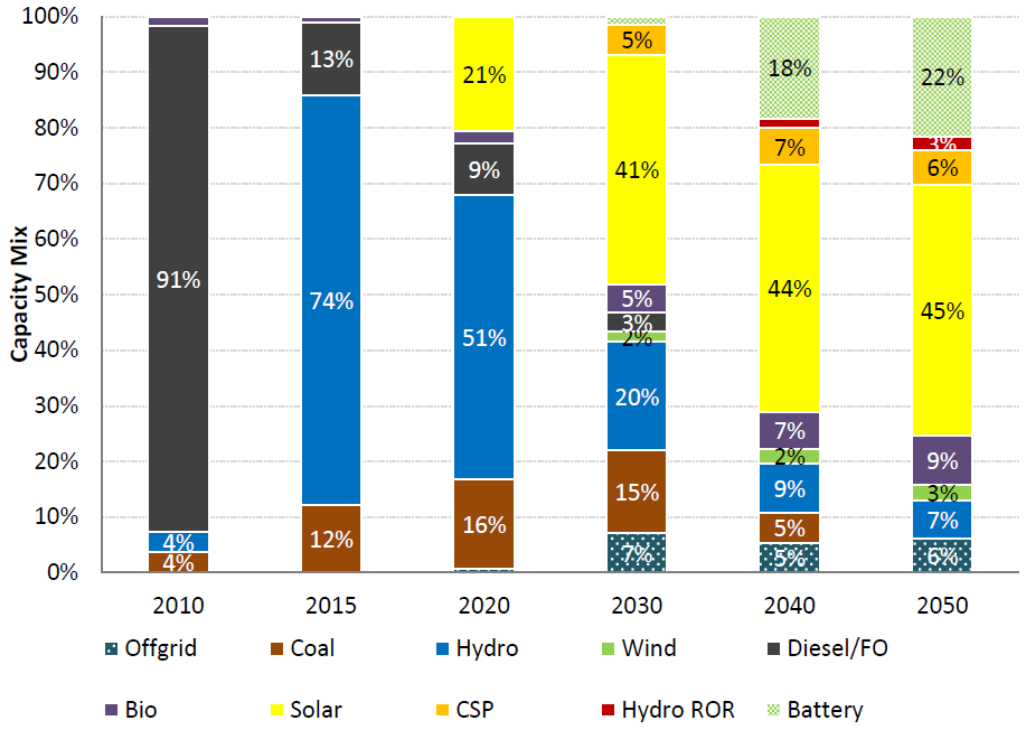


Figure 6: Cambodia Capacity Shares of Electricity Generation by type (WWF, 2016)

2.3. Electricity Development Update

EAC reports the progress of energy development in Cambodia annually through its salient features of power development in the Kingdom of Cambodia in both Khmer and English language. The report shows mainly about the power generation by different sources including renewable energy, progress of electricity transmission services against the power development plan, progress of electricity supply to consumers, growth of electricity connection of consumers to the grid and progress of electricity tariff reduction. The latest report available is at the end of 2018, which can be found in EAC website.

3. Cambodian Energy Sector Development Policies and Strategies

The Government adopted the "Law on Electricity" in 2001 and amended in 2015, which covered all activities related to the supply, provision of services and use of electricity, and other associated activities of the power sector. The law helps reform the current electricity sector, and was endorsed to boost private investors in the power sector in a fair, just, and efficient manner for the benefit of the Cambodian society. The law also prescribes the configuration of the whole energy sector operation and institutional settings in Cambodia including electric power supply and services; generation, transmission and distribution of electricity related activities. Key main objectives of the Law are listed as the followings:

1) The principles for operations in the electric power industry and the activities of licensees in the provision of electric power services;
2) The favorable condition for the investments in and the commercial operation of the electric power industry;
3) The basis for the regulation of the supply of electric power services throughout the country,
4) The principles for:

a) the protection of the rights of consumers, to receive the reliable and adequate supply of electric power services at reasonable cost,
b) the promotion of private ownership on the facilities for providing electric power services, and
c) the establishment of competition wherever feasible within the electric power sector;

5) The principles for granting the rights and obligations, and penalizing the suppliers and consumers of electricity and also the public and land owners in relation to electricity generation and supply facilities; and
6) The Electricity Authority of Cambodia (EAC) for regulating the electric power services.

Cambodian energy policy especially the RE sector remains under-developed until late 1990s due to the post-war situation of the country. A might be the first official energy instrument comes to place was the Cambodia Power Sector Strategy (CPSS) 1999-2006, which was approved in 1999 (RGC, 1999). The objectives of this strategy are summarized as follows:

1) To provide an adequate supply of energy throughout Cambodia at reasonable and affordable price;
2) To ensure a reliable, secure electricity supply, at prices which facilitate investment in Cambodia and development of the national economy;
3) To encourage exploration and environmentally and socially acceptable development of energy resources for all sectors of the Cambodian economy; and
4) To encourage the efficient use of energy, and minimize detrimental environmental effects resulting from energy supply and use.

This first ever adopted strategy focuses on four energy intervention areas: the electricity strategy, renewable energy, a power sector strategy, and a wood energy strategy. The Government has also prepared a power sector master plan, indicating that the fuel mix of power generation in 2030 comprises natural gas (40%), hydropower (35%), coal (15%), import (6%), oil (3%), and renewable energy (1%) (MME, 2014). It has been investigated that in order to reduce energy demand and CO_2 emissions in the future and simultaneously to provide reliable and affordable energy services to all of the end users in the most sustainable manner, the Government declared a circular on the "implementation of electricity saving measures" that required all Government ministries and public institutions to participate in a program on "electricity saving consumption" in 2008 so as to save the national budget and to ensure the effective and efficient use of electricity.

3.1. **Rectangular Strategy**

The RGC has successfully implemented the Rectangular Strategy for Growth, Employment, Equity and Efficiency for the last three phases, helping reshape the face of Cambodia with great pride. The Government identified four priority areas, viz. Road, Water, Electricity, and People to set the agenda for development, while priority order of these four priority areas have been changed according to development phase. The Government has striven to improve the infrastructure through enhanced transport connectivity and internal integration, and the expansion of the coverage of energy and digital connectivity. The Government has reduced the proportion of electricity imported from neighboring countries from 63.1% in 2011 to 18.6% in 2017 of the total electricity consumption, expanded transmission and distribution networks to improve the livelihood of the people in general and, to lower electricity price in industrial zones to support industry and commerce sectors in particular (RGC, 2018). However, challenges include high electricity costs, limited reliability of electricity supply and renewable energy sources have not been included in the energy supply system to its full economic potential. In

response, the government has further lowered the electricity prices, expanding supply coverage and enhancing electricity reliability through the construction of additional sub-stations near economic poles and areas with high economic potential. Concrete strategic policy measures will be laid out for implementing the Political Platform of the Government, aimed at responding to the demand of the people and laying foundations for our journey toward the goals of Cambodia Vision 2030 and 2050 (RGC, 2018).

3.2. National Strategic Development Plan

The strategy provides set of national strategies and plans for Cambodia development. It emphasizes on the necessity of making availability of electricity to the poor with acceptable standards and affordable prices, it also stresses the importance of energy for economic development. To ensure energy security, the RGC has strategized different measures to ensure energy security. Those strategies can be easily reviewed in two approaches: the supply and the demand sides. On the energy supply side, the RGC mainly intends to expand energy supply from indigenous energy resources and to optimize and diversify the utilization of energy. It touches a bit on the RE. From the demand side, the RGC has been trying to integrate environmental and EE concepts and practices in the energy policy both in the government and private sectors. Even though the RE related policies and strategies have been prioritized, there is no indication of the MRV or M&E related RE policies and strategies exists in Cambodia.

3.3. Rural Electrification by Renewable Energy Policy 2006

Following the CPSS by the end of 2006, another energy related instrument was initiated with the first mention of and more focus on the RE-- the Rural Electrification by Renewable Energy Policy (REREP) 2006. The main emphasis of this policy is to increase opportunity for renewable energy technologies through adopting actionable framework and to increase access to electricity in rural areas with a nationwide target. Along with and to support effective and efficient implementation, the RGC in cooperation with JICA had conducted a *Master Plan Study on Rural Electrification by Renewable Energy in the Kingdom of Cambodia,* which, as a result, generated a set of guiding documents for the implementation of projects and programs in accordance with the scope of this REREP. The Master Plan entails two envisions projecting Cambodian future energy target and outlook as follows (JICA, 2006):

- to achieve a 100% level of village electrification, including battery lightning, by 2020; and
- to achieve a 70% level of household electrification with grid quality electricity by 2030.

3.4. Renewable Electricity Action Plan 2002–2012

Another policy supporting instrument is the Renewable Electricity Action Plan (REAP) 2002-2012. The main focus of this supplementary action plan was to give additional measurements to previous rural electrification policy targeting the rural areas. However, this action plan, which is another key initiative developed by the RGC with the support from the World Bank have put emphasis on the adoption of the new and renewable energy technologies that will fall under the framework of the proposed RE based rural electrification policy and strategy (Thusitha, 2018). At the ground level, the plan withholds the RGC's ambition to improve Cambodian rural household's standards by improving their energy access through adding up the REs onto the existing energy supply and expanding REs to where electricity coverage had not yet reached before.

The REAP's implementation would be in three phases: market preparation, early growth, and market scale-up; and is to be carried on by the MME- then the MIME. This action plan gives an

estimation of the total cost of electrification to all villages that is about US$ 427 million for the total of 872, 000 households to be electrified (Thusitha, 2018). It is about US$ 490 of electricity cost per household. However, that amount of household electricity coverage is only for the on-grid electricity. Aside from this, the other 272,000 households would be covered in another off-grid areas through the RE supply from the decentralized mini-grids and solar battery charging. The action plan targets the year of 2020 as the deadline and is estimated the gross investment costs of about $147 million (RGC, 2002). It is noted that there seems to be no M&E instruments in place to track the footprint of this REAP and to measure its distance from the targeted goal.

As an additional fulfillment to these policies and to achieve these targets a plus with the ongoing need of energy supply to rural areas, the Rural Electrification Fund (REF) was created by the RGC in 2004 by the Royal Degree NS/RKT/1204/048. Nearly a decade, the RGC issued a new Royal Decree NS/RKT/0812/734 on 22 August 2012 to amend some Articles of the old Royal Decree to incorporate the Rural Electrification Fund with the EDC. Since then, the REF had been come into place and continue to prolong the REAP's program of providing loan to authorized energy sellers in connecting electricity to the rural households. Two objectives of the REF are:

1) to promote equitable rural electrification with affordable price; and
2) to promote and encourage private partners to share hands in providing rural electricity energy services through applying technically and economically well proven renewable energy technologies (EDC, 2014).

Through this program, Cambodia aims to reach 15% of rural electricity supply from solar and small hydro by 2015. It is put into operation by providing grant assistance to licensees for new connection to households in the targeted areas and this grant assistance is of the support from the World Bank. The scope of the REF interventions are covered in three programs (EDC, 2014):

1) Program for Power to the Poor (P2P): This program aims to provide coordination between rural households with electricity suppliers to access to energy supply from grid connection to their houses;
2) Program for Solar Home System (SHS): a bit different from the first program, it is designed to target those remote households that have lack of access to grid network. Through REF, the EDC will provide subsidy to houses to install the SHS. The paying back option that households can pay to the REF is available in detail in the program paper of the EDC (EDC, 2014); and
3) Program for Providing Assistance to Develop Electricity Infrastructure in Rural Areas: targets those private electricity supplier who have license to access funds to invest on the expansion of electricity supply infrastructure to households in their authorized distribution areas.

From the above RE Policy, Action Plans, and Program; it can be assumed that Cambodia is really diving into the ambitious rural electricity programs that can be characterized by its hybrid system and community electrification scheme, for example the P2P and the SHS program.

3.5. Cambodia Energy Strategy

To ensure successful implementation of the adopted policy and action plans, Cambodia set a number of targets to be achieved as summarized in the followings (Thusitha, 2018):

1) Target 1: comprises of two phases: one is by 2015, Cambodia committed that the National Grid will have enough electricity source to supply to all energy demand. The

Second phase is the by 2018 Cambodia targets to have a National Grid Reserve Capacity of 25%;

2) Target 2: is about the quality of the electricity energy supply. It is projected that by 2020, Cambodia aims to cover all the provinces/cities with High Voltage (HV) grid system. To ensure energy security, a substation will be installed in each province and city for receiving the electricity supply from the National Grid;
3) Target 3: By the year 2020, 80% of villages will receive electricity supply from the National Grid. Whereas the remaining 20% of villages will access the electricity supply from different sources such as import from neighboring countries or isolated system. By the year 2030, 95% of all villages throughout Cambodia will receive electricity supply from the National Grid and the remaining 5% will receive electricity supply from the isolated system with grid-quality electricity;
4) Target 4: From a village level to household level, by the year 2020, Cambodia planned to cover its 50% of all households with full access to grid-quality electricity. Up the next level, by the year 2030, Cambodia aims to provide 70% of all its households the access to electricity supply with similar quality to the National Grid electricity; and
5) Target 5: Cambodia planned to narrow down the gap of electricity tariff between the rural areas and cities that are connected to the National Grid. The plan to reach no more than 15% of the tariff gap by the year 2020.

To achieve the above targets, a number of strategies have been adopted as follows (Thusitha, 2018):

- To expand the electricity energy system to reach out more consumers. There are two expansion – the HV grid system to more provinces and the Medium Voltage (MV) supply to more rural areas. To implement this strategy, the EDC was designated to undertake the mission;
- To expand the areas of electricity supply focusing on the licensees in the rural areas; and
- To encourage private investors in the power sector to contribute to expanding the power supply to new areas.

3.6. Potentials for Renewable Energy in Cambodia

Regarding the bio-energy sector, Cambodia is reported as a potential country to be a bio-energy producer. The capacity to produce bio-energy is not only enough for domestic supply but also can be exported if the underutilized lands are to be used. So far, it seems that there is no bio-energy policy adopted. There was a study on the Cambodia Bio-energy Development Promotion Project which was to access the possibility of this initiative (KCP, ECFA, & JDI, 2007). However, other government's policy provides supports and encouragements relevant parties to invest on bio-energy. Through the existing policies, the RGC recognizes barriers to this bio-fuel development and rural RE. Those challenges would fall into limited information and low level of awareness; weak coordination between relevant agencies; lack of skilled personnel and training facilities; commercial non-viability; inadequate financing arrangement; and unfavorable import taxes and tariff systems. It is reported that there used to be an initiation to establish the multi-Ministry Bio-Energy Committee and Bio-Energy Act or Sub Decree (MME, 2002). It is not yet to come with updates on the progress of this bio-energy initiation.

3.7. National Energy Efficiency Policy (2018-2035)

The RGC developed the first national energy policy in 1994 with primary focuses on the improvement of the living standard of the population, the increase in competitiveness of the Cambodian economy, the reduction in the dependency on imported fuels, and the more effective protection of the natural capital of the country (RGC, 2017). In addition, the National Energy

Efficiency Policy was prepared in 2018 with two main goals: 1) Improve the management and maintenance of existing infrastructure (e.g. buildings) and industrial processes (e.g. for the use of fuel wood) for increased energy efficiency; and 2) Increase the transfer and adoption of energy efficient technology (e.g. fuel efficient vehicles and light bulbs) to reduce energy intensity. The policy also set the overarching target to reduce energy demand by 20% in 2035 relative to the business as usual scenario. If it is effectively implemented, it will result in a reduction of: 1) Energy consumption of 1 million tons of oil equivalent (toe) by 2035 relative to the business as usual scenario; 2) Energy intensity of 65% in 2035, relative to 2014; 3) CO2 emissions of 3 million tons in 2035, or 28.5 cumulative million tons between 2017 and 2035, relative to the BAU scenario (RGC, 2017).

In order to achieve the above-mentioned goal, four strategic elements were identified as followings (RGC, 2017):

- Awareness raising: creating awareness on ways to reduce energy consumption by avoiding waste, and on technologies that increase efficiency by consuming less or by switching to energy sources that are more efficient is a critical first step towards behavioral change and investments in energy efficiency;
- Financial incentives: when awareness is created, the willingness to invest and adopt new technologies can be hampered by the lack of financial resources. If investments offer a positive return in the short term, incentives are not required. In situations where instead the upfront capital cost is considerable, even if the returns are positive and attractive, inventing may not be possible. In these circumstances providing incentives (e.g. through fiscal policy) can accelerate progress towards energy efficiency, also by sharing the economic burden across economic actors (e.g. government and households);
- Capacity building: creating demand is not sufficient for the successful transition to an energy efficient society. Capacity needs to be created to ensure that new processes and technologies are properly implemented and utilized, and to allow domestic supply to emerge as a competitive option for the provision of these services (e.g. audits and equipment inspection) and technologies (e.g. white appliances); and
- Standards: when energy efficiency supports society (e.g. through the reduction of morbidity and mortality), and the reduction of energy consumption generates synergies for multiple economic actors (e.g. buildings efficiency reduces expenditure and increases social well-being as well as economic poverty), standards can be implemented to lead investments in the desired direction. For instance, the implementation of an energy efficiency building code and an energy efficiency standard for the industrial sector would guarantee that new investments in the building and industrial sectors apply energy efficiency measures. When coupled with incentives, standards ensure that targets are reached while the costs are shared across various economic actors

3.8. National Policies and Strategies on Green Growth

The National Green Growth Roadmap (NGGR) was adopted by the RGC in 2009 with three targets (MoE, 2009):

1) short term (2‑5 years), it will make a major contribution to stimulating the economy, saving and creating jobs, and protecting vulnerable groups and ensuring the environmental sustainability;
2) medium term (5‑10 years), it will further promote sustainable and inclusive growth and the achievement of the CMDGs for economic development and social and environmental stability; and

3) long-term (10-20 years), it will contribute to the reduction of Cambodia's carbon dependency and ecosystem degradation – all in favor of sustained economic growth and poverty reduction.

This national roadmap aims to green the development sector through creating enabling environment for green investment to grow in Cambodia. It covers a number of certain green sectors in Cambodia including the enhancement of the management, preservation and sustainable development of forestry and fishery resources and the increase of Cambodian resilience to climate change through implementing D&D Reform and engaging with some key national institutions, including the NCDD. In addition, along with this roadmap, the RGC has been implementing the D&D reform to create an Organic Law.

