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World Bank: Developing Sustainable Rooftop PV in Vietnam #1259789

HCMC and Danang

Final Inception Report

pwc

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Abbreviation

Acronym	Definition
BIDV	Bank for Investment and Development of Vietnam
CAIDI	Customer Average Interruption Duration
CAIFI	Customer Average Interruption Frequency Index
CIT	Corporate Income Tax
COD	Commercial Operation Date
CPC	Central Power Corporation
DOIT	Department of Industry and Trade
DPI	Department of Planning and Investment
DPPA	Direct Power Purchase Agreement
EIA	Environmental Impact Assessment
EPC	Engineering Procurement and Construction
ERAV	Electricity Regulatory Authority Vietnam
ESCO	Energy Service Company
EVN	Vietnam Electricity
EVNHCMC	Vietnam Electricity Ho Chi Minh City
FIT	Feed in Tariff
GDP	Gross Domestic Product
GTI	Global Tilted Irradiation/Irradiance
HCMC	Ho Chi Minh City
MOF	Ministry of Finance
MOIT	Ministry of Industry and Trade
MPI	Ministry of Planning and Investment
MVA	Mega Volt Amp
PDP	Provincial Development Plan
PPA	Power Purchase Agreement
PPC	Provincial People's Committee
RRP	Recommended Retail Price
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SCADA	Supervisory Control and Data Acquisition
TOR	Terms of Reference
USD	United States Dollar
VAT	Value Added Tax
VND	Vietnamese Dong

1. Background

1.1. Objectives

World Bank group has appointed PricewaterhouseCoopers (PwC) as the "Consultant" under selection #1259789 to provide strategic advice to World Bank, Ministry of Industry and Trade (MOIT) and Vietnam Electricity (EVN) for the Development of Sustainable Rooftop PV Program in Da Nang and Ho Chi Minh City. Under this program, PwC along with Baker McKenzie (BM) shall provide support in developing business models for rooftop solar PV deployment in a sustainable and cost-competitive manner leveraging private sector investments and integrating rooftop PV along with other disruptive technologies into Development Plan for the cities of Danang and Ho Chi Minh City (HCMC).

Electricity consumption in Vietnam is on a rapid rise with a CAGR of 11% over the last 5 years and is expected to nearly triple from 2018 through to 2030[1]. The Revised National Power Development Plan VII (Revised PDP VII) in 2016 sets long-range goals for the power generation capacity. The anticipated generation capacity mix by 2030 is coal (55 GW), hydro (22 GW), gas (19 GW), nuclear and imports (6 GW) and renewables (27 GW). GoV has set a target[2] of Solar PV development in the country at 850 MW by 2020, 4 GW by 2025 and 12 GW by 2030, the current levels of solar capacity is 290 MW as on March 2019.

Globally, deployment of utility-scale solar PV projects have enabled countries to meet their climate change commitments and renewable energy targets. However, small – scale rooftop solar PV systems also represent an important part of the market and are bringing the benefits of Solar PV to residents, small businesses and cities.

In large metropolitan areas, energy supply system is facing challenges due to increasing urbanization, aging infrastructure and increased dependency on external grid. Thus, requiring utilities to focus on quality and reliability of power more than ever before. Rooftop solar PV systems offer competitive economics and reliable solutions to these challenges, integrating with other developments in cities including flexible load requirements from EVs, other smart devices etc.

Danang and Ho Chi Minh City (HCMC) cities present similar challenges and thus makes it important for GoV to adopt the solar rooftop business models and policy solutions accordingly.

The key elements of this engagement are:

- Business Model: Understanding development barriers and suggest business models for implementation of Rooftop PV program in Vietnam considering the consumer dynamics of Danang and HCMC.
- Pilot Deployment Scheme: Develop the mechanism of a pilot deployment scheme in these two cities based on recommended business models and distribution network capabilities study being undertaken by World Bank.

[1] MOIT, EVN Annual Report and National Power Development Plan VII - Revised
[2] According to the Revised Power Development Plan VII; Current Installed capacity as per NLDC

1.2. Our approach and progress

The figure below outlines the key tasks, as per the scope of services and the subsequent discussions:-

• Relevant national electricity sector policies and developments • Experiences from solar rooftop in other jurisdictions • Take note of readiness conditions, market evolution, developments in HCMC and Danang city. • Discussions with stakeholders	• Identify legal, regulatory and institutional barriers for Rooftop PV deployment • Assess consumer categories and energy scenario in HCMC and Danang city • Review and propose different business models for rooftop PV deployment • Finalise the strategy and determine a workable business model	• Propose pilot scheme for deployment of selected business model based on distribution network study by WB. • Finalise the deployment scheme for the two cities to be adopted based on consultative workshop.

This report covers the preliminary review of legal and regulatory framework governing the deployment of Rooftop PV in Vietnam along with the status of Solar Rooftop in Danang and HCMC. It also covers global learnings on Rooftop PV models implemented in United States of America primarily New York and California, Germany and India.

An Information Request list to EVN/MOIT has been provided along with this report (Section 5 of this report), to analyze the consumer load profile, consumption pattern, seasonality, Time of day usage and tariff structure for potential deployment model for rooftop systems in HCMC and Danang cities. Such relevant data shall assist in undertaking assessment to determine the potential barriers and solutions for business models for these two cities for the next stage of the report.

1.3. Key interactions and milestones

Following interactions are proposed as part of engagement.

- June last week - meeting with cities PCs and EVN to present inception report along with global learnings.
- August last week - workshop on deployment barriers and business models for these cities
- October last week - workshop on pilot deployment scheme for Rooftop (this is subject to the timelines under study of WB on distribution network capabilities)

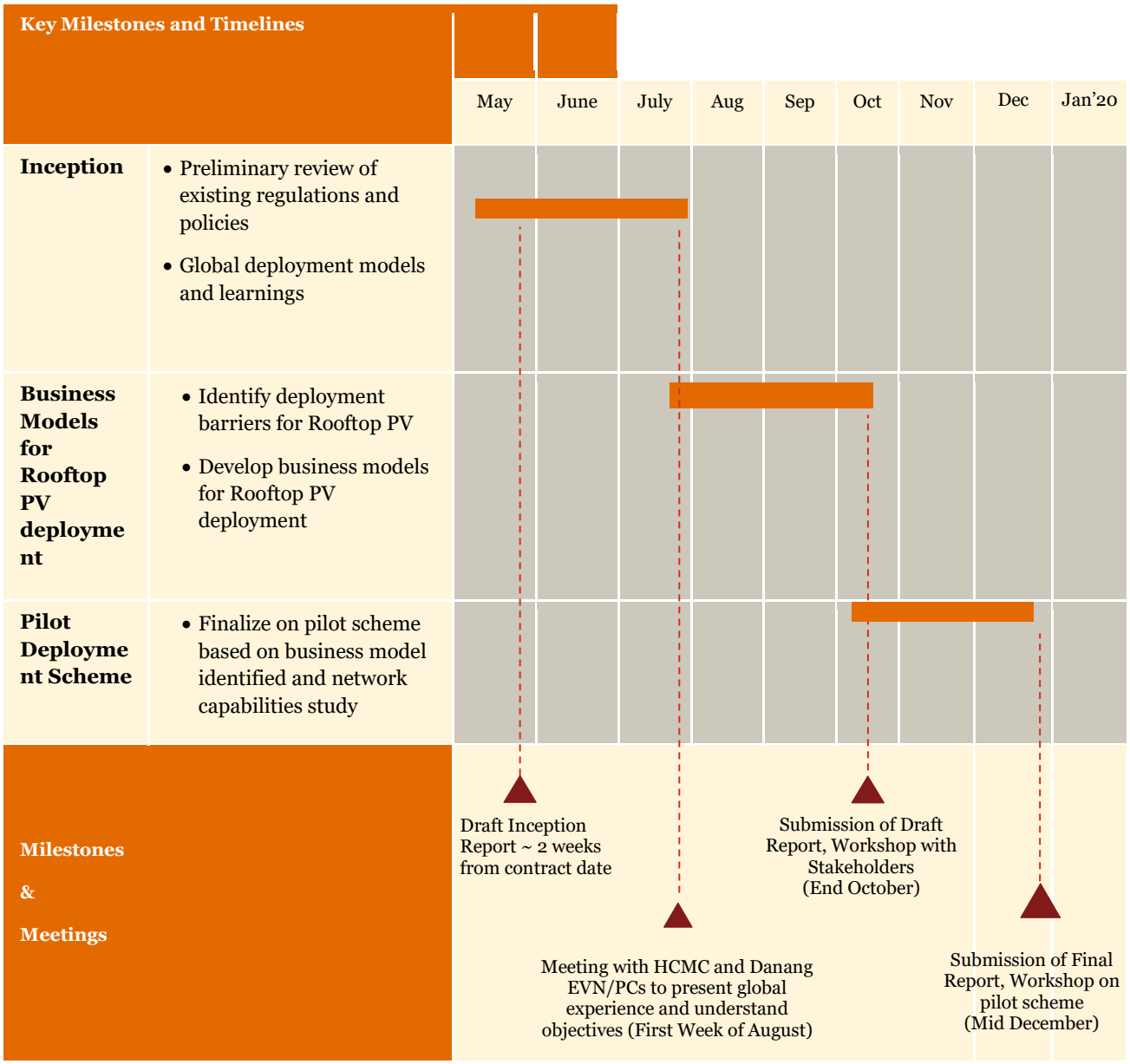


Table 1: Timelines and Deliverables

1.4. Key stakeholders and roles

This section provides an overview of the key stakeholders who are to be engaged in the solar rooftop PV deployment in Danang and HCMC. The purpose is not to comment or recommend, but is for purposes of preparation viz., to identify them and their roles, so that it is suitably covered in the consultation process.

Policy makers both at National and at Province level have a key role, not just in finalizing the rooftop deployment scheme, but in facilitating implementation models as well, such as budgetary support for infrastructure build, regulatory support for grant of incentives, and administrative support for boosting consumer confidence including awareness of Rooftop PV.

In countries that had a successful solar rooftop PV program, strong state support was a key ingredient including for resolution of difficulties (i.e., conflict with other state laws & regulations) and willingness to test progressive ideas as they came up during the consultations or at pre-development stage.

The relevant stakeholders and the key role supporting the solar rooftop scheme are outlined in table below..

Table 2: Key Stakeholders for Rooftop PV deployment

Institutions	Roles and responsibilities for rooftop solar deployment
Key stakeholders at National level	
Ministry of Industry and Trade (MoIT)	• Issuing FiT/tariff applicable for solar rooftop projects, including fluctuations of VND-USD exchange rate for the coming year • Adopt technical regulations on solar rooftop, regulations on connection and metering of electrical energy, provide instruction for the connections and installation of meters, guidance on documentation requirement • Coordinate with ministries to develop Technical standard for the combined use of rooftop solar energy with energy system in constructing apartments and building • Notification and selection of registered vendors or suppliers for Rooftop PV • Guidance to ministries and PCs in issuing policies to promote the investment in rooftop solar development. • Adopt the business model and pilot deployment scheme for the two cities; apply the pilot models to scale up the rooftop solar development nationwide. • Budgetary provisions for rooftop solar investment and promotion.
EVN	• Co-responsibility for grid planning (with EREA and MOIT), capacity addition and grid reinforcement based on rooftop solar deployment. • Provide inputs on technical standards, grid connection process, and payment mechanism applicable to rooftop solar projects. • Lead and engage other power subsidiaries/power corporations in the promotion of rooftop solar development at national and provincial level.
Ministry of Construction (MoC)	• Build technical standards for the combined use of rooftop solar energy with energy system in constructing apartments and buildings. • Publish/notify registered vendors or suppliers for Rooftop PV who are pre-approved/selected.
Ministry of Planning and Investment (MPI)	• Adopt policies to promote the investment in rooftop solar development, both public and private sector investments.
Key stakeholders at City level	
People's Committee	• Monitoring, controlling and inspecting the execution of solar rooftop projects in the cities. • Develop the city master planning considering rooftop solar development targets. • Coordinate with MOIT to identify and implement the appropriate rooftop solar PV deployment scheme. • Provide incentive package to encourage rooftop solar project owners and investors. • Implementing compensation for infrastructure and human resource to invest, carry out and develop solar power projects

Institutions	Roles and responsibilities for rooftop solar deployment
	• Manage activities relating to rooftop deployment in the communes and districts pursuant to the regulations
Department of Industry and Trade (DoIT)	• Carry out the action plan and pilot deployment road map in HCMC and Danang. • Adopt and implement MOIT's support mechanism, business models, and standard PPAs for each particular rooftop solar model.
EVN HCMC & Danang Power Corporations	• Upon receipt of request for rooftop solar interconnection, validate and inform customer on the feasibility of the interconnection plan. • Sign and execute PPAs for rooftop solar PV projects connected to the grid as per identified business models. • Monitor and control the installed capacities of the grid-connected rooftop solar PV projects as per approved targets. • Promote awareness among project owners on selecting and installing PV panels and inverters.
Consumers	• Implement rooftop models as per relevant regulations and policies • Adopt rooftop PV in households, buildings, factories, warehouses and industrial zones to integrate rooftop solar deployment for their energy needs. • Adopt demand side management practices and reduced dependence on grid. • Participate in demand response models as the grid/market matures
ESCOs/EPC/ Manufacturers	• ESCOs invest or develop solar PV projects on leased rooftop through third party ownership models • Comply with policy requirements as provided in regulations to avail incentives on Rooftop PV • Register with MOIT/MOC for compliance with required technical standards • Existing key players in HCMC and Danang are Solar BK, Redsun.
Banks/ Financial Institutions	• Provide priority lending to Rooftop PV sector • Deploy schemes combined with mortgage/housing loans for residential rooftop deployment

2. Rooftop Policy and Regulations

Vietnam government and ministries have built up a regulatory framework for the development of solar projects in general and rooftop solar projects in particular, representing the whole value-chain from conceptualization to implementation for rooftop solar power development in Vietnam. A list of key legal documents, government policies, guidelines, regulations that governs Rooftop PV deployment are listed below.

a) Current legal regulations

List of current legal regulations applicable for solar rooftop PV deployment is provided below

Type	Relevant Decisions and Circulars
Regulations providing enabling provisions or market structure	• Decision No. 2068/QD-TTg dated 25 November 2015 of the Prime Minister approving development strategy of renewable energy of Vietnam until 2030, vision until 2050 ("**Decision No. 2068**"). • Law No. 28/2004/QH11 adopted by the National Assembly on 3 December 2004 on Electricity as amended and supplemented ("**Law on Electricity**"); • Civil Code No. 91/2015/QH13 adopted by the National Assembly on 24 November 2015 ("**Civil Code**"); • Law No. 36/2005/QH11 adopted by the National Assembly on 14 June 2005 ("**Commercial Law**"); • Law No. 68/2014/QH13 adopted by the National Assembly on 26 November 2014 on Enterprises as amended ("**Enterprise Law**"); • Law No. 67/2014/QH13 adopted by the National Assembly on 26 November 2014 on Investment as amended ("**Investment Law**"); • Law No. 47/2010/QH12 adopted by the National Assembly on 16 June 2010 on Credit Institutions, as amended ("**Law on Credit Institutions**"); • Law No. 21/2017/QH14 adopted by the National Assembly on 24 November 2017 on master planning ("**Law on Master Planning**"); • Decree No. 39/2014/ND-CP of the Government dated 7 May 2014 on operations of financial institutions and financial leasing institutions ("**Decree No. 39**"); • Decree No. 50/2016/ND-CP of the Government dated 1 June 2016 on penalties for administrative violations against the regulations on planning and investment ("**Decree No. 50**"); • Decree No. 37/2019/ND-CP of the Government dated 7 May 2019 on implementation of the Law on Master Planning ("**Decree No. 37**"); • Decision No. 648/QD-BCT of the Ministry of Industry and Trade dated 20 March 2019 on adjustment of average retail electricity tariff and regulating electricity selling tariffs ("**Decision No. 648**"); • Circular No. 30/2015/TT-NHNN of the State Bank of Vietnam dated 25 December 2015 on regulations on issuance of licenses, organization and operation of non-bank credit institutions ("**Circular No. 30**");

Type	Relevant Decisions and Circulars
Regulations providing enabling provisions for Solar/ Solar Rooftop	• Decision No. 11/2017/QD-TTg of the Prime Minister dated 11 April 2017 on the mechanism for encouragement of the development of solar power projects in Vietnam ("**Decision No. 11**"); • Decision No. 02/2019/QD-TTg of the Prime Minister dated 8 January 2019 amending and supplementing a number of articles of Decision No. 11 ("**Decision No. 02**"); • Circular No. 16/2017/TT-BCT of the Ministry of Industry and Trade dated 12 September 2017 on project development and model power purchase agreements for solar power projects ("**Circular No. 16**"); • Circular No. 05/2019/TT-BCT of the Ministry of Industry and Trade dated 11 March 2019 amending and supplementing a number of articles of Circular No. 16 ("**Circular No. 05**")[3]; • Official Letter No. 1532/EVN-KD of Vietnam Electricity (EVN) dated 27 March 2019 on guidelines for implementation of rooftop solar power projects ("**Official Letter No. 1532**"); • Official Letter No. 1534/BTC-CST of the Ministry of Finance dated 31 January 2019 on incentive policies for rooftop solar power projects with installed capacity of not exceeding 50kW sent to Tax Departments and Customs Departments of Provinces and Cities under Central Government ("**Official Letter 1534**").

b) **Draft legal regulations**

In addition, the Government of Vietnam is also working on the Drafts Decisions on providing Support Mechanism after Decision 11 for encouraging the development of solar power in Vietnam, applicable from 1 July 2019.

2.1. Regulations applicable for Rooftop PV deployment

The current framework on solar power as provided under Decision No. 11 is effective only until 30 June 2019 (i.e., the first Feed-in-Tariff program) for both utility scale solar and solar Rooftop PV projects.

The Government is working on a new framework applicable from 1 July 2019 (i.e., the second Feed-in-Tariff program), review of the respective two (2) programs is provided below:-

Current Legal Framework (effective until June 30, 2019)

Timeline of select key regulations and decisions relevant to rooftop solar projects in specific are illustrated below:

[3] Circular No. 05 takes effect from 25 April 2019.

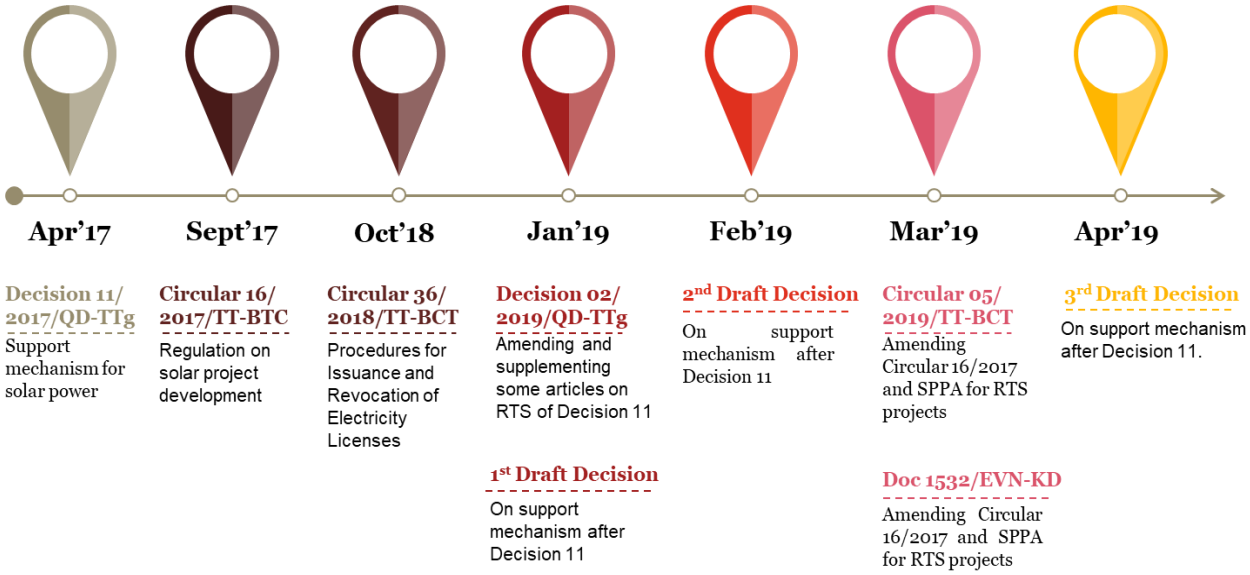


Figure 1 Key regulations applicable for Rooftop PV

1. Decision 11/2017/QD-TTg ("Decision 11") dated April 2017

Decision on the Support mechanisms for the Development of Solar Power Projects in Vietnam

Table 3: Salient features of Decision 11/2017/QD-TTg relevant to Rooftop

Salient points	• Solar power development plans built on a vision for 2030 at a national & provincial scale, for grid connected projects • Introduced the net-metering scheme for rooftop solar power projects.
Counterparty	• EVN to buy all electricity produced by approved solar power projects • It is contracted as per a standard solar power purchase contract (20 year term with extension provision) provided by the Ministry of Industry and Trade.
Pricing mechanism	• Recommended Retail Price (RRP) for grid-connected projects is listed at US 9.35 cents per kWh. This tariff is applicable for the term of PPA. • It is applicable to grid-connected solar PV projects with solar cell efficiency of greater than 16% (or module efficiency of greater than 15%). The electricity purchase price shall be adjusted as per variations in VND/USD exchange rate. • Implement rooftop projects via net metering with two-way electricity meters. If the volume of electricity generated is greater than the amount consumed, the surplus is carried forward to the next trading cycle. At the end of the year or upon termination of the agreement, surplus amount of energy will be sold to the buyer at the price specified in the power purchase agreement (refer to the price above).
Incentives	• There are incentives such as investment capital and tax incentives[4] potentially allocable. • Land incentive[5] - solar PV projects and transmission lines and sub-stations for connection to the national power grid are exempt from land use levies and land rents in line with the current law for projects in the field of investment incentives); import

[4] Decree No. 118/2015/NĐ-CP dated 12 November 2015: Article 16
[5] Decree No. 46/2014/NĐ-CP dated 15 May 2014: Article 19, Article 20

	tax exemption[6] (raw materials, supplies and semi-finished products that cannot be produced domestically).
Contract terms	• Sale of electricity on a standardized Power Purchase Agreement[7] with 20 year term, and extended as mutually agreed by the parties.

