KINGDOM OF CAMBODIA
NATION RELIGION KING

MINISTRY OF MINES AND ENERGY

PRINCIPLES FOR PERMITTING THE USE OF ROOFTOP SOLAR POWER IN CAMBODIA

Prepared by: Inter-ministerial Committee and technical working group for manage, review and decision on study and preparing energy policy on rooftop solar power in Cambodia

APRIL, 2023

UNOFFICIAL TRANSLATE

Kingdom of Cambodia
Nation Religion King

(Logo)
Ministry of Mines and Energy
No. 0159 RTh.ThKTh.BrK

Prakas
On
Launching of the Principles for Permitting the Use of Rooftop Solar Power in Cambodia

The Minister of Mines and Energy

- Having seen the Constitution of the Kingdom of Cambodia;
- Having seen Royal Decree No. NS/RKT/**0918/925**, dated **6** September **2018**, on the Appointment of the Royal Government of the Kingdom of Cambodia;
- Having seen Royal Decree No. NS/RKT/**0320/421**, dated 30 March **2020**, on the Appointment and Adjustment of the Composition of the Royal Government of the Kingdom of Cambodia;
- Having seen Royal Code No. NS.RKM/**0618/012**, dated **28** June **2018**, promulgating the Law on the Organization and Functioning of the Council of Ministers;
- Having seen Royal Code No. NS/RKAM/**1213/017**, dated **9** December **2013**, promulgating the Law on the Establishment of the Ministry of Mines and Energy;
- Having seen Sub-Decree No. **137** AnKr.BK, dated 31 October **2018**, on the Organization and Functioning of the Ministry of Mines and Energy;
- Having seen Prakas No. **0097** RThATh.BrK, dated **12 April 2022**, on the Establishment of an Inter-Institutional Commission for the Preparation of Principle for the Permission to Use Rooftop Solar Energy in Cambodia; and
- Based on the necessity of the Ministry of Mines and Energy;

Hereby Decides

Item 1._
The Principles for Permitting the Use of Rooftop Solar Power in Cambodia is launched with complete content of which as contained in the **"Principles for the Permitting the Use of Rooftop Solar Power in Cambodia"**, which is an annex of this Prakas.

Item 2._
The "**Principles for Permitting the Use of Rooftop Solar Power in Cambodia**", being launched according to this Prakas, aim to improve the management of permission for the use of rooftop solar power in Cambodia to be clear, effective, transparent, equality, accountability, and fairness.

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Item 3._

Heads of all relevant entities and institutions, including the General Department of Energy, the Capital/Provincial Department of Mines and Energy, the Electricity Authority of Cambodia, and the licensees of electricity supply services in the Kingdom of Cambodia shall be jointly responsible for the implementation of the "**Principle for the Permission to Use Rooftop Solar Energy Panel in Cambodia**" being launched according to this Prakas in an accurate and effective manner.

Item 4._

Any Prakas, decisions and provisions that are contrary to the "**Principles for Permitting to Use the Rooftop Solar Power in Cambodia**" being launched according to this Prakas shall be abrogated.

Item 5._

This Prakas shall become effective from the date of signature.

Tuesday, 6th day of waxing moon, lunar month of Chet, lunar year of Rabbit,
Pagnjaksak, 2566 BE
Phnom Penh, 25 April 2023

Minister of Mines and Energy

(Signature and Stamp)

Suy Sem

CC:

- Cabinet of the Council of Ministers
- Cabinet of Samdech Akka Moha Sena Padei Techo Prime Minister
- Cabinets of Samdech/Excellency Deputy Prime Minister
- All Ministries and Institutions
- All Capital and Provincial Administration Offices "to be informed"
- As in Item 3 "To be implemented"
- Documents - Archives

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1. Introduction

1.1. Current situation on the use of rooftop solar power in Cambodia

In the current context, energy sector in Cambodia, not only has the role to meet the growing demand of energy by ensuring that energy supply is sufficient, reliable, and affordable to support its economic growth and social livelihoods, but also to achieve development that is more sustainable by using clean renewable energy. Increased use of renewable energy will also contribute to the achievement of environmental goal and global commitment of Cambodia to reduce greenhouse gases emission.

Solar energy is a renewable source that is clean, no environmental impacts, doesn't contribute to greenhouse gases emission, and Kingdom of Cambodia has a great potential for solar energy production. Now, electricity generation from solar technology is cheaper. Therefore, both public and private sector organizations including electricity consumers are willing to develop the solar energy. However, solar power is available only during the daytime and for a few hours; in addition, its availability fluctuates throughout the day. Thus, to use this energy source, to meet demand and supply reliable electricity to its consumers, for national power grid system it must be combined with other stable sources of energy, and for electricity consumers who use solar energy, they must invest in battery energy storage system to store the energy for use during hours that have low or no solar radiation, or use the electricity supply from national grid as a supplement. In other words, using solar power still has limitations that required consideration; similarly, for electricity consumers using solar energy, they must have battery energy storage system or rely on the supply from national power grid to supply electricity for own demand.

In 2018, Electricity Authority of Cambodia issued a regulation that sets the general conditions in connecting solar power systems of Big Consumers (medium voltage consumers) and Bulk Consumers (high voltage consumers) to the national power grid. The regulations require to submit the application to and get prior authorization of Electricité du Cambodge (EDC) and the licensee supplying electricity to those consumers if the consumers are supplied electricity by a licensee other than EDC. The electricity consumer who develops solar power system shall follow safety and technical standards, and pay the electricity price based on two parts tariff system with charges for both capacity and consumed electricity from national grid that is set separately by Electricity Authority of Cambodia (EAC). In 2022, the study of Power Development Master Plan for 2022-2040 has indicated that national power grid system of Cambodia can absorb a maximum solar power of up to 3,115 MW, which is equal to 29.8% of potential sources of total domestic electricity energy in 2040.

So far, Cambodia has successfully implemented the auction mechanism and direct negotiation mechanism to develop utility scale solar power for national grid system resulting in a lower electricity price from solar power than from any other electricity generation technologies. This has been helping to reduce the unit cost of electricity from the national power grid to all electricity consumers in the national power grid. On contrary, few electricity consumers developed rooftop solar power for own use, but observed that the development of rooftop solar power of consumers so far has much higher electricity price than that of national power grid.