This NGGR establishes national direction toward sustainable development as set forth in the NSDP. To establish in the direction, the RGC needs to engage with other development partners both from the private enterprises and NGOs to help greening the country. Activities to be taken include the awareness raisings, eco-efficiency of production and consumption through providing capacity building for each specific sector and implementing other green growth policy. The roadmap also plans to mainstreams green growth concept into overall national strategic development with purposes to ensure the inclusiveness and sustainability for the overall country's development. The remarkable point standing out from this NGGR is, aside from the aspiration to further develop economy for people benefits and integrating conservation and restoration of natural and capital, the prioritization of the importance of the RE which is counted as one among other seven fundamental needs. These green economic needs are to be fulfilled through green economic growth projects and programs. In this fulfillment, the RGC prioritizes eco-efficient and resource efficient innovations that will hopefully bring about new green jobs which can replace the current unemployment rate and contribute to green growth.

In 2011, Cambodia's MoE signed a Memorandum of Understanding (MoU) on Green Growth Cooperation with the Global Green Growth Institute of the Republic of Korea (GGGI) with aims to develop a master plan for Cambodia's green growth- the NGGMP in strategic partnership with the GGGI. Along with this, the RGC established the National Committee on Green Growth chaired by the Prime Minister in 2012. As a result, the RGC finally produced that National Policy on Green Growth and the National Strategic Plan on Green Growth in March 2013. The National Strategic Plan on Green Growth (NSPGG) (2013-2030) aims to promote national economy with growth stability, reduction and prevention of environmental pollution, safe ecosystem, poverty reduction, and promotion of public health service, educational quality, natural resource management, sustainable land use, and water resource management to increase energy efficiency, ensure food safety, and glorify the national culture (NCGG, 2013).

4. Obligations under the UNFCCC, the Kyoto Protocol, and the Paris Climate Agreement

Under Articles 4 and 12 of the UNFCCC, Cambodia as a signatory party of both the UNFCCC and the Kyoto Protocol (KP) must report her GHG emissions by sources and removals, national mitigation and adaptation measures, and any other relevant achievement towards the objective of the Convention, the country must set up institutional arrangements for the national approval of CDM under the KP.

The Department of Climate Change (DCC) of the National Council for Sustainable Development (NCSD) has exclusively been established with the primary roles and responsibilities of assisting the RGC in dealing with national related climate change issues and in assisting Cambodia in fulfilling its international obligations. The formulation of national communications under the UNFCCC falls under the purview of the DCC and provides the basis for institutional continuity at both the policy-making and technical levels, across a comprehensive range of government

stakeholders. Furthermore, as indicated in previous section, the DCC acts as the Secretariat of Cambodia's Designated National Authority (DNA) for the CDM. A selection of members of the NCSD relevant to mitigation activities forms the Board of the Cambodian DNA. Cambodia submitted her INDC, which was identifying as a low emitter but highly vulnerable to the negative effects of climate change, to the UNFCCC and the INDC development is necessarily aligned with the country's development priorities.

Cambodia signed the Paris Climate Agreement on 22th April 2016 at the UN Headquarters in New York and ratified accordingly. The country is expected, among other benefits of greater financial support, to get supports of technology transfer and capacity building in response to climate change and disasters; participation in a new carbon pricing mechanism; and reduction of the country's adaptation costs in the long-term. Although Cambodia will be subject to specific obligations under the Agreement, the rights and privileges are expected to considerably outweigh the obligations, as the Paris Climate Agreement provides flexibility for developing countries, based on common but differentiated responsibilities and respective capabilities, taking into consideration actual national circumstances. The Agreement entered into force for Cambodia on 8th March 2017 in accordance with its Article 21 (3), which reads as follows: "For each State or regional economic integration organization that ratifies, accepts or approves this Agreement or accedes thereto after the conditions set out in paragraph 1 of this Article for entry into force have been fulfilled, this Agreement shall enter into force on the thirtieth day after the date of deposit by such State or regional economic integration organization of its instrument of ratification, acceptance, approval or accession."

5. Institutional Framework for Energy Development and Management

The Law on Electricity stated that no person may operate as an electric power utility or services providers without a valid license issued from the Electricity Authority of Cambodia (EAC). Only three main governmental institutions shall have responsibility over energy governance, including the Ministry of Mines and Energy (MME), the Electricity Authority of Cambodia (EAC) and the Electricite Du Cambodge (EDC). Roles and responsibilities of each of these energy institutions are shortly presented as follows (ACET, 2016):

1) The MME shall be responsible for setting and administrating the government policies, strategies and planning in the power sector;
2) The EAC shall ensure that the provision of services and the use of electricity shall be performed efficiently, qualitatively, sustainably and in a transparent manner. EAC is also responsible for updating the energy development including both supply and demand sides via its annual report on overview of Cambodia energy development; and
3) The EDC as the operator shall be responsible to generate, transmit and distribute electricity throughout Cambodia. Its main functions are supplying electricity, developing the transmission grid and facilitating import and export of electricity to and from neighboring countries. It was originally established in 1958, re-established in 1979 as part of the then-the Ministry of Energy and made responsible for electricity supply in Phnom Penh. Supplies in other provincial cities were the responsibility of provincial authorities through their departments of industry.

In addition to these three government energy institutions, which are the top national level institution, there are a number of sub-national level institutions in the power sector, which are key involved actors in either generation and/or provision of electricity from the EDC. They can briefly be listed as below (Thusitha, 2018) and a further breaking down structure of key energy institutions in Cambodia can be viewed in Figure 7.

1) Independent Power Providers (IPPs) are private companies that have received a license from the EAC to generate electricity for public consumption. IPPs generate electricity and sell it to the EDC, who then distribute to the national grid. At the end of 2015, there were 20 generation licenses issued and valid (in addition to the EDC), representing IPPs. They provide 89% of the electricity produced in Cambodia, and sells it to the EDC.
2) Rural Electricity Enterprises (REEs) are privately-owned electricity providers, who provide power in rural areas (mainly using diesel generators, few using biomass gasifiers). Although approximately 600 REEs provide power through diesel-based mini-grids and over 1000 operate battery charging stations, only around 250 REES are actually licensed by the EAC. Sizes vary between 50 and 5,000 customers; around 40 have more than 1,000 customers. Most REEs are rather small, providing rural villages with electricity. The average installed capacity is 232 kW (minimum 20 kW, maximum 1.43 MW). About half of REEs offer 24h service, the rest operates only 4-12 hours per day.

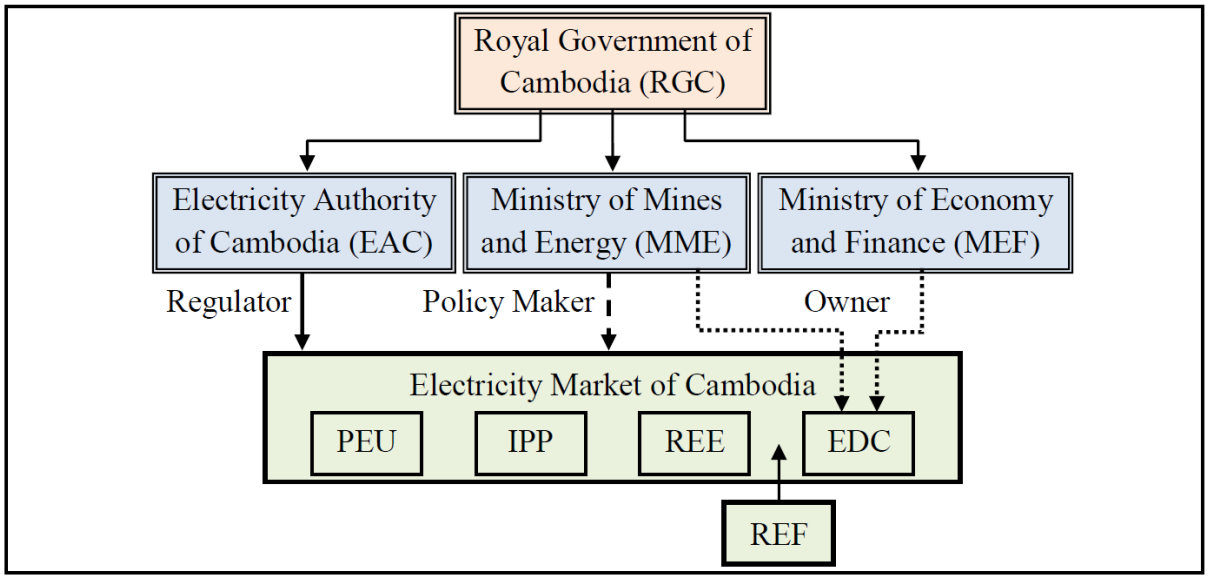


Figure 7: Institutional set-up of the power sector in Cambodia (Thusitha, 2018)

6. Current status of national climate MRV and M&E activities and initiatives

6.1. Cambodia Climate Change Monitoring & Evaluation Framework

The Cambodia Climate Change Strategic Plan (CCCSP) was adopted in 2013 as a foundation of guiding framework for all policy making, project development and activities in addressing climate change. Determination of institutional establishment and coordinating arrangement among climate change stakeholders have been pointed out in the CCCSP. This means that in terms of policy level, Cambodia has well been prepared. However, further discussion on policy implementation has been in progress. The CCCSP suggests the establishment of a National Framework for the M&E of Climate Change (NFM&ECC). The goal of this national framework is ambitious which is to create a national platform through which all national and sub-national development plans related to sustainable development and climate change will be integrated based on the guidance of the NFM&ECC.

The achievement of the NFM&ECC is the demanding and exhausting work requires tremendous efforts, knowledge sharing, collaboration, responsibility and accountability from the institutions concerned. However, this promising M&E proposal will yield tremendous fruitfulness for the country. One of its main benefits is the generation of new knowledge and evidences that are most needed and very critical for policy making and for implementing in the future. Currently, the NFM&ECC is being developed by the CCD with aims to (NCCC, 2013a):

- Measure to what extent adaptation efforts have been effective in keeping development on track in a changing climate;
- Monitor climate change mitigation actions and low-carbon development policies;
- Generate evidence and lessons as a basis for future policy development;
- Facilitate the coherent integration of the M&E of climate change in national development planning and key sectors; and
- Provide the information required to fulfil the reporting obligations towards the UNFCCC and development partners.

It seems that there are not many energy sector related to the M&E framework policy available in Cambodia recently except the NFM&ECC. Thus, the rest of this paper is to examine the rational and evolutionary progress of the NFM&ECC in Cambodia.

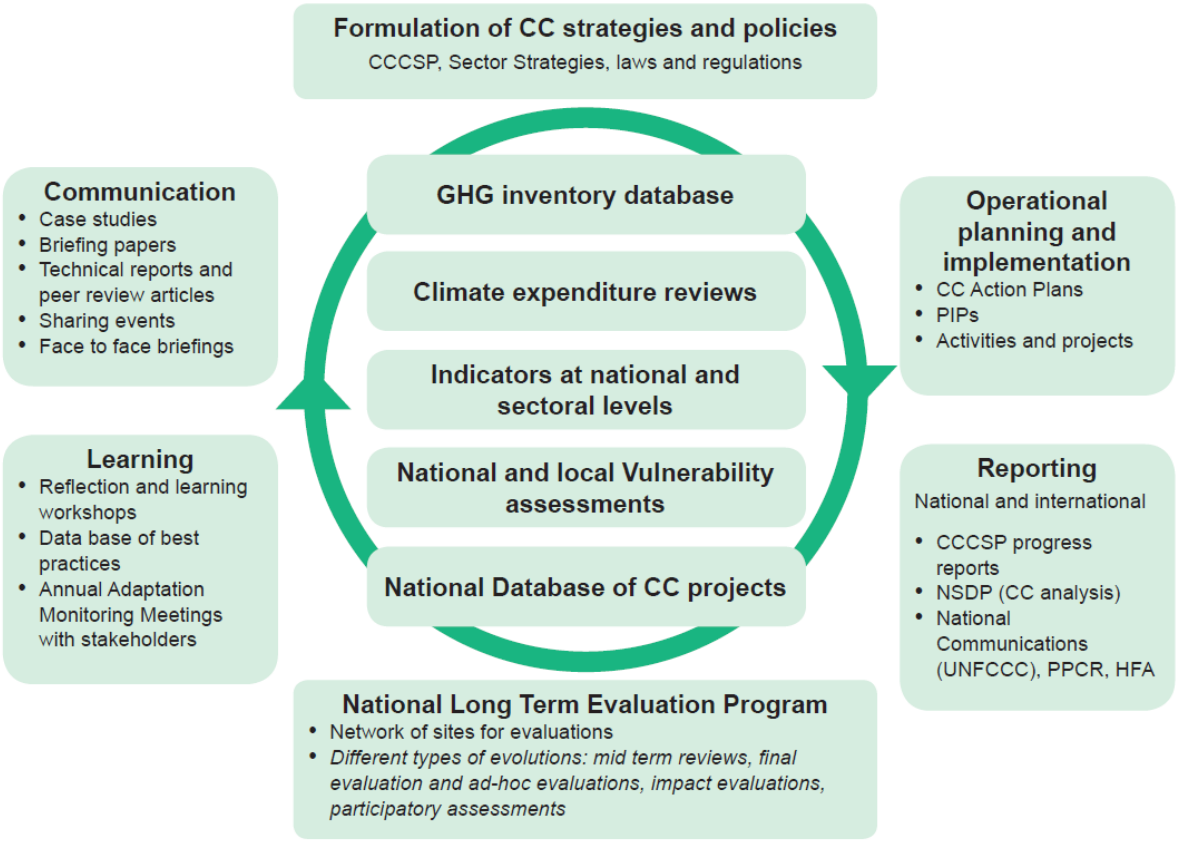


Figure 8: Main components of the National Climate Change M&E Framework (NCCC, 2013b)

6.2. Update on Progress of National Framework for M&E of Climate Change

6.2.1. National Framework for M&E of Climate Change at National Level

In order to better understand the evolution and progress of the NFM&ECC since it was adopted in 2013, it is better to have some basic ideas of indicatory components of this M&E framework. Hence, the question here is what does the NFM&ECC measure?. The NFM&ECC adopts the twined tracking approaches of which one approach is to measure national responses to climate change through the downstream tracking system. The upstream approach measures how well the national institutions in addressing climate risks are. The indicators used in this downstream approach are the institutional readiness indicators. This cross-cutting approach is mainstreamed throughout the national institutions as far as the climate change is concerned. The other approach is the downstream approach, which applies the impact indicators to measure the climate vulnerability and GHG emissions in the country.

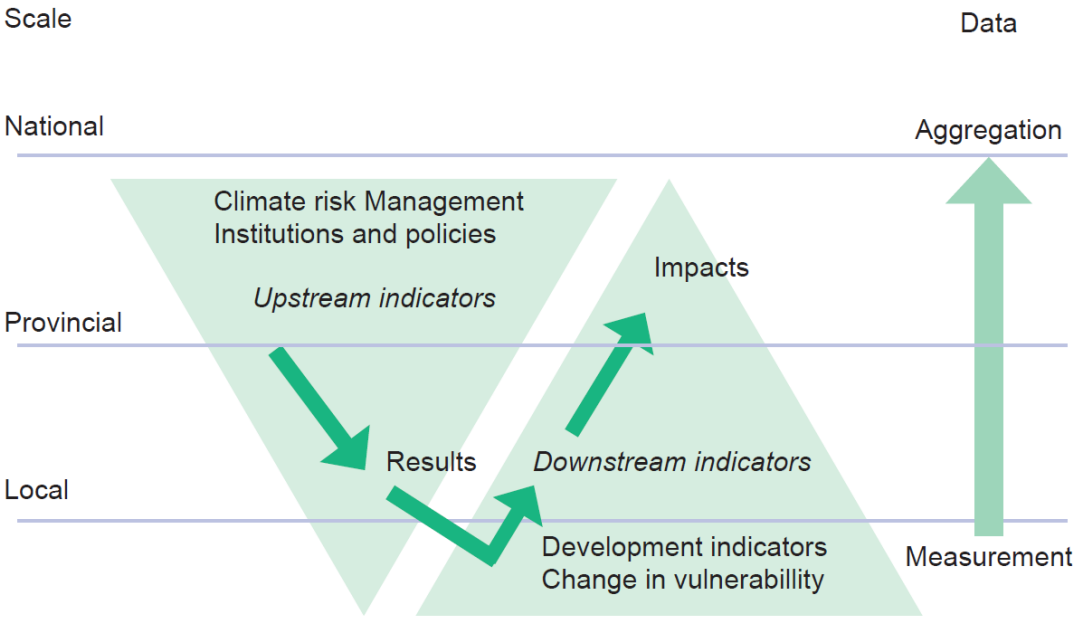


Figure 9: Indicator framework of the NFM&ECCC based on two mainstreams – downstream and upstream (NCCC, 2013b)

To measure the climate change responses addressed by Cambodia as committed in the national climate change policy and strategy, two sets of measuring indicators were developed during the adoption of the NFM&ECC. One set of indicators is for national institutional readiness measurement and the other one is for the impact measurement. The former is developed for the upstream approach, which comprises of five different and relevant indicators which are specifically designed to examine the functional and performing integrity of climate change concerned institutions in Cambodia. For the impact measuring, there are three indicators that are designed to compare the impact of climate change responses against the performance by climate change institutions.