Key Takeaways

a) Excess generation net of consumption at the end of the year shall be payable at tariff linked to the USD/VND exchange rate. The tariff applicable considering exchange rate fluctuation is VND 2,086/kWh before 1st Jan 2018, VND 2,096 /kWh for 2018 and VND 2,134 /kWh for 2019.

b) This FiT is applicable for both type of solar projects- Rooftop and Ground mounted.

c) The FiT is lower than peak hour tariff as per Time of Use[8] as given below.

- Industrial- VND 2,964 per kWh,
- Commercial- VND 4,587 per kWh

2. Circular 16/2017/TT-BCT ("Circular 16") dated September 2017

Circular on Project Development and Model PPA applied to solar projects

Table 4: Salient features of Circular 16/2017/TT-BCT

Salient points	• The Circular details additional instruction for Decision 11. • It specifies for a solar project: (i) Planning and development aspects, (ii) Sell price of electricity generated by grid connected solar projects and rooftop solar power projects, (iii) Standard PPA for grid and rooftop projects, and (iv) role of key institutions.
Limiting conditions	• Circular 16 sets out the conditions for developing a solar project. A project must be contained in the provincial or national master plan for solar power development, and if it is not, the sponsor should apply for such a listing.
Licensing requirement	• Solar projects, both grid-connected and rooftop, of capacity 1 MW or above must meet licensing requirements of the MoIT.
Power Purchase Agreement	• The use of model PPAs is mandatory for the sale and purchase of power generated from rooftop projects between the owner of a rooftop project and the power purchaser (i.e., the relevant local / regional EVN's Power Corporations)[9]. • Parties to this model PPA (i.e., the building owner and EVN) may supplement certain contents to the model PPAs to clarify their rights and obligations but may not change the substantial contents of the model PPAs[10]. • As such, the room for negotiation or revisions or amendments to the model PPAs are generally limited.

[6] Circular No.83/2016/TT-BTC guiding the implementation of investment incentives: Article 5
[7] For template of draft SPPA, please see the annex.
[8] Refer to Appendix A1 for more detail
[9] Circular No. 16, Article 17.
[10] Circular No. 16, Article 18.

Key Takeaways

a) The risk sharing mechanism provided in the PPA has few limitations. For instance, it does not provide compensation in event of EVN is unable to offtake the power generated. Similarly, in the event the grid access is unavailable due to planed outages, the PPA offers no financial safeguards (such as deemed generation).

b) It is important to assess whether the model PPA for Rooftop PV is adopted by EVN, considering various risk sharing gaps in PPA. Given that, MOIT and the MOF had no guidance on the finalization, payment scheme and invoicing mechanism for such net-metering purposes.

c) Under Circular No. 16/2017, there are certain limitations for revisions to the model PPAs, specifically:

i. The use of model PPAs is mandatory for the sale and purchase of power generated from rooftop projects between the owner of a rooftop project and the power purchaser (i.e., the relevant local / regional EVN's Power Corporations).[11]

ii. Parties to this model PPA (i.e., the building owner and EVN) may supplement certain contents to the model PPAs to clarify their rights and obligations, but may not change the substantial contents of the model PPAs.

3. Decision No. 02/2019/QD-TTg ("Decision 02") dated January 2019

Amendments and Supplements to certain Articles of Prime Minister's Decision No. 11/2017/Qd-Ttg dated April 11, 2017 on Mechanism for Encouragement of Development of Solar Power in Vietnam

Table 5: Salient features of Decision No. 02/2019/QD-TTg

Salient points	• Promulgates new payment scheme to address the net-metering issue of the rooftop solar power projects under Decision 11 • Responsibilities of government agencies particularly MOIT and MOF are amended
New payment scheme for rooftop solar power projects	• Rooftop solar power projects shall be entitled to a mechanism for purchase and sale of electricity that separates the direction of delivery of electricity from the direction of receipt of electricity in two-way/bidirectional meters. This mechanism has replaced the previous net-metering scheme under Decision No. 11. • Accordingly, the electricity seller must pay for any energy output received from EVN's power grids (i.e., import energy if any) in accordance with the relevant existing regulations (i.e., retail tariff with EVN). • On 20 March 2019, the MOIT issued Decision No. 648 to specify the new average retail power tariff level of VND 1.864.44 per kWh (exclusive of VAT) as well as the new retail tariff rates to be applied from 20 March 2019. Accordingly, the retail electricity tariff structures and allocations vary between different types of customers (industrial, commercial and household / residential), voltages and time-of-use (peak, normal and off-peak hours), as detailed in Annex A1. • The electricity buyer (i.e., relevant EVN's Power Corporations) shall pay for any energy output generated to EVN's power grids from rooftop solar power projects (i.e., export energy if any) at the purchase tariff as regulated by the MOIT, as discussed further below. • All rooftop solar power projects having their commercial operation date (operation and metering confirmation) prior to 1 July 2019 will enjoy FIT of US$9.35/kWh under Decision 11. The price of rooftop solar power for following year must be adjusted according to the exchange rate between Vietnamese Dong and USD issued

[11] Circular No. 16, Article 17.

	by the State Bank of Vietnam on the last date of release of exchange rate in the previous year. • Removes the condition that the electricity is sold to the buyer once a year, at the end of the year, or when the contract is terminated. • The MOIT shall promulgate technical regulations on solar power, regulations on measurement of energy of solar power projects and provide instructions on the connection, installation of electricity meters and the calculation of rooftop solar power project.
Change in responsibilities of government agencies	• The Ministry of Industry and Trade will now promulgate regulations on connection of solar power projects and it will no longer be required to provide instructions on the calculation of the net-metering mechanism, as such, mechanism has been removed. • The Ministry of Industry and Trade will also be required to provide instructions on calculating purchase prices for solar projects in accordance with the VND-USD exchange rate; instead of imposing adjusted purchase prices for solar power projects for the following year based on the VND-USD exchange rate. • The Ministry of Finance is no longer required to consider amending regulations on exemption of rooftop projects from taxes and fees.

Key Takeaways

a) Rooftop solar power projects shall be entitled to a mechanism for purchase and sale of electricity that separates the direction of delivery of electricity from the direction of receipt of electricity in two-way/bidirectional meters. This mechanism has replaced the previous net-metering scheme under Decision No. 11.

b) Accordingly, the electricity seller must pay for any energy output received from EVN's power grids (i.e., import energy if any) in accordance with the relevant existing regulations (i.e., retail tariff with EVN), as detailed in tariff structure (Appendix A.1).

c) The electricity buyer (i.e., relevant EVN's Power Corporations) shall pay for any energy output generated to EVN's power grids from rooftop solar power projects (i.e., export energy if any) at the purchase tariff as regulated by the MOIT, as discussed further below.

- The current regulations of Decision No. 02 and Decision No. 11 **take effect only until 30 June 2019** and the tariff of US 9.35 cent/kWh mentioned above will be applicable to rooftop solar power systems which comes into commercial operation and finalize meter readings before 1 July 2019.
- In such case, this tariff will be applicable for the **PPA term of 20 years**[12] from the actual commercial operation date.
- For rooftop solar power projects and systems which achieve COD from 1 July 2019 afterwards, a new FiT for rooftop solar power will apply as discussed in relation the Draft Decision[13], which is proposed to replace the current regulations of Decision No. 02 and Decision No. 11 and prevails EVN's existing guidelines.

[12] Extension provision on mutually agreed terms
[13]Refer First Draft dated January 2019 and Second Draft dated February 2019 and Third Draft dated April 2019

4. Circular No. 05/2019/TT-BCT ("Circular 05") dated 11 March 2019

Amending Circular 16 and providing additional guidelines on the payment mechanism for energy output generated and exported from rooftop solar power projects to EVN's grids.

Table 6: Salient features of Circular No. 05/2019/TT-BCT

Salient points	• Effective from 25 April 2019, Circular No. 05 provides **a new model power purchase agreement (PPA) template for rooftop solar power projects**, replacing the previous Circular No. 16's rooftop solar PPAs for implementing the new scheme of Decision No. 02 for rooftop solar. • It also includes further clarifications on tariff payments for power exported from rooftop solar power systems to EVN's grids, invoicing and payment settlements, required timelines and obligations of rooftop power generators and EVN.
Abolishing the net-metering mechanism	• Circular 05 abolished the payment calculated by net-metering mechanism for rooftop solar power projects. Particularly, amount of power loaded from project to grid and amount of power received from grid will be separately calculated without using net-metering mechanism.

Calculating the power purchase price	• Circular 05 amended Article 16 of Circular 16 as follows:
	  • Before 1 January 2018, the power tariff was VND 2,086 per kWh (excluding VAT, equivalent to 9.35 US cents per kWh, based on the central exchange rate of VND 22,316/USD announced by the State Bank of Vietnam on 10 April 2017);
	  • From 1 January 2018, the power tariff above will be adjusted in accordance to the VND-USD exchange rate fluctuation based on the central exchange rate of Vietnamese dong to US Dollars announced by the State Bank of Vietnam on the preceding year's last date of announcement of such exchange rate.

Energy Payments and Billing Period	• Under Circular No. 05, based on power output agreed by both parties and the power tariff as discussed above, EVN is required to make energy payments to the power seller for power exported on a monthly basis[14]. • In terms of timeline relating to EVN's payment, Circular No. 05 provides that it must be made within seven (7) working days from the date on which: (A) the power seller agrees with EVN on meter readings and output of power generated and exported to EVN's grid (as notified by EVN), and (B) Sufficient set of payment request and supporting documents has been submitted to EVN. Documents like statements of monthly meter readings and energy output, invoices issued by the power generator (in case the power generator is a business company which issues invoices on a monthly basis); and relevant tax documents including applicable taxes and official fees (if the revenue is subject to taxes)[15]. • If EVN fails to make energy payment to the power seller within the above-mentioned timeline, Circular No. 05 provides that EVN is required to pay late payment interest on the entire amount of late payments, which will be accumulated the date preceding the due date until the date on which EVN makes actual payment. The late payment

[14] Article 4.1(b) of Model PPA for rooftop solar power projects under Annex to Circular No. 05.
[15] Article 4.3(a) and 4.1 of Model PPA for rooftop solar power projects under Annex to Circular No. 05.

	interest is determined based on a one (1) -month average interbank interest rate as announced by the State Bank of Vietnam at the time of EVN's payment.[16]
Amendments to the model power purchase agreement	• The annual power purchase price of agreement will be amended based on the central exchange rate of Vietnam dongs against the US dollar announced by the State Bank of Vietnam on the last announcement day of previous year; • Regulating on monthly payment for amount of power loaded from project to grid to project owner being enterprise and project owner being individual or organization other than enterprise; • There is no longer regulation on the net-metering mechanism; • Regulating the payment and invoice issuance of value added tax to the revenue from power loaded from project to grid.

Key Takeaways

a) Decision No. 02 has changed the rooftop solar power scheme from a net-metering scheme to a scheme of separation of import power and export power as discussed above. Specifically, earlier, under Decision No. 11's net-metering scheme, consumed energy and generated/exported energy output were netted off for each payment cycle. Under the new scheme of Decision No. 02, there is be no provision for netting off between consumed energy and generated/exported energy. The consumer shall pay for the import of energy from grid for its own consumption at retail supply tariff and will get credit for the export of energy as per the prevailing feed-in-tariff. This Circular No. 05 provides template for rooftop solar PPA to govern the case in which there is excess energy exported by the building owner to EVN's grids.

b) The model PPA regulated by the MOIT will apply to energy output **exported and sold to EVN only.**

c) The model PPA provides details on metering and billing arrangement. Refer to Appendix A.2 for further details.

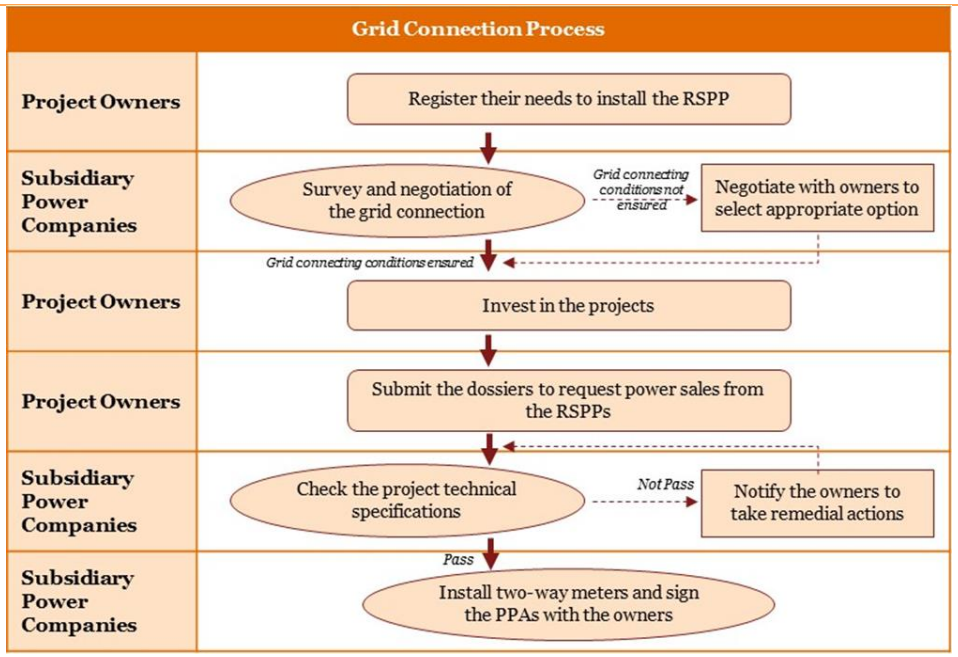
5. Doc 1532/EVN-KD - Implementation guidelines of EVN for Rooftop Solar projects dated 27 March 2019

This document details the implementation guidelines for rooftop solar projects issued by EVN to its subsidiaries and Power Corporations.

Table 7: Salient features of Doc 1532/EVN-KD

Salient points	• EVN authorizes its subsidiaries to sign and execute PPAs for rooftop solar PV projects connected to the grid parts under the latter's respective control in accordance with the Decision No.67/QD-EVN dated February 28, 2018. • Power Corporations shall closely monitor and control the installed capacities of these grid-connected rooftop solar PV projects to avoid overload of distribution grids and transformers. • Power Corporations shall advise project owners on choosing and installing PV panels, inverters with manufacturer's certificate of origin and certificate of quality and with high efficiency, durability and a long warranty period to ensure investment efficiency.

[16] Article 4.3(b) of Model PPA for rooftop solar power projects under Annex to Circular No. 05.

Grid Connection Procedures	 **For a rooftop solar PV project with capacity ≥ 1 MWp, the Project Owner shall prepare a solar PV development plan and obtain an electricity operation license as stipulated in Circular No. 16/2017/TT-BCT and Circular No. 12/2017/TT-BCT dated 31 July 2017 by the MOIT.*

Potential new legal framework (effective from 1 July 2019)

The Government has not officially issued final specific tariff and rooftop solar business models to be applied from 1 July 2019. Thus, this section is based on the information provided at draft stage and is subject to change per the forthcoming official Decision of the Prime Minister. The previous two drafts are detailed in Appendix A3.

Third Draft dated April 2019

Latest draft on support mechanism post applicability of the current Decision 11 (after 30 June 2019)

Table 8: Salient features of Third Draft dated April 2019

Salient points	• The Third Draft extends the application of new FiT mechanisms from 1 July 2019 to 31 Dec 2021 (instead of to 31 Jun 2021 as in Second Draft). • The Third Draft updates the classification of rooftop solar power models
Revised FiT mechanisms	• The Draft Decision proposes the same FiT format as Second Draft with same irradiance regional classification but removes "Solar project with integrated storage" technology. • There is no impact on FiT rates of Rooftop PV. Only the FiT rates for Floating solar power projects is increased by about 5.7%
Rooftop solar power models	The Third Draft updates the classification of rooftop solar model • **"Intermediary power sale and purchase" model** is removed from the Draft Decision. • The Third Draft included **"Excess power sale business" model,** which is defined as a model of rooftop solar power systems under which organizations and individuals invest in and install rooftop solar power systems to (i) sell parts of power energy

	outputs to other organization and individuals and (ii) sell excess power energy output to the national grid.
Technical requirements	• Under the Third Draft, rooftop solar power systems directly or indirectly connected with the national grid must register their grid connections with EVN or its authorized entities. • Investors of rooftop solar power systems must also ensure compliance with the requirements on electrical power safety and construction safety under the relevant legal regulations.
Next Steps	• In addition, the Draft Decision requires the MOIT to formulate detailed regulations on the procedures and formalities for grid connection registration, grid connection agreements, technical requirements for interconnection facilities and examination of conditions of grid connection for operation. • As the next step, the MOIT is required to fomulate new model PPA templates for rooftop solar projects under the "Whole power selling business model", "Consumption household model" and "Excess power selling model" (for the case of the power seller/developer selling excess electricity to the grid), as well as detailed guidelines for energy payments. The maximum term of the PPA for rooftop solar power projects is 20 years from the commercial operation date. Upon expiration of the PPA's term, the parties may extend the term or enter into a new agreeement in accordance with the applicable regulations. • With respect to the "Direct power sale and purchase" model and "Excess power selling model" (for the case of the power seller/developer selling to non-EVN power purchasers), the power seller/developer may freely reach an agreement with private power consumers/purchasers on tariffs and PPA terms in accordance with applicable legal regulations of Vietnam.

Key Takeaways

- The proposed tariffs for sale of power output from rooftop solar power systems to the national or EVN grids[17] are as follows:

Timeline for COD	Zone 1		Zone 2		Zone 3	
	VND/kWh	USD/kWh	VND/kWh	USD/kWh	VND/kWh	USD/kWh
1 July 2019 - 30 June 2020	2,448	9.85	1,933	8.47	1,697	7.43
1 July 2020-31 Dec 2021	2,203	8.86	1,740	7.62	1,527	6.69

Danang is included in Zone 2 and HCMC is in Zone 3.

- These FiT will be applicable for the solar rooftop PV projects commissioned before Dec 31, 2021. There is no clarity on applicable tariff beyond these timelines and whether rooftop systems will also be aligned with bidding mechanism planned for utility scale solar projects.

[17] For the "Direct power sale and purchase" model, under the Third Draft, the tariff and the terms of the direct power purchase agreement (DPPA) between the power seller/developer and private power consumers/ purchasers shall be "implemented in line with the current regulations" (which we understand mainly including: Civil Code, Commercial Law and other relevant implementing regulations). It implies that the parties to this DPPA may not be subject to the FiT for rooftop solar power systems or the standard terms of model PPA template regulated by the MOIT.

- Rooftop Solar models proposed as per latest draft of April 2019 by MOIT for prime minister approval are:

1. **"Power Consumption" model,**

   Defined as a model of rooftop solar power projects installed with a two-way metering system together with the household's power consumption system for directly consuming power generated from the household's rooftop solar power system, simultaneously receiving power directly from the grid of EVN/the Power Purchaser.

   Under this model, any excess energy output after self-consumption by the household will be backfed onto the grid. Payment and invoicing will be made separately between power output delivered/exported and power output received/imported by the household/business. This model is proposed following the recently issued Decision No. 02 of the Prime Minister on the new tariff mechanism for rooftop solar, which replaced the former net-metering scheme.

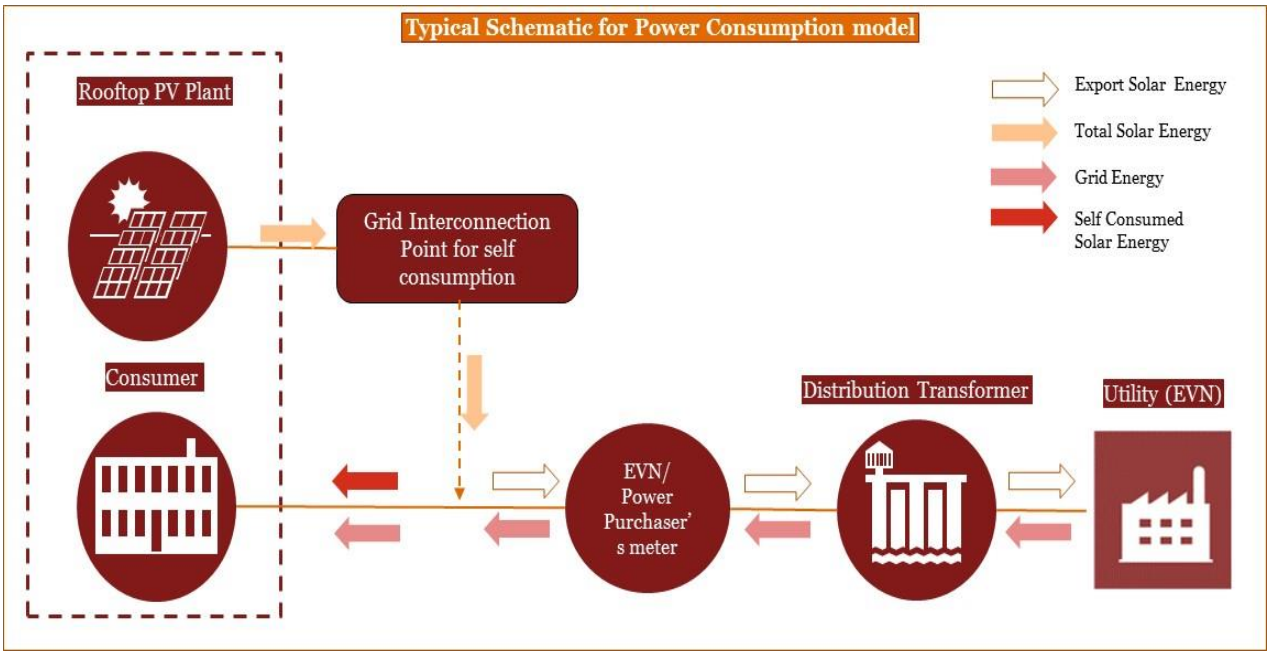


Figure 2: Schematic of Power Consumption model

2. **"Entire power sale business" model**,

   Defined as a model of rooftop solar power project installed and measured independently from the power consumption. This system is directly connected to the Power Purchaser's grid and selling the entire generated power output to the Power Purchaser, and the household/business does not directly consume any power generated from its rooftop solar power system.