1.2. Challenges and solutions for the use of rooftop solar power in Cambodia

According to the situation presented in 1.1. above, regarding the permit to use rooftop solar power connecting to the national power grid has some challenges as below:

1) Issuing permission to the grid connected electricity consumers to use rooftop solar power will reduce the ability to develop utility-scale solar power that is having cost-effective and helping reducing overall electricity sale prices for electricity users;

2) Issuing permission to the grid connected electricity consumers to use rooftop solar power requires to have clear management on the technical and safety aspects to avoid issues with the stability, quality, and safety of national grid and its electricity distribution system;

3) Although the electricity price of rooftop solar power is higher than electricity price of utility-scale, to provide a just equitable electricity supply to all the consumers, the installation of rooftop solar power must be managed or determined cost clearly to be accurate and competitive not to allow each electricity consumer implementing freely as before; and

4) In setting price for electricity consumers using rooftop solar power, the tariff must be fair for all relevant parties including rooftop solar power users.

According to the Power Development Master Plan, the potential of solar power injecting to the national grid has been limited. So, as per the economic aspect and challenges presented above, the development of solar power should be given all to the national grid to develop utility-scale solar to further reduce price for all consumers. However, with the increased climate commitments of the private sector, the importing countries, some buyers, and institutions that import manufactured goods and products from Cambodia have put conditions to reduced carbon footprint of goods and products. Therefore, factories based in Cambodia that export their products to other countries are seeking to use rooftop solar power to demonstrate their contributions to the environmental and climate change obligations. In this case, with the existing regulations, permitting electricity consumers to use rooftop solar power to fulfill their environmental and climate change obligations may face some challenges as below:

1) No limit on number for issuing the permit to electricity consumers to develop rooftop solar power clearly;

2) No clear principle(s) for management of the permit to electricity consumers who use rooftop solar power; and

3) The installation service for rooftop solar power systems are not yet managed properly, causing electricity users to receive fraud on technical aspects, quality, and costs associated with the installation of rooftop solar power.

In order to address these challenges, a study on the use of rooftop solar power in Cambodia under cooperation between Ministry of Mines and Energy (MME) and the United Nations Development Programme (UNDP) has provided recommendations to allocate the development of solar power, as set in the Master Plan, one part through quota system to the electricity consumers who have necessity to install rooftop solar power by setting management principles, roles and responsibilities of Ministry-institutions and relevant departments, and determining clear implementation coordination mechanism.

1.3. Definitions

Rooftop Solar Power refers to solar PV power system that installed behind the consumer meter and within the premise of the consumer for serving electricity consumption of electricity user that can be the system installed on land or on a roof.

The permit to use rooftop solar power refers to the permit to install and use the rooftop solar power.

2. Vision

Principles for permitting the use of Rooftop Solar Power in Cambodia has vision *"to enhance the management of permitting to use rooftop solar power in Cambodia to be clear, effective, transparent, equality, accountability, and fairness"*.

3. Goals

Principles for permitting the use of Rooftop Solar Power in Cambodia has goals as following:

1) Issue permit based on the application to install rooftop solar power to any electricity consumer that shall not impact the electricity supply from the national power grid;

2) Allocate the capacity of solar power development as set within the Master Plan based on the **quota scheme** to electricity consumers who want to fulfill their environmental and climate change obligations; and

3) Manage issuance of permit, installation, and use of rooftop solar power following clear, transparent, equality, accountability, and effectiveness on both technical and safety.

4. Permit Management Framework

To achieve the above vision and goals, the principles for permitting the use of Rooftop Solar Power in Cambodia prepares a permit management that has three frameworks as below:

1) Roles, Duties, and Responsibilities of Ministry-Institutions and departments

2) Permit issuance, management measures to use rooftop solar power

3) Mechanism to facilitate support for implementation.

The three permit management frameworks above facilitate, interact, and complement each other to promote and facilitate support to electricity consumers in processing the application request, and implement rooftop solar power based on one principle that pay attention to equality, transparency, fairness, and is manageable.

5. Roles, Duties, and Responsibilities of Ministry, Institutions, and Stakeholders

Roles, Duties, and Responsibilities in processing the applications and issuance of permits to use rooftop solar power in Cambodia shall be governed by the stakeholders as follows.

5.1. Ministry of Mines and Energy

Ministry of Mines and Energy is the responsible institution for policy development, power development master plan, safety standards and technical regulations of energy sector. It has the following roles and responsibilities for permitting to use rooftop solar power in Cambodia.

1) Set principles for permitting the use of rooftop solar power in Cambodia;

2) Check and determine annual quotas capacity for rooftop solar power – by nationwide, - provincial capital, and zones in close coordination with Electricité du Cambodge;

3) Check and set capacity of rooftop solar power system that classified as small, medium, and large size of rooftop solar power system;

4) Set technical and safety standards for the installation of the rooftop solar power system with Electricité du Cambodge; and

5) Check and monitor the implementation of Principles for permitting the use of Rooftop Solar Power in Cambodia.

5.2. Electricity Authority of Cambodia

The Electricity Authority of Cambodia that is the independent regulator and arbitrator between electricity suppliers and electricity consumers in energy sector, and has the roles and responsibilities in implementing Principles by issuing license to the Rooftop Solar Service Providers in Cambodia as below:

1) Manage the provision of rooftop solar installation services and/or service providers through licensing, setting license conditions, and monitoring of service delivery;

2) Issue regulations on setting conditions for issuing licenses to rooftop solar installation service providers and in regulating the licensee's services;

3) Disseminate information on capacity of annual solar rooftop quotas nationwide and by province, and provincial capitals and zone wise, by updating semesterly;

4) Prepare procedures for application including templates, check, inspection, and issuing of permit for requester to install rooftop solar power;

5) Issue the permit to the applicant to install solar rooftop power to both Category 1 and Category 2 in consultation with the Ministry of Mines and Energy and Electricité du Cambodge;

6) Compile data and information on applicants who have received the permit to install solar rooftop power and provide details to the Ministry of Mines and Energy and Electricité du Cambodge; and

7) Calculate and set price that the solar rooftop installer shall pay based on the quota system, and principle of fairness price between all parties as set out in point 6.4.

5.3. Electricité du Cambodge

Electricité du Cambodge that is state enterprise manages the national power grid and is the service provider of electricity supply through sub-stations to the transmission network and in some distribution zones in the Kingdom of Cambodia has roles and responsibilities in implementing Principles for permitting the use of Rooftop Solar Power in Cambodia as below:

1) Participate with Ministry of Mines and Energy in setting national annual quota capacity for rooftop solar and separate quotas by province, and provincial capitals and zones wise;

2) Participate with Ministry of Mines and Energy in setting the capacity of the rooftop solar power system by small, medium and large size of rooftop solar power system;

3) Participate with Ministry of Mines and Energy in setting technical and safety standards for rooftop solar power system installations;

4) Analyze the impact of rooftop solar systems on the power supply and distribution network, and model the installation of large size rooftop solar systems;

5) Monitor the impact of the rooftop solar systems over time;

6) Witness during the test and commencement of rooftop solar power system; and

7) Billing for electricity consumers who install rooftop solar power Category 2 shall settle the bill as per the Article 6.4 (5).