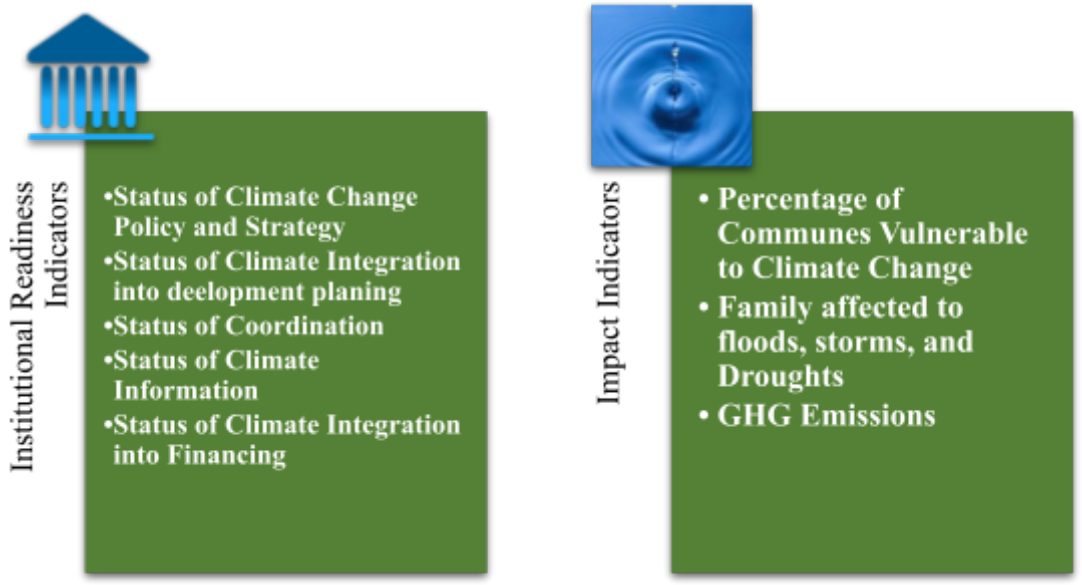
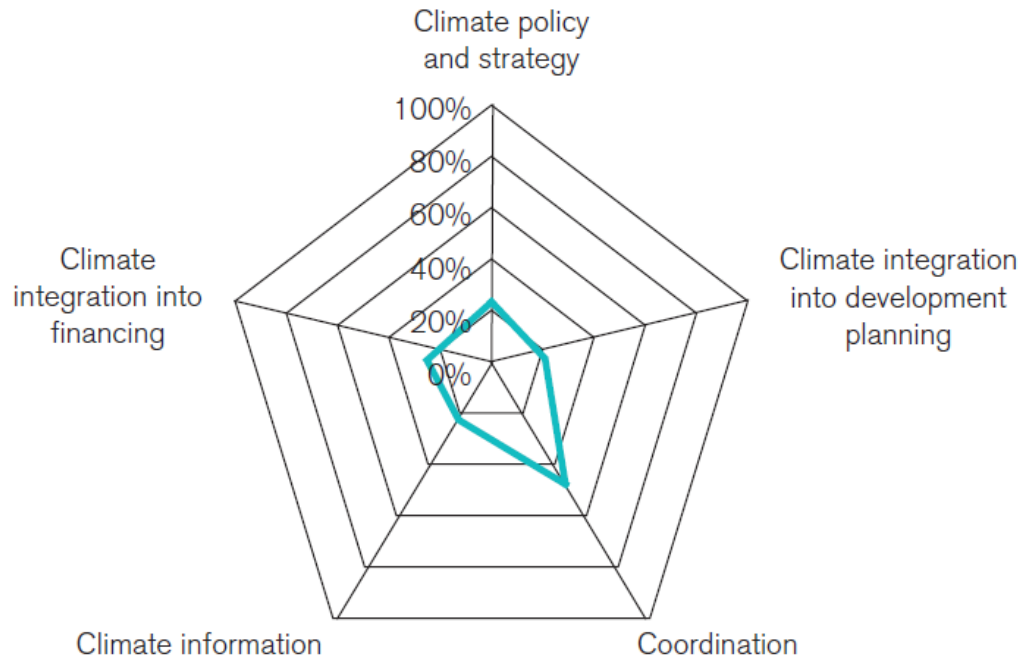


Figure 10: National Framework of M&E for Climate Change in Cambodia

6.2.2. How well is Cambodia performing its CC responses from 2013 to 2017

To be able to conduct M&E of climate change responses, we need baseline indicators. According

to the IIED, the lead institution in cooperation with the MoE and other stakeholders in developing this National Framework of M&E on Climate Change, only 7 of 8 above indicator baselines were successfully developed in 2014, one year later after the adoption of the NFM&ECC. It is reported that the GHG emission indicator baseline, which is to measure the GHG emission per sector and per capita was not yet adopted and was planned to finalize to be able to measure the GHG emission by 2017. Hence, it is not yet clear up to this point that the GHG emission indicator is already put into practice. Also, it is reported that the RGC planned to integrate 2 or 3 more indicators into the sectoral M&E framework of climate change (DCC, 2016), and this is still an ongoing process up to this date (NCCC, 2013b).



	Indicator	2014 baseline
1	Climate policy and strategy	30%
2	Climate integration into development planning	25%
3	Coordination	45%
4	Climate information	17%
5	Climate integration into financing	25%

Figure 11: Baseline of Institutional Readiness Indicator in 2014 (DCC, 2016) (Rai, Brooks, Tin, Neth, & Nash, 2015)

The result of the indicator baseline establishment in 2014 shows that the process of making climate change policy and strategy is in progressive stage with average level. Very noticeably, Figure 11 presents that Cambodia invested significantly on the coordinating mechanism, the highest performance and most resourced-attractive area of climate change responses by that time. Reversely, the baseline figure indicated that institutional responses to climate change in terms of information collection, access, and sharing are not yet well performed. Whereas the integration of climate change into institutional planning and financing stood at an average compared to the overall institutional assessment. For the impact indicator set, three indicators were used to establish the baseline in 2014. By that time, about 17.2 percent (279 communes) of the total communes were “highly” vulnerable to climate change and above 31.5 percent (512 communes)

are very vulnerable to multiple climate change hazards. Figure 8 presents the baseline of vulnerability of climate change in Cambodia.

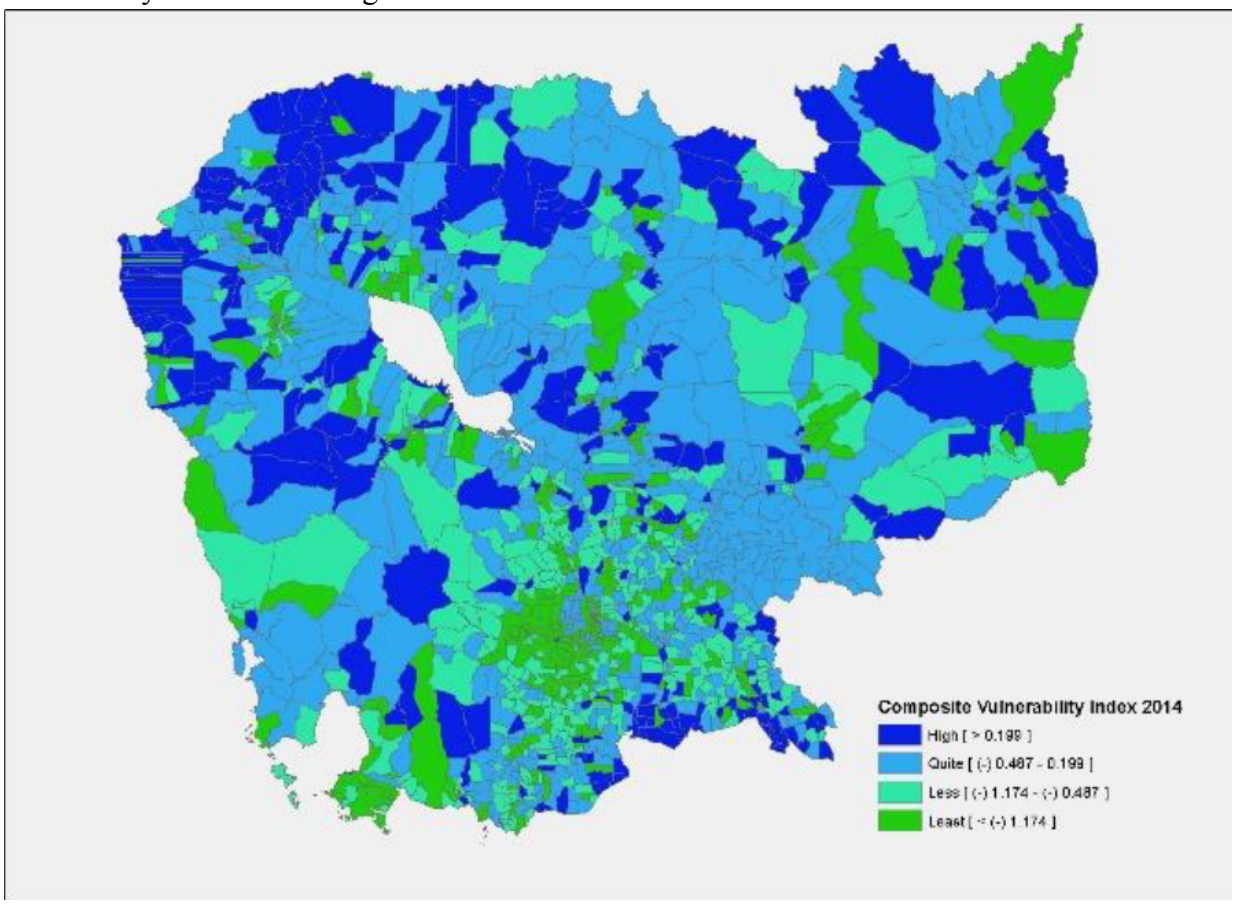


Figure 12: Baseline of Impact Indicators of the NFM&ECC by 2014 (DCC, 2016)

The second indicator of this impact indicator set is to measure the numbers of families affected by floods, storms, and droughts. The 2014 baseline shows that during that time there was 14 out of 1, 000 families are vulnerable to climate change. It is to notify that the GHG emissions baseline was unable to conduct by that time.

6.3. **M&E of Climate Change at Sectoral Level**

From this baseline, in 2015 another reported conducted by the IIED to measure the progress and implementation of the National Framework M&E of Climate Change. What standing out from this 2015 baseline compared to the 2014 national baseline is that this newly updated one is another advanced step on implementation of the framework by achieving the Sectoral Level M&E framework on climate change.

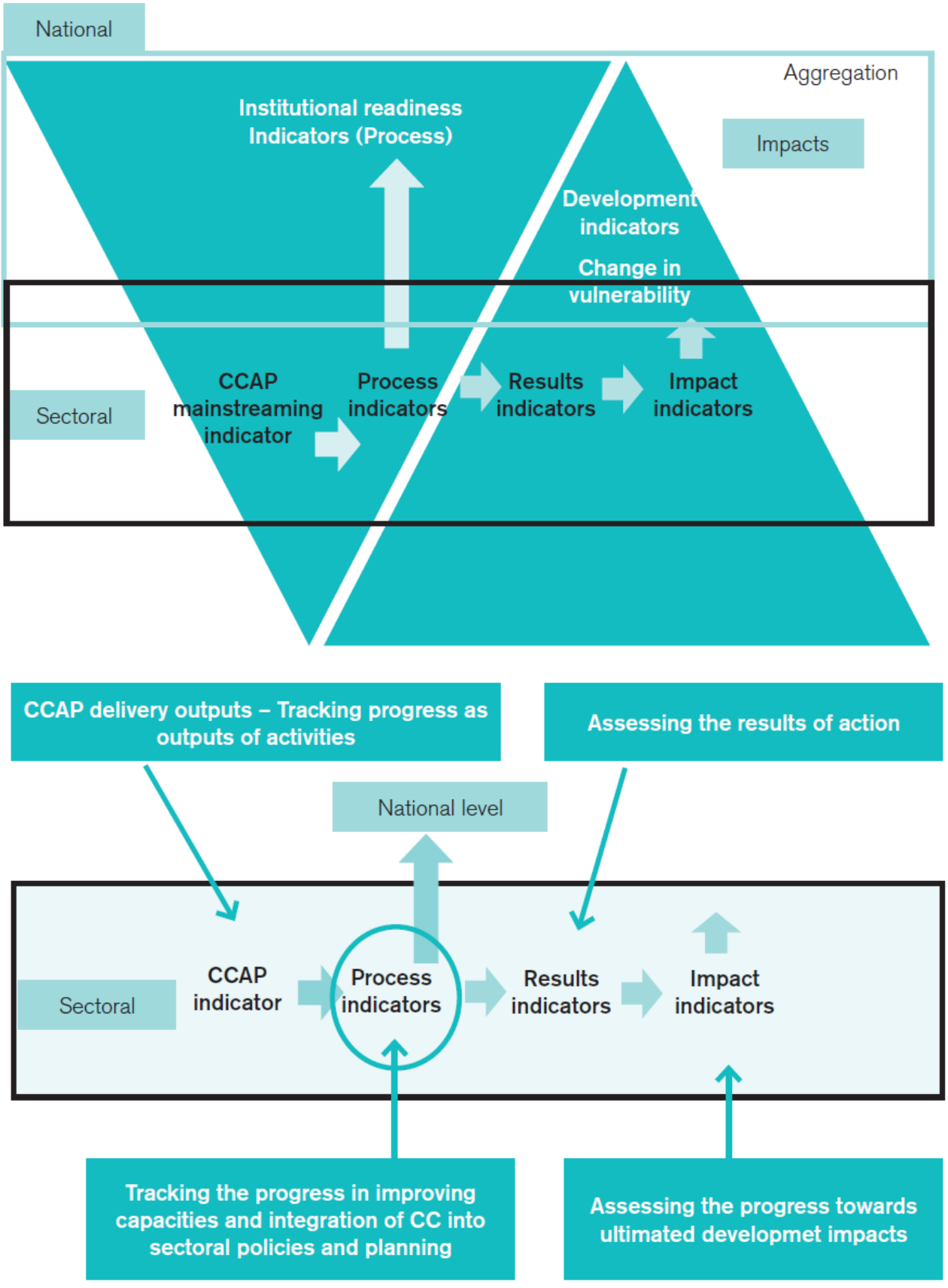


Figure 13: M&E Framework of CC at Sectoral Level 2015 (Rai, Brooks, Tin, Neth, & Nash, 2015)

The institutional indicators in this sectoral level M&E framework are less than the one in the National Level framework. There are only four of them, which are listed below (Neha Rai et al. 2015):

1) Climate change into sectoral planning: The level of inclusion of climate change in sectoral planning and linkages with national planning;
2) Institutional capacity and coordination: The establishment and functionality of institutions and coordination mechanism for climate change response and the implementation of the MPWT's CCAP;
3) Climate information: Production, access and use of climate change information at sectoral level; and
4) Climate integration into financing: Availability and effectiveness of a financial framework for climate change response.

6.4. MRV framework for the REDD+ implementation strategy

The other ongoing MRV system is the MRV framework for Cambodia REDD+. The development of the MRV system is seen as still in the early stage; however, the country has been making some key milestones in REDD+ readiness, which include the finish of the National REDD+ Strategy (NRS), the policies and measures (PAMs) for implementing the REDD+. The NRS had been presented by the RGC in front of the COP21 of the UNFCCC in 2015. Currently, additional achievements of the REDD+ include the establishment of institutional arrangement and coordinating and reporting networks, and the development of a REDD+ monitoring system for forest carbon, and the establishment of a national forest inventory system. These key milestones are made by ranges of cooperation between the RGC and other supporting partners, including the UN-REDD+, UN Food and Agriculture Organization (FAO), and the financial supports from Forest Carbon Partnership Facility (FCPF). The MRV/REL Technical Team is the key responsible body in charge of the development of a national MRV system. The MRV system will be based on an assessment of the forest area change, using both satellite imagery to estimate forest cover, and ground based measurements of carbon stocks in different forest types (RGC, 2012). Additionally, ground trothing and surveys will be used to verify results and to provide additional data. In the process of the REDD+ MRV, Forest monitoring system and set of governance indicators were developed by a Consultation and Safeguards Technical Team (MAFF, 2017).

6.5. **Identifying gaps and potential to improve M&E framework in Cambodia**

In TAMD report of M&E framework of CC 2015, IIED could suggested four main challenges of M&E to be further addressed. However, it important to mention that the 2015 baseline TAMD is only scoped within the assessment of Minister of Public Work and Transportation. Those framework gaps are included (Rai, Brooks, Tin, Neth, & Nash, 2015):

1) long timescales associated with climate change and adaptation;
2) attributing the outcomes of adaptation to specific actions, interventions or policies;
3) shifting baseline conditions of climate change over time, which can make it difficult to interpret adaptation results; and
4) contextualization of adaptation outcomes within wider environmental changes, which may impact adaptation interventions and thereby alter the results.

One more significant point taken from reviewing these previous M&E baseline is the absence of GHG emission in both the national and sectoral framework level. Therefore, this suggested the significance and rationale for this ICAT project to review other best practices that have already been done in other countries to be contextualized with Cambodian context in order to finally produce a reliable and workable new M&E framework of CC specifically designed for monitoring and evaluation of the RE and GHG emission. Given this National Framework of the M&E on Climate Change and the existing national mechanisms running and cooperating with

the UNFCCC, it is recommended that the proposing MRV system of the ICAT should be piggybacked on the currently running framework and institutional arrangement.

7. Selected Policies for the Application of the ICAT Methodology Pillar I

This section will cover the selection of policies to be assessed for applying the ICAT's methodological MRV. For the first part covers below steps: description of the selected policy, decision on opting for individual or package policy to be assessed, and the choice between ex-ante assessment scenario of policy assessment based on the ICAT's guidance. The ICAT's methodological framework covers only three types of policy:

1) Feed-in Tariff Policies: price-based instruments that provide a fixed guaranteed electricity price or a fixed or fluctuating price premium;
2) Auctions and Tender Policies: quantity-based instruments that set the fixed amount of electricity generation from renewable sources to be achieved, where the market determines the price; and
3) Tax Incentive Policies: use the tax system to improve the financial viability of the RE investments.

Cambodia has developed numbers of programs and policies, some of them relating to policy type of the ICAT and some are not. The RE Policy to be reviewed for the ICAT framework application includes: the Renewable Energy Policy 2006, the REAP, the Rural Electrification Funds, and the master plan of the RE Policy 2006 envisioned (JICA, 2006). Below is the policy analysis of the Master Plan and the Cambodia Nationally Determined Contributions (NDC).

7.1. The Master Plan for the RE

In 2006, the RGC initiated the Rural Electrification by Renewable Energy Policy (REREP), one of the first mention of and more prioritizing on the RE ever made. This policy initiation was to respond to the urgent needs of electricity supply to the rural areas of Cambodia with a nationwide target and also to maximize indigenous resources of energy supply. A long with the REREP, the RGC had conducted a *Master Plan Study on Rural Electrification by Renewable Energy in the Kingdom of Cambodia* to ensure the effectiveness and efficiency of the REREP implementation. The Master Plan Study was conducted with the support from JICA. The study generated a set of guiding documents for implementing projects and programs under the scope of the REREP. This section is dedicated to analyze the Master Plan, which will be categorized based on its scope, target level, description of specific interventions, achievement & key identified barriers of the MP implementation, and concluding remarks, as described below.

7.1.1. Target Level

The Master Plan entails two envisions projecting Cambodian future energy target and outlook as follows (JICA, 2006):

- to achieve a 100% level of village electrification, including battery lightning, by 2020; and
- to achieve a 70% level of household electrification with grid quality electricity by 2030.