   The Power Seller/generator and EVN/Power Purchaser may freely reach an agreement for the connection point to be either in front of, or behind, the Power Purchaser's meter. Under this model, costs of investments and installation of meters and costs for upgrading interconnection systems/facilities shall be borne by the Power Seller.

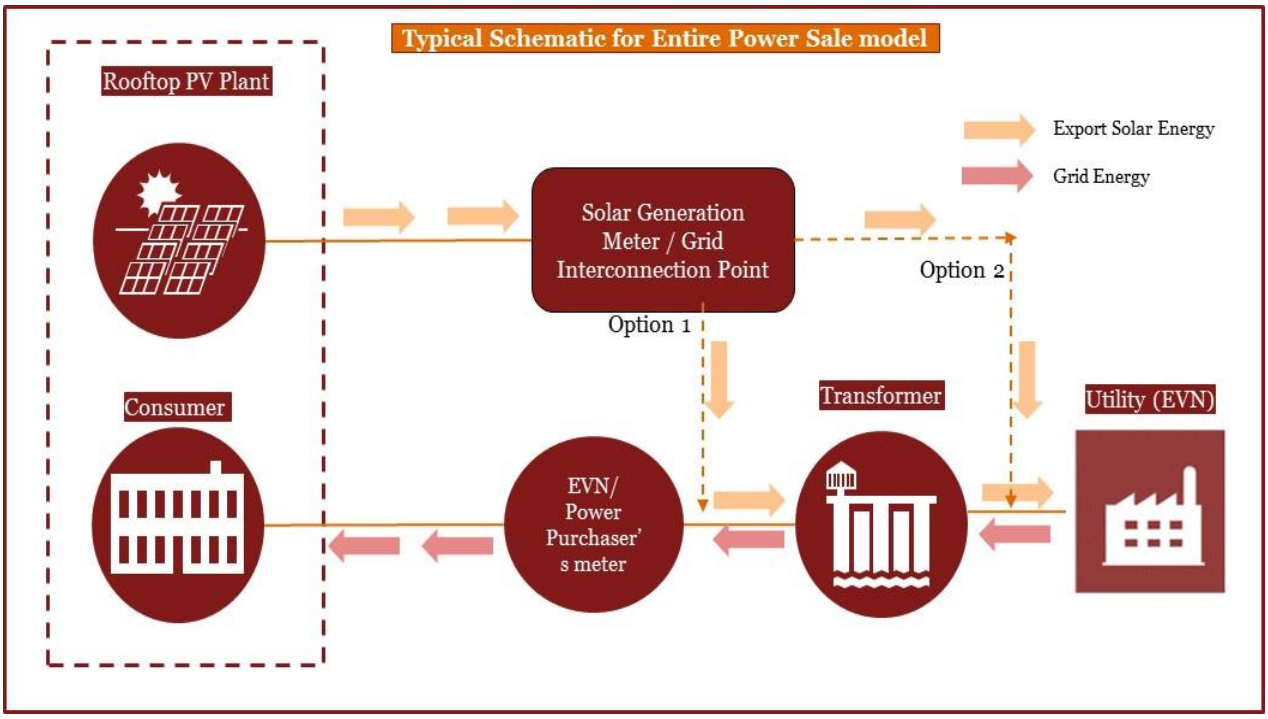


Figure 3: Schematic of Entire Power Sale model

3. **"Direct power sale and purchase" model**,

   Defined as a model of rooftop solar power project under which individuals and organizations invest, generate and sell power from their rooftop solar power projects to other individuals and organisations not connecting or utilizing national grid systems

   If the Power Seller does not use the national grid at all, the Power Seller and the private Power Purchaser may freely reach an agreement on metering and interconnection arrangements in accordance with applicable regulations on civil and commercial transactions.

   If the rooftop solar power system is indirectly connected to the national grid, the Power Seller must reach an agreement with the provincial-level Power Corporation/Utility for installing a bidirectional meter to record power output consumed and power output generated from the solar power system on a monthly basis.

   Under this option, costs of investments and installation of meters and costs for upgrading interconnection systems/facilities shall be borne by the Power Seller. In addition, the Draft Decision requires the MOIT to formulate detailed regulations on the procedures and formalities for grid connection registration, grid connection agreements, technical requirements for interconnection facilities and examination of conditions of grid connection for operation.

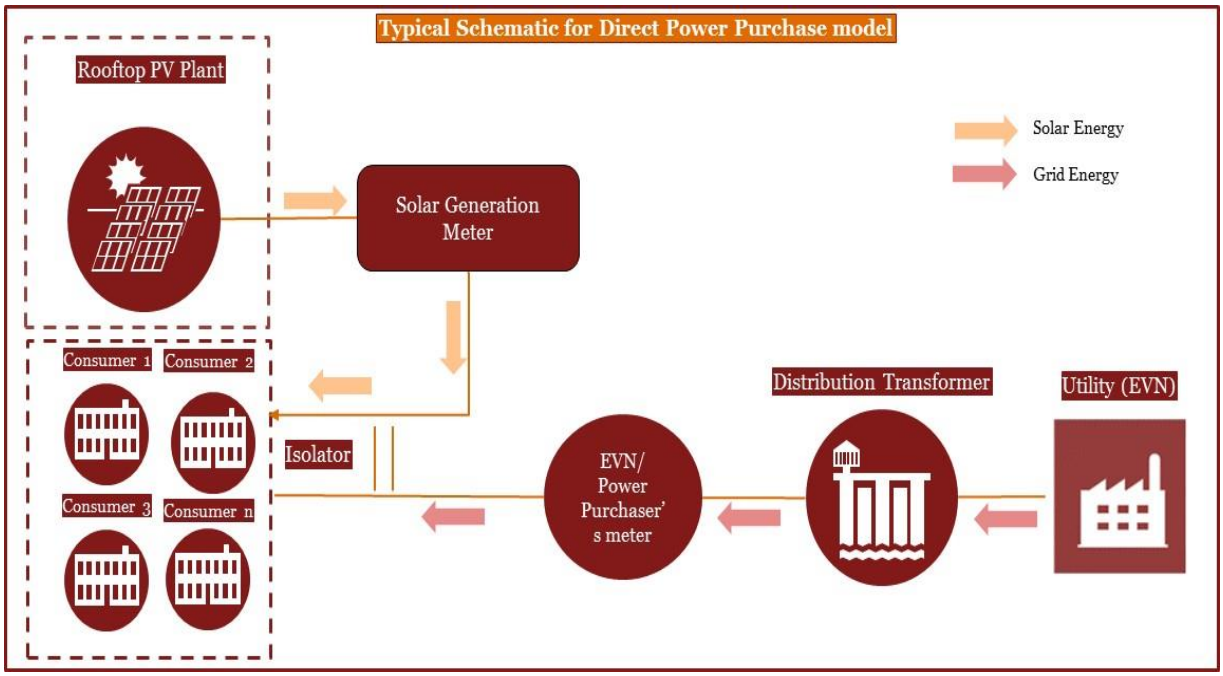


Figure 4: Schematic of Direct Power Purchase model

4. **"Excess power sale business" model,**

Defined as a model of rooftop solar power systems under which organizations and individuals invest in and install rooftop solar power systems to (i) sell parts of power energy outputs to other organization and individuals and (ii) sell excess power energy output to the national grid.

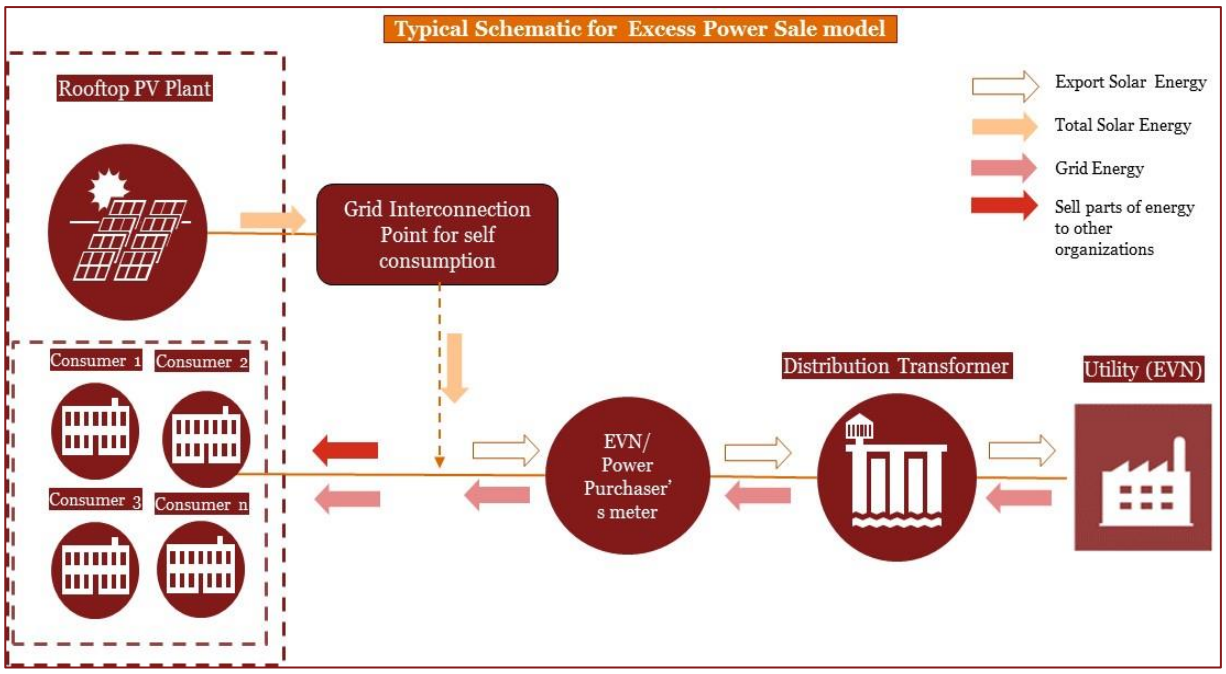


Figure 5: Schematic of Excess Power Sale Model

2.2. Provision of rooftop leasing under real estate laws

This section highlights the key provision of laws/regulations governing the rooftop leasing for the deployment of Rooftop PV.

1. Operating lease model

Vietnamese law provides for Operating Lease as follows:

a) "*Operating Lease*" is defined as "a form of lease mode by which the leasing company shall rent an asset to the operating lessee for use in a specified period of time on the principle that the lessee shall return the asset upon expiration of the lease duration. The leasing company shall be the legal owner of the asset during the lease duration. The lessee shall have the use of the asset and pay the rental throughout the lease duration as stated in the Operating Lease agreement.

b) Leasing companies conducting Operating Lease activities shall comply with regulations on lease of assets under the Civil Code and other relevant legal regulation.

2. Financial lease model

Vietnamese law provides for Financial Lease as follows:

a) "Financial Lease" is a form of mid-long term credit extension which meets one of the following criteria:

- at the expiry of the lease term, the lessee shall be entitled to receive ownership over the assets or to continue to lease the assets in accordance with the agreement among the parties;
- at the expiry of the lease term, the lessee shall be entitled to a priority right to purchase the assets at a nominal value, which is lower than the actual value of the assets at the time of such purchase;
- the term of the lease will be at least 60% of the depreciation lifecycle of the assets;
- the total rentals under the lease are at least equal to the value of the assets at the time of signing of the lease agreement.

Key implications on the Rooftop PV projects

There are certain issues with leasing regulations/ laws as highlighted below:-

a) If an equipment-leasing scheme contains any one (1) of the above criteria of Financial Lease, there is a risk that the scheme may be triggered as Financial Lease from Vietnamese law perspective and if so, it is subject to additional requirements applied to Financial Lease under the Law on Credit Institutions. Again, as noted, the level of this risk will have to be assessed and determined on a case-by-case basis.

b) As a general principle, given the four elements of Financial Lease discussed above pursuant to Vietnamese law, if an equipment-leasing scheme contains any one (1) of the above criteria of Financial Lease. In that case, there may be a risk that the authorities of Vietnam can take a strict or conservative or broad view to opine that an equipment leasing arrangement may constitute a Financial Lease rather than an Operating Lease.

c) Under Article 113 of the Law on Credit Institutions, Financial Lease is defined as a form of "credit extension", which is defined as "an agreement allowing an organization or individual to use a sum of money or a commitment allowing the use of a sum of money on the repayment principle by [credit extension operations, including financial Lease].[18]

d) Under the legal definition of Financial Lease, "The lessor commits to buying the property for Financial Lease at the request of the lessee and holds its ownership over financially leased property during the lease term.

[18] Article 4.14 of the Law on Credit Institutions.

The lessee uses the leased property and pays rentals during the lease term under a financial leasing contract".[19]

e) The financial lease arrangement will bear a risk that it would not be entitled to any Corporate Income Tax (CIT) incentive as highlighted in section 2.3. Additionally, the strict licensing requirement may be concern, since only financial lease companies may apply for financial lease business under the Law on Credit Institutions.

f) The highlighted risk can be mitigated through appropriate contract design. Additionally, it can be argued that such contracts are for sale and purchase of solar energy, thus differing from conventional financial lease arrangement. However, this may be subjected to the specific terms and conditions of contracts and interpretation of relevant authorities.

2.3. Fiscal incentives available for rooftop PV

The Rooftop PV projects are eligible for following fiscal incentives:

a) Corporate Income Tax (CIT) incentive for rooftop solar power business

Under current CIT regulations[20], income from a new investment project engaged in producing renewable energy or clean energy (including Rooftop PV) is entitled to CIT incentives including 10% preferential CIT rate for 15 years, 4-year CIT exemption and subsequent 9-year 50% CIT reduction.

CIT exemption of the project is applied and counted continuously from the first year from which the company has taxable income from the project. In case, the company does not have taxable income within 3 years from the year that the project generates its first revenue, tax exemption is applicable from the fourth year that the project generates its first revenue. CIT reduction is applied and counted continuously right after the full utilization of the CIT exemption.

Below three examples are provided for the ease of understanding:-

Example 1: Company A is established in 2019 to implement investment project X. The project X is entitled to 10% CIT rate for 15 years, 4 years of CIT exemption and subsequent 9 years of 50% CIT reduction. Company A has its first revenue and taxable income in 2020 (of the project X). CIT incentives are applied as below.

Year (20xx)	***19***	***20***	***21***	***22***	***23***	***24***	***25***	***26***	***27***	***28***	***29***	***30***	***31***	***32***	***33***	***34***	***35***	***36***	***37***
CIT Pref. rate		*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
CIT exemption		*x*	*x*	*x*	*x*														
CIT reduction						*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*					

Example 2: Company B is established in 2019 to implement investment project Y. The project Y is entitled to 10% CIT rate for 15 years, 4 years of CIT exemption and subsequent 9 years of 50% CIT reduction. Company B has its first revenue in 2020 and has taxable income in 2022 (of the project Y). CIT incentives are applied as below.

Year (20xx)	***19***	***20***	***21***	***22***	***23***	***24***	***25***	***26***	***27***	***28***	***29***	***30***	***31***	***32***	***33***	***34***	***35***	***36***	***37***
CIT Pref. rate		*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			

[19] Article 3.7 of Decree No. 39.
[20] Decision 11, 2017 also highlights the fiscal incentives applicable for Rooftop PV

CIT exemption			*x*	*x*	*x*	*x*													
CIT reduction							*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*				

Example 3: Company C is established in 2019 to implement investment project Z. The project Z is entitled to 10% CIT rate for 15 years, 4 years of CIT exemption and subsequent 9 years of 50% CIT reduction. Company C has its first revenue in 2020 and has taxable income in 2026 (of the project Z). CIT incentives are applied as below.

Year (20xx)	***19***	***20***	***21***	***22***	***23***	***24***	***25***	***26***	***27***	***28***	***29***	***30***	***31***	***32***	***33***	***34***	***35***	***36***	***37***
CIT Pref. rate		*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*			
CIT exemption					*x*	*x*	*x*	*x*											
CIT reduction									*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*	*x*		

Remarks and key observations

1) The rooftop PV business may be provided through a Solar Power Purchase Agreement ("PPA Model") or an Lease (also termed equipment lease) agreement (which can be either a Financial lease or an Operational lease/property lease) ("Lease Model").

   - *Under the Lease Model*, the substance of this business is an equipment lease whereby a power-generating generator leases its solar equipment to its client and then the client will use this leased solar equipment to generate electricity for the client's consumption. The project under this Lease Model will bear a risk that it would not be entitled to any CIT incentive as no CIT incentive is provided for "equipment lease" business.

   - *Under the PPA Model*, the substance of this business is solar energy production, generation and sale whereby a power generating entity installs solar equipment to generate electricity, then sells the generated electricity to its client and/or EVN (if applicable in case of selling excess solar energy to EVN's grids). As the generation and sale solar power energy is considered production of renewable energy, the project under the PPA Model may be entitled to the CIT incentive package of 10% preferential CIT rate for 15 years, 4-year CIT exemption and subsequent 9-year 50% CIT reduction.

b) Import duties for rooftop solar power project

A renewable energy, clean energy generating project such as rooftop solar power project is considered a special preferential project, which is entitled to import duty exemption with respect to imported fixed assets.[21]

In addition, imported materials, supplies and spare parts of special preferential projects that cannot be domestically manufactured are exempt from import duties for five years from the manufacturing commencement date.[22]

[21] Article 16.11 - Duties Law.
[22] Article 103.15 - Circular 38.

As such, rooftop solar power generators may be entitled to the above import duties incentives with respect to its business under the PPA Model.

For the Lease Model and energy efficiency business, as these business lines are not subject to investment incentives, there is a risk that it would not be considered production, generation and sale of renewable energy and would not be entitled to import duties incentives given that there is no specific import duties incentives for "equipment lease".

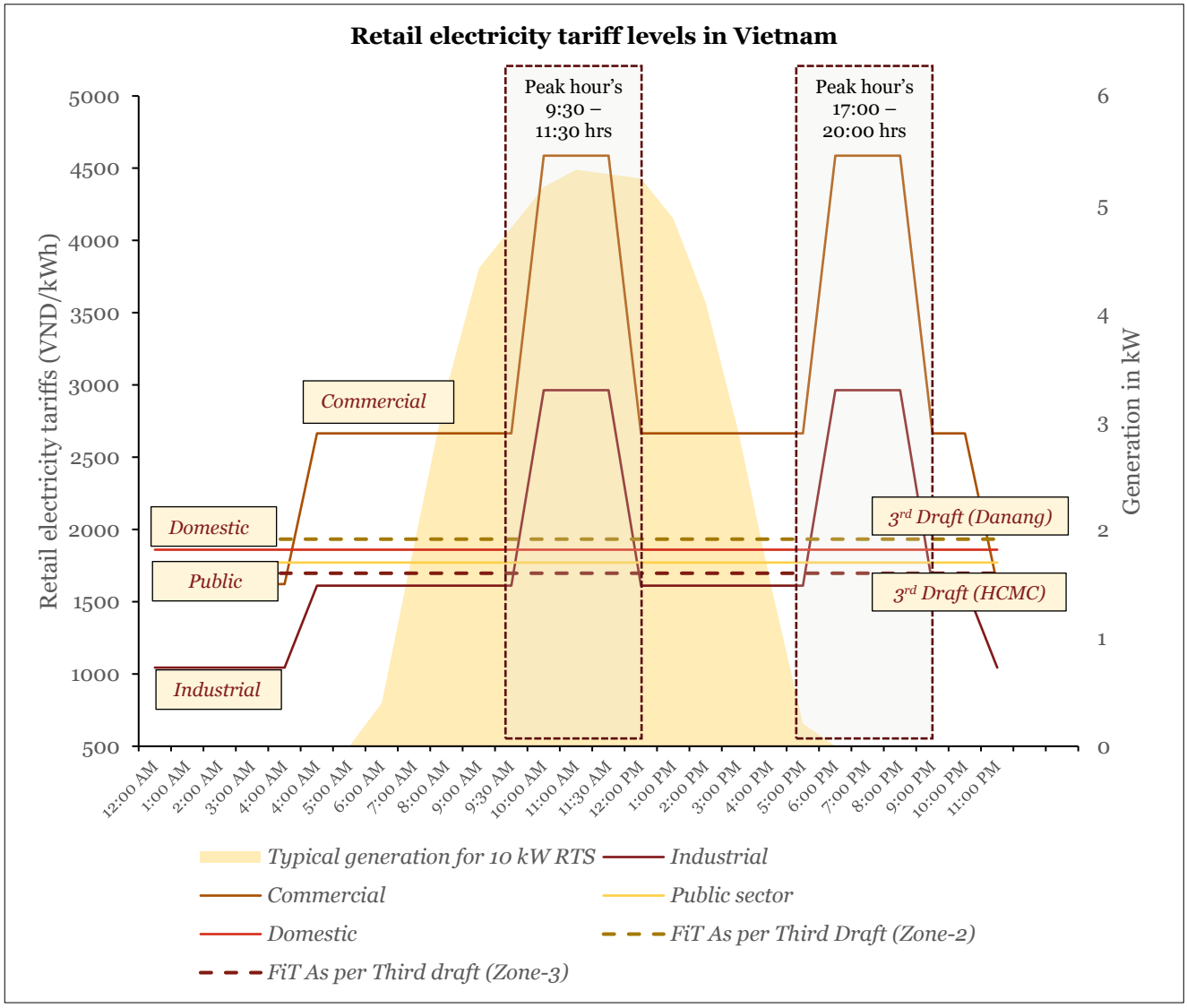
3. Power Market Scenario

This section provides an overview of power scenario in the two cities based on publicly available information. The purpose of this section is to provide a direction for analysis to be covered in subsequent phases of the engagement based on data shared by EVN/MOIT/PCs.