5.4. Electricity Distributors

The electricity Distributors are the service providers of electricity supply in their distribution zones under the license framework issued by the Electricity Authority of Cambodia following the Law on Electricity in Kingdom of Cambodia. Their roles and responsibilities in implementing Principles for permitting the use of Rooftop Solar Power in Cambodia is as below:

1) Facilitate and guide electricity consumers in their respective supply zones to place request through application forms to use allotted quotas of rooftop solar;

2) Provide information to Electricité du Cambodge that is relevant to analyze the impacts of rooftop solar on the electricity supply network, and model the installation of large size rooftop solar power;

3) Participate, along with Electricité du Cambodge, as witnesses during the test and commencement of rooftop solar power system; and

4) Help send the invoice of Electricité du Cambodge to the electricity consumers who install the rooftop solar system Category 2 to pay in case of request from Electricité du Cambodge.

5.5. Service Providers for Rooftop Solar Power Installation

Article 1, 5 and 41 of the Electricity Law of the Kingdom of Cambodia have determined that:

The electrical power service means the generation, transmission and distribution of electricity and other additional or miscellaneous services related to the above services. Each electric power service provider is required to have a license issued by the Electricity Authority of Cambodia. No person may operate as an electric power utility or supply electric power services except he/she has performed under and in accordance with the terms of a valid license issued by the Authority.

According to above statement, the Service Providers for Rooftop Solar Power Installation are companies providing some or all of the services such as consultation, design, equipment supply, installation, testing, operation and maintenance, and decommissioning of electricity generation from the solar power system that must have roles and responsibilities as below:

1) Must request and register as a service provider for Rooftop Solar Power Service provider with Electricity Authority of Cambodia;
2) Must have a "License to Install, provide Operation and Maintenance service but not to own the Rooftop Solar PV system and not to sale the electricity from the Rooftop Solar PV system" issued by the Electricity Authority of Cambodia; and
3) Must operate the rooftop solar installation services in accordance with the conditions set in the license, regulations, codes of conduct and rooftop solar energy standards.

5.6. Applicants

The electricity consumer who intends to use rooftop solar power for own location, either not connected to the national grid or connected to the power supply network of the national power grid can submit application to use rooftop solar power. The applicants have the following roles and responsibilities:

1) Must be the legal owner of the location that is intending to use electricity within the premise;
2) In case the premise is leased from another party, applicant must have a legal permit from the premise owner for installing rooftop solar, clearly mentioning the number of years of lease of the premise;
3) Applicants for installation of a rooftop solar power system at a location connected to the supply from national power grid must use the rooftop solar installation services providers licensed by the Electricity Authority of Cambodia for installation of the solar installation; and
4) Applicants for installation of a rooftop solar power system at a location not connected to the national power grid system must use the rooftop solar installation service providers licensed by the Electricity Authority of Cambodia only for the medium and large size applications.

6. Measure to Manage Permit for the use of Rooftop Solar Power

Issuing permit to use rooftop solar power must follow 5 management measures as following:

1st: Classification of application categories and setting permit methodology

2nd: Procedure for quota setting

3rd: Procedure for Application, Issuing permit, Installation, and Decommissioning

4th: Principle of fairness in Electricity Price among all parties

5th: Technical and safety standards

6.1. Classification of application categories and setting permit methodology

To facilitate the process of issuing permit to use rooftop solar power in Cambodia, the application requests are classified into 2 categories as below:

1) The application request to install rooftop solar power serving electricity consumption location **not** connected to the national power grid system called **"Category 1 Request".**

2) The application request to install rooftop solar power serving electricity consumption location connected to the national power grid system called **"Category 2 Request".**

The methodology to issuing permits for both categories of requests is also different and is set as below:

1) The Category 1 requests that do not impact the electricity supply of national power grid system must receive permits for all installations provided the applications are submitted and ensuring compliance with safety and technical standards. The application procedure, issuing permit, and installation for Category 1 Request is detailed in the section 6.3.

2) For the Category 2 requests that may impact the electricity supply of national power grid system, on both electricity supply to consumers and utility-scale solar, the permits to use rooftop solar power must follow quota scheme. The application procedure, issuing permit, and installation for Category 2 Request is detailed in the section 6.3.

6.2. Procedure for Quota Setting

Quota scheme refers to the system of allocating potential for solar power development that is defined in the Power Development Master Plan provided to Category 2 Requests for them to fulfill environment and climate change obligations. The allocation of potential for solar power development that is defined in the Master Plan provided to Category 2 Request must be defined annually following procedure as below:

1) Define annual capacity for solar power development nationwide based on the capacity defined in the Power Development Master Plan for electricity sector and adjust to practical variation.

2) Define overall national quota for solar farm development and for Category 2 Requests

3) Allocate overall national quota for Category 2 Requests by province, and provincial capitals and zone wise.

4) Allow electricity consumers connecting to the supply of national power grid in province, provincial capitals and zone wise to apply for installation of rooftop solar power based on their needs until all the rooftop solar power quota allocated for their province, provincial capitals and zones is utilized.

The rooftop solar power system of Category 1 request applicants that have received permit and installed are not classified as the rooftop solar PV system in the quota scheme as allocated above.