The Study covers "the rural areas of the whole Cambodian territory (off-grid area)", excluding Phnom Penh Municipality, 4 special cities, and the other 20 provincial capitals. Areas which have been and will be electrified by the National Grid (on-grid areas) and those areas covered by the REE licensed from the EAC have been excluded from the study area. As presented above, the Master Plan does not present the intended level of mitigation to be achieved. The only

available target level is the coverage of the electricity supply to the rural areas of the country. The Master Plan along with the REAP and REF described action plans and strategies to reach the targeted energy supply; but the M&E and KPI seems not available in the policy. Therefore, it is obvious that the policy does not have a separate target of GHG emissions reduction; however, it is designed in open manner.

To realize the two targets, the RGC's RE policy relies on different indigenous energy sources which include: Grid expansion from the existing areas, Diesel stand-alone, Mini-Utility System, Cross-border Power Supply from neighboring countries (Thailand, Vietnam, and Lao PDR), and Renewable Energy (Solar, Wind, Mini-micro hydro, Biomass, Biogas, Bio-fuel, etc…). The aims of this RE policy is to provide access to reliable, safe and environmentally clean electricity services to rural areas, at an affordable cost to the national community. The policy functions as a market enabler and encourage private sector participation in providing rural renewable electricity services. This RE policy is seen as one of the most comprehensive RE policy, as the policy is designed to cover the whole spectrum of sustainable development, which is not only limited to the RE energy development, but also to ensure adequate resources and appropriate institutional mechanisms to empower the poor, particularly those in rural areas.

7.1.2. Description of specific interventions

i. Tariff differentiation

To ensure the practicality and the effectiveness of the policy implementation in order to reach policy goal in line with other RGC national development policies, different types of tax incentive programs have been introduced to and as complementary to this RE policy. The inducement of the tax and incentive programs aims to encourage the most efficient systems for generation, transmission and distribution of electricity from clean and renewable energy sources, to enable a rational electricity tariff policy through promotion of differentiated tariffs based on cost recovery principles. Tax exemptions and Tax incentive programs on the RE are presented in the Short-term Policy Measures (SP) (2006-2008) and Mid-term Policy Measures (MP) (2009-2012) under the Electricity Strategy of the Master Plan. The incentive programs in Cambodian RE can be grouped into three categories: (1) tax exemption system on imports of renewable energy equipment, (2) the cross – subsidy system, and (3) the access to soft loans. It is important to notify here that the rationales behind the establishment of this incentive program is to optimize financial sources for subsidies to the CEDs and the REEs.

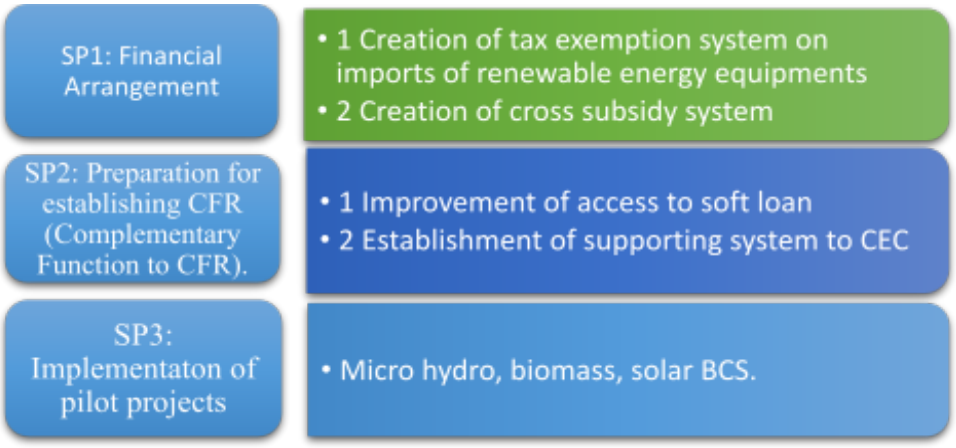


Figure 14: Mid-term policy measures (MP) (2009 – 2012)

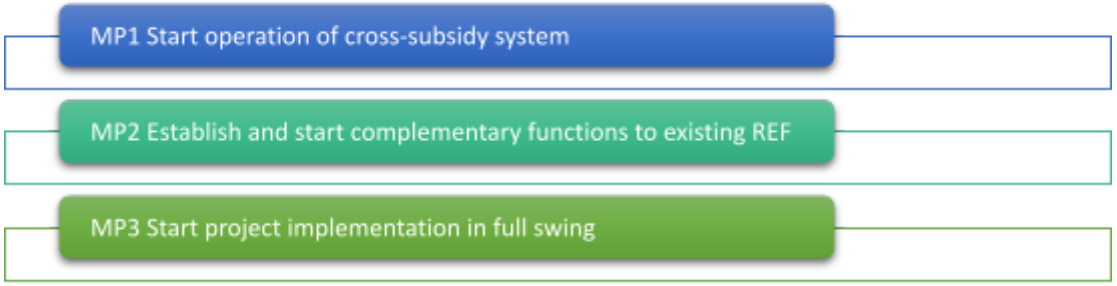


Figure 15: Financial Arrangement of the MP (JICA, 2006)

Tax exemption for the renewable technology import is very important for implementing the MP because Cambodia's ability to manufacture such kinds of technologies is not yet ready. As proposed by the JICA team who conducted the Study of the MP, the tax exemption for RTs import is subjected to 15% of customs tax and 10% of VAT. It was estimated that the tax exemption on imports of renewable energy equipment is equivalent to financial support of $13 million in total from 2009 to 2020. Advantages give suggestion to this proposing tax exemption is presented in this figure below:

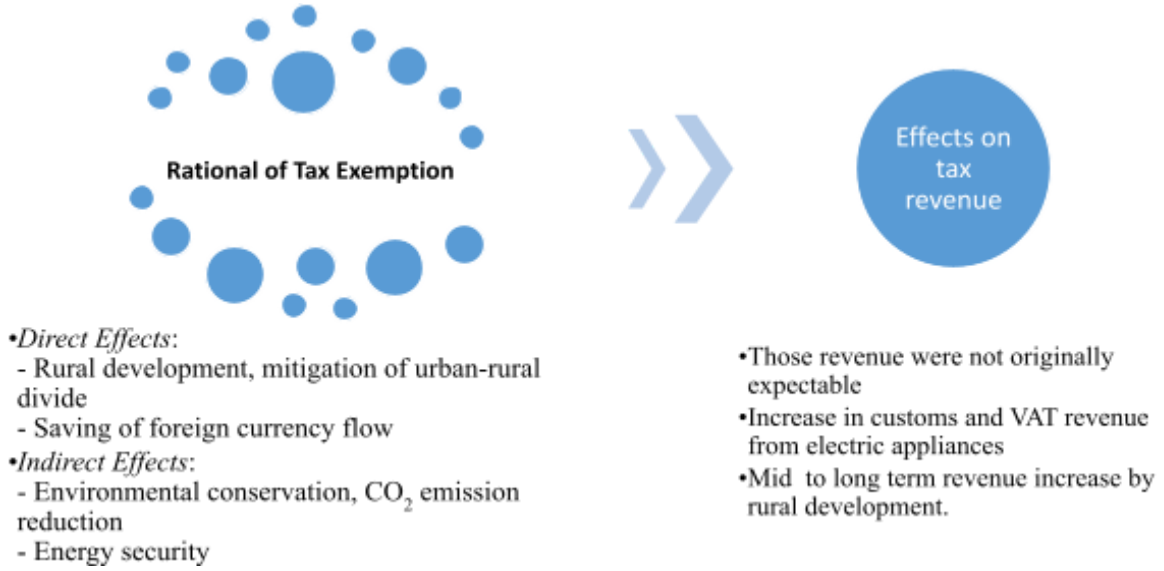


Figure 16: Rational for tax exemptions and effects on tax revenue (JICA, 2006)

Through imposing these tax exemptions, Cambodia hopes to take benefits from tax revenues in different ways. One of those benefits is the long term expectation of the increase in tax revenue from the import of the renewable technology appliances and the increase level of household income due to the industrial development resulting from rural electrification of the rural households.

In addition to these imposing taxations, Cambodia also created cross-subsidy system as a complementary implementation to ensure sufficiency of energy supplies in the country, especially in the rural areas and along the borders with neighboring countries – from Vietnam, Thailand, and Laos since 2008. This cross-subsidy system was to be at 1.5 to 2 percent of the revised electricity tariff. The proposed cross subsidy is run by sourcing from the grid users and by adding it on top of the proposed CFR. The MP clarified the importance of the cross-subsidy system and redemption from the tariff surcharge on the electricity price and proposed to establish the cross-subsidy system which sourced from the EDC users and the REE users. Cross-subsidy from the grid users is reported to have $40 million scale in total from 2009 to 2020 as documented in the MP.

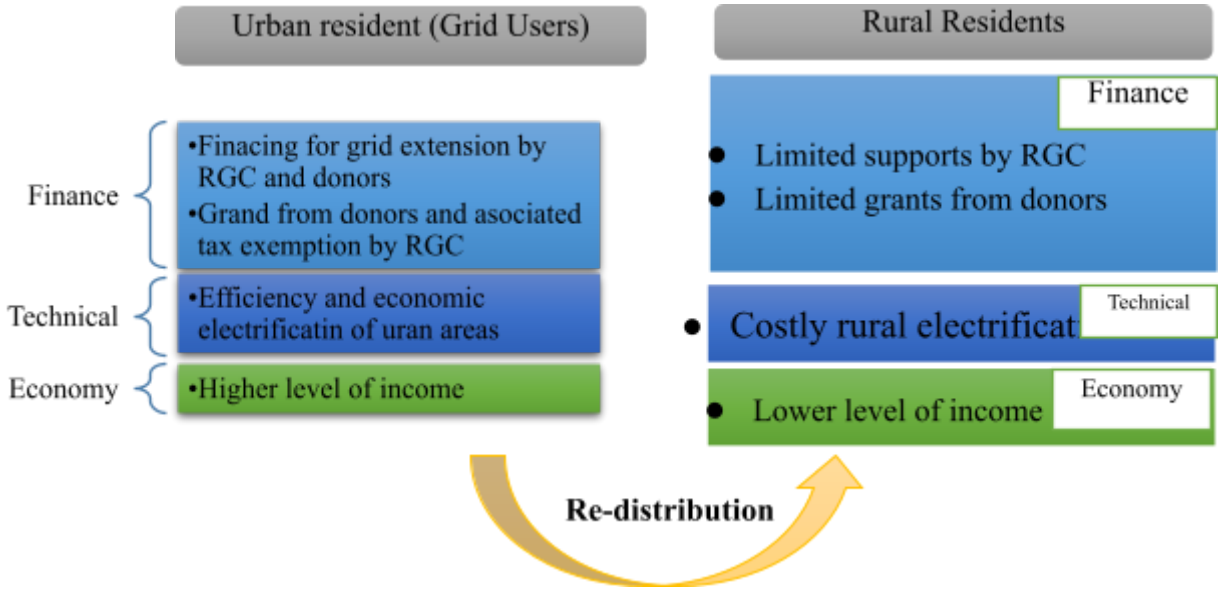


Figure 17: The need for Cross Subsidy Program (JICA, 2006)

Another incentive program for the RE policy is the improvement of access to soft loan, which is one of the key interventions of the strategic plan of the MP with the aim to establish the complementary function to the REF. To better understand the soft loan program, it is better to remind the operation of the REF dated back to 2005. As presented previously, the REF was adopted to prolong the implementation of the REAP with the scope of intervention covering the supports of more than 300 households, SHSs, micro-hydro and diesel power within the limitation of the subsidies of 25 percent including the provision of technical assistance. In continuation of the REF, the commentary function to the REF had been proposed to be established attached with soft loan and technical assistance provisions to any projects deploying biomass technologies. Main features of the soft loan program is summarized in the table below:

Table 1: Functions of Existing REF and Proposed CFR

Items	REF	CFR
Target Body	REF	CEC & REE
Type of Electrification Supports	Grid Extension	Mini grid by biomass power
	Mini grid by micro-hydro	Solar BCS
	Mini grid by diesel power	Others
	SHS	
Extension of supports (proposal of study team)	Mini-grids by biomass power	
	Solar BCS	
Content of Supports	25% of Subsidy to REE	CEC: 60% loan plus 25% subsidy
		REE: 50% loan plus 25% subsidy
	Technical Assistance to REE	TA to CEC and on biomass technology through DIME and NGO
Notes:	Projects with beneficiaries greater than 300 households will be supported.	No specific limit in community size except mini-grids by biomass power that should preferably have a

		size greater than 200 households.

Source: (JICA, 2006)

ii. The legality

The RE Policy is still on awaiting for finalization as the draft is still being in progress to come into force. The RE policy is acknowledged through the Master Plan and through interventions of the REAP and the REF in 2006.

iii. Financial Arrangement

To implement this MP, the MEF/MME (then MIME) arranged finance of about $427 million from the sources described below. This is a huge amount of budget needed to ensure the well-functioning of the program. The MP entails a list of four sources of subsidy as shown below:

1) Tax exemption on imports of renewable energy equipment (equivalent to financial support of $13 million in total from 2009 to 2020);
2) Cross-subsidy from the grid users ($40 million scale in total from 2009 to 2020);
3) Operating surplus of the pilot projects after deducting expenses and reserved money for future maintenance and replacement, and service fees from CEC for supporting activities (these are to be used for supporting activities by the MIME/DIME); and
4) Grant from donors, equity capital contribution in-kind (grant projects).

Table 2: Summary of financing requirements to implement the Master Plan by the Year 2020

Type of Electrification	*Total Costs*	*Fund Sources*		
		Subsidy	*Equity*	*Loan*
Grid electrification	280, 140	70,035	42,021	168,084
Off-grid electrification	146, 887	54,219	20,903	71,764
Total	427,027	124,254	62,924	239,848

Unit: $1,000; Source: (JICA, 2006)

Table 3: Rural Electrification Plan and Financing Requirements

Type of Electrification	No. of Candidate Villages	No. of h.h. to be electrified by year 2020	Total Cost ($1,000)	Total Cost per h.h. ($/h.h.)	Fund Source of Capital Costs		
					Subsidy	Equity	Loan
Electrified as of 2005	2,062	(350, 345)	-	-	-	-	-
Newly Electrified by Grid	6,411	600, 000	280,140	467	70,035	42,021	168,084
MHP/Hybrid	137	9,000	11,064	1229	5532	1,106	4,426
Biomass	3,071	168,000	99,498	592	24,875	14,925	59,699
Diesel	392	23,000	9760	424	2,440	2,440	4,880
Sub-total of Mini-grid	3,600	200,000	120,322	602	32,847	18,471	69,004
Solar BCS	1,720	60,000	21,045	351	19,993	1,052	0
SHS (World Bank)		12,000	5,520	460	1,380	1,380	2,760
Sub-total of off grid area	5,320	272,000	146,887	540	54,219	20,903	71,764
Village data unknown	121	-	-	-	-	-	-
Total	**13,914**	**872,000**	**427,027**	**490**	**124,254**	**62,924**	**239,848**

iv. Achievement of the RE Policy Implementation

Upon developing the MP based on the recommendation from the JICA study team, six priority projects as shown in below table were proposed for feasibility and implemented by the CECs as the main operators. These six schemes are scattered around five different provinces Battambang, Mondul Kiri, Pursat, Kratie, and Stung Treng with total construction cost of $2,119,200.

Table 4: Electricity Tariff and Economic and Financial Indicators of Promising Projects

No.	*Province*	*Scheme*	*Construction Costs ($)*	*EIRR (%)*	*Night time Electricity Tariff ($/kWh)*	*FIRR (%)*
1	Battambang	Samlout	559, 000	27.4	0.335	5.6
2	Mondul Kiri	Bu Sra	534,000	12.6	0.16	7.1
3	Pursat	Pramaoy	86,000	33.3	0.4	5
4	Pursat	Samraong	219, 300	37.3	0.27	4.9
5	Kratie	Kampong Kor	689,100	30.9	0.35	5.2
6	Stung Treng	Srea Ta Pan	31,800	-	0.447	12.2

Source: (JICA, 2006)

During the feasibility it was proposed that the two micro-hydro projects were under the operation of the CEC; however, during the design and construction of the projects, because of the technical complexity, the MME was the implementing body under a semi-force account system. The projects were handed to the CEC and the regional power company to be in charge of power generation and distribution upon the completion of the construction. Through this handover, the CEC was the implementing body who was undertaking the operation and maintenance of the facilities, and management of the electricity business.

v. GHG Emission Expected by the MP Implementation

Table 5: GHG Emission Expected by the MP Implementation

Target Electrification Areas	Total Capacity		Construction Cost		GHG emission effect (in 30 years)	
1. Samlout Electrification Project (Battambang Province, micro-hydro/Biomass Hybrid)	582 kW		$5,328,000		9,912 tCO2	
2. Bu Sra Electrification Project (Mondul Kiri Province, micro-hydro)	80 kW (Micro-hydro power)		$534,000 (power plant: $363,000, dist. line: $171,000)		5,900 tCO2	
3. Pramaoy Electrification Project	Phase 1	Phase 1+2	Phase 1	Phase 1+2	Phase 1	Phase 1+2
(Pursat Province, micro-hydro/ Biomass Hybrid)	20 kW	45 kW	$86,000	$193,200	1,432 tCO2	3,302 tCO2
4. Samraong Electrification Project	Phase 1	Phase 1+2	Phase 1	Phase 1+2	Phase 1	Phase 1+2
(Pursat Province, Biomass)	64 kWe	180kWe	$219,300	$1,093,000	5,238 tCO2	13,968 tCO2
5. Kampong Kor Electrification Plan	Phase 1	Phase 1+2	Phase 1	Phase 1+2	Phase 1	Phase 1+2
(Kratie Province, Biomass)	120 kW	640 kW	$689,100	$3,275,600	9,525 tCO2	52,482 tCO2
6. Srae Ta Pan Electrification Project (Stung Treng Province, Solar BCS)	4 kWp		$31,800 (BCS equipment: $31,500, shelters & fencing: $300)		None	

vi. Identifying Challenges of Policy Implementation

Having been implementing for more than a decade so far, the MP have reached the achievements to a certain points as presented above. However, numbers of challenges are identified as barriers to the effective and efficient implementation of the Master Plan. Those challenges include:

- Lack of the RGC renewable energy/generation target;
- The on-grid RE regulatory environment is unclear;
- Lack of fair value paid for excess generation sent to grid;
- Access to finance;
- Taxation issues;
- High cost of electricity from the RE other than big hydro;
- Limitation of potential of other RE; and
- High upfront investment cost of the RE.