Existing Tariff Structure in EVN

The comparison of proposed FiT rates for solar rooftop vis-à-vis the prevailing retail electricity tariffs for various consumer categories as determined by Decision No. 468 is presented in the graph below. This indicates that daytime peak can be partially met by solar rooftop generation thus providing demand reduction for EVN during peak hours i.e. 9:30 hrs to 11:30 hrs.

Figure 6: Retail Electricity Tariff structure and Solar Rooftop analysis



Source: PwC Analysis, Generation through PVSyst simulation for 1.05 DC:AC loading, Decision no 468, Draft decision on FiT; Generation graph is indicative only

For the above graph, the following assumptions have been considered:

Sl No	Parameter	Remarks
1	Time of use Tariffs	Time of Use tariffs applicable from Monday to Saturday are considered. The normal hours, peak hours and off-peak hours are specified in Appendix A1
2	Industrial Consumers	Retail electricity prices for production voltage levels between 6kV and 22kV is considered
3	Commercial Consumers	Retail electricity prices for business for voltage level less than 6 kV is considered
4	Public sector	Retail electricity prices for public sector which includes Hospitals, nursery schools, kindergartens, schools, for voltage levels less than 6 kV
5	Domestic Consumers	Retail electricity prices for domestic use for consumer that consumes 200 kWh monthly
6	Solar generation	A typical solar generation profile for a day has been considered for the analysis considering fixed tilt Multi-crystalline polysilicon modules.

Based on the analysis for tariff structure of the country, the daytime peak energy requirements during Monday – Saturday could be addressed partially by solar rooftop PV deployments, however for HCMC and Danang whether actual load requirements also have similar peak needs to be verified. Further analysis on Rooftop PV in these two cities enabling reductions in peak demand requirements shall be carried out in subsequent report.

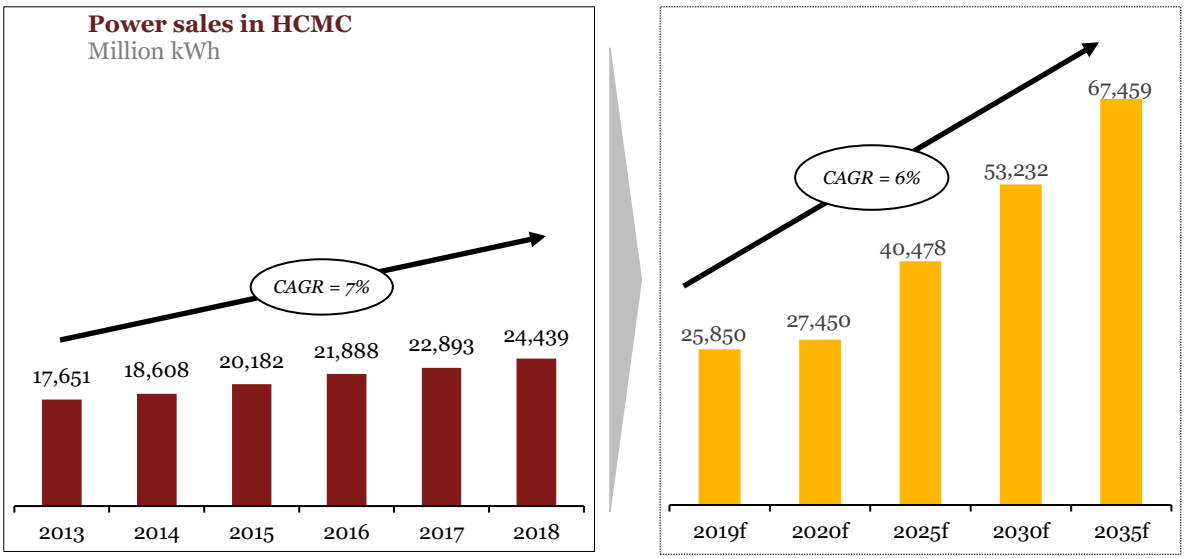
3.1. Ho Chi Minh City (HCMC)

Energy scenario and outlook

Ho Chi Minh City is one of the most developed urban hub in Vietnam with high population density and rapid economic development. As a result, electricity consumption is high among residential, commercial, and industrial consumer groups within the city, in comparison to other Vietnamese cities.

The below chart depicts the five-year historical data, from 2013 to 2018, of electricity sale (in kWh) in HCMC. It is observed that sale of electricity has grown at a CAGR of 7% during this period.

Figure 7: Historical and future estimation of electricity sale in HCMC



Source: EVN HCM, HCMC's Power Development Plan

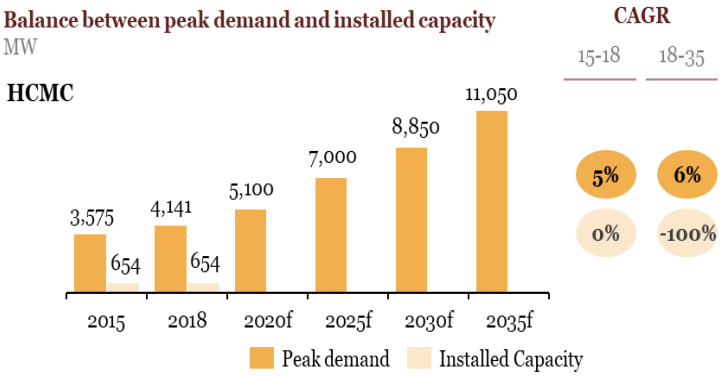
HCMC has demonstrated remarkable economic development with GDP growth rate of 7%-9% over the last 5 years. From 2013 to 2018, HCMC has witnessed population growth at a CAGR of 2% and the number of registered enterprises grew at a CAGR of 11%. It is likely that the future prospects of electricity demand in HCMC will be driven by growing industrialization and rapid urbanization.

Out of the total land bank earmarked for development of Industrial Zone (IZ), 35% of the land will be developed into functional IZ by 2025, which shall have surge in electricity demand for the city.

Currently, two thermal plants (total capacity of 654 MW) are installed within HCMC to cater the demand. The two power plants were able to meet only 15.8% of the city's peak demand in 2018. Also, setting up of new large scale power plants in the city will be a challenge due to its limited land bank. Further, the PDP VII has scheduled discontinuance of HCMC's two thermal power plants because of limited availability of gas.

Hence, majority of the demand is likely to be met from other regions through high voltage transmission lines making it dependent on the grid to meet its energy requirement.

Figure 8: Peak Demand requirements of HCMC



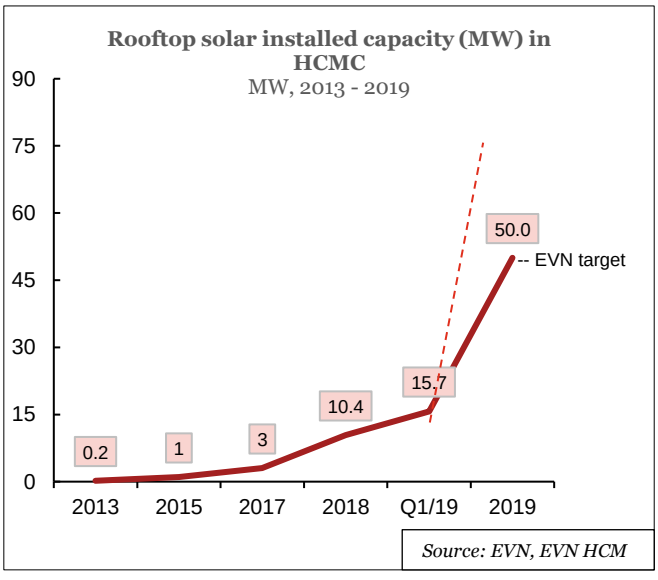
Source: PDP VII

For further details on the status of thermal power plant, refer to Appendix A.6

Overview of solar and rooftop solar development plan

HCMC has substantial potential for renewable energy especially solar photovoltaic, to meet this growing demand. It is observed that only 0.1% of HCMC's total energy consumption was met through renewable energy in 2018. It is reported that the city is planning to increase its share of energy consumption from renewable energy sources to 1.74% (equivalent to 96MW) by 2020[23].

Figure 9: Rooftop PV installed capacity in HCMC



An effective solution is deploying coordinated rooftop solar systems and other demand response solutions like smart inverters, storage, EVs for better demand response capabilities such as peak load scenarios, ramping requirements, transmission or distribution constraints, or voltage irregularities.

Such aggregated Rooftop deployment shall also assist in reducing the dependence on external grid for the energy requirements of the city. This solution becomes further attractive considering the favorable solar radiation that HCMC receives. According to Global Solar Atlas (WB Initiative) data, HCMC yields a promising GTI (Global Tilted Irradiation) solar irradiation in the range of 1,780 to 1,895 kWh/m²/year with a total rooftop potential of 6300 MW (according to

[23] Market news

the report on the technical assessment of the potential of rooftop solar energy in Vietnam released by the World Bank in 2017).

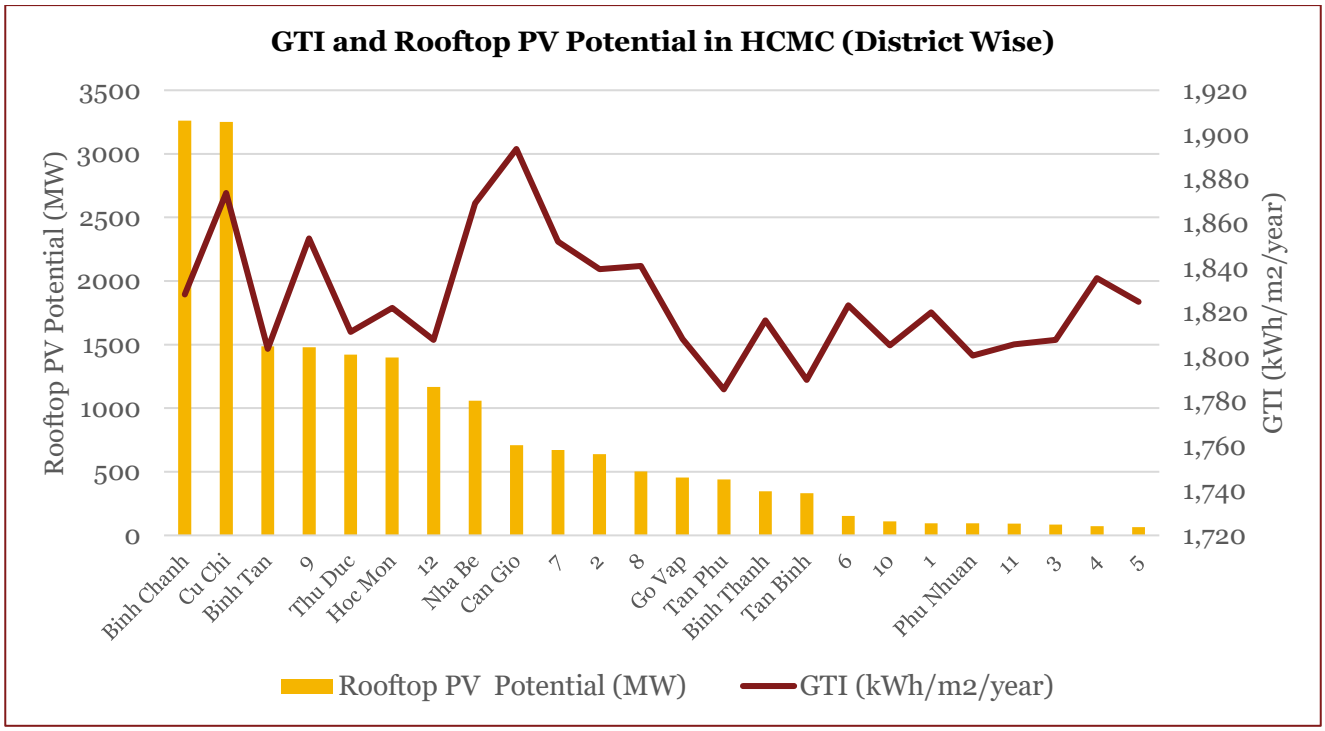
EVN have 906 households, offices and enterprises in Ho Chi Minh City with total installed rooftop solar capacity of 10.4 MW by the end of 2018. EVN HCM reported that 365 households adopted rooftop solar, thereby adding a total capacity of around 5.34 MW during the first quarter of 2019.

City has also seen deployment of large Rooftop PV systems (greater than 100 kWp). Few of the examples of such installations are as below

- 297.46 kWp Rooftop PV capacity at EVN HCMC office buildings (consumer under commercial category)
- 198.4 kWp Rooftop PV capacity at manufacturing facility of Tan Tao Importing & Processing Zone commissioned in 2017.
- 159.64 kWp Rooftop PV capacity at Ho Chi Minh City University of Technology (consumer under public sector) commissioned in 2016.

The number of household with rooftop solar in the city have increased to 1,271 with a cumulative capacity of 15.72 MW. There is still significant capacity addition required to meet the target of 80 MW by 2019 envisaged by EVN HCM and EVN's assigned target capacity of 50 MW in 2019.

Solar Rooftop Potential



Source: Data extracted from http://rooftoppvpotential.effigis.com/, Global Solar Atlas

Figure 10: Solar irradiation level comparison and Rooftop Potential

The graph above presents the total Rooftop PV potential in a district and its annual GTI levels. There is a variance of 5% across districts in GTI, varying from 1780 kWh/m2/year to 1895 kWh/m2/year. This preliminary analysis indicates good radiation potential in districts with rooftop space for rooftop PV installations. A second order analysis shall be done at district level in subsequent reports based on the consumer category, rooftop potential and irradiation potential to assess effective deployment schemes for pilot rooftop implementation.

The table below illustrates HCMC's current rooftop solar installed capacity and its estimated potential.

Table 9: Rooftop PV installed capacity and potential in HCMC

Number of households with installed rooftop solar	906
Total number of suitable rooftops for solar	148,880
% of potential met	0.61%
Total installed rooftop solar capacity in 2018 (MW)	10.38
Estimated potential rooftop solar capacity (MW)	6,379
% of potential met	0.16%

The geospatial analysis from Effigis[24] provides some vital information on suitable rooftop area and solar irradiation at 175 communes in 24 districts. The average suitable rooftop area for setting up solar plant within HCMC was approximately 14.6% of the total available area. The suitable rooftop area ranged from 0.1% to 46%.

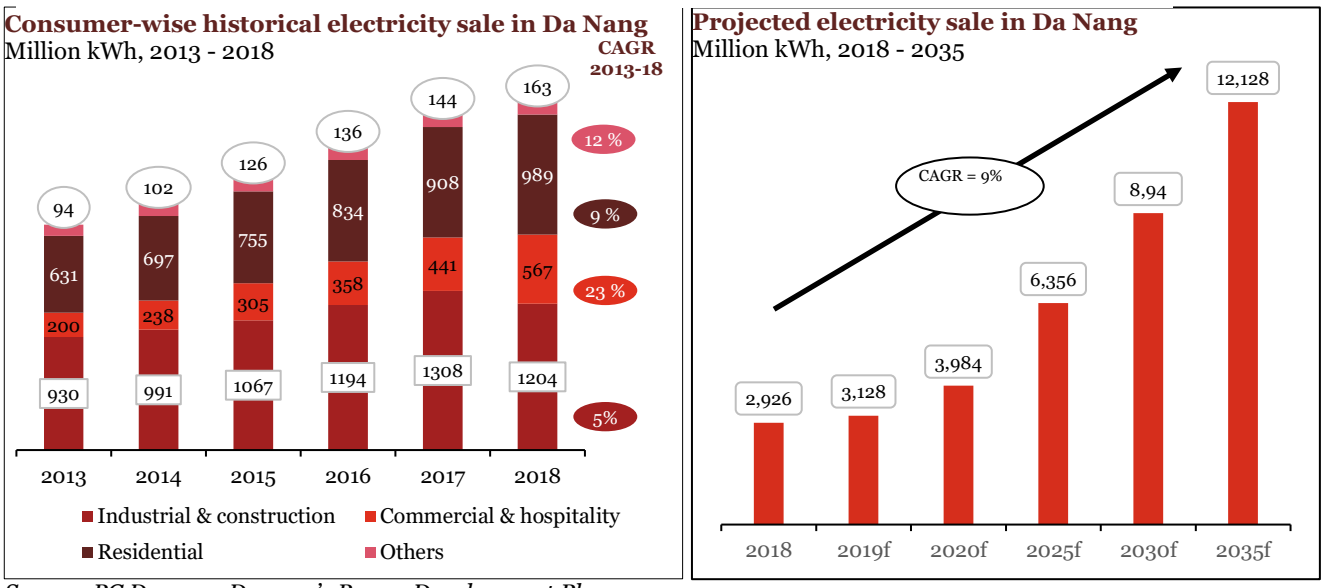
3.2. Da Nang City

Energy scenario and outlook

Da Nang is a socio-economic center and a popular tourist destination in the Central of Vietnam. With the fourth largest seaport in the country, Da Nang is set to become one of the country's major urban centers and has recorded remarkable changes in its economic development. Its gross domestic product (GDP) growth rate has been higher than the country's average rate[25].

The charts below depict the electricity sold to each consumer group in Da Nang as well as the outlook for the city's electricity consumption in the medium to long-term.

Figure 11: Electricity sale (Million kWh) in Da Nang - historical and future scenario



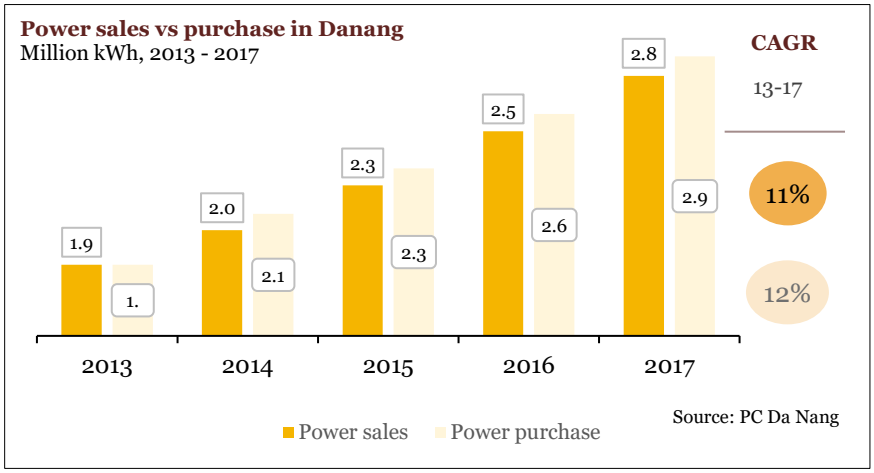
Source: PC Danang, Danang's Power Development Plan

[24] Data extracted from http://rooftoppvpotential.effigis.com/
[25] World Bank report- Energizing Green Cities in Southeast Asia – Da Nang

Service sector has been one of the largest economic drivers in the city followed by industry and construction sectors respectively. Growth in service sector is likely to drive rapid increase of energy consumption in the commercial category due to increasing occupancy rates. Tourism sector is undergoing growth as Da Nang is expected to become a major national tourist hub. Further, the electricity consumption of tertiary buildings is estimated to increase from 204 GWh in 2013 to about 688 GWh in 2025[26], of which hotels account for about 25 percent of the electricity consumption.

From the electricity supply point of view, Da Nang faces challenges similar to those faced by HCMC. The city has limited land resources and does not have any power plant within the province (neither existing nor planned under revised PDP VII). Hence, the demand is being met through import from other regions through the EVN grid.

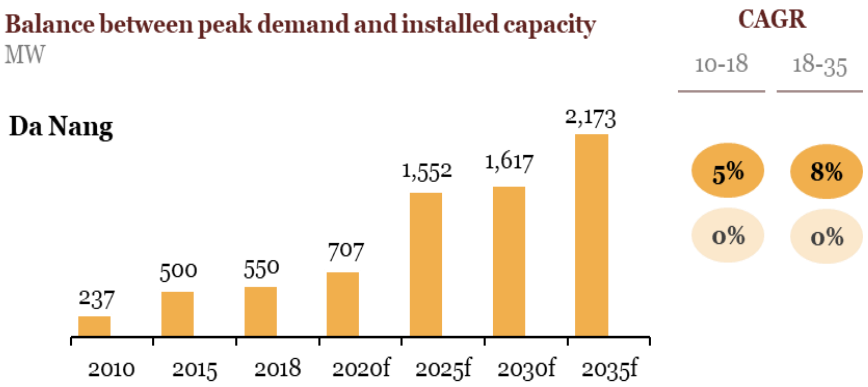
Figure 12: Historical electricity demand-supply scenario (2013-17)



In fact, the city has no current power plant or any planned project development pipeline. Thus, Danang continues to rely totally on the transmission grid for electricity supply.

The chart below depicts the past and projected balance between the city's demand and supply.