6.3. Procedure for Application, Issuing Permit, Installation, and Decommissioning

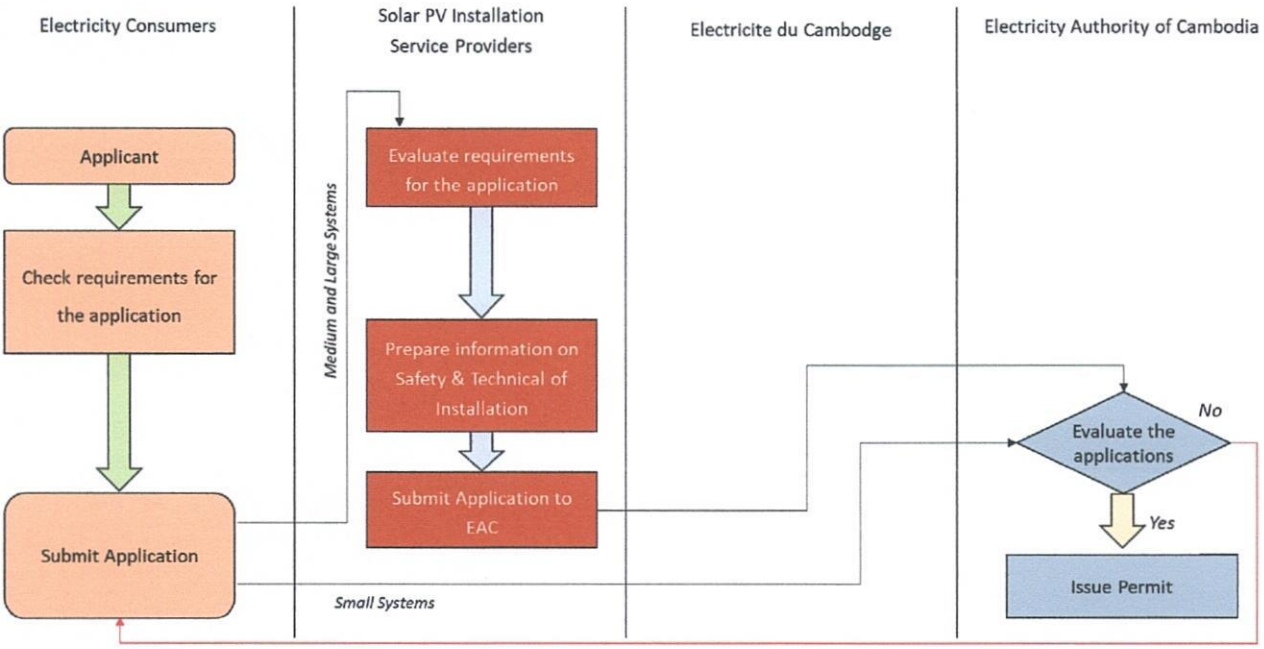
Electricity consumers who wish to use rooftop solar power under Category 1 and Category 2 must apply for permit to use the rooftop solar power to the Electricity Authority of Cambodia. The permit shall state the maximum capacity of rooftop solar power that is allowed to install, with a justification to use for a period of 7 years and may request renewal and shall have stated the requirement to start construction within 6 months for Category 1 and 3 months for Category 2 requests upon receiving the permit.

The Application, Issuing Permit, Installation, and Decommissioning must follow procedure as below:

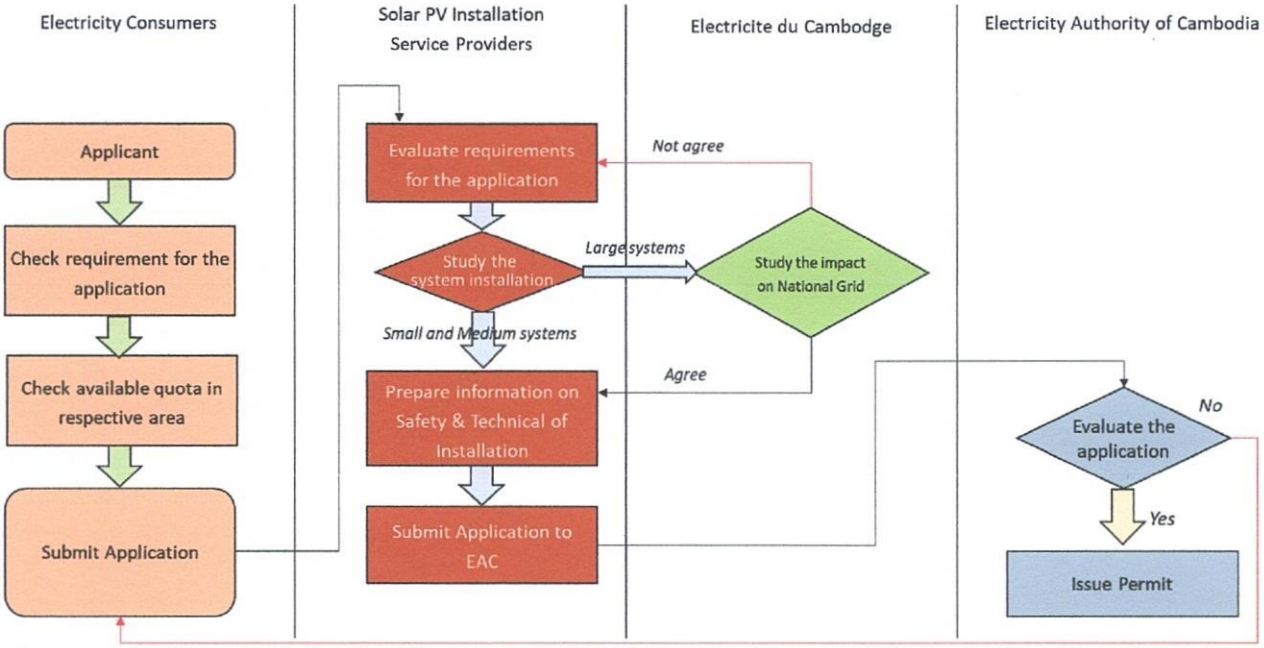
6.3.1. Procedure for Submitting Application and Issuing Permit

The application and issuance of permit must follow the procedure set out in the diagrams below:

For Category 1 Application



For Category 2 Application



Based on above diagrams, Electricity Authority of Cambodia shall issue regulation on the application procedure and issuance of permit to manage applications and permits issuance clearly and transparently.

For rooftop solar PV consumers under Category 1 who wish to connect to the electricity supply of national power grid to draw electricity from grid must submit the application to use rooftop solar power for

Category 2, following the procedure as stipulated in section 6.3.2 below, before connecting their rooftop solar PV with the national power grid to draw electricity.

6.3.2. General Principles for Application of Installation of large size rooftop solar power system for Category 2 Requests

The application to install large rooftop solar power system for Category 2 request must follow the principles as below:

1) Only if there is quota allocated and is available for that area;

2) Granting the permit shall be made in accordance with the necessity and importance of the installation of rooftop solar energy and on first-come-first-serve basis up to the allocated quota capacity for that area or up to expiry of allotted quotas because of delays in the construction. Electricity Authority of Cambodia must define criteria for implementation this work in consultation with the Ministry of Mines and Energy and Electricité du Cambodge.