These challenges can also be drawn from the experiences of implementing the MP that can be grouped into two parts – technical challenges and the social and environment. It is also very important to notice that the key challenges highlighted here are those mentioned in the MP right after the feasibility study and the implementation around the years of 2005 – 2006. The situation from that time onward might be different. For the target electrification area 1, it is learnt that the public tendering of the RPC which was a challenge the project. There are numbers of social and environmental aspects involved which include the security of the project site by that time was still under the mining areas and the movability of local migration which affects the ability of the electrification supply. Technical issues toward implementing the target 2 includes the difficulty of the site access due to the bad condition of roads in the rainy season, the difficulty of construction in some site locations which have penstock pipes on a steep cliff, and the changes of river levels and water discharges during the dry season. For electrification plan target 3, the technical problem is similar to the second site and that is the shortage of water in the driest month; save costs for installation and operation of the BCS; the possibility of utilizing existing houses; and voluntary charging work should be studied and decided through participatory planning.

Table 6: Challenges of Policy Implementation

Barriers	Description
Policy and Regulatory	▪ Underdeveloped policy and regulatory framework on energy and RE development. The absence of an approved, comprehensive renewable energy development policy and law hinders the success of private and donor-led investments.
	▪ Policies in the electricity sector have been unable to resolve high tariff barriers. One of the main reasons for the low electrification rate is that poor households cannot afford the high electricity prices or the high up-front connection costs. These costs consist of utility fees, in-house wiring, and the service line and can easily reach $100. Grid extension projects have focused mostly on building sub-transmission and distribution lines, while the last step of
	▪ Lack of government support or investment incentives
Institutional	▪ Inadequate institutional capacities, including (i) organizational and managerial support, (ii) conceptual integration of energy and related fields,(iii) RET planning, implementation and maintenance, and (iii) rural energy supply with appropriate technology at the household and
	▪ Weak capacity at provincial-level stakeholders to manage energy issues
Technical	▪ Weak applied research and development of RET
	▪ Lack of information on market characteristics and resource potential (pre- feasibility study of the projects and renewable energy resources)
	▪ Lack/limited knowledge among RET suppliers and private power producers which inhibits the adoption of clean fuels for power generation.
Commercial	▪ Uncompetitive market structure. The high price of electricity in Cambodia has undermined the competitiveness of Cambodian industries.
	▪ Domestic firms and foreign investors identify the high costs and supply shortages of electricity as a main obstacle to doing business in the country. This is critical, especially as the government aims to diversify from garments to other sources of growth such as commercial rice farming, other agribusiness, tourism, and manufacturing.
Financial	▪ Limited access to investment capital and affordable financing/loans. In order to extend their grids, REEs need to borrow at high costs from commercial banks, which require rather large collateral, as project and corporate finance structures are not used. Most REEs cannot afford the financing costs and cannot expand their grids, even when consumers could afford the
	▪ High investment costs of RET including high import taxes on equipment
	▪ Weaknesses in financing, banking and incentive systems (e.g. import tax, fiscal, incentives
Information and awareness	▪ Poorly developed management information system and weak monitoring and evaluation framework on energy sector.
	▪ Limited RE information available.
	▪ Lacking public awareness for energy efficiency and renewable energy sources.

Source: (MME, Expression of Interest to Participate in SREP – Kingdom of Cambodia)

The social and environmental concerns over this site construction is the living conditions of the minority groups and the conservations of environmental areas. Aside from this, availability of local capacity for maintenance and operation was also a concern by that time regarding the issues of establishment of workable measures for raising equity capital. For the six projects, social and environmental aspect covers issues relating to in setting up the CEC and operation of the BCS, particular consideration will be required for achieving cooperative charging at the BCS between the Lao and Khmer users. Human capitals capable of being in charge in this project was also a big concern, as people do not have experience of this type of projects. Therefore, capacity and technical assistance from the outside especially by the DIME and by suppliers; and coordinating supports from NGOs for setting up such structural arrangement are important.

vii. Enforcement mechanisms

Since the RE Policy in Cambodia does not have FiT, the policy is more in tax incentive based and supporting programs. The reported data on electricity generation and all of its relevant is in the accountability and management of the MME. There is no feed in tariff premium for the RE policy in Cambodia. The payment mode is done by collecting fee from grid users in which the

tax fee is included. The government does have a condition for RETs to be imported but there is no quota of importing the products. There is no net metering, biofuel and heat obligation mandated in the policy.

SUMMARY OF THE MASTER PLAN:

Given Cambodian circumstance and the development pace, it is seen that the MP is ambitious RE goal toward sustainable development of the country. The reviews of these existing RE policy against the guidance as stipulated in the ICAT's methodological framework in the section of types and description of policy turned out that there is no Feed-in Tariff policy for the grid connected RE system available in Cambodia energy policy. It is the project investors and consumers are the determinants of the selling tariffs (ACE, 2016). The solar home system (SHS) as programed in the REF allows the installation for off-grid connection for only own power generation, but the power purchase agreement has to be approved from the EDC with any power generators who attempt to produce power from solar PV and connect into National Grid.

TAX INCENTIVE POLICY:

Since the adoption of the Electricity law in 2002, several arrays of tax and investment incentive programs have been developed among which are through the REAP and REF programs. However, it is reported that the exact numbers of company and programs of these incentives are unavailable so far (ACE, 2016). Therefore, the attempt to quantify the tax exemption programs is still remaining a challenge. From the above policy list, it seems that the auction policy type is absent from Cambodian policy landscape, but there is tender policy available in place. For example, the allowance for bidding procurement on Solar PV supply to grid has been piloted in Bavet, Pailin province. With this regard, the policy type to be considered for framing into ICAT methodology would the tax incentive policy. A further breaking down of policy analysis should be thoroughly conducted to see which type of policy incentives Cambodia is adopting and implementing and what the policy gaps are. In short, among the three policy type envisioned in the ICAT's guidance, the MP and relevant RE policy of Cambodia would be best suit in the tax incentive policy type.

7.2. Cambodia NDC

The second most relevant policy for applying this ICAT's MRV tool to be selected here is the Cambodia INDC, which submitted to the UNFCCC in 2015. This INDC is being implemented along with other climate change and development policy. Scope of gases included in the contribution as declared by the INDC are Carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O) and its geographical coverage extends to all national territories.

The INDC deployed three complementary methodology includes: historical GHG inventory, baseline GHG projections, and the mitigation options. The GHG inventory is based on data reported in the Second National Communication (SNC) following Tier 1 guideline-- default emission factors in the IPCC, and country specific activity data from 2000. For the baseline GHG projections, each sector included is selected based on the IPCC Good Practice Guidance. The INDC entails a list of mitigation options which were formulated based on inputs and involvements from needs analyses, experience from successful projects, pilot projects, feasibility studies, literature reviews and expert opinion that the RGC have been implemented previously and have been updated. The analysis of this Cambodia NDC can be divided into three key sections – the mitigation in key sectors, the adaption, and financial arrangement which will be discussed section by section as the followings.

7.2.1. Mitigation

In line with the Lima Call for Action, Cambodia as a least developed country had proposed a GHG mitigation contribution for the period 2020 – 2030. The INDC entails action plans to address climate change by implementing mitigation and adaptation through financial support from the international communities in accordance with Article 4.3 of the UNFCCC. The ambitious INDC focuses on LULUCF, energy, manufacturing, and transport as main sectors to reduce GHG emissions as committed with the total reduction of 3,100 (27%) Gg. CO2eq. by the year 2030 compared to the baseline. The renewable energy is prioritized which is accountable for most of the contribution to GHG emissions reduction in the mitigation actions listed in the INDC. The target is 1800 (16%) Gg. CO2eq. reduction in the year 2030 compared to the baseline. The BAU of GHG emissions by the target hear is estimated to be 11,600 Gg. CO2eq. To reach this target, the RGC prioritizes three energy sources: (1) connecting national grid with renewable energy generation (solar energy, hydropower, biomass and biogas) and to connecting decentralized renewable generation to the grid, (2) promoting off-grid electricity such as solar home systems, hydro (pico, mini and micro), and (3) promoting energy efficiency by end users.

Additional RE relevance in the INDC is the mitigation target in the manufacturing industry sectors which aims at reducing 727 (7%) Gg. CO2eq. The mitigation action is promised to be implemented through the promoting use of renewable energy and adopting energy efficiency for garment factory, rice mills, and brick kilns. Transport is also included as one of the main sectors for mitigation action, which plans to reduce 727 (7%) Gg. CO2eq. However, this sector is out of the scope of the RE study. The INDC also extends to cover relevant sectors, which include the promoting energy efficiency for buildings and more efficient cook stoves, reducing emissions from waste through use of bio digesters and water filters and the use of renewable energy for irrigation and solar lamps. These sub-sectors together accounts for 155 (1%) Gg. CO2eq. of the GHG emissions reduction ambition. Additional information on the mitigation goals and actions listed as follows:

Table 7: Summary of Cambodia INDC

Information Contained in Cambodian	Mitigation	Target	Unconditional	Reduce GHG emissions by 27% from BAU levels in 2030 in energy, manufacturing, and transportation sectors.
			Conditional	Additional LULUCF contribution of 4.7 tCO2e/ha/year (equivalent to 10.6 MtCO2e of additional sequestration compared to BAU).
		Basis of Target	Analytical Basis	• Mitigation potential evaluated based on sectoral reductions and "previous needs analyses, experience from successful projects, pilot projects, feasibility studies, literature reviews, and expert opinion." • BAU projections developed using the LEAP model for energy sector and COMAP for LULUCF sector.
			Existing Policies	• Cambodia Climate Change Strategic Plan 2014-2023 • Green Growth Policy and Roadmap • National Forest Program (2010-2029)
			Mitigation Actions	Mitigation actions include:

INDC			• 16% reduction in energy emissions (1.8 MtCO2e). Includes renewable generation and promoting energy efficiency. • 7% reduction in manufacturing emissions (0.727 MtCO2e). Includes renewable energy and energy efficiency for factories and brick kilns. • 1% reduction from other sources (0.155 MtCO2e). Includes energy efficient buildings, cook stoves, and biodigesters. • Increase forest cover to 60% of total land through the implementation of the *National Forest Program (2010-2029)* and the Forest Law Enforcement, Governance and Trade program. • 3% reduction in transportation emissions (0.39 MtCO2eq.). Includes mass transit and motor vehicle inspections.
	Adaptation	Included in INDC	Yes
		Implementation Strategies	Yes; climate change adaptation mainstreamed in national and subnational planning, including through the National Adaption Plan.
		Priority Sectors	Agriculture; Infrastructure; Forestry; Health; Coastal Zones.
		Data Quality & Transparency	The INDC includes qualitative actions to incorporate adaptation into Cambodia's priority sectors.
	Participation		The INDC developed under the National Council for Sustainable Development, which has representatives in relevant ministries.
	Financial Assistance		US$1.27 billion for implementation of the INDC activities (to 2018).
	Technical Needs Identified in the INDC		• Technical support to develop the MRV and M&E systems. • Technical support for a detailed technology needs assessment.

Information from other sources	GHG Inventories and Reports	• Submitted First National Communication in 2002. • A Second National Communication is under development. • Latest inventory submitted to the UNFCCC was for 1994, prepared using Tier 1 methodology following IPCC 1996 Guidelines. • No BUR submitted to date.

7.2.2. Adaptation

The adaptation actions envisioned in the INDC is to acknowledge the vulnerability of Cambodia to climate change impact and to call for urgent interventions to address this issue. This susceptibility of Cambodia to climate change can be mapped out as three key intervening areas: (1) the Tonle Sap Great Lake, (2) Forest areas in the northeast and southwest parts of Cambodia are at risk for drought, (3) Half of Cambodia's provinces have been impacted by flash floods, particularly in the Mekong region. To adapt to the climate change, numbers of adaptation projects have been prioritized as followings:

- Improving the adaptive capacity of communities;
- Developing resilient infrastructure (including roads);
- Restoring ecosystem health and improving resilience of protected areas;
- Developing resilient agriculture systems (including forestry, fisheries, and coastal agriculture);
- Strengthening technical and institutional capacity for climate change impact assessments and developing climate change projections; and
- Improving national health programs.

In implementing these adaption actions as stated in this INDC, number of ongoing and planned processes, policy, strategies, plans, and activities have already been undertaken and implemented Those initiatives are to mainstream adaptation into both national development and in specific sectors. At the national level, Cambodia had adopted the National Strategic Development Plan (2014-2018), and the Cambodia's Climate Change Strategic Plan (2014-2023) in which indicators to track implementation of climate change actions are incorporated.

7.2.3. Financing

Just like other LDCs and according to the Paris Agreement in 2015, Cambodia's ability to implement the above key mitigation actions and adaptation actions are corresponding to the international community supports in the form of "financing, capacity building, and technology transfer". Climate change financial framework is to be adopted and is estimated based on the climate change action plans. In this climate change financial framework, analysis of financing sources, coting, and climate change impacts on economy are included a long with a set of key

recommendations on financing modalities for implementing the CCCSP. It is promised in the INDC to be refined by the following of 2018. Since its submission to the UNFCCC up to 2018, the estimation of the financial needs to implement the INDC's priority activities which are also planned in conjunction with the sectoral climate change action plans of Cambodia Climate Change policy is estimated to be at $1.27 billion. This estimation cost is also included the climate financing absorption capacity of Cambodia to effectively implemented the prioritized activities. In 2012, according to the climate change financial framework, the climate change related expenditure is estimated to 6.5 percent of public expenditure, or 1.31 percent of national GDP. This figure is planned to increase to 1.5 percent in 2018, according to the National Strategic Development Plan.

Sources of Cambodian climate change financial support that Cambodia received is channeled through bilateral, multilateral and market based mechanisms. So far, the country have been accessing to the Green Climate Fund (GCF) and also the REDD+ mechanism. It is estimated in the INDC that the total climate change funding from bilateral/multilateral and global climate fund accounts for 40 percent of the total climate investment of Cambodia.

SUMMARY OF THE INDC:

The INDC along with its future revisions and relevant instruments are to be the integral part of the Cambodia Climate Change Policy Framework meaning that the implementation of the INDC has to be in line with the existing framework. This brief review of the INDC reveals that in terms of policy framework, supporting strategies and programs, Cambodia is ready from the national to the sub-national level. However, what is needed most for ensuring the implementation of these policy frameworks and instruments is the coping mechanisms and monitoring and evaluating mechanisms.
To monitor the inflow of the international form of financial and technical supports and to track the implementation of the climate change related policies and projects budgeted by these financial supports, the Official Development Assistance database is needed. In this regard, the INDC also acknowledges and prioritizes the development of the MRV and M&E system.

i. Selecting individual or package of policy

Since the MP (and its supporting instruments such as the REAP and REF) and the INDC are paralleled with the RE policy and Climate Change policy, the two are recommended to assess in same package of policy for the ICAT's MVR proposal. This assessment in package is based on the criteria as guided in the ICAT's Methodology as presented in this table below:

Table 8: Criteria to be considered for assessing package of policy

Criteria	Questions	Guidance	Comments
Objectives and use of results	Do the end-users of the assessment results want to know the impact of individual policies?	If "Yes", undertake an individual assessment	To be confirmed
Significant interactions	Are there significant (major or moderate) interactions between the identified policies, either overlapping or reinforcing, which will be missed if policies are assessed individually?	If "Yes", consider assessing a package of policies	The INDC is the mainstream of the development and climate change related policy. GHG mitigation target set in the Cambodia INDC and RE policy by the MP are being implemented to reach the target.
Scope and level of incentive	Does one policy clearly provide a stronger incentive than the others?. Do the other policies spur additional emission reductions not already covered by the policies with stronger incentives?. See the decision tree to assess overlap in incentives provided by different policies.	If "Yes", consider focusing on the policy superseding the others in an individual assessment	
Feasibility	Will the assessment be manageable if a package of policies is assessed?. Is data available for assessing the package of policies? Are the policies implemented by a single entity?	If "No", consider undertaking an individual assessment	
	For ex-post assessments, is it possible to disaggregate the observed GHG impacts of interacting policies? If "No", consider assessing a package of policies	For ex-post assessments, is it possible to disaggregate the observed GHG impacts of interacting policies? If "No", consider assessing a package of policies	Irrelevant

ii. Summaries of Key Points to envision the MRV

FOR THE MASTER PLAN:

The pilot projects implemented in the Electrification Phase 1 (2005-2008) should be monitored for further lessons on management by the CEC and operation and maintenance of the biomass gasifier power including fuel tree farming. Based on these lessons, an implementation program of the off-grid electrification should be prepared including a financial support plan of the REF and CFR. In parallel with implementation of the off-grid electrification, the following issues should be further studied and countermeasures prepared and executed:

1) Reinforcement of related authorities including supervisory ministries and agencies;
2) Examination of allocation of the government finance and arrangements for obtaining the ODA support;
3) Development and reinforcement of the private financial system in Cambodia;
4) Support for fostering and reinforcing the implementation body (CEC/REE); and
5) Exemption from corporate tax (the MEF).

For the Short-term Policy Measures (SP) (2006-2008) which is already completed long time ago, three strategic plans are to be conducted the MRV. A number of pilot projects to be included and monitored. There should be a framework for listing down all of these projects and activities for the sake of easier following up.

FOR THE INDC:

In order to identify the GHG impacts of the policy, it is useful to first consider how the policy is implemented by identifying the relevant inputs and activities associated with implementing the

policy. Inputs are resources that go into implementing the policy, while activities are administrative activities involved in implementing the policy. These inputs and activities lead to intermediate effects, which are changes in behavior, technology, processes or practices that result from the policy. These intermediate effects then lead to policy's GHG impacts (the reduction in emissions). The identification of intermediate effects enables a complete and accurate assessment, and is necessary to identify the potential GHG impacts of the policy and develop a causal chain. In order to identify the intermediate effects, users should identify the stakeholders, and the inputs and activities that are needed to implement the policy.

8. Mapping out the MRV of the ICAT's Methodology Framework for Cambodia

8.1. Identify GHG Impacts

This section presents the mapping out of the most common GHG impacts of the above RE policy – the package of the Master Plan and the INDC of Cambodia. It is also attempt to identify additional impacts of the above policy if any can be identified during this process. In this section, the assessment period will also be proposed. The objectives of these proposing processes is solely to suggest the most practicability of the GHG impacts estimation.