Figure 13: Peak Demand requirements in Danang

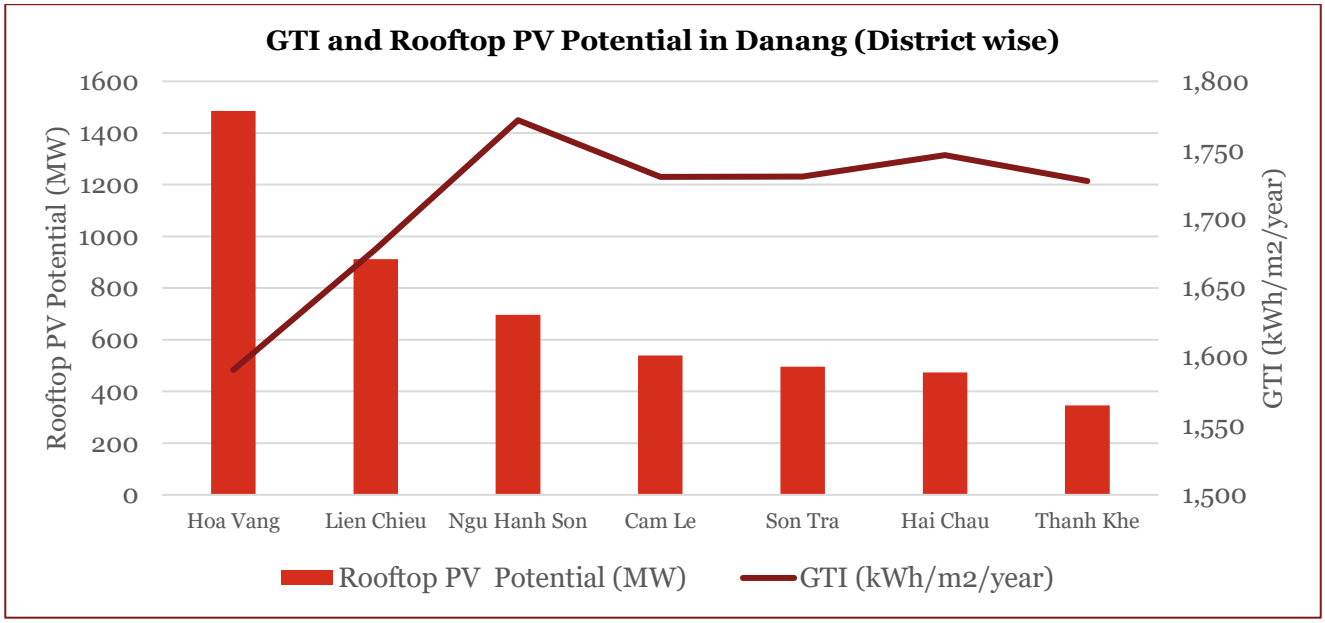


Source: PDP VII, Danang's Power Development Plan, PC Danang

With Distributed Energy Resources like Rooftop Solar, daytime peak requirements could be addressed through large-scale deployment of Rooftop Solar for commercial and industrial categories thus reducing the dependency on National grid.

[26] World Bank report- Energizing Green Cities in Southeast Asia – Da Nang

Rooftop solar potential



Source: Data extracted from http://rooftoppvpotential.effigis.com/, Global Solar Atlas

Figure 14: Solar Irradiation level and Rooftop potential for Danang

The graph above presents the total Rooftop PV potential in a district and its annual GTI levels. There is a variance of more than 10% across districts in GTI, varying from 1590 kWh/m2/year to 1780 kWh/m2/year. This preliminary analysis indicates the selection of districts for pilot scheme shall need to consider irrational levels along with rooftop potential. A second order analysis shall be done at district level in subsequent reports based on the consumer category, rooftop potential and irradiation potential to assess effective deployment schemes for pilot rooftop implementation.

At the end of 2018, current installed capacity of rooftop solar was 0.5 MW, only ~ 0.04% of its full potential solar rooftop. Additionally a 1 MW solar rooftop PV is being planned by a shopping center in Son Tra district.

Table 10: Rooftop PV installed capacity and potential in Danang

Number of households with installed rooftop solar	100
Total number of suitable rooftops for solar	316,535
% of potential met	0.03%
Total installed rooftop solar capacity in 2018 (MW)	0.5
Estimated potential rooftop solar capacity (MW)	1,140
% of potential met	0.04%

Source: World Bank Report

The geospatial analysis from Effigis[27] provides some vital information on suitable rooftop area and solar irradiation at 57 communes in seven districts. The average suitable rooftop area for setting up solar plant within Da Nang was approximately 17% of the total available area. The suitable rooftop area ranged from 0.2% to 30%.

[27] Data extracted from http://rooftoppvpotential.effigis.com/

4. Global Learnings

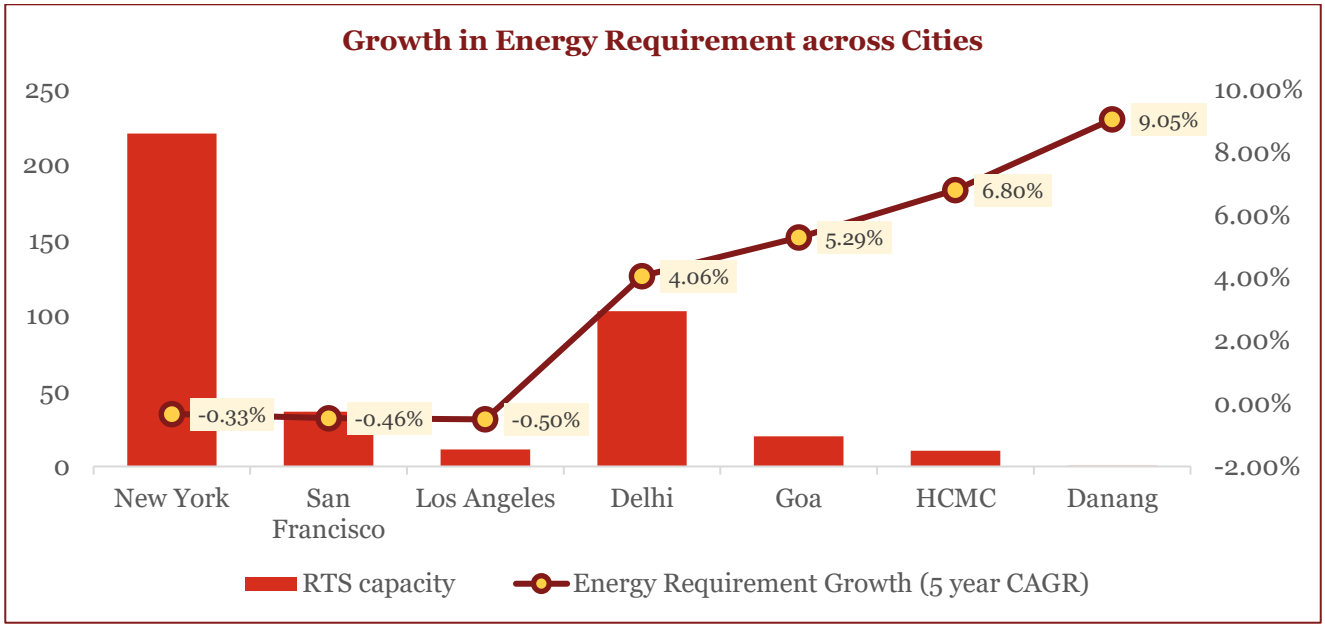
4.1. Overview

Solar photovoltaics (PV) has witnessed exponential growth with top five countries contributing 85% of the global addition, in 2017. In 2016 and 2017, 77 GW and 78 GW solar projects were installed globally, with China alone accounting for around 46% of this capacity[28].

While most capacity additions continued to be in large utility scale projects in Solar PV, there is an evident shift toward distributed solar PV. Of the 19.4 GW of distributed capacity addition in 2017, rooftop systems saw a three-fold increase of 2 GW installed capacity. The governments have also started emphasis on distributed projects – particularly rooftop systems for self-consumption – in an effort to lessen the burden on transmission network and to reduce curtailment issues with Renewables.

Further, Cities have taken a leading role in renewable energy deployment and have formulated wider urban planning efforts/ initiatives to transition to more sustainable and low carbon cities. City action plan driving renewables both supplement and complement frameworks that exist at the national and provincial levels. Many cities have used their direct regulatory and purchasing authority to shape renewable energy pathways within their jurisdictions.

Rooftop Solar PV has also enabled addressing the energy requirements in these cities and reducing their dependence on transmission network capabilities. A demand growth and installed rooftop solar PV capacity for select cities indicate how cities have been able to address their energy security needs through Rooftop Solar.



Source: PwC Analysis

Figure 15: Cities Rooftop Solar capacity and energy requirement growth

Many cities have adopted building codes that require the use of low-emissions energy sources and building-integrated renewables, in particular for new buildings. Germany introduced building codes that require the installation of solar PV on all new buildings, similarly California State in United States adopted similar policy in 2018 for all new homes to have rooftop Solar PV installed.

[28] REN 21 Global Status Report

Increasing EVs and other forms of electrified transport have also enabled the increase of renewable share in energy consumption in the cities. For example, In New Delhi (India), trains of the Delhi Metro Rail Corporation are being powered for nearly 60% of their requirements by purchase of power from utility scale solar PV power plant, while auxiliary services such as lighting and air conditioning are being powered by rooftop solar PV.

Business models for Rooftop Solar

A variety of business models exist that enable city governments, local businesses, households and large corporations to deploy rooftop solar. These diverse business models have emerged in response to a mix of factors, including price reductions in solar PV modules, supportive incentives and policies, new digital technologies and changes in consumer awareness towards climate change. These models can be categorized under four main categories, as provided below:

1) Self-Consumption Model

   The most prevalent model for rooftop solar installations where the rooftop owner buys the rooftop solar system and uses the benefit of the generation for internal consumption. Excess energy generated from rooftop solar system may or may not be fed back to the grid based on local regulations. This model has various advantages such as quick payback period, risk-adjusted returns over longer duration, low payment risks and sole ownership of all rooftop system. However, key challenges are mainly the requirement of upfront capital and technical capacity limits leading to reduced rooftop capacity over the potential.

2) Third Party Ownership Model

   A third party invests capital in the rooftop solar system and sells power to the rooftop owner/ occupier at a rate lower than their grid tariff. This model is often called the OPEX or PPA model because the rooftop owner pays for the system over a number of years during its operation. This model has been quite prevalent in the US, where the model along with tax breaks proved attractive to a large numbers of consumers. It also allows innovative structures like aggregation of various consumer demand to enable higher rooftop solar PV installations.

   The key advantage of this model is the developer (third party) takes up the technical risk, and the rooftop owner does not need to invest upfront capital. It also reduces the liquidity risk and provides better usage of tax incentives made available under policies. However, payment risks, legal challenges on ownership of land/roof are some of the key challenges under this model.

3) Solar Leasing model

   The customer leases the system from an installer/ developer but pays for it over time. This lease may be either a financial lease or an operating lease. At the end of the lease tenure, consumer has the option of renewing the lease, purchasing the equipment at fair market value or having the system owner remove the equipment. This model provides balanced cash flows, thus enabling better use of capital and lower planning risks. It also enables large businesses and private sector to act as solar leasing companies, enabling consumers to install solar power directly on their rooftops or on adjacent land at little-to-no upfront cost. Some of the key challenges are payments default issues, limited tax benefits and ownership issues.

4) Peer to Peer energy trading model

   In some cities, customers that generate from their own rooftop supply can use energy-trading platforms to trade excess energy with their neighbors, making it possible to monitor and exchange energy among peers. Participants often receive better financial return than what is available through traditional net metering or feed-in tariff policies that compensate producers for the excess energy supplied to the grid. Energy trading systems are active in very few cities around the world namely in London (United Kingdom), Pennsylvania (United States) and few cities in Germany. The key challenge is typically the

market maturity and size of individual plants that are often too small to efficiently direct/ trade energy. Further, the inexperience of many small generators with trading/peer to peer exchange market also faces challenges during implementation or rollout.

Other Developments

Storage Technology

Distributed solar-plus-storage has become cheaper than retail electricity from the grid in several regions. In 2017, an estimated 40% of new solar rooftop installations in Australia included energy storage systems, mostly in the residential sector.

Further, Time of use rates have incentivized customers to couple storage with rooftop solar, which makes the solar more valuable to the grid by extending generation into evening peak as well. Storage contributes to the flexibility of rooftop systems by providing ramp up/down, frequency regulation and absorbing excess generation (reducing curtailment).

Smart Inverters

Smart inverters allows flexibility through their ability to ride through fault conditions, communicate with grid operators and manage voltage. Smart inverters also allow for frequency response and enable communication with response to grid needs. Many states in US are focusing on smart inverters and its specifications including the communication protocols. Hawaii's PUC authorized the activation of new smart inverter functions for solar PV and storage systems. California mandated all inverters connected to the grid – whether for residential and commercial rooftop solar PV, battery systems or EVs – to be smart inverters so that utilities can communicate with them as needed.

Demand Response

Utilities are beginning to use distributed generation as a solution to grid needs in cities. With more flexibility available in the system due to technologies like storage, smart inverters etc, targeted energy efficiency and sophisticated demand response is possible using rooftop solar PV. Further, with increasing mix of flexible loads like smart charging of electric vehicles in cities, rooftop solar plays an important role in Demand Response management in urban setup.

Community Solar

To gain the support of everyday consumer in advancing the energy transition, civil society participation is critical. Consumers can actively shape the energy infrastructure of their cities in a range of ways, including by making direct investments in renewable energy technologies and by opting into renewable energy purchasing programs offered by local utilities. In recent years, the number of community energy projects using solar PV and other renewable sources has increased steeply and is no longer limited to European countries but are being adopted in places like Thailand, North America etc. Community energy that has been more prevalent in rural areas in the past are now increasingly being adopted in the urban projects as well. Rooftop PV are being deployed in portfolios where large aggregations of rooftop installations are coordinated to meet the grid needs reducing the overall capacity needs for the utility.

Thus, it is important to adapt these global developments while considering the Vietnam Power scenario, existing and proposed regulations to develop a suitable rooftop PV deployment model for HCMC and Danang.

Summary of key learnings for successful rooftop PV deployment

- Policy: Governments have clearly identified targets for rooftop solar PV, often separate from utility scale solar targets. This has driven the awareness and deployment of rooftop PV, which has enabled innovative business models.
- Regulatory: Initiatives like changes to building codes to enable rooftop PV installations along with other energy efficiency measures. Defined set of technical standards and specifications with empaneled vendors for consumers to choose for deployment of solar rooftop PV. Such standard specifications have enabled consumers to choose the right set of counterparties reducing the learning curve/lead time for selection of vendor.
- Incentives: Financial packages to support upfront investments for residential and other public establishment consumers. PACE program in US, performance linked financial package in India are few of these examples.
- Market Creation: To scale up rooftop deployment, aggregation of rooftop capacities allows portfolio development attracting private sector investments. Models like solar leasing, bidding of pre-identified large number of project sites to create the much-needed market for interested project developers are few examples of market creation for scaling up rooftop capacity.
- Market forces (customer choice), new technologies, and declining costs drives the scope and scale of the transformation. Rapid growth in PV installations needs to be evaluated against the technical constraints and models should be accordingly adopted for integration of Rooftop along with other disruptive technologies.

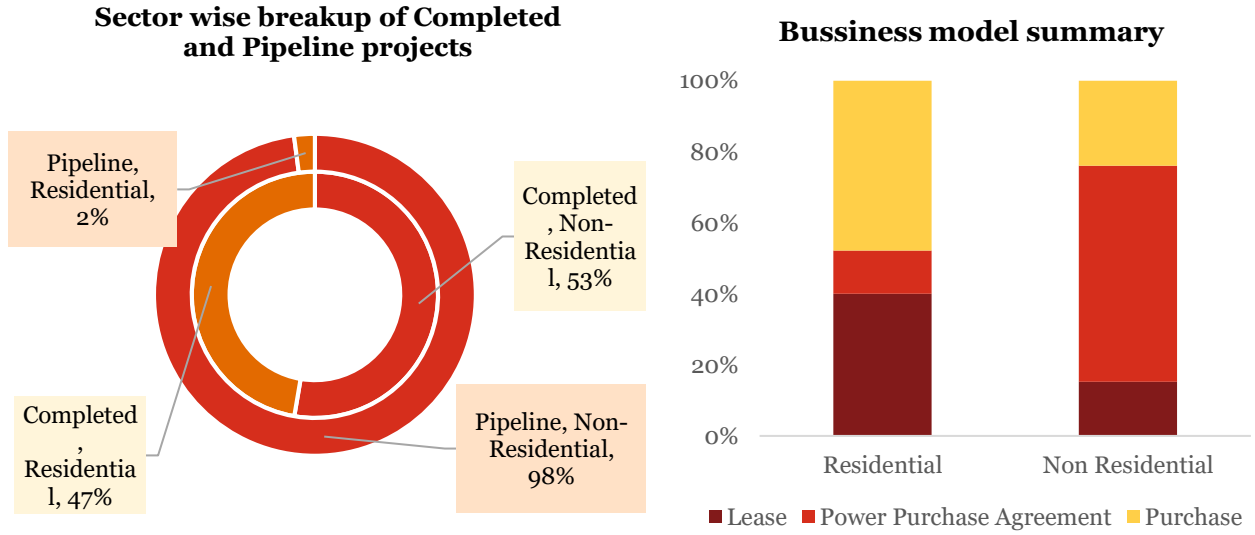
4.2. United States of America

4.2.1. Rooftop Market

At the end of FY19, cumulative operating solar PV capacity in the USA was 62 GWdc, with rooftop PV installation capacity at ~27 GW. This comprises of 14.5 GW of residential and 12.5 GW of non-residential solar installations. The rooftop PV deployment has seen different models taking shape in different states in the country. Such stark difference is visible in rooftop PV deployment in New York State and California State, where New York rooftop PV market is dominated by Non-Residential sector (~ 72%) while in California it is the Residential sector that leads the way at 65%.

New York State Summary

The state has a cumulative installed rooftop PV capacity of 1.37 GW with nearly 1 GW in pipeline as on March 2019.



Source: NYSERDA

Figure 16: New York State rooftop market summary as on March 2019

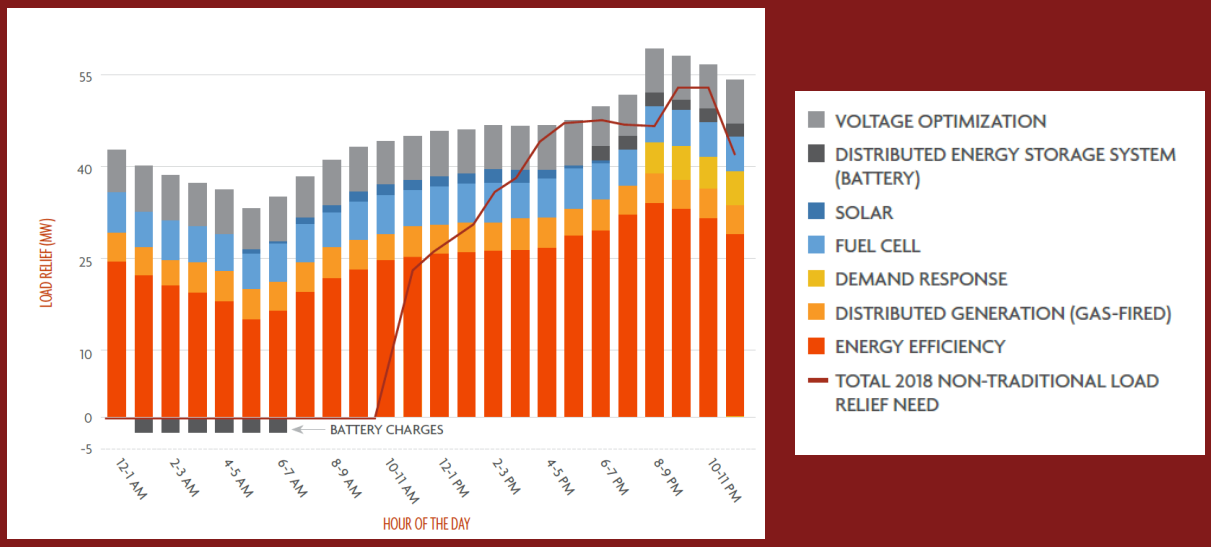
The non residential sector have major installation through Power Purchase Agreement Model or the Third Party Ownership model as compared to Residential where majority of Rooftop PV investments is through direct purchase or leasing model. This has also resulted in higher rooftop PV system size with 65% of the total installed capacity having rooftop system capacity of more than 100 kW dc. The average installed capacity of the rooftop PV system across state was 25 kWp.

Several incentives have been made available in the state to make projects more affordable for homeowners like NY-Sun Incentive Program, incentives at local level, real property tax exemptions and a real property tax abatement program in New York City. Most solar PV installations in New York State do not increase the taxable value of a home; however, local governments can opt out of this exemption.

Further utilities are successfully and proactively engaging in conversation on non-wires solutions within their traditional distribution planning process. ConEd in New York is one of the first utility projects in US to source local Distributed Energy Resources from Rooftop to reduce its cost of network expansion.

Case Study: Meeting Load Growth with Distributed Energy Resources (DER): Consolidated Edison's (ConED) Brooklyn-Queens Demand Management Project (BQDM)

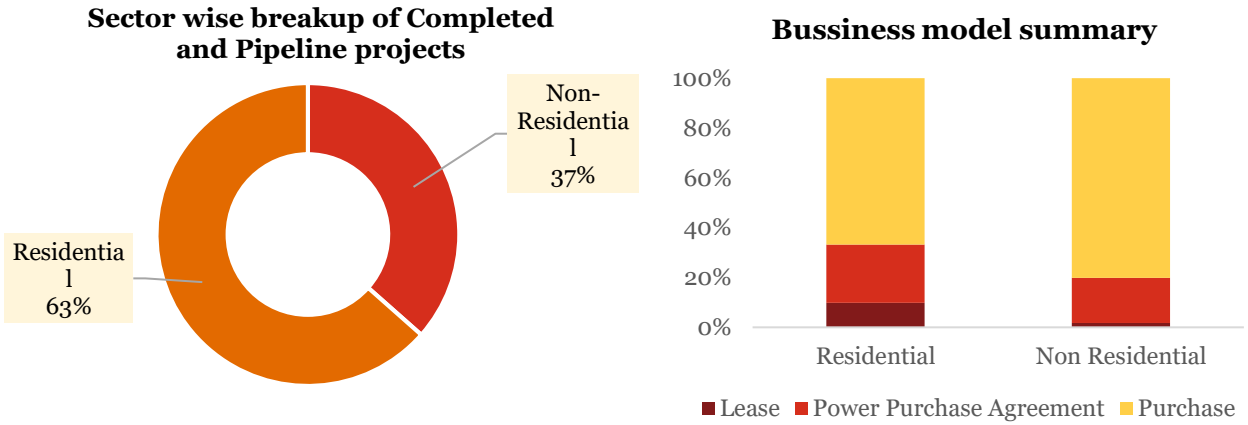
ConED in New York, had proactively source local DER. ConED was forced to undertake investment of $1.2 billion for grid upgradation. Instead, ConED pursued a mix of solution: Technical grid upgradation on and implementation of DER. The solution included portfolio of DER such as distributed generation, energy efficiency, demand response and battery storage. The figure below presents the load relief due to measured adopted under the Program.