3) Must submit the application to Electricity Authority of Cambodia by assigning solar PV installation service provider who has license from Electricity Authority of Cambodia as the installation service provider, or requester to Electricity Authority of Cambodia to appoint solar PV installation service provider.

4) The application procedure and application form must follow details explained clearly on the website of Electricity Authority of Cambodia.

5) Electricity Authority of Cambodia will be responsible for running the application process and shall verify the application, notify the Applicant whether its application is accepted, advise the Applicant to proceed with national grid impact study if required to do study, and provide detail information of the application to the Distribution Licensees and Electricité du Cambodge within ten (10) working days from the date of complete submission of an application.

6) Upon receiving permit from Electricity Authority of Cambodia, the Applicant shall commence to install the rooftop solar power within three (3) months from the date of the notification (date of notification inclusive) from Electricity Authority of Cambodia. Failure to install by the applicant within this period shall be deemed withdrawn and permit is automatically revoked. Any processing fee paid shall not be refunded.

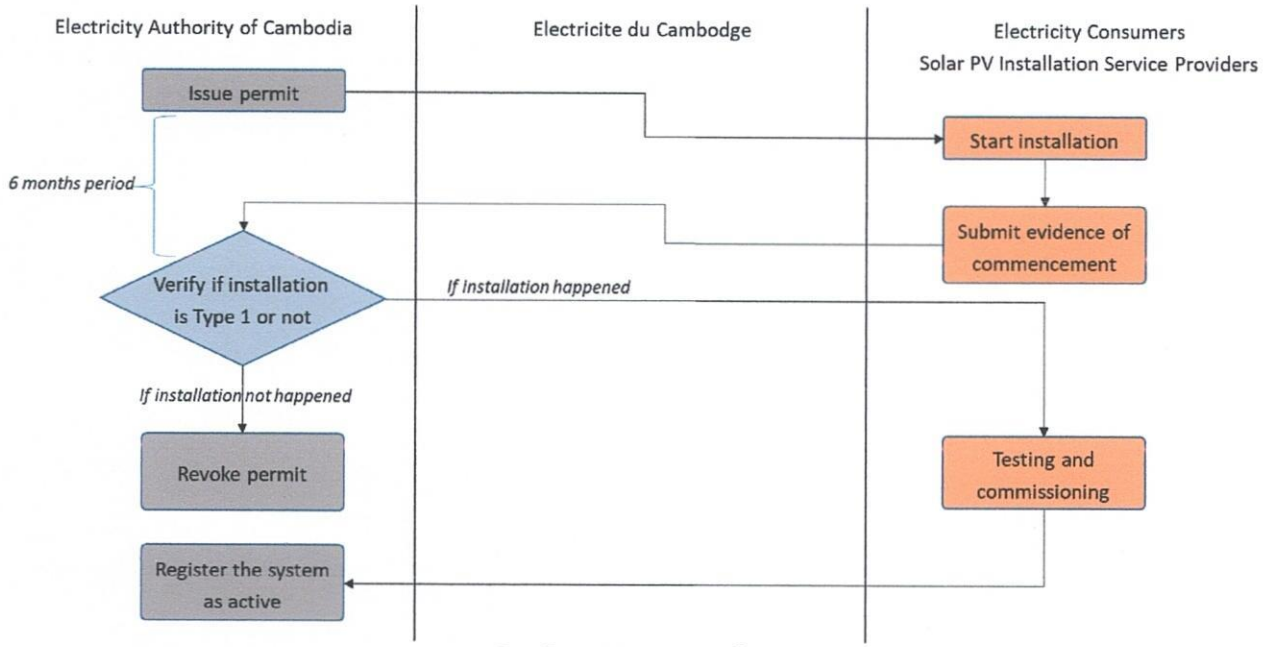
7) No refund of application fee in the event the Applicant decides to withdraw the application after submitting the application. The applicant will not receive any payment for the units of electricity injected to the national power grid system by the rooftop solar system.

8) No power purchasing agreement (PPA) or long-term contracts / arrangements are permitted.

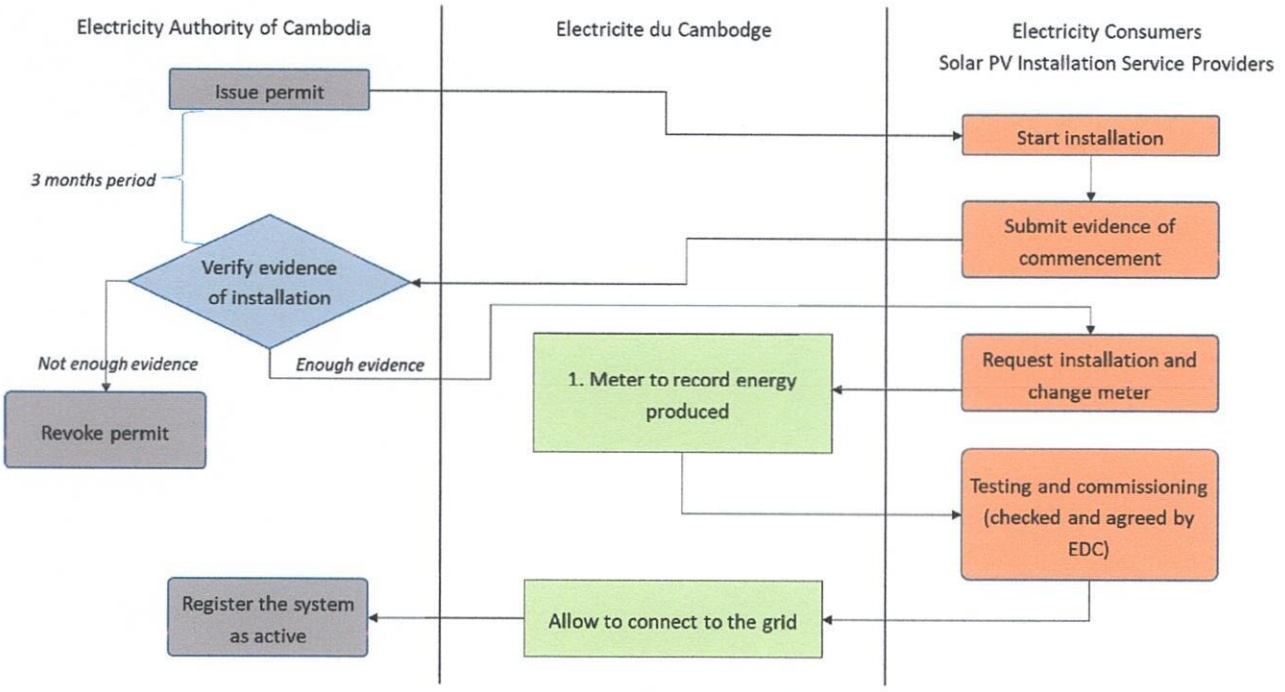
9) No third-party sale of electricity is allowed for rooftop solar power either by installing the system for selling electricity to electricity consumer or for multiple consumers.