GHG impacts as defined in the report and by considered as most relevant to Cambodian context is conformed with the definition as used in the ICAT's guidance which refers to the "changes in the GHG emissions that result from the policy implementation". Without previous specification as a reference for this term in Cambodia's RE policy, this GHG impacts is to be recommended to stay focus on the reduced emissions from the existing electricity sources as listed in Cambodia MP and the INDC. The emissions reduction from the current electrification sources covers: (1) Grid expansion from the existing; (2) Diesel stand-alone, Mini-Utility Systems; (3) Cross-border Power Supply from neighboring countries (Thailand, Vietnam and Lao PDR); and (4) Renewable Energy (Solar, Wind, Mini-micro hydro, Biomass, Biogas, Bio-fuel, etc.).

8.1.1. Identify intermediate effects

In order to identify the GHG impacts of the policy, it is useful to first consider how the policy is implemented by identifying the relevant inputs and activities associated with implementing the policy. Inputs are resources that go into implementing the policy, while activities are administrative activities involved in implementing the policy. These inputs and activities lead to intermediate effects, which are changes in behavior, technology, processes or practices that result from the policy. These intermediate effects then lead to policy's GHG impacts (the reduction in emissions).

8.1.2. Identify potential GHG impacts

Types of GHG impacts to be considered for Cambodian context is the intended and unintended impact. As provided in the INDC, "Intended" means reduced GHG emissions from fossil fuel power plants and reduced GHG emissions from national manufacturing of fossil fuel power plant equipment, while "Unintended" refers to increased GHG emissions in other jurisdictions; increased GHG emissions from manufacturing of equipment for renewables.

Further steps of the MP is to reduce, even to stop/discard using Diesel Generation sets and to replace them by Renewable Energy Technologies (RET). From these ambitious leaps, impacts of the MP on the reduction of GHG emissions would fall into the following points:

- ✔ 5% of new electricity generation or 6 MW of mini hydro & 850kw of village hydro;
- ✔ 50 000 households (HH) will be supplied by electricity from renewable technologies on a competitive basis;

- ✔ 12 000 households will be served by Solar Home System; and
- ✔ A sustainable market for renewable electricity systems.

From these action plans, the GHG emissions reduction as promised in the INDC as follow:

- ✔ 16 percent reduction in energy emissions (1.8 MtCO2e), including renewable generation and promoting energy efficiency.
- ✔ 7 percent reduction in manufacturing emissions (0.727 MtCO2e), including renewable energy and energy efficiency for factories and brick kilns.
- ✔ 1 percent reduction from other sources (0.155 MtCO2e), including energy efficient buildings, cook stoves, and biodigesters.

From this proposal of GHG impact quantification, a list of GHG impacts should be developed.

8.2. **Define the GHG assessment boundary**

Before going to conduct the ex-ante assessment for RE selected policy, GHG impacts and source categories must clearly be defined as these are the most important to characterize the national inventory system, which will be later on used for establishing the baseline scenario and the ex-ante assessment of the policy. This key source category has also significant influence on the total inventory of GHG emissions determined. According to IPCC (2000), the importance of key source categories has on total GHG inventory of a country is that it determines the absolute level of GHG emissions and the trend in which the GHG emissions will come about from different or additional source categories.

There are two types of GHG assessment boundary to be considered here, one is the existing GHG key source categories as already identified in the SNC submitted to the UNFCCC in 2015 and the other one is this proposing ICAT's GHG assessment boundary. First, the SNC's proposal was investigated in order to understand what type of framework that had already adopted in Cambodia context and next the ICAT's GHG assessment will be discussed followed by proposing a new source category for the MRV framework.

So far, Cambodia have already conducted two GHG inventories. The first is the INC developed in 1994, while the second is the SNC developed in 2000. The level and the trend assessment of the key source categories are included in the two inventories. The source category level was developed as a key determinant in order to estimate different sources contributing to the total GHG inventory. It can be noted in the SNC that source categories from different sectors other than the energy sectors are enlisted in which the key source of emissions from rice production and enteric fermentation in domestic livestock are seen as the highest contributors. The estimation of GHG emissions from the energy sector was 331.31 Gg.CO2eq. in the base year 1994 and 546.12 Gg. CO2eq. in the year 2000 with cumulative sum of 91. 27%. However, it seems that the energy sector estimated here was limited to the industrial sector only.

Table 9: Key assessment results in the SNC

Inventory Categories	Base Year Estimate 1994 (Gg.CO2eq.)	Current Year Estimate 2000 (Gg.CO2eq.)	Total	Cumulative Sum
CH4 emissions from rice production	3158.36	14365.01	57.90%	57.93%
CH4 emissions from enteric fermentation in domestic livestock	3417.69	3440.31	13.90%	71.80%
N2O (direct and indirect) Emissions from agricultural soils	2209.21	2363.69	9.50%	81.34%
Residential CH4	713.37	1142.88	4.60%	85.94%
CO2 Mobile combustion: road vehicles	825.25	774.39	3.10%	89.07%
CO2 Emissions from energy industry	331.31	546.12	2.20%	91.27%
CH4 Emissions from manure management	462.84	469.79	1.90%	93.16%
N2O Emissions from manure management	1203.55	343.11	1.40%	94.55%
Residential N2O	98.9	224.7	0.90%	95.45%

Source: SNC

Attached with the source category level assessment, the SNC's GHG inventory also conducted the source category trend assessment, which focuses on the changing trend of emissions from source category over certain period. To assess this source category trend, source categories that have a different trend to the trend of the overall inventory are identified. In this SNC, eight key source categories were identified in which the energy sector was absent.

Table 10: Source Category Trend Assessment Result as presented in the SNC

Trend Assessment Results	Base Year (1994) Estimate (Gg.CO2eq.)	Trend Assessment (%)	Cumulative Sum (%)
CH4 Emissions from rice production	3,158	46.99	46.99
CH4 Emissions from enteric fermentation in domestic livestock	3,418	17.95	64.93
N2O Emissions from manure management	1,204	11.26	76.19
N2O (direct and indirect) Emissions from agricultural soils	2,209	10.81	86.99
CO2 Mobile combustion: road vehicles	728	3.58	90.58
CH4 Emissions from manure management	463	2.41	92.98
N2O Emissions from wastewater handling	130	1.34	94.32
Other Sectors: Residential CH4	713	1.33	95.66

8.3. GHG Impacts and Source Categories as guided in the ICAT's Methodology Guidance

Key takeaways from the above source category level and source category trend assessment from the SNC is that the GHG impacts and source category assessment for the energy especially for the RE sector was absent or even uncovered. The absence or incompleteness of the GHG inventory to cover the RE energy sector suggests rationale for developing new comprehensive

source category assessment specifically for the RE energy sector with specific purpose for this MRV framework.

The development of the source category assessment is very critical point for developing the GHG assessment boundary that will define the scope of the assessment used for foundation of the GHG ex-ante assessment in this MRV framework. This proposing GHG assessment boundary should clearly define scope or limitation of the GHG impacts and source category of GHG emissions to be assessed. This is because, for most RE policies, it is the only GHG impact that is categorized as both very likely and of major magnitude. Decision has to be made either to opt for the GHG developed for the SNC as the basis for this GHG assessment boundary or choosing to develop as a new one. In short, to ensure accuracy and most reliable source of GHG impact and source category of GHG emissions assessment as for the setting up of the GHG assessment boundary, it is recommended that there should be the most updated version of GHG inventory to be developed and that will be utilized for the baseline for the MRV. Either option, the proposing point in the ICAT's guidance to categorize the GHG impacts and source categories together as presented in table is recommended. However, the GHG impacts with source categories listed in this table needs to be verified from the experts either it is fit to Cambodia context or it is verified through calculation or new GHG inventory development. The purpose of presenting this table here is to suggest the format/framework for the GHG assessment boundary – GHG Impacts & soured categories – which should be developed based on this guidance.

Table 11: GHG impacts and Source Categories included in this GHG Emission Boundary

GHG impact	GHG	Likelihood	Relative magnitude	Included?	Explanation
Reduced GHG emissions from existing and new fossil fuel power plants	CO2	Very Likely	Major	Included	The main GHG impact of RE policies
Increased emissions from the Importing of RE equipment	CO2, CH4, N2O	Possible	Minor	Excluded	Considered insignificant for most RE policies and is offset
Reduced emissions from construction of New Hydro power plants	CO2, CH4, N2O	Possible	Minor	Excluded	Considered insignificant for most RE policies, and is
Reduced emissions from lower energy use due to increased cost of electricity	CO2, CH4, N2O	Possible	Minor	Excluded	Considered insignificant for most RE policies
For geothermal power plants, fugitive emissions of CH4 and CO2	CH4, CO2	Possible	Moderate	Policy dependent	Significant for RE policies involving geothermal power
For hydro power plants, emissions of CH4 and CO2 from water reservoirs	CH4, CO2	Possible	Moderate	Policy dependent	Significant for RE policies involving hydro power plants with reservoirs
For biomass power plants, emissions associated with agriculture and land-use change	CO2, CH4, N2O	Very likely	Minor-Major	Included	Significant for most biomass power plants

8.4. BAU Scenario of GHE emissions

To calculate the ex-ante GHG emissions, it is compulsory to have BAU scenario. There are some previous GHG emissions calculation already done and reported in the SNC. However, this estimation of GHG emissions seems to be broad in scope, not specific for the RE energy sector, and not based on methodology designed for the RE energy sector, especially those methodological framework for the GHG impacts and GHG source category assessment as envisaged in the ICAT's guidance. Despite this nature of the existing estimated GHG emissions assessment, below are some evident information of what Cambodia had done so far in her efforts in developing GHG inventories. The GHG 2000 inventory placed the country as the net carbon sink with total GHG emission of 47,709.06 Gg.CO2eq. and removal was 48,165.86 Gg.CO2eq. Table below presents the contribution of each sector to the total GHG emissions.

Table 12: Total Emissions and Removals by sector in 2000 (Gg.)

GHG source and Sink Categories	CO2 Emissions	CO2 removals	CH4	N2O	Total
Energy	2,052.59		28.19	0.4	2,767.30
Agriculture			875.52	8.79	21,112.16
Land use change & Forestry	22,858.73	-48,165.86	32.06	0.22	-24,565.50
Waste			10.18	0.05	229.24
Total	**24,911.32**	**-48,165.86**	**945.95**	**9.46**	**-456.81**

8.5. GHG Emissions from the Energy Sector

The GHG inventory in the SNC submitted to the UNFCCC entails diverse source categories including energy, industry, transport, and other sectors. The method used to calculate this national GHG inventory deployed sectoral and reference approaches based on the IPCC guideline. In the reference approach, GHG emissions in the whole country is calculated based on the carbon content of fuels supplied. The data used to calculate the national emissions was derived from the annual records of the import of all fuels. Estimating through this reference approach, Cambodia total GHG emissions from the energy sector accounted for 2,047.56 Gg.

GHG estimation using the sectoral approach computed based on data from the carbon content of fuels supplied to main fuel combustion activities. By using the reference approach, Cambodia total emission was estimated at 2,767.30 Gg.CO2eq., 74% of total CO2 emissions, 21% of CH4 emissions, and 5% of N2O emissions contribution. From the National GHG inventory, it can be reflected that the energy sector accounts for the largest contribution to the GHG emissions, but source category in the energy sector limited only in the fuel combustion activities. The source categories defined in this document is very limited to include the scope of the RE. There are missing data especially data required by the IPCC sectoral approach relating to the fuels supplied to main fuel combustion activities and those sectors and subsectors that data is unavailable are mentioned in the SNC report. In short, it is still concerned that the GHG emissions impacts and source categories were not specifically covered in the National GHG inventory, which requires proper future methodology specifically designed to measure and develop it.

Table 13: Sectoral Report for National GHG Inventories in the SNC

GHG Source and Sink Categories	(Gg.)			
	CO2	CH4	N2O	CO2eq.
Total Energy	**2,052.59**	**28.19**	**0.4**	**2,767.30**
Fuel Combustion Activities (Sectoral Approach)	2,052.59	28.19	0.4	2,767.30
1. Energy Industries	383.59	0.02	0	384.85
2. Manufacturing Industries and Construction	313.66	0.1	0.01	320.01
3. Transport	704.76	0.11	0.01	708.82
a. Civil Aviation	0	0	0	
b. Road Transportation	695.92	0.11	0.01	699.95
c. Railways	8.84	0	0	8.87
4. Other Sectors	462.38	27.95	0.37	1,164.41
a. Commercial/Institutional	61.64	0.3	0	68.5
b. Residential	189.34	27.63	0.37	883.66
c. Agriculture/Forestry/Fishing	211.4	0.01	0	212.24
5. Other (please specify)	188.19	0.03	0	189.21
Memo Items*				
International Bunkers	55.55	0	0	
Aviation	55.55	0	0	
Marine	0	0	0	0
CO2 Emissions from Biomass	9,193.33			

* *Note: International Bunkers and CO2 emission from biomass are excluded.*

8.6. **Baseline emissions scenario**

Based on the national GHG inventory, GHG mitigation measures have been suggested based on the identified mitigation assessments. All source categories enlisted in this baseline scenario covers the energy industries (all emission related to electricity generation), manufacturing industries, transport, and other sectors. The assessment based on baseline emissions scenario, total emissions suggests the trend of GHG emissions increase from 2,643 Gg.CO2eq. in 2000 to 5,533 Gg.CO2eq. in 2010, and to 25,549 Gg.CO2eq. in 2050 (see Table 14). By the INDC targeted year 2030, total emissions from these selected sectors will be at 11,599 Gg.CO2eq. in which the largest contributor will be the transport sector (4,631 Gg.CO2eq.), followed by the energy industry sector of 3,539 Gg.CO2eq.

Table 14: Total emissions including Biogenic Carbon Dioxide 2000-2050 (Gg.CO2eq.)

Standard emissions /Year	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
A1 Energy Industries	385	1,008	1,453	1,212	1,931	2,849	3,539	4,430	5,567	7,023	8,888
A2 Manufacturing Industries	320	508	689	828	923	1,024	1,144	1,270	1,414	1,578	1,766
A3 Transport	709	1,249	2,000	2,465	3,040	3,751	4,631	5,720	7,069	8,742	10,816
A4 Other Sectors	1,229	1,304	1,392	1,482	1,658	1,977	2,285	2,623	3,025	3,505	4,079
Sub Total	2,643	4,070	5,533	5,987	7,551	9,601	11,599	14,043	17,075	20,848	25,549

Biogenic CO2 Emissions /Year	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
A2 Manufacturing Industries	243	999	1,663	1,935	2,138	2,366	2,643	2,950	3,314	3,743	4,253
A4 Other Sectors	10,284	9,373	8,595	7,807	6,878	6,549	6,016	6,276	6,577	6,923	7,324
Sub Total	10,527	10,372	10,258	9,742	9,016	8,915	8,659	9,227	9,890	10,667	11,577
Total (Gg.CO2 eq.)	13,170	14,442	15,791	15,729	16,567	18,516	20,258	23,270	26,965	31,515	37,126

Source: Generated with LEAP, using default emissions

8.7. **Mitigation options based on the baseline emissions**

Based on the GHG Emission baseline, mitigation options were developed and proposed by referring to existing documents from literature reviews and UNFCCC documentation, expert verifications, project pilot, and feasibility studies. Set of indicators were developed to measure the feasibility of these proposing mitigation options and finally proposing for taking actions. If these proposing mitigation actions are to be successfully implemented, the total GHG emissions will be mitigated as projected in the Table 15 below. From this, the total emissions mitigation is to be at 11,599 CO2eq. of which the energy industry sector alone will contribute to 1,826 CO2eq. or 16% of GHG saving compared to the baseline as projected to the INDC targeted year 2030. In addition, the SNC highlighted that the effectiveness of this mitigation options will substantially rely on costly technology, behavioral change and solutions to investment barriers.

Table 15: Baseline emissions compared to the potential of all proposed mitigation options

Year	2010	2015	2020	2025	2030	2035	2040	2045
Total Baseline Emissions	**5,533**	**5,987**	**7,551**	**9,601**	**11,599**	**14,043**	**17,075**	**20,848**
Energy Industries								
Grid Connection REEs	3	12	30	51	**80**	106	140	172
Grid Connection Auto Producers	18	152	269	268	**309**	354	430	492
Grid Connection Battery Charging Stations		5	12	16	**16**	14	12	10
Solar Power Plant	0	0	1	2	**5**	9	18	36
Solar Home Systems	0	6	16	22	**22**	19	16	12
Pico Hydro	-							
Mini and Micro Hydro		2	3	4	**4**	4	4	4
Rice Husks for Electricity Generation	27	67	167	417	**445**	463	481	498
Energy efficiency end users	22	55	138	344	**592**	797	1,002	1,264
Energy efficient buildings	50	85	193	285	**354**	443	557	702
Methane emissions reduction from hydro dams	-							
Sub Total Savings	120	384	829	1,409	**1,826**	2,210	2,659	3,191
% savings compared to Baseline	2%	6%	11%	15%	**16%**	16%	16%	15%
Manufacturing Industries								
Rice milling, Garment, Rice Mills, Brick Works	326	373	429	497	580	681	803	953
Organic Waste Methane recovery	-	-	-	-	-	-	-	-
Rice Husk Briquettes	-	-	-	-	-	-	-	-
Efficient Charcoal Production	-	-	-	-	-	-	-	-
Landfill gas recovery	-	-	-	-	-	-	-	-
Cement Production heat recovery	-	-	-	-	-	-	-	-
Biofuel	13	32	79	147	147	147	147	147
Sub Total Savings	**339**	**405**	**508**	**644**	**727**	**828**	**950**	**1,100**
% savings compared to Baseline	**6.10%**	**6.80%**	**7%**	**7%**	**6%**	**6%**	**6%**	**5%**

Note: Gg.CO2eq. excluding LULUCF sectors
Source: SNC, 2015

8.8. Choosing the right MRV Method for Cambodia's RE policy

8.8.1. Brief Review of Characteristics of Cambodia's RE Policy

Among the three policy types in the ICAT's Methodology Framework, Cambodian RE policy especially the MP of the Renewable Energy for the Rural Electrification falls in the type of tax incentive policy meaning that Cambodia's RE Policy is suitable for applying the method envisioned in the ICAT's framework for conducting the MRV formulation. Cambodia's GHG emissions reduction is ambitiously targeted as stated in her NDC along with mitigation actions and options available in the SNC and NDC, yet the MRV framework for the adopted policies, strategies, and action plans are not fully developed. Therefore, this absence gives justification for proposing this ICAT's MRV frameworks and the following section is to explain rational of how the ex-ante GHG impact assessment is highly recommended for the MRV development.