Source: Gridworks and GridLabs report on The Role of Distributed Energy Sources in Today's Grid Transition.

California State Summary

The state has a cumulative installed Rooftop PV capacity of 7.28 GW as on March 2019 with Residential having nearly 4.62 GW of Rooftop installations.



Source: CSS

Figure 17: California State rooftop market summary as on March 2019

Both non-residential sector and residential sector have major installation through direct purchase or self-consumption model. This has also resulted in lower Rooftop System size with only 35% of the total installed capacity having rooftop system capacity of more than 100 kW dc. The average installed capacity of the Rooftop system across the state is 8.74 kWp.

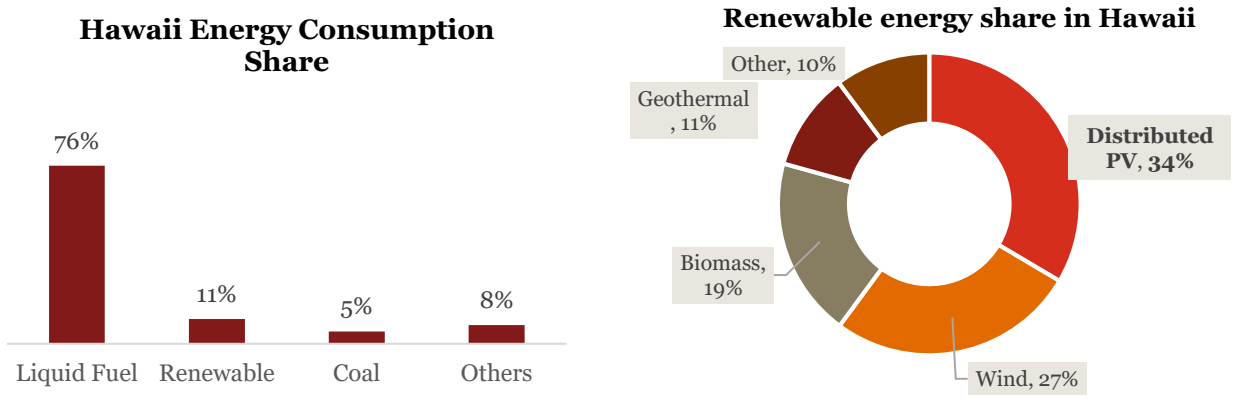
Rooftop PV installed through purchases are mostly through bids and contract with solar companies (or a general contractor) to have them deploy the rooftop projects at their property. The project then gets added to the overall price of home and paid through the mortgages.

Since 2015, EV and Rooftop Solar PV systems have also been installed together. Of the total 128.3 MW installed for EV infrastructure, 72% of them has been in Residential sector.

Around 15,000 new homes are built each year currently in California and California Energy Commission (CEC) has recently mandated all new homes to have rooftop solar panels from 2020.

Hawaii State Summary

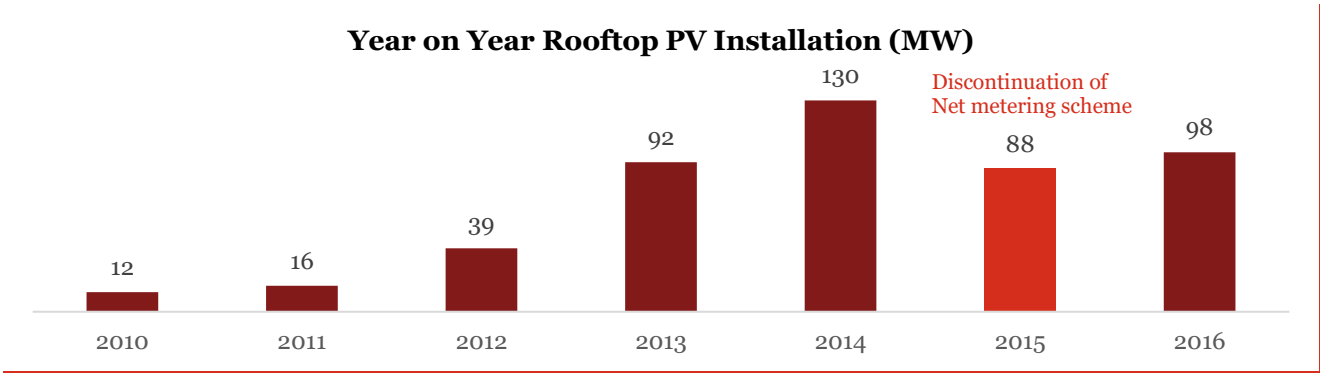
In 2008, Hawaii Clean Energy Initiative (HCEI) had targeted to achieve 70% clean energy by 2030, counting both renewable energy and efficiency gains. Further, in 2015, the Hawaii legislature amended the state's renewable portfolio standard and set the deadline for obtaining 100% of the electricity from sustainable renewable resources by 2045. To achieve the goal, U.S. Department of Energy (DOE) and the Hawai'ian Electric Company (HECO) focused on developing strategies to allow higher renewable energy penetration through setting up distributed solar PV system.



Source: EIA, Hawaii State Energy Office

Figure 18: Hawaii Energy Market Summary

Since the inception of Net metering program in 2011, over 60,000 customers had installed solar PV system at their premises in Hawaii Electric, Maui Electric, and Hawaii Electric Light service territories. The Hawaii Electric company has seen a rapid growth in the PV installation. The market has essentially doubled every year from 2010 to 2013.



Source: Hawaii Electric Industries

Figure 19: Solar PV installation in Hawaii

However, considering the technical constraints in grid integration of such rapid scaling-up of solar PV rooftop, in Oct 2015, the Hawaii Public Utilities Commission (PUC) ended the Net metering program under Decision and Order No. 33258. The PV capacity under Net Metering Scheme were close to 50% of the system peak (30% of HECO, 42% of HELCO and 53% of MECO respective utilities in Hawaii islands) leading to system integration issues for daytime loads. The Scheme was grandfathered i.e. existing customers under scheme continued with the scheme while no additional capacities where to be added under Net metering scheme. The Net metering scheme had provided the required jump-start to Hawaii for its vision for higher renewables share in its energy purchases (100% by 2045).

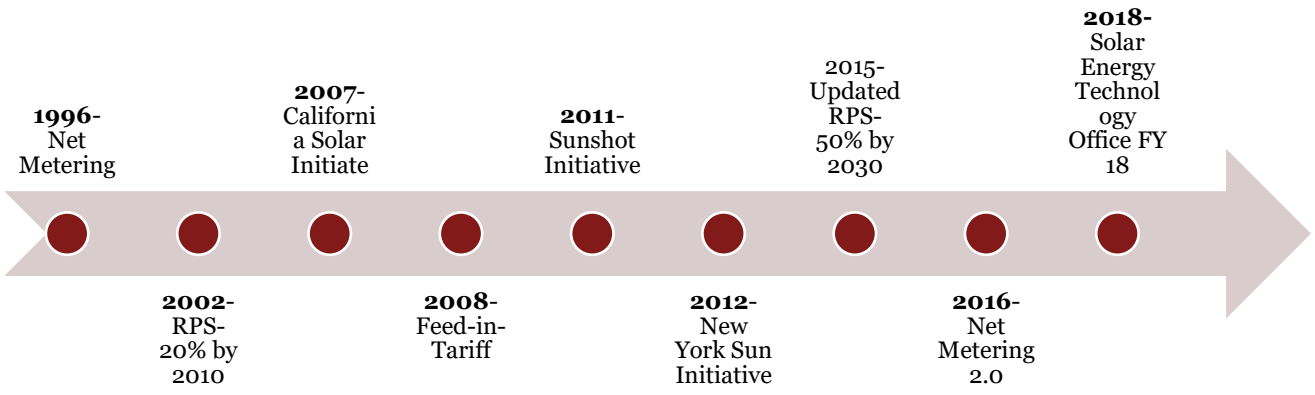
The net metering program was replaced by the adoption of two interim option: a grid supply option and self-supply option. Later, the interim tariff were replaced in 2018 by new tariffs: Customer grid supply plus (CGS plus), Smart Export and Community based Renewable Energy.

a) Customer Grid Supply Plus (CGS Plus): The CGS plus tariff is available on a first-come, first-served basis to residential and "small commercial" customers (including government entities) until the aggregate capacity limit for the specific region/utility has been met. Customers will receive a monthly bill credit for energy injected to the grid. The system shall also include equipment that allows to remotely control the output of the system, and curtail it as needed to ensure grid stability.

b) Smart Export: The Smart Export tariff is for renewable energy system that are integrated with the energy storage devices. The excess generation can be used to charge the batteries/storage system. Electricity exported to grid will receive credit based on the prevailing tariff. Customers are expected to charge the battery storage system from the rooftop solar or other renewable system during the daylight hours (9:00 a.m. – 4:00 p.m.) and use that energy to power their home in the evening. Energy exported to the grid during the daylight hours is not compensated with credit.

c) Community based Renewable Energy: The program allows a person or entity to own and operate community-based renewable energy system. Through this program, customer will contract directly with project owners, and they will be eligible to obtain credit on their proportionate share of electricity produced by the system.

4.2.2. Evolution of Policies



1996- California Net metering law was announced which enable customer and utility to settle the excess energy pumped to grid. In addition, the provision of Renewable Energy Credit (REC) was introduced.

2002- The California Renewable Portfolio Standard required its large utilities to buy 20% of supplies from renewables by 2017

2007- California Solar Initiative planned around capacity addition of 3 GW in California. The program had a total budget of USD 2.167 Billion between 2007 to 2016. The initiative paid customers either all at once for smaller systems (<=30 kW) or over the course of five years for larger systems (for >30 kW).

2008- The California Public Utilities Commission announced FiT, which was a simple mechanism for small renewable generators to sell power to the utility at predetermined/regulated price. It was proposed to procure 480 MW from RE generator capacity lower than 1.5 MW.

2011-Sun Shot Initiative was launched by The US Department of Energy (DOE) with the goal of making solar energy fully cost competitive with traditional energy sources before the end of the decade. In September 2017, SunShot successfully met the utility-scale solar cost target of USD 0.06/kWh, three years earlier than expected. The SunShot 2030 goal of utility-scale solar tariff is targeted at USD 0.03/kWh.

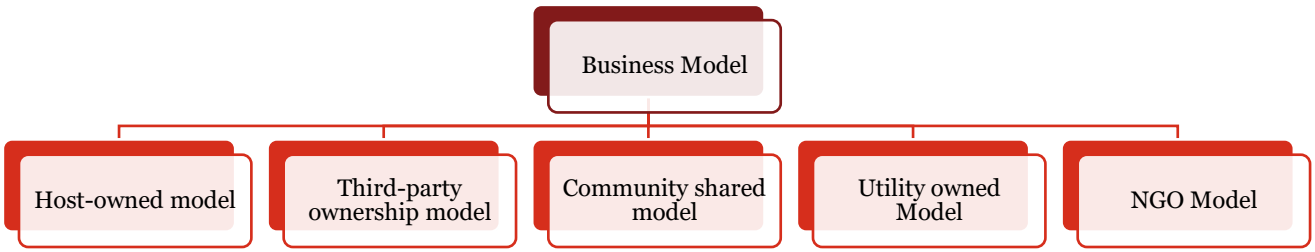
2012-New York Sun Initiative was launched to increase the solar installation in State. In April 2014, a commitment of nearly 1 billion USD was made for expanding deployment of solar capacity. Under NY-Sun, cash incentives[29] are provided for residential systems, non-residential and commercial systems. It is targeted to install capacity of 3.175 GW by 2023.

2016-Net metering policy 2.0 removed the limit of 1 MW or under and extended it to capacity sized to generate up to the customer's annual load. Electricity consumed from the grid is reviewed at the smallest interval times (1 hour for residential, 15 minutes for all others) rather than at the end of each month and pay NBCs on the net consumption.

2018- Solar Energy Technologies Office Fiscal Year 2018 (SETO- FY2018)[30]: It is a funding program to address the affordability, flexibility and performance of solar technologies on the grid. DOE announced USD 53 mn in funding for projects that would focus on PV research and development.

4.2.3. Business Models

On the basis of ownership, the Business models for Rooftop PV prevalent in US are classified as follows:



Host-owned model: In this model, individual (host) owns the Solar PV system, i.e., the owner of the property on which the project is installed (rooftop) and the electricity produced by the project is primarily for that individual. For any excess generation, the solar system sends it into the grid and the system owner gets the credit.

[29] Under NY-Sun, cash incentives are provided for residential systems that are 25 kW or less and for small commercial systems that are 750 kW or less in upstate and PSEG Long Island region and non-residential sites in the Con Ed region up to 7.5 MW or less. Separate MW budgets for three different specified regions (Con Edison, PSEG Long Island and the rest of the state) have been established. In addition, the program provides additional incentives for low to moderate-income households, which have a household income of less than 80% of the State Median Income (SMI) or Area Median Income (AMI), whichever is greater. Households that get qualified receives double the standard incentive amount for systems up to 6 kW. Additional incentives include a standard incentive of USD 0.80/watt in upstate and Long Island region and USD 0.40/watt in Long Island region. In September 2017, NYSERDA increased the Upstate Residential MW Block incentive from USD 0.30/watt to USD 0.35/watt.

[30] On October 23, 2018, the DOE announced that it would provide USD 53 mn in funding for 53 projects in the SETO FY2018 funding program. Of those projects, 31 would focus on PV research and development. On March 22, 2019, an additional USD 28 mn in funding has been announced for 25 projects, 18 of which would focus on PV research and development.

This model, however, has certain disadvantages, including high upfront and maintenance cost and transaction cost associated with grid interconnection in case of capacity greater than 1 MW.

Third-party ownership (TPO) model: The TPO model offers customers with the benefits of a solar PV system without the requirement of upfront investment. In TPO model, third-party financier or system owner handles installation, engineering, maintenance and financing services for the PV system on the host customer's property for a period of 10 to 25 years via solar lease or a power purchase Agreements (PPA). There are two types of arrangement under this mode: - a) Solar Lease and b) Solar PPA.

Community-shared model: This model is also known as "Shared Solar" allows customers to buy or lease part of a larger, offsite shared solar PV system. The main advantage of community solar arrangements is that it allows customers to use solar energy without installing their own solar energy system. Individuals who have insufficient solar resources or roof conditions, who do not own their homes or buildings and who are unable or unwilling to install an onsite solar PV system for financial or other reasons, prefer this model.

Utility-owned Model: In this model, the solar rooftop system is installed and owned by the electricity utility in the region. For instance, Dominion Resources (utility in Virginia) installed and owned 20 small-scale rooftop systems in 2013-2014. The utility will be responsible for installation of systems and also it will own and operate the systems sized 200 kW - 1 MW on leased rooftops Typically such model is implanted on Public institutions or Government Owned establishments.

Utility driven model: The solution includes portfolio of DER such as distributed generation, energy efficiency, battery storage and demand response to meet the load requirements of the utility. Utility benefits from replacement of costs otherwise required on transmission network the serve the load.

NGO Model: In this type of model, the high upfront cost of distributed solar power can be overcome when individual rooftop owners come together and do bulk purchasing of solar panels. This model began in Portland Oregon in 2008 and later was adopted by many other cities throughout Oregon. As per the experience of Portland city in Oregon State in the USA, under this model, 90% of the cost can be bought down when combined with the state's tax credits and cash incentives. Homeowners interested in solar power get together in educational workshops where they form a group and decide on the size of solar installations and the contractor.

4.2.4. Financing Instruments

The initial cost of a solar PV system acts as a barrier for deployment in Rooftop. In order to overcome this barrier, the following financing mechanisms have been adopted and these options are available for procuring solar PV for residential and non-residential purpose in the USA..

For Residential

Traditional Self-Financing

- Cash purchase
- Home equity loan (HEL)
- Home equity line of credit (HELOC)
- Cash-out mortgage refinancing (COMR)

Third-Party Ownership

- Power purchase agreement (PPA)
- Solar lease

Utility and Public Financing

- Onbill and meter-secured financing
- Public financing (including credit-enhanced and revolving loans)
- Property assessed clean energy (PACE) financing
- Utility owned solar system

For Non-residential

Traditional Self-Financing

- Cash purchase

Third-Party Ownership

- Power purchase agreement (PPA)
- Solar lease

Utility and Public Financing

- Bond financing, direct investment, energy performance contracting and green tariffs
- Property assessed clean energy (PACE) financing
- Utility owned solar system

Figure 20: Financing mechanisms in rooftop for residential and commercial users

Traditional Self-Financing

a) Loans usually leads to direct ownership. Consumer pays for the solar panels rather than electricity production, thus the risk of performance falls on the commercial solar consumer. The loans are designed[31] to provide concessional/benefits to the consumer.

b) Cash Purchase is the most common and simple way of solar financing wherein customer directly purchases, owns and is responsible for maintaining the solar installation. Purchasing a PV system will require consumer to pay significant value at once, which could be challenging for few consumer.

Homeowners that do not wish to purchase the system upfront with cash can choose Home Equity Loan (HELs) (also known as second mortgages), Home Equity Line of Credit (HELOCs), and Cash-out Mortgage Refinancing (COMRs).

Third Party Ownership Model

Third Party Model comprises of two varieties:-

a) PPA Model:- In this model, the consumers buy generated electricity from a third-party developer through a price decided in the contract per kWh, typically for 10–20 years. The developer installs, owns and operates the system. Any excess electricity can be sold to the utility. This results in the reduction or elimination of the upfront cost of the system, allowing those with less income to afford rooftop systems. There are two types of PPA:

   i. On-site PPA:- The electricity produced is directly tied to consumer meter, reducing the amount of electricity purchased from utility

   ii. Off-site PPA: - Consumer does not utilize the electricity generated rather agrees to pay fixed price per unit for electricity generated from PV system, which is sold by electricity producer to electric grid and is compensated at market rate. If the market power is more than fixed PPA price, the producer pays to the consumer, and if it is less, the consumer pays the difference to the electricity producer

b) Lease Model: -The building owner pays monthly instalments to the third-party rooftop owner ('developer') as he leases the system through a long-term contract, while the cost of the system is borne by the developer. The building owner consumes electricity at a price that is at times lower than what he would pay to the utility.

Utility and Public Financing

The government and utilities can play a significant role in the advancement of rooftop solar PV. Some of these initiatives are outlined below:

a) Property Assessed Clean Energy (PACE) program:- PACE acts as a municipal financing mechanism through which property owners receive 100% financing in the form of loans for their renewable energy projects through the municipality. This loan is repaid through property tax bills. Municipalities collect this funding from local people through the issuance of green bonds. The repayment obligation also remains with the property, so if a solar customer sells one's home, the new owners simply take responsibility for the remaining payments as well as ownership of the solar array. Projects that are

[31] In the US, solar loans have been structured into two parts so that a consumer can take advantage of 30% federal ITC. The first one is that the loan can be split into 12-18 months at zero interest and other is long term fully amortizing loan for 70%, wherein consumer pay full amount of ITC bridge loan after receiving the tax benefit. Interest rates may vary depending on the consumers credit score

eligible for PACE financing are responsible for energy efficiency improvements such as insulation, weather sealing and high-efficiency water heaters as well as solar and other on-site RE systems.

Based on the multiple PACE pilot programs, it has been observed that PACE properties have lower foreclosure rates, better energy savings and have provided other benefits, consistent with the initiative's overall policy objectives.

b) Bond Financing [Municipal bond-PPA model]: Under this, bonds with low interest rates are issued by the government in order to raise funds and the proceeds are then handed over to a project developer in exchange for an attractive lease purchase agreement. The developer can then sell the electricity through a PPA to the DISCOM.

c) On bill financing: - This is an instrument through which renewable energy projects are paid for by utility customers on their monthly electricity bills. Utilities take advantage of the fact that they can obtain lower interest loans than consumers, and in turn make available the finance they have obtained through to commercial, residential and community projects in the form of a loan. This loan is in turn repaid to the utility as a line item on the monthly electricity bill.

d) Utility owned solar system: - The utility installs, owns and operate the rooftop systems. These systems can be installed on leased commercial and public properties within the utility's service territory. This model saves on the transaction cost of payments through utility bills.

4.2.5. Key challenges

Some of the major bottlenecks faced by the country to deploy solar rooftop projects are discussed below[32]:

a) Financing – Financing and incentives challenges needs to be addressed in order to promote installation of solar PV at local and state levels. The traditional treatment of distributed PV utilities requires change in order to pace up the growth rate of solar PV deployment which in part have been addressed through programs such as PACE.

b) Real Estate barriers - Almost one-third of all American houses are rented, and an average family shifts its home 11 times, which becomes a challenge in justifying the 25-year investment in solar PV. Rented homes and multiple tenant homes have little incentive to adopt rooftop solar projects

c) Advancement in solar PV efficiency and reliability – The US has witnessed increased deployment of solar PVs; however, the greater challenge is achieving competitive energy cost and large-scale PV deployment. In order to accomplish LCOE goals set by SunShot, it is critical to consider various metrics. For example, higher module efficiency is important, though not enough to fulfill the LCOE goals. Hence, PV system reliability with lower degradation rates and longer system lifetime might be much more relevant and important.

d) Soft Cost –DOE estimated that in the rooftop installation, 64% of price is contributed by soft cost associated with installation of rooftop solar PV. Soft costs are usually associated with permitting, customer acquisition and other non-hardware costs. Addressing these challenges is difficult due its intangible nature. One needs to address nature of rules, permitting processes, financing tools, economies, etc. in order to address challenges related to soft cost, all across the states.

e) Grid Integration: The rooftop PV integration with existing grid can bring grid stability issues (through unpredictable and unbalanced supply and demand). For example, Hawaii had to discontinue Net metering policy due to higher penetration from existing rooftop PV projects (more than 50% of the system peak).