6.3.3. Procedure for System Installation

Applicants can proceed with the installation of the rooftop solar PV system on their own roofs soon after receiving the permit from Electricity Authority of Cambodia. All installations of the rooftop solar power system, implemented by the licensed solar PV service providers, must follow the procedure set out in the diagrams below:



For Category 1 Installation



For Category 2 Installation

6.3.4. Procedure for Change of Ownership

When there is a change of ownership of the premise of the rooftop solar power installation, electricity consumer, who received the permit to use rooftop solar power, shall notify to Electricity Authority of Cambodia on the change and request for termination or ask new premise owner to continue using rooftop solar power by giving information about the status and change of ownership of the system. Conditions for change of ownership include situations such as changing ownership of the compound that is being prepared to install rooftop solar power system – selling a house, selling a building etc. In such cases, Electricity Authority of Cambodia will initially revoke the existing permit to use rooftop solar power, then

issue new permit to use rooftop solar power to new owner after verification that rooftop solar power system complies with the conditions of the issued permit to the former premise owner.

6.3.5. Procedure for Decommissioning

When a rooftop solar power system permit comes to an end, or is terminated or ended by any other means, the owner of the rooftop solar system shall mandatorily notify to the Electricity Authority of Cambodia. Then, the system shall be dismantled to free up capacity within the quota system and can be included in the next round of rooftop solar quota determination / announcement.

6.4. Principles of Fairness in Electricity Price among All Parties

In the current system of electricity price determination in Cambodia, when some electricity consumers have installed rooftop solar power and other have not, it is required to have mechanism to maintain a balance between both parties. When any consumer installed the solar power connecting to the national power grid, the consumer avails the solar power as and when available and draws its balance requirement of electricity replacing solar energy when low or no from the national power grid. This practice results in idle generation capacity of national power grid, increasing the cost of generation in the national power grid causing the impact on other electricity users. It is therefore important for those users pay compensation tariff to maintain fairness to other electricity consumers. Parties involved in setting compensation tariff mechanism for a fair price include electricity generators, distributors, all electricity consumers connected to the national power grid system, electricity consumers installing rooftop solar power, and solar PV installation service providers. Maintaining fairness has mechanism as follows:

1) Regularly, every 6 months or 1 year, check the installation cost of rooftop solar power that be installed by electricity consumers, manage, and make sure that the installation cost is reasonable and competitive. Such management is important point of fairness between all parties. Electricity Authority of Cambodia, who issues license to solar PV service provider, shall publish the basic installation cost that is reasonable and competitive for installation of different capacities of solar installation. This basic installation cost will be used to calculate the electricity cost from rooftop solar power by different capacity that includes small, medium and large size of rooftop solar installation in Cambodia.

2) The cost of development of rooftop solar PV installation by consumers, based on quota, is expected to be higher than the cost of development of utility scale solar; hence it is necessary to manage clearly and properly to maintain fairness for other electricity consumers.

3) The electricity from utility-scale solar PV installation will be combined with other sources of electricity generation and imports to meet the consumption demands of electricity consumers altogether at a tariffs rate determined by type of users. When an electricity consumer is permitted to develop rooftop solar power based on quota, the cost of power development must be managed clearly and appropriately, although the cost is higher than the utility scale solar PV system. To provide fairness to other consumers, the electricity consumers using energy from rooftop solar power in any location shall pay compensation cost for that amount of energy at a **Compensation Tariff of Variable Energy from Rooftop Solar** as detailed in Paragraph 5 below.

4) According to the fairness principle, the Compensation Tariff of Variable Energy from Rooftop Solar plus electricity price from rooftop solar power shall not exceed the General Tariff rate for electricity supplied by national grid system to the electricity consumers having solar generation. The rooftop solar power users based on quota, who have received the permit to use rooftop solar power in fulfilling their environmental and climate change obligations, will not pay electricity price exceeding other same category electricity consumers without solar PV installation. For rooftop solar power users serving the location that is not connected with the national power grid system and not importing electricity from grid to meet the actual consumption needs shall not be required to pay the Compensation Tariff of Variable Energy from Rooftop Solar.

5) The consumer using electricity from the supply of national power grid either in the supply zone of EDC or of private distributor when receives permit to rooftop solar power from Electricity Authority of Cambodia shall pay electricity price as follows:

(i) Pay to electricity distributor (Private distributor licensee or Electricité du Cambodge) on the electricity price that electricity consumer used:

= [Units of electricity consumed from the supply of National Grid (kWh) x Grid electricity tariff applicable to the consumer ($/kWh or KHR/kWh)]

(ii) Pay to Electricité du Cambodge on the overall Compensation Tariff of Variable Energy from Rooftop Solar

= =[{Units of electricity supplied from the rooftop solar (in kWh) – Units of line loss at voltage of supply had this electricity supplied from the grid, calculated at the line loss rate notified by EAC (in kWh)} x Compensation Tariff of Variable Energy from rooftop Solar applicable to the consumer (in $/kWh or KHR/kWh)]

(iii) Compensation Tariff of Variable Energy from Rooftop Solar applicable to the electricity consumer shall be calculated as below:

= [General Tariff for the grid supply as applicable to the consumer ($/kWh or KHR/kWh) – Cost of solar generation per kWh for small, medium and large size of rooftop installation as applicable as decided by Electricity Authority of Cambodia from time to time ($/kWh or KHR/kWh)]

Wherein:

Grid electricity tariff and the Compensation Tariff of Variable Energy from Rooftop Solar are the tariff notified by Electricity Authority of Cambodia from time to time for the category of consumer and size of rooftop solar installation. This is normally assessed by Electricity Authority of Cambodia for every 6 months to 1 year.

6) According to the fairness principle, rural electricity enterprises (REEs) who are distributors of electricity, participating in the relevant works on the using of rooftop solar power in the supply system of national grid system shall receive cost allocation one part from the Compensation Tariff of Variable Energy from Rooftop Solar received from electricity consumers using rooftop solar power in their distribution zones.