8.8.2. Ex-ante estimation of selected policy GHG impact

If the proposing updating GHG inventory and the GHG assessment boundary, in which GHG impact of the MP and Cambodia INDC mitigation actions are developed, that means the GHG Impacts on emission migration would have been mapped out. This will provide a basis steps for developing an estimation of the GHG Impacts of the policy ex-ante. Ex-ante assessment, according to the ICAT, is used to assess policy that is already planned or adopted, but not implemented. The objective of this policy assessment method is to estimate the expected policy

impacts in the future. This fully reflects Cambodian RE policy situation as the REREP was acknowledged by the MP since 2006 and is projected to complete in 2020, 100% of all villager have access to electricity; and in 2030 70% of all household have access to electricity. Up to this date 2018, it has already been in the 4th phase of the action plan implementation. Concerning data derivability is also another aspect to opt for ex-ante assessment for Cambodian RE policy since the ex-ante assessment accepts historical data if its objective is to estimate future effects of the policy. In implementing the REREP policy, so far number of RE addition have been added onto the current policy meaning more power generation will be added onto the existing grid. Given this addition, the RE addition and the GHG impacts of them are to be assessed through a proposing MRV.

Estimating GHG impacts ex-ante is divided into two parts. First, the RE addition of the policy is estimated. RE addition is the additional installation of renewable energy capacity or electricity generation from renewable sources realized via the policy, expressed in megawatts (MW) or megawatt-hours (Mwh) respectively. Second, the GHG impacts from this RE addition are estimated. RE addition is estimated through a process of estimating the maximum implementation potential of the policy (the maximum resource potential of for the technology or the policy cap) and then following stepwise guidance to evaluate the policy design characteristics and other factors that affect the likelihood that the policy will achieve this maximum implementation policy. The result is the actual RE addition the policy is expected to achieve. Once the RE addition has been estimated, it can then be translated into a GHG emission level or GHG emissions reductions.

Table 16: Development of Power Generation

No	Domestic Generation Expansion Plans	Fuel Types	Install Capacity/ MV.	Year
1	Kamchay Hydro Power Plant	Hydro	193.2	2011
2	Coal Power Plant (I) in Sihanouk Ville – Phase I	Coal	100	2012
3	Kiriroam III Hydro Power Plant	Hydro	18	2012
4	Atay Hydro Power Plant	Hydro	120	2012
5	Coal Power Plant (I) in Sihanouk Ville – Phase II	Coal	100	2013
6	Tatay Hydro Power Plant	Hydro	246	2014
7	Lower Stung Russei Chhrum Hydro Power Plant	Hydro	338	2015
8	700MW Coal Power Plant (II) – Phase 1	Coal	270	2013
9	700MW Coal Power Plant (II) – Phase 2	Coal	100	2014
10	700MW Coal Power Plant (II) – Phase 3	Coal	100	2015
11	700MW Coal Power Plant (II) – Phase 4	Coal	100	2016
12	Lower Sesan II – Lower Sreapok II	Hydro	400	2016
13	Stung Chhay Areng Hydro Power Plant	Hydro	108	2017
14	700MW Coal Power Plant (II) – Phase 5	Coal	100	2017
15	Sambo Hydro Power Plant	Hydro	450/2600	2019
16	Coal Power Plant III or Gas Power Plant	Coal/Natural Gas	400	2020
Total		**3,173.20**		

Source: Mr. Eav Ritouch, EDC, 2011.

8.9. **Estimate GHG impacts using grid emissions factor method**

If ex-ante assessment is to be selected for Cambodia's RE policy assessment, the next step is to determine the calculation method choice between the emission trajectory method and the Grid emission factor method. Between the two methods, given specific nature of the selected policy, Cambodia should use emissions trajectory method to estimate the ex-ante estimation of the GHG impact for its RE policy. By considering the objective of the GHG impact assessment, which is not only to measure the GHG emissions level of implementing mitigation actions but also tracing

the effectiveness of implementing policy to meet the targeted policy impact, it is to propose the emission trajectory method for this assessment. The possibility of the future energy mix as planed in Cambodia as well as the limited availability of assessing data is also a reason for selecting this method. Assessment criteria for this proposal can be viewed in the table below:

Table 17: Criteria for selecting Method to estimate GHG Impact Ex-Ante

Selection Factors	Methods		Cambodian RE policy Characteristics
	Emission Trajectory Method	Grid Emission factor method	
Objectives	• To estimate sectoral GHG emission levels achieved after an intervention	• To estimate GHG emission reductions from interventions	
	• To estimate GHG emission reductions from interventions (by comparing baseline GHG emissions to policy GHG emissions)	• Especially suitable for single projects or other smaller scale interventions	
	• Especially suitable for larger scale interventions		
Policy Expected Impacts	More appropriate for policies with larger impacts on the energy system (the size of the energy system and the size of the intervention)	more appropriate for those with small impacts	The MP of Cambodia expected impacts covers the whole territory and the whole energy system in Cambodia
Timeframe	Longer Timeframe	Shorter Timeframe	MP: Long Timeframe 2005 – 2020
			NDC submitted date to 2030
GHG Emission Level	Appropriate in particular for determining whether policies are on track to meet goals such as NDCs or RE targets and to inform goal setting	Not designed for this GHG Emission Level.	The GHG Emission Level had already been targeted as stated in the INDC and Mitigation Actions have been implemented.
GHG Emission Reduction	Appropriate in particular for assessing the effectiveness of policies and improving their design and implementation	Appropriate in particular for assessing the effectiveness of policies and improving their design and implementation	
Advantages	Dynamic; accounts for interactions between the RE technologies incentivised by the policy and the electricity mix over time	• High level of calibration; methodologies have been developed for a wide range of GHG emissions reduction interventions under the CDM and revised and improved over time	
	Emission level calculations; not necessary to develop a baseline scenario	• Methods are widely accepted and used for project-level analysis, including through harmonisation efforts of bilateral and multilateral funds	
		• Energy sector model not needed; may be easier to use than emission trajectory method	
Disadvantages	Low level of standardization; many commonly used models exist (e.g., LEAP), though there is no standardized approach for developing emission trajectories	• Relatively static; methods account for future development (e.g., operating margin method) but only to a limited extent	
		• Assumptions about the baseline scenario may be contested	
		• More challenging to estimate GHG impacts over longer timeframes	

In summary, from the above GHG emissions reduction target as stipulated in the INDC and action plans of the Master Plan along with the GHG inventory presented in the SNC, the ex-ante

estimation of these two policies can be estimated. As the GHG emissions reduction has already estimated in the SNC, therefore the ex-ante estimation provided in the ICAT's methodology should be treated as a verification tools for the previous estimation. Sample of the GHG Impact Assessment and the calculating of the Policy Ex-ante by using Grid Emission Factor Method will be calculated and verified later upon the approval of these proposal methodologies by the consultation for this report.

8.10. Summary of the Mapping out of the MRV Methodology

Existing barriers and gaps in current reporting mechanisms and the MRV system design:

The Climate Paris Agreement in 2015 established universal and harmonized measurement, reporting, and verification (MRV) provisions for climate change mitigation. The MRV is central to effectively implementing the Nationally Determined Contributions (NDCs), which describe countries' mitigation goals and policies. Measurement is needed to identify emissions trends, determine where to focus on GHG reduction efforts, to track mitigation-related support, to assess whether mitigation actions planned under the NDCs or otherwise are proving effective, to evaluate the impact of support received, and to monitor progress achieved in reducing emissions. Reporting and verification are important for ensuring transparency, good governance, accountability, and credibility of results, and for building confidence that resources are being utilized effectively. While, the Monitoring and evaluation (M&E) are effective tools to enhance the quality of the project planning and management. Monitoring helps one to understand whether the projects are progressing on schedule and to ensure that project activities, deliverables, outputs/outcomes and results are proceeding as planned, while evaluation is a tool to help one assess to what extent the project has achieved the objective set forth in the project document (Watson, 2006). The RGC encourages regular monitoring and evaluation in order to ensure that the National Strategic Development Plan (NSDP) implementation proceeds along the intended path and at the required pace to achieve its goals and targets (MoP, 2014). It is emphasized that monitoring helps in assessing whether the implementation of a program, project, or any other, is on the right path, while evaluation is the "end-game" analysis of the effort.

Cambodia is implementing its national monitoring and evaluation (M&E) framework to measure the performance of its national and sectoral responses to climate change, using the International Institute for Environment and Development (IIED) Tracking Adaptation and Measuring Development (TAMD) approach (Rai, N. et al, 2015), especially after the launching of the CCCSP (2014–2023). The TAMD is a twin-track framework that evaluates adaptation success as a combination of how widely and how well countries or institutions manage climate risks (through "track 1", or "upstream" indicators) and how successful adaptation interventions are in reducing climate vulnerability and in keeping development on course (through "track 2", or "downstream" indicators). It was pointed out that the aims of the national M&E framework for measuring climate change responses is to measure the extent to which adaptation and mitigation efforts. This measurement is to see if it has been effective in keeping development on track in a changing climate; generate evidence and lessons as a basis for future policy development; and facilitate the coherent integration of the M&E of climate change in national development planning and key sectors. Additionally, Cambodia developed the MRV framework for the REDD+ implementation strategy limited to other sectors, for instance, energy and waste. It is, therefore, time for this project to take the development of the MRV framework for the energy sector, specifically the renewable energy into account. The detail conceptual framework to design the MRV in the renewable energy will be capture in the next report.

Rational:

Reviewing the available National GHG inventory and existing data on GHG emissions and mitigation actions in the energy sector, lesson can be drawn that the GHG impacts and source

categories specifically dedicated to the RE was not yet covered. Despite emissions baseline and emissions mitigation options have already been established, the limitation of data availability to produce this GHG inventory and partiality of the source category concerning energy sector, which missed out the RE, suggest new update of GHG inventory and redefinition of GHG assessment boundary particularly for the RE sector. Likewise, a sound and contextual based MRV system needs to be developed to trace the effectiveness and efficiency of mitigation options as well as relevant or not yet defined GHG mitigation projects/actions in line with the implementation of the RE policy in Cambodia.

9. Stakeholders Consultation: Path of Implementing the Proposed MRV for the RE Sector

To realize the proposal for the MRV framework for the RE sector in Cambodia lies in five broad range steps as shown in figure below. Each of them involves its own particularity and complexity and some of which will need further clarification and verification from concerned authorities, stakeholders, and national consultations.

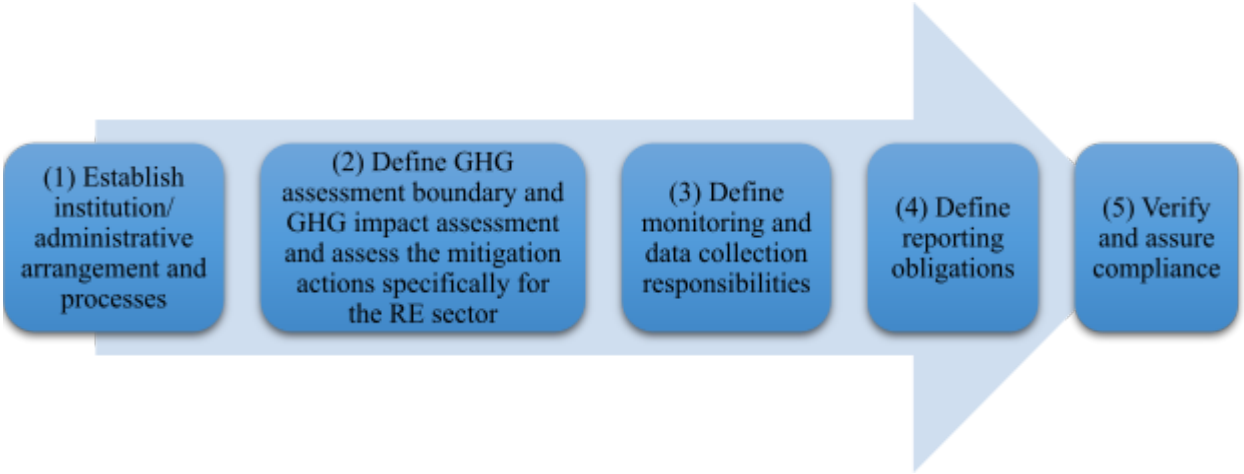
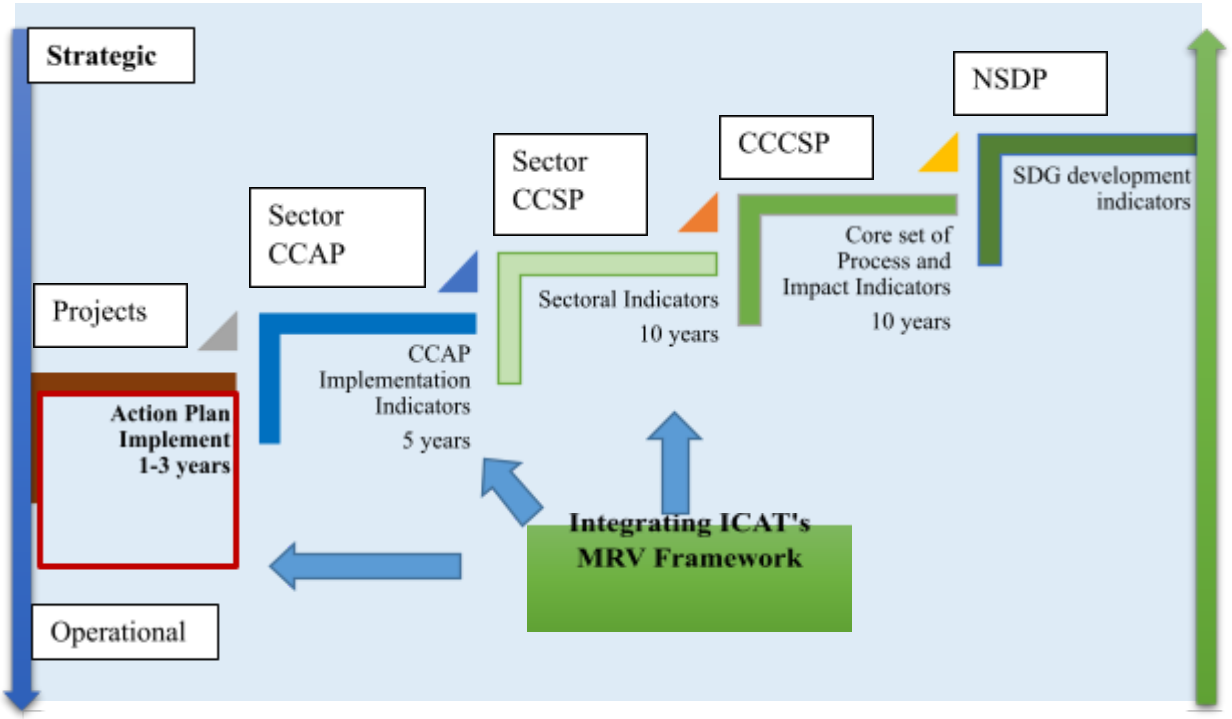


Figure 18: Institutional Arrangement for setting up the MRV framework for the RE Sector

9.1. Establish Institutions/Administrative Arrangement and Processes

Since the current CC M&E is already embedded into 9 ministerial lines of the RGC, therefore it is recommended that the proposed ICAT framework, specifically for the assessment of the RE should be placed under the responsibility and accountability of the existing National Framework for the CC M&E. From this conceptual and methodological framework, below is the diagram envisions the ICAT Framework Pillar I with the existing M&E framework for RE MRV in Cambodia.



NSDP= National Strategic Development Plan, CCCSP= Cambodian Climate Change Strategic Plan, SCCP=Sectorial Climate Change Plan, and CCAP=Climate Change Action Plan

Figure 19: Integrating ICAT's Framework in Crosscutting Level of National CC M&E framework

To proceed the above methodological design and to incorporate the ICAT's MRV into Cambodia RE context, institutional and administrative arrangement to be in charge of this MRV setting up and implementation has to be identified and established. The first task to do this institutional arrangement is to identify which institution and to what extend of authority and responsibility for this ICAT's MRV Methodology framework application into the existing RE policy, ongoing projects, and administrative arrangement. This designated institution will be responsible for:

- Designing the overall MRV Framework for the RE policy in Cambodia (some of this competency might be involved with political responsibility);
- Implementing the MRV application including assessing the RE policy action plan and projects;
- Developing GHG inventory, which covers all needed information relating to the RE policy impact and source category useful for conducting the MRV for this particular sector;
- Monitoring data collection and data reporting and also monitoring the RE policy implementation as well as the implementation of the MRV on the RE policy;
- Analyzing and reporting data; and
- Quality control and quality assessment and assurance.

In reality, Cambodia already has functional CC body at the national level, which has full information and coordinating role for climate change and related M&E framework. The existing M&E framework on Climate Change lies in the responsibility of the National Council for Sustainable Development (NCSD), which is directly in charge of all climate change related policies and also makes report to the UNFCCC. Beneath this top national body lies the 9 line ministries that will have their own respective policies and actions that embedded the mitigation actions toward the goal as set forth in the national development policy and climate change policy. Only the M&E development is a critical point to investigate in this existing national institutional arrangement. As far as the available data and information are concerned, there are

two M&E or MRV frameworks that had been developed and implemented in two ministries. One is the under the operation of the MAFF (REDD+ MRV system) and the other is under the NCSD/MoE, using International Institute for Environment and Development (IIED) Tracking Adaptation and Measuring Development (TAMD) approach (Rai, N. et al, 2015). For the next stage, the RE sector has become the critical point for the government to consider for establishing new MRV for this sector in particular given the readiness and lesson learnt from the previous MRV and M&E system and the demanding trend of global and national RE energy regime. The availability of national existing body in charge of the M&E framework from the top national level to the bottom-technical level suggests the feasibility and applicability of the MRV of the ICAT in the existing. This suggestion shall fall under the MME in particular given the fact that this line ministry is directly in charge of this sector and has already involved in this sector. The recommended operational flow of this proposed MRV is presented in Figure 20. The remaining task from now on is to define responsibility and scope of tasks for the department or section in this ministry in order to kick off the proposed MRV.