[32] https://icma.org/sites/default/files/307440_Sunshot%20Solar%20Outreach%20Partnership%20Case%20Study_Compilation.pdf

f) Tariff Structure: Level of cross subsidy of consumer tariff also impact the scale of implementation of Rooftop PV, utilities would have to have a balanced integration among consumer categories to reduce the cost of supply to outweigh the impact from cross subsidy in tariff.

g) Other considerations- Many districts and states have historical preservation guidelines, which require many neighborhoods to install solar panels in ways that are not visible from streets. This reduces the available roof space.

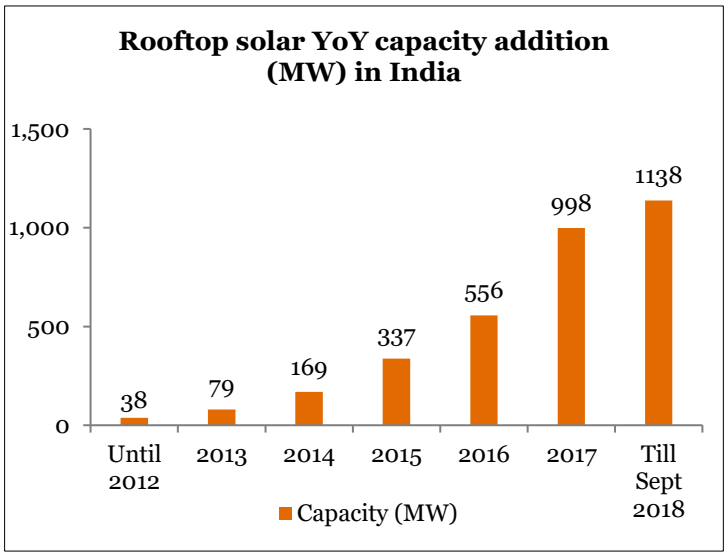
4.3. India

4.3.1. Rooftop Market

India has 3.4 GW of installed capacity for rooftop solar PV as on September 2018. Capacity addition in the 12-month period ending September 2018 is estimated at 1,538 MW. India has set an ambitious target of 40 GW from Rooftop Solar PV by 2022.

The rooftop solar market in India has grown rapidly at a CAGR of 80% in the last three years. The installed rooftop solar capacity increased from 286 MW in 2014 to 3315 MW in September 2018. This accelerated growth in rooftop solar systems is driven by economic considerations for Commercial and Industrial consumers due to falling prices of Rooftop PV system. The policies and state bank's home loan schemes have also attracted capacity additions in residential sector addressing specific state level challenges.

Figure 21: Rooftop solar capacity addition in India as on September 2018



However, with the availability of better project financing rates and decline in module/system costs, rooftop solar is expected to have further additions in coming years.

The rooftop solar market growth and penetration varies due to factors such as variance in retail electricity tariffs, regulations at national and state level.

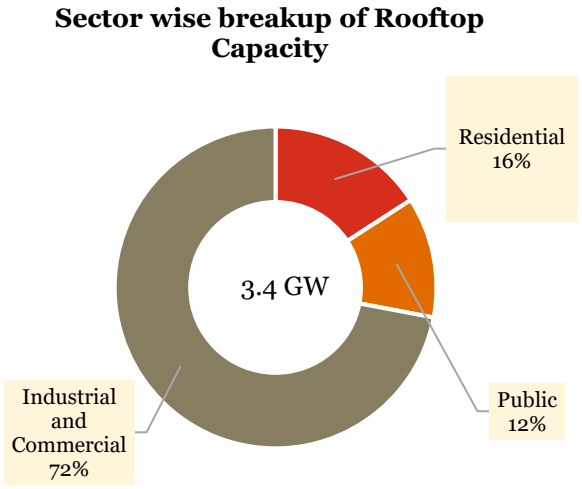


Figure 22: India Rooftop sector wise breakup

Currently Commercial and Industrial (C&I) consumers dominate the market with about 70% share of total installed capacity. This can be attributed to the high retail electricity tariffs (~ 120-150% above the average cost of supply) paid by these consumers.

In some cases installation of rooftop solar by C&I consumers may provide energy savings as high as 20%-40%[33]. In addition, C&I consumers have access to cheaper capital for installation of rooftop systems, which further improves its business case. At the end of September 2018, public sector consumers accounted for 12% (~ 490 MW) of total installed rooftop solar capacity and residential consumers accounted for the remaining 16% of market share. Public sector installations has been dependent on auctions that are held at National level by SECI or at state/municipal level by nodal agencies, municipals and other government bodies.

[33] Based on PwC research

4.3.2. Key central and state policies

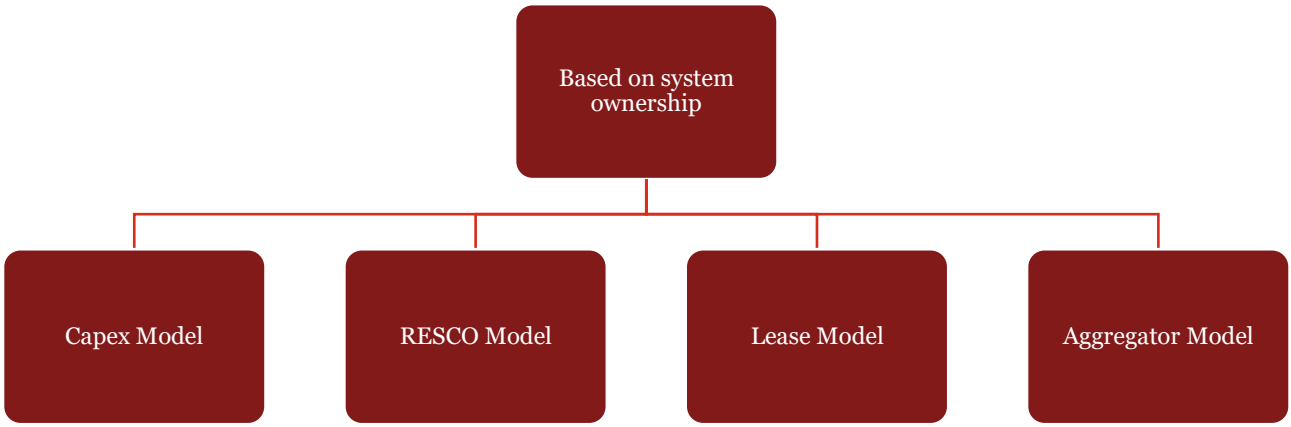
Sl No	Name of policy	Description	Remarks
Central level policy			
1	SRISTI (Sustainable Rooftop Implementation for Solar Transfiguration of India)	• Key objective is to bring distribution utilities to the forefront as implementing agency for rooftop solar. • CFA will be provided only for residential consumers and will be limited up to 5 kWp capacity. • Distribution utilities will be provided with performance linked incentives since they are the implementation agency. Incentives will be based on the incremental rooftop capacity installed in the distribution network from the installed base capacity (capacity installed as on 31 Mar 2018). • The total financial outlay for rolling out this policy is estimated as INR 23,450 Crores. • SECI, the central agency responsible for renewable energy auctions in India would float an annual tender for equipments	• CFA is limited only to residential sector because this sector already enjoy the benefit of subsidized retail electricity rates and hence do not have an extra incentive to install rooftop solar • The pattern of performance incentives are progressive in nature i.e. for 10% incremental capacity in an year, incentive is 5% of project cost of the capacity installed in that year
2	Off-Grid & Decentralized Solar Applications scheme	• The Government approved Central Financial Assistance (CFA) for implementation of grid connected rooftop solar plants. • The Government increased the CFA from initial INR 600 Crores to INR 5000 Crores • The CFA is allocated to provide capital subsidies (from 30% to 70% of the total capital expenditure) to residential, institutional and social sector consumers • The CFA was sanctioned for aggregate project capacity of 2363 MWp to different implementing agencies	Out of the sanctioned capacity of 2363 MWp, only 225 MWp was commissioned. The major issues identified are listed below[34]: • Considerable delays in tendering for awarding projects • Reluctance of distribution utilities due to revenue loss • Lack of mandatory notifications by state nodal agencies • Degradation of quality of systems by bidders to quote low prices and win contracts

[34] SRISTI (Sustainable Rooftop Implementation for Solar Transfiguration of India) – Ministry of New and Renewable Energy, Grid Connected Rooftop Solar Division

Sl No	Name of policy	Description	Remarks
State level policy			
1	Gross metering policy and Net-metering	• Gross metering is the billing system that allows export of all the energy generated by the rooftop plant to the grid and purchased by the distribution utility at a prior determined price. • Net metering is a billing system that allows rooftop owners having solar system installed at their rooftop to sell any excess electricity generated from solar system to local electricity utility. • In India, almost every state in India has its own net-metering and/or gross-metering policy as notified by respective State Electricity Regulatory Commission (SERCs). • These policies specify the rooftop capacity limits that can be installed, ownership options available, billing mechanism for energy settlement, financial assistance applicable for setting up rooftop solar projects.	For instance, in the state of Madhya Pradesh, the rooftop solar policy specify the following: • Financial assistance: Accelerated depreciation @ 40%, 10 year tax holiday on solar projects and loans upto INR 15 Crores will be disbursed under priority sector lending • Technical specifications: The cumulative capacity of all solar systems installed in an area should not exceed 30% of the rated capacity of the distribution transformer in that area • Billing Mechanism: Net-metering scheme and energy settlement is carried out annually.

4.3.3. Business models

Figure 23: Different types of business models for deployment of rooftop solar in India



Business models based on system ownership

Business model	Description	Remarks
CAPEX Model	• The entire investment for procuring, construction and commissioning of the rooftop solar plant is borne upfront by the power consumer • The consumer hires a solar EPC company, which provides turnkey installation of entire solar power system. In addition, the EPC player may also carry out annual operation and maintenance (O&M) of the plant on mutually agreed commercial terms	• Low transaction costs, lower payment risks and sole ownership of the rooftop plant • However, requirement of upfront capital, high interest rates on the money borrowed, delays in receiving subsidies for setting up of the project are few of the challenges in implementing this model.
RESCO Model (OPEX Model)	• An investor or project developer (also called Renewable Energy Service Company – RESCO) invests the upfront capital expenditure for setting up the rooftop plant and sells energy to the consumer at a per unit price under a PPA. • The terms and conditions (such as tenure, tariff) of the power purchase are governed by a power purchase agreement signed between RESCO and the consumer.	• The technological risk is mitigated here since ensuring performance guarantee of the rooftop solar plant is completely in the scope of RESCO • Prevents customers from locking up significant capital in terms of upfront investments. • Major disadvantage of this model is payment risks because the long-term PPAs signed between RESCO and consumer generally lack provision of termination compensation. Due to this, consumer is not legally bound to remain in the contract.
Lease model	• In this model, the customer leases the system from a developer and pays a rental amount over time. The mode of lease may be either a financial lease or an operating lease. • At the end of the lease tenure, the asset is fully transferred to the customer.	• Prevents customers from locking up significant capital in terms of upfront investments and will help in meeting their short term financial demands • The lease model is not popular in India because of limited tax benefits available to lessors and thus reduced returns to equity. • Other risks involved in this business model are payment default issues and ownership issues
Aggregator model	• Under this model, the third party/ RESCO, aggregates the demand of various consumers and installs rooftop solar captive power plants up to the total capacity of the cumulative contracted load of the selected group of customers connected with the same distribution transformer. • This model is now picking up pace in India and has been tried by various DISCOMs and banks.	• Helps the aggregator to gain scale and offer resulting into low transaction cost. Financial institutions save considerable time and resources in conducting • In order to gain a complete line of credit for rooftop financing, developer aggregates the portfolio of projects so that the project financing cost can be significantly reduced. Hence, the end consumer is offered competitive tariffs. • This model assists in better risk management due to lower risk of project failure arising from any one individual buyer.

Case study: Aggregation of 35 MW of grid-connected rooftop solar projects

PwC assisted Government of Madhya Pradesh (India) in deployment of Rooftop PV scheme under a tender mechanism to aggregate 35 MW of grid connected rooftop solar systems. The tender covered rooftop installation on 291 government colleges, 159 police establishments, Municipal Corporation and private entities. The projects were selected based on rooftop area, estimated capacity within the rooftop area considering the shading aspects, contract demand, external transformer capacity, feeder availability, credit rating of consumer etc.

The bid winners were entitled to capital subsidy for setting up rooftop projects under central and state level policies. The lowest tariff quoted was INR 1.58/kWh ($ 0.022/kWh) with an escalation by 3 percent per year over a period of 25 years.

Few of the key highlights of this tender are listed below:

- *Better risk profiling:* The group capacity ranges from 50 kW (individual private organization) to 5.4 MW (all projects of a genre across the state under one government department). For each consumer category, separate bidding was undertaken and the winner has to implement all the projects in that group. It enabled better project execution planning, efficient material procurement and efficient financing.
- *Providing extensive detail in the data room* - Unique data room was created and made accessible to interested/prospective bidders to address information asymmetry. This included information like Google coordinates of the buildings, indicative solar PV array layout superimposed on Google image and electricity consumption history of probable consumers. Such information enabled developers to size the Rooftop capacity accurately and thus lower overall price discovery.
- *Aggregation to gain scale* - Pre-identification of numerous project sites and grouping them into project groups created the much-needed market for interested project developers. This saved the bidders from spending their energy in identifying procurers that have enough electricity demand and space for rooftop solar solutions.
- *Robust payment security mechanisms* – A robust payment security mechanism was designed which was a win-win for all key stakeholders: consumer, developer, and government.

4.3.4. Financing instruments

The major financing instruments used for rooftop solar deployment is Equity scheme and Debt scheme. The schemes differ with respect to the financing cost and cost of obtaining finance. The cost of financing is dependent on the perceived risks (counterparty risk, performance of the rooftop solar plant, regulatory risk in respective Indian states) and related guarantees as well as project size and consumer category.

- *Owner's equity:* is mainly used for small installations in the residential and commercial segments. The scheme is being used because of the relatively low investment costs of the smaller installations and availability of 30% capital subsidies for installing solar rooftop plants.
- *Project Finance:* is mainly used for large-scale industrial and commercial systems. This is due to the effort involved in the extensive approval process (covering audits, certification, etc.) which is only justified for larger investments. This scheme is especially based on stable positive cash-flows and bankable power purchase agreements.

- *Loan schemes:* Punjab National Bank, an Indian multi-national bank has availed a line of credit of $ 500 Million from Asian Development Bank for financing Rooftop Photovoltaic Solar Power Projects. The proposed $505 million sovereign-guaranteed

  Solar Rooftop Investment Program (SRIP) is a multi-tranche financing facility, consisting of $500 million financial intermediation loans and a $5 million capacity development technical assistance. The target group under this scheme include sole proprietorship firms, Limited Companies, Private Limited companies, Trusts, Associations, Special Purpose Vehicle (SPV) and Non-Banking Finance Companies (NBFCs). This scheme is mainly found in the commercial and industrial segment.

4.3.5. Key challenges

Despite India's considerable progress in bringing down the cost of rooftop solar installations, the deployment rate is still insufficient to achieve the national target of 40 GW by 2022. Considering the current rate of annual capacity additions, it is estimated that around 10 -12 GW of rooftop solar will be installed by 2022. Few of the key barriers identified for slower adoption of rooftop solar are listed below:

- *High upfront investment requirement:*
  - One of the biggest challenge for the slow deployment of rooftop is the limited access to debt finance. Unlike in the case of large-scale ground mounted solar projects, the cost of debt for setting up small-scale rooftop solar systems is significantly high, which makes the projects commercially unviable. The higher cost of debt for rooftop solar projects can be attributed to increased transaction costs and efforts required for carrying out due-diligence. Though, aggregator model (discussed earlier) can address those challenges, but the scale is yet to pickup.
- *Technical challenges*
  - It is observed that very limited technical expertise is available to determine the most optimal rooftop capacity by considering key technical parameters (few key parameters - available rooftop area, shading, solar insolation and strength of the roof). To bridge this gap, ministry has empaneled developers with standard specifications for Solar Rooftop PV.
- *Commercial challenges*
  - There is a perception of risk and performance among consumers towards installation of rooftop solar. This perception can be attributed to lack of awareness about rooftop solar advantages, incentives available for setting up rooftop plants and regulations governing rooftop solar
  - Due to limited eligibility criteria for rooftop projects, which are awarded through competitive bidding route, few players, bid at exceptionally low prices disrupting the market.
- *Policy and regulatory challenges*
  - Even though, every state has its own net-metering policy, very few states have carried out on-ground implementation of the policy. Though the central and state policies provide provision for single window clearance for projects, based on market inputs, it is observed that there is significant delay in obtaining necessary permits and clearances for setting up rooftop solar plant.
  - The central rooftop solar policy has provisions for capital subsidy (central financial assistance of 30% of capital expenditure) to residential consumers for development of rooftop solar plant. However, delay in disbursement of subsidies have been attributed for slower adoption rates in residential sector.

4.4. Germany

4.4.1. Rooftop Market

Germany is widely considered the most successful country at rapidly transitioning toward renewable energy systems through feed-in tariffs. The annual capacity installation for solar PV in Germany peaked around 2.95 GWp in 2018[35]. At the end of 2018, Germany stood fourth in market share of total installed solar PV, with a total installed capacity of 44 GW in 2018.

Germany's successful drive to meet and exceed its aggressive renewable electricity goals was largely due to its FIT (Feed-In-Tariff) regime. The FIT policies have been designed to support market rapid scale-up, and stand out as a policy that has delivered transparency, longevity, and certainty to investors in German renewable energy projects.

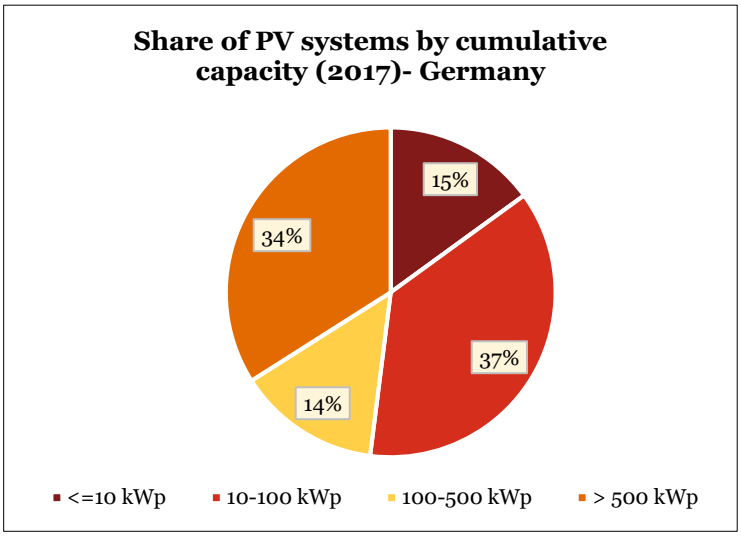


Figure 24: Installed capacity of Solar PV system

While large PV-systems (> 500kWp) account for about one-third of the total installed capacity, the number of such large-scale systems is only 1% of the total installed systems. This indicates a growth in the number of small-scale and rooftop solar systems.

Solar PV installation breakup for 2018 is residential consumers (14%), commercial consumers (58%) and large-scale/ground mounted systems (28%).

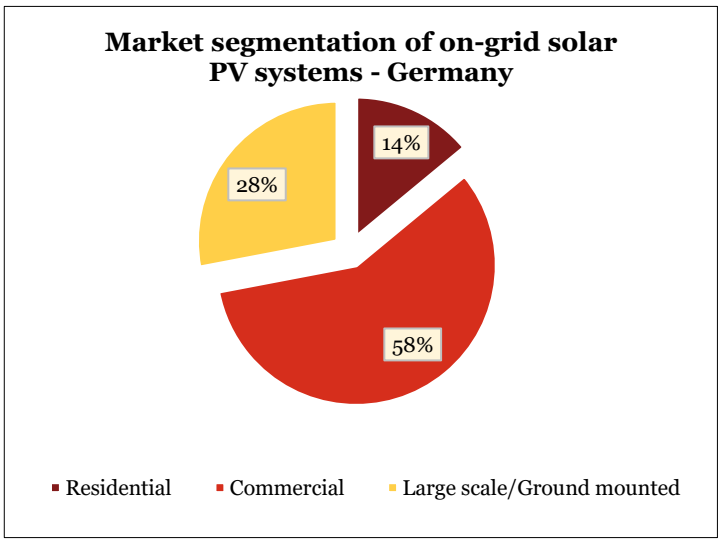


Figure 25: Market segmentation of on-grid solar PV systems in Germany

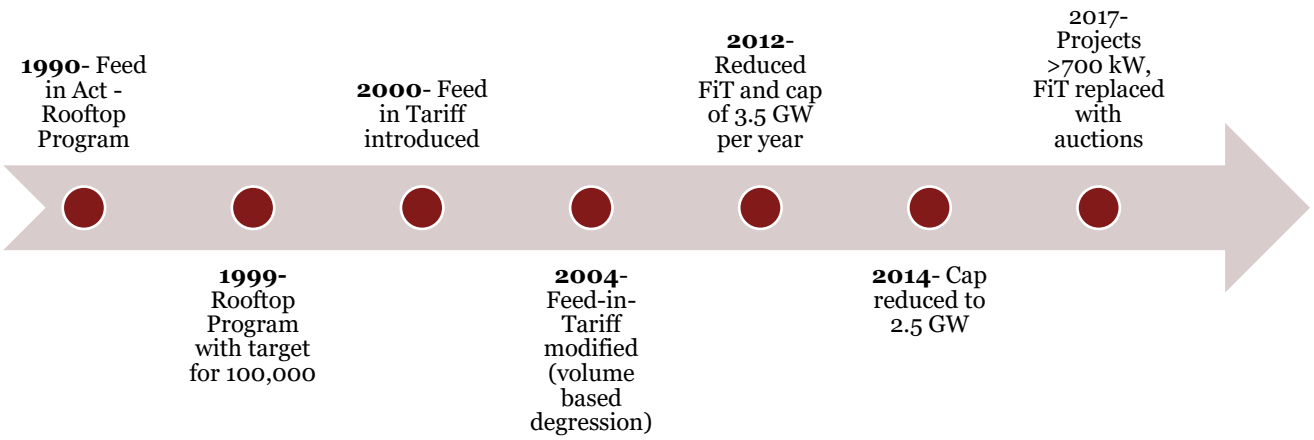
The commercial solar segment is composed of 660,000 systems of system size ranging from 10kWp to 1000 kWp. The total installed capacity in this segment is around 24 GW.