7) In case, electricity consumers in the service area of national grid system install rooftop solar power and connect to the national power grid, but do not have permitted quota from Electricity Authority of Cambodia, those electricity consumers shall pay the Compensation Tariff of Variable Energy from Rooftop Solar at a rate equal to = General Tariff for the grid supply as applicable to the consumer – Cost of solar generation per kWh of utility-scale solar as applicable as decided by EAC from time to time.

8) Electricity consumers in the service area of national grid system, who have already installed rooftop solar power and connected to the national power grid, on the date of first notification of permitted quota by Electricity Authority of Cambodia, shall immediately apply for permission and get permission within the time notified by EAC. Failure to do so, will mean the consumer is not having the required permission and the provision of paragraph 7 above will be applicable.

According to the above fairness mechanism, Electricity Authority of Cambodia shall set a list of electricity tariff for electricity consumer who has installed rooftop solar power following the principles as below:

1) Notify the cost of installing different capacity range of rooftop solar power system, considered to be reasonable and competitive on a regular basis (every 6 months or 1 year);

2) Calculate the average electricity price rate from rooftop solar power system;

3) Determine the Compensation Tariff of Variable Energy from Rooftop Solar to be realized from consumers with rooftop solar power system and determine ratio that Electricité du Cambodge to pay to the rural electricity distributors;

4) Set up to have a meter to record the electricity produced by each rooftop solar power system. Payment shall be made according to the meter reading;

5) No reimbursement for the solar energy injected to the national grid system and no excess energy is allowed to settle at different times as Cambodia doesn't have Net Metering or Net Billing policies, but encourages consumers to install rooftop solar power with battery energy storage system (BESS) to accommodate its usage requirements, reducing the amount of energy that can be returned to the national grid system;

6) The size of the rooftop solar power system is determined by the size of the system inverter.

6.5. Technical and Safety Standards

All installations of Solar PV Power and rooftop solar power system are required to conform to mandatory safety and technical standards. If any installation of rooftop solar power system is found out not conforming to the safety and technical standards, the installation will have penalties and is required to modify to meet safety and technical standards. Even with all these, if the rooftop solar system is not conforming, and cannot be modified, the permit to use rooftop solar power will be revoked. The premise will be disconnected from the national power grid electricity supply. Safety and technical standards for rooftop solar power system are arranged into the following categories:

- Electrical standard
- Civil works / Physical structure standard
- Metering standard
- Earthing standard
- Lightning standard

6.5.1. Electrical standard

Each equipment, installation, and connection of rooftop solar power system both installation connecting to the supply of national power grid and installation not connecting to the supply of national power grid must complied with applicable national standards and, if no national standard, must be complied with IEC standards. In addition, rooftop solar power system that are connected to the supply of national power grid shall comply with the following additional technical conditions:

A. Protection and Maintaining Electricity Quality and its Supply from National Power Grid

A.1. Limit DC Power Injection

The rooftop solar power system shall not inject DC current to the national grid greater than 0.5% of the inverter full rated output current.

A.2. Limit of Flicker

The solar PV Project shall not create objectionable flicker for other consumers on the National Grid. The solar PV Project shall comply with the limits in the applicable standard as follows:

- IEC 61000-3-3 for inverters with rated current ≤16 A per phase and not subject to conditional connection

- IEC 61000-3-11 for inverters with rated current ≤75 A per phase and subject to conditional connection

- IEC 61000-3-5 for inverters with rated current >75A per phase and subject to conditional connection.

The measurement of flicker is given by the short term probability flicker severity (P_{st}) and the long term probability flicker severity (P_{lt}). According to IEC standard 61000-4-15, the measuring time for P_{st} and P_{lt} should be at least lasting for ten minutes and two hours respectively. According to IEC standard 61000 the voltage flicker limits at different voltage levels is as follows:

Short term probability flicker severity (P_{st})	MV-HV	1.0
Long term probability flicker severity (P_{lt})	MV-HV	0.65
	MV	0.8

A.3. Limit of Harmonic Injection

The rooftop solar power system shall not inject harmonic current and voltage into the supply system of national grid exceeding the values given below:

Harmonic Voltage Limits

Bus Voltage at point of coupling	Maximum individual Harmonic component (%)	Maximum Total Harmonic Distortion (TIID) (%)
1kV and less	5.0 %	8.0 %
1 kV<V≤69 kV	3.0 %	5.0%
69 kV<V≤161 kV	1.5%	2.5%
Above 161 kV	1%	1.5%

Odd Harmonic Current Distortion Limits as % of Inverter Rated Current

For volage 69 kV or less						
$SCR=I_{SC}/I_L$	h<11	11≤h<17	17≤h<23	23≤h<35	35≤h	TDD
<20	4.0	2.0	1.5	0.6	0.3	5.0
20-50	7.0	3.5	2.5	1.0	0.5	8.0
50-100	10.0	4.5	4.0	1.5	0.7	12.0
100-1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0
For 69 kV<V≤161 kV						
<20	2.0	1.0	0.75	0.3	0.15	2.5
20-50	3.5	1.75	1.25	0.5	0.25	4.0
50-100	5.0	2.25	2.0	1.25	0.35	6.0
100-1000	6.0	2.75	2.5	1.0	0.5	7.5
>1000	7.5	3.5	3.0	1.25	0.7	10.0
For volage above 161 kV						
<50	2.0	1.0	0.75	0.3	0.15	2.5
50 or more	3.5	1.75	1.25	0.5	0.25	4.0

For h ≤ 6, even harmonics are limited to 50% of the harmonic limits shown in the tables above. For 8 ≤h < 50, even harmonics range is as specified in the tables for odd harmonics above.

Where:

SCR = Short circuit ratio (Utility short circuit current at point of common coupling divided by the Customer average load current)

h = Harmonic number

ISC = Utility short circuit current at the point of coupling

IL = Current average load current

TDD = Total Demand Distortion

A.4. Other issues to maintain quality of electricity in the supply system of national grid

For other aspects of protection and maintaining quality of electricity from rooftop solar power system, relevant International Standards shall be followed.

A.5. Arc-Fault Circuit Interrupter (AFCI)

The solar system on the roof shall have a disconnect device that protects the Arc-Fault Circuit Interrupter (AFCI). The inverter must meet technical requirement in accordance with the international standard, IEC 63027. Proof of AFCI function must be provided at the time of application for actual-project's site inspection, after installation, must attach the certification by independent inspection agencies such as TUV, Bureau Veritas and Intertek.