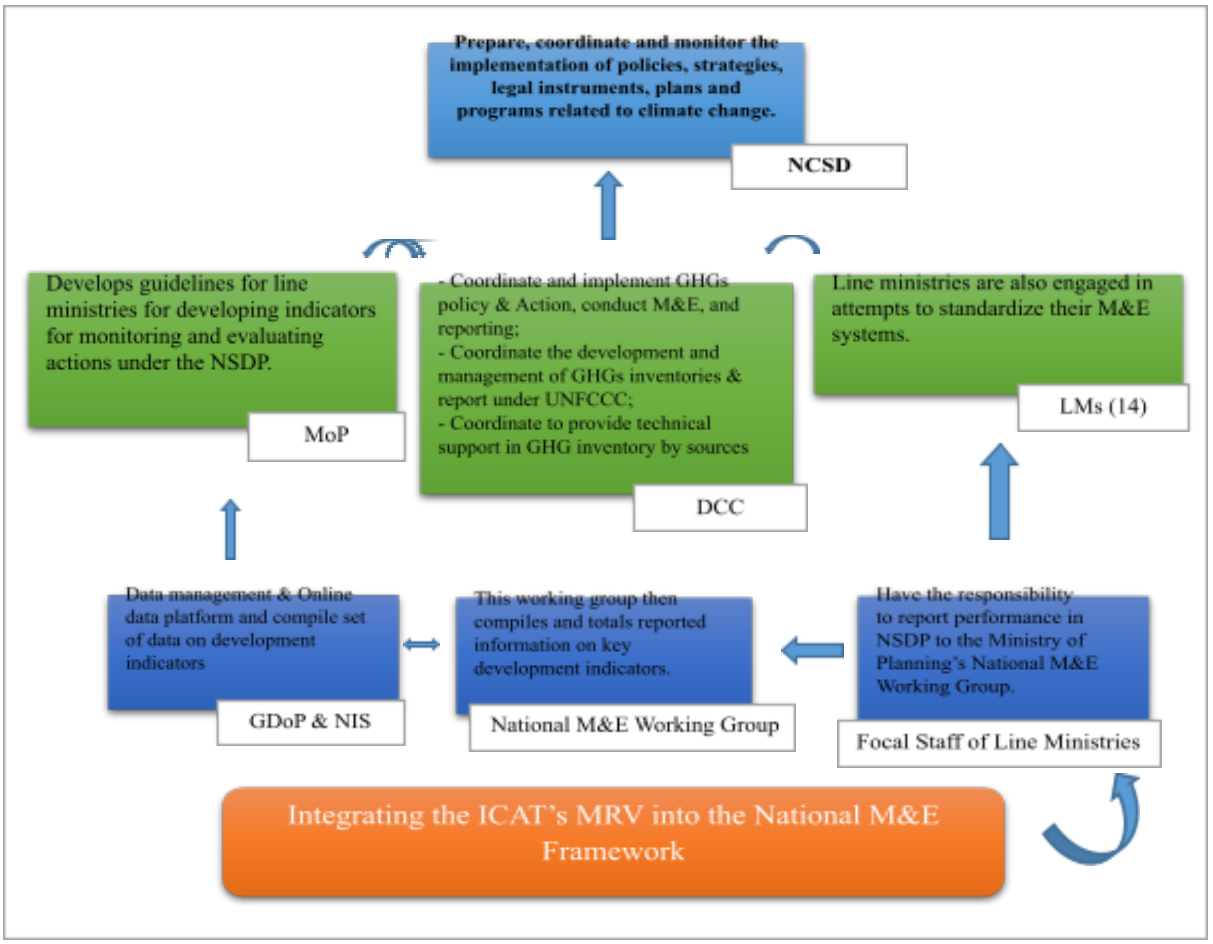


Figure 20: Recommended Operational Flow of the ICAT's MRV framework into the National M&E Framework

Having been reviewed all the existing national frameworks of CC M&E and existing mechanisms of the MRV that is under the accountability of the MoP, the proposed ICAT's Methodological Pillar I given in the guidance manual is identified as importantly relevant to Cambodia existing MRV framework. The most advantageous aspect of this ICAT's framework is the focus on GHG emissions that is relevant to Cambodia RE policy target. The flexible and optional characteristics of the framework could make use of the existing M&E framework that will lead to more opportunity for effective and efficient RE policy implementation by building up on the previous progress of the RGC and line ministries. This supplementary applicability of the ICAT's framework will provide additional standardizing sources of the M&E framework for Cambodia to track GHG emissions and reduction potentials. The framework will also bring

about potential that do not need surplus investment cost, and resources to develop the second M&E framework for the energy sector in Cambodia.

9.2. Define GHG assessment boundary and GHG impact assessment and conduct mitigation actions specifically for the RE sector

Following the decision on designating responsible institutions and processes, the next and most important step is to start working on the defining GHG Impact assessment following the guidance of section 8 (8. Mapping out MRV of the ICAT's Methodology Framework for Cambodia) of this paper based on the ICAT's guidance in the GHG Impact assessment section. Given Cambodia circumstance and the absence of the ultimate standard that fit country's specific context, a full analysis on the method options provided in the ICAT's guidance is recommended in section 8 and these method suggestions are briefly suggested as below:

DETERMINING THE SCOPE OF THE MRV FOR THE RE POLICY:

Data quality and data availability are two key aspects for considering when conducting the analysis of this MRV method option. Cambodia needs to be aware of country specific circumstances such as data quality and data availability as this issue is one of the biggest concern for the country situation, especially relating to the RE sector and the GHG inventory formulation and reversion.

SETTING THE MRV CRITERIA AND PERFORMANCE INDICATORS:

For method suggestion 2 (Setting the MRV Criteria and Performance Indicators), six criteria or assessment principles as enlisted in the ICAT's guidance need to be identified and confirmed with experts and consultations. Key indicators need to be considered to making sure the policy assessment fall under the assessment principles as proposed by the ICAT's Methodology or not. These key indicators need to be discussed during the consultations and with the experts. The ICAT's framework identified six assessment principles of the MRV systems that are essential to the objectives of the policy assessment. In reviewing these criteria, it is reflected that some of these key principles are in line with the UNFCCC guideline for the country to prepare its National Communication to the UNFCCC (see Table 18).

Table 18: ICAT's Assessment Principles and Key Indicators to be confirmed

Objectives of the RE policy assessment	Define the objective of the RE policy assessment (e.g.: to trace the effectiveness of the RE policy implementation and to measure the GHG emissions of the RE policy interventions). Policy selected here proposed to be the MP of the RE and the Cambodia INDC.					
Criteria/Assessment Principles	Relevance	Completeness	Consistency	Transparency	Accuracy	Comparability
Key Indicators	- Is there a clear mechanism for feeding information back into the policymaking process? - Is there strong integration in the institutional structure between policymaking and data collection? - Is information presented in different formats and at different levels of technical detail?	- Are all relevant sectors covered? - Are all relevant gases covered? - Are all years since the base year covered? - Are all relevant source categories covered? - Is geographical coverage complete?	- Does data collection occur on a regular schedule? - Does reporting occur on a regular schedule? - Is information collected and delivered frequently enough to provide policymakers (and other relevant audiences) a solid understanding of national circumstances/trends or policy performance?	- Are underlying data publicly available for review and use? - Are data collection and/ or emissions estimating methodologies publicly available and clearly described? - Is transparent expert review part of the reporting process? - Is there a clear identification of sources of	- Are data collected, and are estimates made, based on sound, well-established, widely accepted methods? - Are data accessible and subject to third-party or public review? - Is the system itself—meaning the institutional and procedural apparatus responsible for developing emissions/mitigation estimates—subject to review either internally or by third parties? - Are data sources likely to be unbiased and accurate?	- Are consistent calculation and reporting methods employed over time, agencies, different levels of government, sectors, and/or policies? - If methodological changes are made, are they applied to previous years' data? - Does the system use internationally accepted units, protocols, methods, etc.?

	- Are data used in quantitative analysis related to policymaking			uncertainty and methods for measuring it? - Does the system include standardized documentation of methods and key decisions, and strong record-keeping practices in general?	- Is there a process for adopting the most up-to-date methods or otherwise improving estimation methods over time? Are previous emissions and mitigation estimates recalculated using updated methodologies? - For all significant sources of emissions, are methods the most sophisticated available? - Does the system include a process for developing and maintaining institutional capacity over time—for example, through a dedicated, permanent staff with relevant expertise?	

Since the ICAT's methodology does not cover most of the data quality aspect as faced by Cambodia situation. Cambodia may choose to combine methods by deploying other tools or methodology to ensure the quality and availability of data for conducting the GHG impact assessment. It needs to be decided either to opt for some tools, methodologies, and approaches for the ICAT's MRV and adopt them to the country's own circumstances or to adopt the full framework. Actually, Cambodia can use the whole ICAT for the whole mitigation actions particularly for the most significant policies and measures with large impact on GHG emission reductions. Yet, for some other mitigation actions processes can be a combined method as long as the GHG emissions are ensured the quality and availability. Having reviewed the existing data tools and given the reality of the current process of the RE implementation, it is to recommend that a standard of data measurement for this GHG impact assessment need to be developed along with the methodological processes as presented here and also in the section 8. Achieving this preliminary stage of the proposing methodology will ensure the next stage, which is to define the data collection responsibility and monitoring process.

9.3. **Define monitoring and data collection responsibilities**

By the year of developing this report, it has reached the midterm of the RE Master Plan since its development in 2006. The implementation is action based and never have any monitoring, reporting, and verification procedures associated with implementing the policy even though it was mentioned to be developed for this RE sector in the CCCSP. With the absence of the MRV framework for this particular sector, the coordinating body that is to be in charge of the MRV is not yet developed. However, the existing body accounts for the whole national M&E for climate change is the CCD. The data management system of overall energy sector lies within the coordination and cooperation of the EDC, EAC and GDE of the MME as presented in Figure 21 below. These institutions are in charge of QA and controlling and managing data reading, recording, auditing, and archiving all relevant data and documents. Under the EDC management, the monitoring data for net electricity generation at the plant level can be obtained from the periodic electricity meter records kept by the power producer and/or the electricity board or grid company. Further data collection responsibility and data collection monitoring body or processes need to be discussed and updated from this existing system.

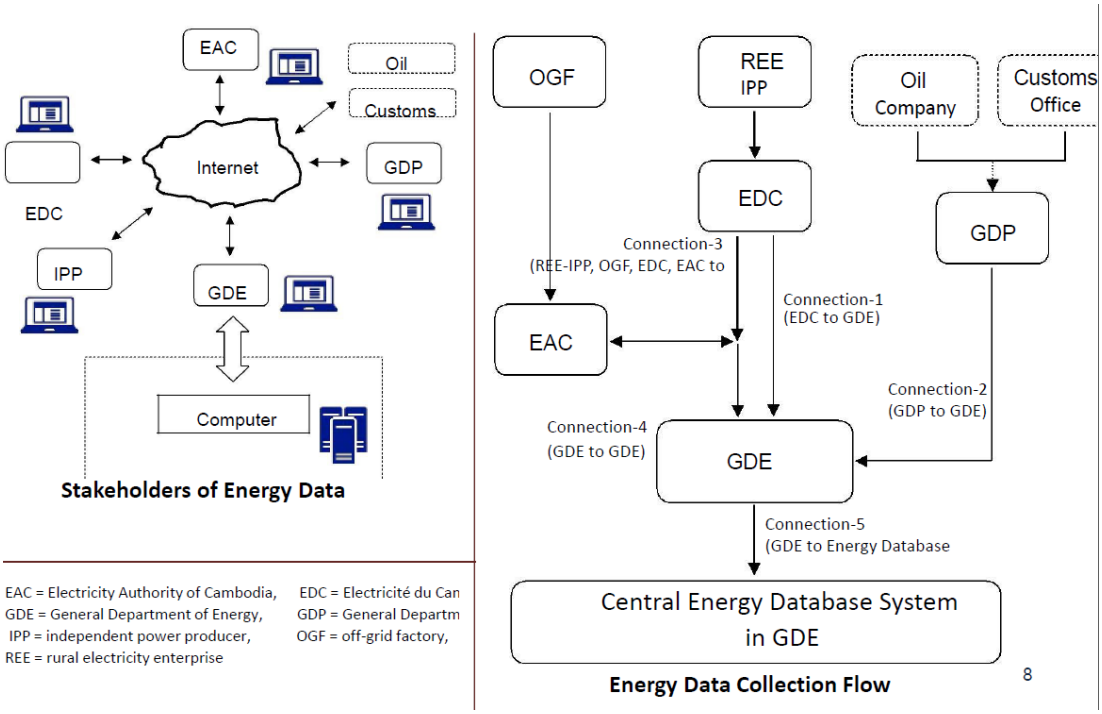


Figure 21: Existing data collection flow of the MME (NRED, 2016)

9.4. **Define Reporting Obligations and Processes**

Reporting of the MRV implementation should comply with requirements as recommended in the ICAT guidance and comply with the spirit of the article 4 of the UNFCCC in which commitments of all Parties to addressing GHG emissions are defined. It is indicated that, all Parties, *"...taking into account their common but differentiated responsibilities and their specific national and regional development priorities, objectives and circumstances..."* shall *"...formulate, implement, publish, and regularly update ... programs containing measures to mitigate climate change by addressing anthropogenic emissions by sources and removals by sinks of all greenhouse gases..."*.

The recommended information to report by the ICAT as presented in the guidance and also attached in the Appendix I of this paper seems to be in compliance with the requirement of the UNFCCC. Even though the Convention set different commitments between developed (as annex I) and developing countries (as Non annex I) Cambodia, as a party to the Convention should report measurable, reportable, and verifiable nationally appropriate mitigation commitments or actions. However, this Convention ensures that the country's mitigation report should take differences in each national circumstances into consideration with no obligation to limit GHG emissions. This reporting process should be standardized and be in charge of the GDE of the MME with coordination with the DCC of the NCSD.

9.5. **Monitoring and Quality Assurance**

Upon designing MRV system for mitigation actions of the RE policy, next is the development of a monitoring plan for this MRV. The purpose is to ensure that the information reported fulfill the requirements of the ICAT or the UNFCCC mitigation standards, the methods used appropriately, and the assumptions made in the report is reasonable and relevant. For Cambodia's case, the MME would be the best candidate for adopting this planning and two types of verifications are recommended:

- Third party verification: The key challenge with this regard is the ambiguity of availability of the accreditation processes in Cambodia's M&E system. This requires a confirmation from checking the current Climate Change M&E mechanisms. If this accreditation standards is absent in the country, then it is of an opinion that the MME should establish this standard. It is reported that the UNFCCC also has the accredited verifiers which can be approved to the local context. However, if this third party verification is not "a must" for policy adoption, then it can be optional for Cambodia even though it is recommended to have third party verification for mitigation policies. Aside from choosing the verifiers from accreditation processes available from the UNFCCC or other countries, the ICAT could be one of the selection for this verification process.
- "In House" quality assurance: This "in-house" refers to the QC/QA conducted by the MME for Cambodia's case as this body is the main and focal point for the RE sector. This internal quality control/assurance should be performed in coordination with the National M&E Working Group (WG) and with the MoP who is in charge of facilitating the MRV system for the line ministries to implement. Mechanism needs to be established to ensure avoidance of any conflict of interests among key line ministries or concerned stakeholders. This can be assured with the application of the existing protocols and quality assurance guidelines and exiting laws and regulations.

10. Conclusion and Recommendation

The MRV is a demanding and long processing task that will continue for many years to come. This requires a strong and competent institution with sufficient financial and human resources to undertake the project. The review of Cambodia's policy framework and RE institutions as well as the proposed MRV system suggests important roles of institutions which will directly and formally be in charge of this MRV of mitigating actions on the RE policy is formalized through laws, decrees, or other legal instruments. Following this formalization of the responsible institution or a department from the ministry, it is necessary to establish system in which procedure, relationships, and responsibility of each responsible institution or department are clearly defined. A reliable mechanism needs to be also established to ensure functionality of this establishing body and the coordinating process with the current National M&E mechanism of climate change.

For methodological part, it is very necessary, for the time being, for Cambodia to prepare for the data availability for conducting the MRV system to apply for the mitigation action of the MP and the NDC. New update of GHG inventory and GHE emissions baseline is needed for conducting the GHG impact assessment and the ex-ante policy assessment. These proposal plans await for confirmations from key stakeholders and experts. Therefore, a stakeholder workshop involved all concerning parties and experts is proposed to be held soon by earlier 2019 for finalization some technical parts relating to the methodologies as well as the formulation of body in charge of the proposed plans.

In short, the advantage of this ICAT Methodology Framework is that it applies to broader policies or actions, such as the renewable energy policy at the sector or jurisdiction level, including individual mitigation projects. It is applicable to policies and actions at any level of government. The application of the MRV might be useful in the future for other sectors such as transport, commercial, residential, etc.

Appendix 1: Recommended Information to report and to be confirmed in the stakeholder consultation

General Information		Comments
The name of the policy assessed	REREP and Cambodia INDC	To be selected and confirmed during the stakeholder consultation workshop
The person(s)/organisation(s) that did the assessment		To be discussed and confirmed during the stakeholder consultation workshop. To be identified (or the GDE of the MME?)
The date of the assessment		
Whether the assessment is an update of a previous assessment, and if so, links to any previous assessments		Presumably, it is the first assessment to be conducted
Chapter 1: Objectives of Assessing the GHG Impacts of the RE Policies		
The objective(s) and intended audience(s) of the assessment.		
Chapter 2: Steps and Assessment Principles		
Opportunities for stakeholders to participate in the assessment		To be ensured by the establishing body in charge of this MRV formation and implementation.
Chapter 3: Describing the RE Policy		
Individual policy or a package of related policies.		Should the package between RE policy and INDC, but further integration of the two into one package needs to be confirmed.
Whether the assessment is ex-ante, ex-post, or a combination of ex-ante and ex-post		
Chapter 4: Identifying Impacts: How RE Policies Reduce GHG Emissions		
a list of all GHG sources of the policy identified, using a causal chain, showing which impacts are included in the GHG assessment boundary		
A list of potential GHG impacts that are excluded from the GHG assessment boundary with justification for their exclusion		
The assessment period		
Chapter 5: Estimating RE Addition of the Policy Ex-Ante		

1. An estimate of the maximum implementation potential that the policy is expected to achieve 2. A refined estimate after accounting for policy design characteristics 3. A refined estimate after accounting for factors that affect the financial feasibility of RE technologies 4. A refined estimate after accounting for other barriers (Table 7.4provides a sample template for this barrier analysis) 5. The estimated RE addition of the policy upon completion of the steps in Sections 7.1 to 7.5 6. The method or approach used to assess uncertainty 7. An estimate or description of the uncertainty and/or sensitivity of the results in order to help users of the information properly interpret the results	
Chapter 6: Estimating the GHG Impacts of the RE Policy Ex-Ante	
Objectives of the assessment, and the policy's expected impact and timeframe	
Two approach: Emission trajectory using energy model, and grid emission factor using combined margin approach.	To be discussed and confirmed during the stakeholder consultation workshop.
Chapter 7: Monitoring Performance over Time	
A list of the key performance indicators used to track performance over time and the rationale for their selection and sources.	

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