B. Anti-islanding

The rooftop solar power system that installed with connection to supply system of national grid shall follow anti-islanding to protect safety in the operation of supply system of national power grid as follow:

The design and installation of the rooftop solar PV system, that is installed for connection to the supply system of national grid, shall be equipped with appropriately rated protective devices to sense any abnormality in the national grid system and carry out automatic isolation of the solar PV system from the national grid system. The automatic isolation or islanding of rooftop solar power system shall ensure that during disconnection period there is no electricity supply injection to the national grid regardless of low or over voltage conditions.

Adequate rated fuses and fast acting circuit breakers on input and output side of the inverters and disconnect/isolating switches to isolate DC and AC system for maintenance shall be provided.

6.5.2. Civil works / physical structure standard

The preparation of civil works and physical structure of any category of rooftop solar power system shall follow technical conditions as below:

- The solar PV array shall be installed on the terrace or on ground in the premise shall be free from any obstruction and/or shadow to minimize effects of shadows due to adjacent solar PV panel rows.
- Solar PV arrange shall be oriented in the South direction to maximize energy yield
- The solar PV array must be installed on the rooftop in such a way that there is sufficient space on the rooftop for maintenance etc.
- The solar PV installation should not have any damage whatsoever to the rooftop to avoid leakage or rainwater filtration from the rooftop.
- Should apply waterproof layers on roof surface and have a suitable slope before erecting the footing for the solar PV module mounting structure to fully ensure roof is entirely leakproof.

- Should have ample clearance between the inverter and DC/AC distribution boxes for adequate cooling and ease of maintenance.
- During cabling the solar PV array, care must be taken such that no loose cables lie on the rooftops.
- After installation of solar PV array, the roof top should look clean and tidy.
- During the system installation, should follow principles of neatness, tidiness, and aesthetics.
- Reinforced Cement Concrete (RCC) Works – all materials used viz. Cement reinforcement, or steel beams shall be as per relevant standard. Reinforcement would need to be done with high strength and based on a suitable standard.
- Brick Works (if any) – shall use 1st grade bricks and waterproof cement plastering by adhering to a quality standard.
- Display of mandatory items – near to inverter shall have diagrams displaying the connections of the installation.
- For painting on concrete, masonry, and plastered surface there should be a suitable standard.
- All Civil works required for the installation of the solar PV array, other electrical works in evacuation infrastructure, wherever necessary, shall be the responsibility of the solar PV installation service provider.
- The arrangement of inverter accommodation shall be designed to enable adequate heat dissipation. Mount within the existing infrastructure available in consultation with the person-in-charge of the premise. The series inverters should have a roof over to protect against rainwater and weather to the local climatic conditions.

6.5.3. Metering standard

Metering requires two meters in the case of Category 2 wherein 1st meter for recording amount of energy produced by the rooftop solar power system, and 2nd meter is to record electricity drawn from the national power grid system. Energy meters should be installed and maintained in accordance with standard provisions in Cambodia.

6.5.4.Earthing standard

All rooftop solar PV system should have a dedicated earthing system that conforms to an international standard, such as regulation IS:3043 2018 "Code of practice for earthing (Second Revision)," that governs the earthing practices of solar PV systems and IS 732:2019 "Code of practice for electrical wiring installations (Fourth Revision)".

6.5.5.Lightning standard

All rooftop solar PV system should be provided with lightning and over voltage protection. The source of over voltage can be lightning or other atmospheric disturbance. The lightning conductors shall be made as per applicable standards to protect the system from lightning strikes.

7. Establishment of One-Window-Service Web Portal

To support the control of issuance of permit to use rooftop solar power in Cambodia and monitor the implementation to be easy and effective, *"Principles for permitting the use of Rooftop Solar Power in Cambodia"* sets out to establish one-window-service web portal. The one-window-service web portal in this Principles refers to the website that was established to support all relevant works on the rooftop solar power in Cambodia as defined below:

- Collect all relevant information on rooftop solar power such as regulations, standards, procedures, data, quota systems, instructions, and announcements;
- Facilitate processing of Applications to use rooftop solar power from the requesters;

- Coordinate between Ministry of Mines and Energy, Electricity Authority of Cambodia, Electricité du Cambodge, and rooftop solar PV installation service providers in processing of applications – issuance of permit, technical approval after complete installation, and financial approval.
- Announce the Quotas, and permits related to rooftop solar power application in Cambodia;
- Provide monitoring table with all necessary data and information on applications that Electricité du Cambodge can study and analyse the impact on national power grid operation, and can allow Electricité du Cambodge to report back on the impact of each application;
- Provide data and information helping the Ministry of Mines and Energy in conducing study to improve the policy on energy sector development in the future; and
- The One-Window-Service Web Portal can define rights in using the website between Ministry of Mines and Energy, Electricity Authority of Cambodia, Electricité du Cambodge, rooftop solar PV installation service providers, the applicants to use rooftop solar power, and public to have different level of access according to their respective role, duty, and responsibility.

Because the Electricity Authority of Cambodia is the regulator and arbitrator of all relevant parties, the one-window-service web portal shall be established and managed by the Electricity Authority of Cambodia. The Electricity Authority of Cambodia shall prepare and issue a decision on the contents, establishment, management, and use of the one-window-service website.

8. Conclusion

The "Principles for permitting the use of Rooftop Solar Power in Cambodia" is the important approach to support the use of rooftop solar power of electricity consumers. When the "Principles for permitting the use of Rooftop Solar Power in Cambodia" is adopted, electricity consumers who have obligation to use rooftop solar power to fulfill environmental and climate change commitments will have priority in receiving quota for installation and own use of rooftop solar power in a framework ensuring technical and safety standards are adhered, ensuring economic effectiveness, and electricity price that has fairness among all parties including rooftop solar developers. The "Principles for permitting the use of Rooftop Solar Power in Cambodia" will play important role in realizing the obligations of Cambodia in greenhouse gas emission reduction under the Paris Agreement as stated in the Cambodia's Nationally Determined Contributions (NDCs).

Having seen the importance and necessary of permitting the use of Rooftop Solar Power in Cambodia, Ministry of Mines and Energy has decided to determine the "Principles for permitting the use of Rooftop Solar Power in Cambodia" as the principle in issuing permits to use rooftop solar PV in Cambodia. The principle has set the vision, goals, Permit Management Framework, management measures, and clear coordination mechanism for permitting to use rooftop solar power in Cambodia.

The Ministry of Mines and Energy hopes that the adoption of the "Principles for permitting the use of Rooftop Solar Power in Cambodia" will help promoting management of the permitting to use rooftop solar power in Cambodia to be clear, effective, transparent, and fairness that all relevant parties can accept in resolving the existing challenges.