The residential market segment includes solar PV systems with system size up to 10kWp. At the end of August 2018, it is estimated that total 970,000 systems adding up to 6 GW was installed within this segment.

With falling PV system and battery costs, storage is likely to experience an increased deployment in rooftop solar PV. With potential retro fitment possibilities for existing installed rooftop solar PV capacities.

[35] BSW-Solar

4.4.2. Evolution of policies



1990 – 2000: Germany adopted Feed in regime in 1990 and since than there has been several amendments and measures taken to improve the efficacy of the program. The StrEG ("Electricity Feed-in Law") was Germany's first feed-in-tariff. The feed-in-tariff was set at 90% of the retail electricity rate i.e. rates ranged from 8.5 – 8.8 EUR cents/kWh during the period of 1990 to 1999. In addition, rebates up to 70% of the system cost and low cost financing options for 100,000-rooftop program was provided to encourage rooftop solar installation.

In 2000, Germany passed the EEG law ("Renewable Energy Law") which introduced the concept of FiT. The EEG law has continued to promote it while adapting the details to the current market scenario. The law was passed to set cap on rooftop program and projects to control impact on ratepayers. Along with the 100,000 Roofs Program (which offered zero-interest loans starting in 1999), the EEG drove cumulative capacity to 435 MW by the end of 2003. Market growth accelerated under the amended EEG, with cumulative capacity expanding to 5,979 MW by the end of 2008.

In 2008, the EEG law was amended to remove rates for building-façade integrated PV but encouraged captive consumption by introducing payments on top of the retail electricity rate for PV electricity consumed onsite. The amendment established a "corridor" or "flexible" digression system for rooftop solar PV whereby the rate would decrease each year based on the capacity volume (MW) installed during the previous year.

In 2012, the German government set a "floating cap" on solar power, limiting it to 2.5 to 3.5 gigawatt per year and reducing the feed-in remuneration of small rooftop panels (under 10 kilowatt) from 24.43 cents per kilowatt-hour to 19.5 ct/KWh.

In 2014, the amendment to EEG retained the absolute cap on installed capacity of solar power in Germany as 52 GW. Installations beyond this target will not receive any funding under the EEG. The tariffs applicable to rooftop solar PV systems will depend on the size of the installation.

Policy incentive for rooftop solar with storage

In 2013, a program of incentives for storage units was introduce which aimed at increasing self-consumption and developing rooftop solar PV with battery storage in Germany. Market stimulation program was introduced to boost the installation of local stationary storage systems in conjunction with small PV systems (< 30 kWp). Within the agenda of this support program, around 20000 decentralized local storage systems were funded by the end of 2016. The program saw 44% reduction in storage costs from 2013 to 2018 More than 100,000 PV systems installed in 2018 contributing to nearly 40% of the overall installations.

A continuation of this program is planned considering the high number of installed battery storage systems, it is estimated that around 100,000 battery storage systems have been installed by the end of August 2018.

4.4.3. Business models for rooftop solar

	Market premium model/self-consumption model	FiT Model	Landlord- tenant electricity supply
Description	• The market premium model or self-consumption model allows the owners of rooftop solar PV systems to consume the electricity generated from their system directly instead of injecting it into the grid.	• The FiT programme for rooftop solar is the most important driver for propelling Germany as one of the largest rooftop solar markets in the world.	• The shared PV system use in mutli-apartment buildings. The electricity is generated by installation of rooftop solar plants on a residential building and the electricity generated is supplied to consumers (tenants) living in the building
Remarks	• Reduced payment of EEG surcharge due to self-consumption • Difficulty of low income households due to upfront investment requirement • For systems without energy storage, the self-consumption is dependent on coinciding supply and demand profiles • Currently, self-consumption model is attractive since only partial EEG surcharge is applicable. However, for procurement of electricity through grid additional charges such as grid fees, surcharges, electricity tax may be applicable.	• Assured revenue model for investors to develop Rooftop PV systems • With reduction of FiT, cost of debt financing has increased because financial institutions now look at the creditworthiness of the investor. Hence the equity contribution of investor has increased from 20% to 25-40%. • Local accumulation of smaller PV systems in sparsely populated regions require that the distribution network and the transformer stations are strengthened at certain sites.	• In this model a building owner invests in a PV system and leases the system to a tenant. Hence, there can be only one user of the PV system such as single-family buildings, companies, etc. in order to qualify for self-consumption and avoid the payment of the complete EEG surcharge. • The lessee is responsible for the rooftop solar PV system and excess electricity can be sold to public grid at the corresponding Feed-in-Tariff • This business model involves counterparty risks because the leasing contract between the lessee (tenant of the building) and the lessor (building owner) specifies the amount of the monthly rent and defines that the risks of the plant operation are covered by the lessee.

4.4.4. Financing instruments

With the reduction of the Feed-in Tariff (FiT)[36], financial institutions now look at the creditworthiness of the investor. Hence, the equity share of the investor increases (from 20%, to 25-40%, depending on the credit), which deters the access to financing. To overcome these difficulties two major innovative financial instruments have been developed namely: crowdfunding and leasing.

[36] FiT reduction of 70% per kWh since 2010. Source Fraunhofer ISE, "Aktuelle Fakten zur Photovoltaik in Deutschland".

	Leasing	Crowd investing
Description	Leasing is emerging as the way of financing PV systems for self-consumption. The main characteristic is that the risks of operating the system are transferred to the electricity consumer or lessee in order to qualify for self-consumption and avoid the payment of the complete EEG surcharge. Leasing is a preferred option to install rooftop solar where the building owner does not have the capital or willingness to invest in a photovoltaic system. Few of the business models which can be deployed based on this financing instrument is Investor leases the rooftop solar system to building owner. This model is applicable to single-family buildings, companies Investor leases the rooftop solar system to tenant. Building owner invests in a rooftop solar system and leases the system to the tenant.	Crowdinvesting is an equity-based crowdfunding where the investors become shareholders and benefit from the returns of the project. (For eg:- a subordinated loan- a mezzanine instrument for which no collateral is required) Crowdinvesting is suitable for the installation of PV systems in the residential (multi-family), commercial and industrial sector. Equity crowdfunding is subject to securities and financial regulation because it involves investment into commercial enterprise. Few of the key crowdinvesting platforms – Bettervest, CEPP INVEST, GreenVesting The implementation steps for crowdfunding are listed below: Prepare marketing plan to attract investors Prepare required documentation and compliance to apply for crowdfunding financing instrument Prepare a detailed funding application of the project, which includes- profitability analysis of the project, creditworthiness of project owner/company, prepare investment prospectus Online publication of the project by posting on the crowdfunding platform where it can be examined and funded by the investors

4.4.5. Key challenges

The following challenges have been reported to scale up installation of rooftop solar systems in Germany

- *Financial challenges:*
    - It is reported that there has been difficulty in obtaining bank credit in the case of financing rooftop solar projects. One of the financing instruments that covers this gap is crowdinvesting.
- *Operational challenges:*
    - The FiT scheme has been challenged as a drain on public finance. The levy (reallocation charge) on conventional power to finance FiT has led to a surge in power prices for all households.

5. Next Steps

5.1. Deployment barriers and Business models recommended for Rooftop PV

Legal and Regulatory Review

i. This report provides preliminary review of the existing legal framework. Subsequent reports shall provide detailed review of the legal and regulatory framework and identification of key barrier based on the discussion with MOIT, EVN, PC and other key stakeholders (including end consumer) in next phase.

ii. Analyze the legal, regulatory and institutional barriers of developing solar rooftop PV for different consumer groups (residential, commercial industrial, government etc.) with a focus on both cities.

iii. Identify legal/regulatory constraints and relevant solutions for the development of a comprehensive deployment strategy/action plan based on the selected business models.

Deployment Barriers

i. Identify key challenges based on consumer category namely residential, commercial, public and industrial.

ii. Discuss with key stakeholders to understand existing barriers for rooftop PV deployment.

iii. Analyze potential impact on Rooftop PV deployment based on such deployment barriers and identify available mitigation measures to overcome these barriers.

Business Models

i. Based on the key barriers identified and global learnings highlighted in this report, recommend the business models for Rooftop PV deployment based on consumer category profile for Da nang and HCMC. Similar business model can be rolled out at national level by MOIT based on the consumer category mix of other cities.

ii. Discuss findings and recommendations in Danang and HCMC with stakeholders to finalize the outcome

5.2. Information Request List

The following information is requested from World Bank, EVN and People's Committee of HCMC and Danang.

Table 11: Information Request from WB, EVN, PC and MOIT

Sr.No.	Information Request	Comments
A	**Studies to be shared by WB**	
A.1	Geospatial analysis reviewing the Rooftop PV potential and the rooftop availability in HCMC and Danang	As specified in TOR
B	**Data Requirement from GoV/MOIT/PCs**	
B.1	Provincial Power System Plan for HCMC and Danang	Including PDP VIII proposed plans
B.2	Rooftop PV targets for HCMC and Danang as per Power System Plan for 2025 and 2030	
B.3	Rooftop PV targets for Vietnam	

Sr.No.	Information Request	Comments
C	**Data Requirement from EVN (HCMC and Danang)**	
C.1	Monthly consumer wise consumption details for past 1 year in HCMC and Danang covering each commune a. Category of consumer b. Voltage level c. Connected load d. Maximum Demand (MD) e. Time slot wise split i.e. monthly consumption during peak, offpeak, normal hours f. Capacity (MVA) of connected Distribution Transformer	
C.2	Category wise (Industrial, Commercial and Residential category of consumers) cost of supply of electricity for EVN	National level data
C.3	Interruption Details in HCMC and Danang of last two years a) SAIDI b) SAIFI c) CAIDI d) CAIFI	
QC.4	List of consumers/capacity registered for interconnection for installing rooftop for less than 1 MW	
C.5	List of consumers/capacity with commissioned rooftop capacity in the city	
C.6	Procurement Plan and availability of Net meters by voltage level (planned for metering Rooftop PV)	Plan available till 2020 or 2025

5.2.1. Structured discussion with consumers

In order to understand the potential barriers for select consumer category, discussions with consumers shall be undertaken post the initial discussions for inception report with required assistance from EVN and PCs. The preliminary structured questions for discussions with consumers is provided in the table below:-

Table 12: Preliminary structured discussion with consumers (Industrial, Commercial and Residential)

Category	S.No.	Question	Answer
Awareness	1	Is the consumer aware of Rooftop policy and decisions of MOIT/EVN?	<Yes, No>
	2	Does the Consumer possess general awareness about the following? a) Capital expenditure of installing a Rooftop per kWp b) Operational costs per kWp c) Major component suppliers in the market d) Major ESCO/EPC companies e) Models of Implementation - Capex, PPA mode, Lease mode etc.	< Not aware, Aware (Fair, Good, Excellent)> < Not aware, Aware (Fair, Good, Excellent)> < Not aware, Aware (Fair, Good, Excellent)> < Not aware, Aware (Fair, Good, Excellent)> < Not aware, Aware (Fair, Good, Excellent)> < Not aware, Aware (Fair, Good, Excellent)>
	3	Is the consumer aware of standard technical specifications required for Rooftop PV and suppliers providing such services	<Yes, No>

Commercial	4	Existing percentage use of alternate sources of Energy such as Diesel Generator set, Storage- Inverter etc. to meet their electricity needs.	%
	5	The alternate source for energy requirement is to meet additional demand or load shedding.	<Load shedding duration, Additional demand>
	6	Current measures of Demand Side Management namely Time of day measures for peak off peak, energy efficiency measures. A) For Industrial consumers, is the consumer already shifting their demand during the daytime using shift operations to utilize the benefits of Time of Day charges?	<Yes, No>
Regulatory	7	Application procedure for obtaining registration of Rooftop PV in the premises	<Subjective Response>
	8	Issues in behind the meter connectivity i.e. for sale of power to other organizations and individuals	<Subjective Response>
Financing	9	Is there a need for financing/funding requirements for installation of Rooftop?	<Yes, No>
	10	Availability of funds/bank loans for installation of Rooftop.	<Yes, No>
	11	Availability of USD loan for Solar Rooftop PV or availability of loan for domestic consumers as top up on home loans?	<Yes, No>
	12	Summary of key Issues faced while raising funds/financing from banks	<Subjective Response>
General	13	If consumer has already registered/installed for Rooftop PV, please elaborate on metering requirements a) Are net meters (two-way electo-meters) available in local market? b) Lead time for issue of net meter from EVN for Rooftop PV deployment.	<Subjective Response>
	14	If consumer has already registered/installed for Rooftop PV, feedback on other potential barriers faced	<Subjective Response>

Appendix A. - Appendices

A.1. Tariff structure

EVN's Retail Tariffs

(Attached together with Decision No. 468)

Table 13: EVN's Retail Tariff

No.	Groups of customers	Electricity price (VND/kWh)
1	**Retail electricity prices for production**	
1.1	**Voltage of 110 kV or higher**	
	a) Normal hours	1,536
	b) Off-peak hours	970
	c) Peak hours	2,759
1.2	**Voltage from 22 kV to less than 110 kV**	
	a) Normal hours	1,555
	b) Off-peak hours	1,007
	c) Peak hours	2,871
1.3	**Voltage from 6 kV to less than 22 kV**	
	a) Normal hours	1,611
	b) Off-peak hours	1,044
	c) Peak hours	2,964
1.4	**Voltage of less than 6 kV**	
	a) Normal hours	1,685
	b) Off-peak hours	1,100
	c) Peak hours	3,076
2	**Retail electricity prices for public sector**	
2.1	**Hospitals, nursery schools, kindergartens, schools**	
2.1.1	Voltage of 6 kV or higher	1,659
2.1.2	Voltage of less than 6 kV	1,771
2.2	**Public lighting; public sector entities**	
2.2.1	Voltage of 6 kV or higher	1,827
2.2.2	Voltage of less than 6 kV	1,902
3	**Retail electricity prices for business**	
3.1	**Voltage of 22 kV or higher**	
	a) Normal hours	2,442
	b) Off-peak hours	1,361

No.	Groups of customers	Electricity price (VND/kWh)
	c) Peak hours	4,251
3.2	**Voltage from 6 kV to less than 22 kV**	
	a) Normal hours	2,629
	b) Off-peak hours	1,547
	c) Peak hours	4,400
3.3	**Voltage of less than 6 kV**	
	a) Normal hours	2,666
	b) Off-peak hours	1,622
	c) Peak hours	4,587
4	**Retail electricity prices for domestic use**	
4.1	**Retail electricity prices for domestic use**	
	Level 1: 0 – 50 kWh	1,678
	Level 2: 51 – 100 kWh	1,734
	Level 3: 101 – 200 kWh	2,014
	Level 4: 201 – 300 kWh	2,536
	Level 5: 301 – 400 kWh	2,834
	Level 6: 401 kWh or higher	2,927
4.2	**Retail electricity prices for prepayment meters**	2,461
5	**Wholesale electricity price in rural areas**	
5.1	**Wholesale electricity prices for domestic use**	
	Level 1: 0 – 50 kWh	1,403
	Level 2: 51 – 100 kWh	1,459
	Level 3: 101 – 200 kWh	1,590
	Level 4: 201 – 300 kWh	1,971
	Level 5: 301 – 400 kWh	2,231
	Level 6: 401 kWh or higher	2,323
5.2	**Wholesale electricity prices for other purposes**	1,473
6	**Wholesale electricity prices for collective living quarters, residential areas**	
6.1	**Districts**	
6.1,1	**Wholesale electricity prices for domestic use**	
6.1,1,1	Substation invested in by the seller	
	Level 1: 0 – 50 kWh	1,568
	Level 2: 51 – 100 kWh	1,624
	Level 3: 101 – 200 kWh	1,839
	Level 4: 201 – 300 kWh	2,327

No.	Groups of customers	Electricity price (VND/kWh)
	Level 5: 301 – 400 kWh	2,625
	Level 6: 401 kWh or higher	2,713
6.1,1,2	Substation invested in by the buyer	
	Level 1: 0 – 50 kWh	1,545
	Level 2: 51 – 100 kWh	1,601
	Level 3: 101 – 200 kWh	1,786
	Level 4: 201 – 300 kWh	2,257
	Level 5: 301 – 400 kWh	2,538
	Level 6: 401 kWh or higher	2,652
6.1,2	**Wholesale electricity prices for other purposes**	1,485
6.2	**Communes**	
6.2,1	**Wholesale electricity prices for domestic use**	
6.2,1,1	Substation invested in by electricity seller	
	Level 1: 0 – 50 kWh	1,514
	Level 2: 51 – 100 kWh	1,570
	Level 3: 101 – 200 kWh	1,747
	Level 4: 201 – 300 kWh	2,210
	Level 5: 301 – 400 kWh	2,486
	Level 6: 401 kWh or higher	2,569
6.2,1,2	Substation invested in by the buyer	
	Level 1: 0 – 50 kWh	1,491
	Level 2: 51 – 100 kWh	1,547
	Level 3: 101 – 200 kWh	1,708
	Level 4: 201 – 300 kWh	2,119
	Level 5: 301 – 400 kWh	2,399
	Level 6: 401 kWh or higher	2,480
6.2,2	**Wholesale electricity prices for other purposes**	1,485
7	**Wholesale electricity prices for commercial – service – domestic complexes**	
7.1	**Wholesale electricity prices for domestic use**	
	Level 1: 0 – 50 kWh	1,646
	Level 2: 51 – 100 kWh	1,701
	Level 3: 101 – 200 kWh	1,976
	Level 4: 201 – 300 kWh	2,487
	Level 5: 301 – 400 kWh	2,780
	Level 6: 401 kWh or higher	2,871

No.	Groups of customers	Electricity price (VND/kWh)
7.2	**Wholesale electricity prices for other purposes**	
	a) Normal hours	2,528
	b) Off-peak hours	1,538
	c) Peak hours	4,349
8	**Wholesale electricity prices for industrial zones**	
8.1	**Wholesale electricity prices at 110 kV bus bar of 110kV/35-22-10-6kV substation**	
8.1.1	Total installed capacity of transformers of substation is greater than 100 MVA	
	a) Normal hours	1,480
	b) Off-peak hours	945
	c) Peak hours	2,702
8.1.2	Total installed capacity of transformers of substation is from 50 MVA to 100 MVA	
	a) Normal hours	1,474
	b) Off-peak hours	917
	c) Peak hours	2,689
8.1.3	Total installed capacity of transformers of substation is less than 50 MVA	
	a) Normal hours	1,466
	b) Off-peak hours	914
	c) Peak hours	2,673
8.2	**Wholesale electricity prices at medium-voltage bus bar of 110kV/35-22-10-6kV substation**	
8.2.1	Voltage from 22 kV to less than 110 kV	
	a) Normal hours	1,526
	b) Off-peak hours	989
	c) Peak hours	2,817
8.2.2	Voltage from 6 kV to less than 22 kV	
	a) Normal hours	1,581
	b) Off-peak hours	1,024
	c) Peak hours	2,908
9	**Wholesale electricity prices for markets**	**2,383**

Time-of-use (peak, normal and off-peak hours) classifications are detailed as follows:[37]

*+ **Normal hours***

From Monday to Saturday:

- From 4.00 a.m. to 9.30 a.m. (5 hours and 30 minutes);
- From 11.30 a.m. to 5.00 p.m. (5 hours and 30 minutes);

[37] Circular No. 16/2014, Article 5.1.

- From 8.00 p.m. to 10.00 p.m. (2 hours).

Sunday:

-From 4.00 a.m. to 10.00 p.m. (18 hours).

+ ***Peak hour***

From Monday to Saturday:

- From 9.30 a.m. to 11.30 a.m. (2 hours);
- From 5.00 p.m. to 8 p.m. (3 hours).

Sunday: No peak hours.

+ ***Off-peak hours:***

All days: from 10 p.m. to 4 a.m. of the following day (6 hours).

The power purchasers subject to this three-rate / time-of-use pricing include:[38]

- Customers using electricity for production, business, services, using electricity supplied via dedicated transformers of 25 kVA or above or having average electricity consumption of 2,000 kWh/month for three consecutive months;
- Retailers of electricity in industrial zones;
- Electricity purchasers buying electricity in order to retail electricity for non-household consumption purposes in commerce – service – residential building complex.

[38] Circular No. 16/2014, Article 5.2.

A.2. Metering and Billing arrangement as per Circular No. 05

Summary of Metering and Billing Arrangement in the current Model PPA for Rooftop Solar under Circular No. 05

1. Timelines for reading meters and energy output. Circular No. 05 imposes the following timelines for reading meters and energy output exported to EVN's grid:

   - Within 1 (one) working day from the date of reading meters, EVN as the power purchaser must notify the power seller on the meter readings and the rooftop solar system's power output generated onto EVN's grid.

   - If the power seller disagrees with the details of the meter readings and output of power generated onto EVN's grid as notified by EVN, then the power seller is required to provide its feedback within 1 (one) working day from its receipt of EVN's notice.

   - Upon expiration of the above time limit, if the power seller does not provide any feedback to EVN, then it will be deemed that the power seller has agreed with the meter readings and the power output generated to EVN's grid as notified by EVN.

2. Energy Payments and Billing Period

   - Under Circular No. 05, based on power output agreed by both parties and the power tariff as discussed above, EVN is required to make energy payments to the power seller for power exported on a monthly basis. Circular No. 05 provides for a specific formula for determination of the energy payments as well as a general implication of value-added tax (VAT) in this case.

   - In terms of timeline for EVN's payment, Circular No. 05 provides that it is within 7 (seven) working days from the date on which (i) the power seller agrees with EVN on meter readings and output of power generated and exported to EVN's grid (as notified by EVN) and (ii) a sufficient set of payment request and supporting documents must be submitted to EVN.

   - If EVN fails to make energy payment to the power seller within the above timeline, under Circular No. 05, EVN is required to pay late payment interest on the entire amount of late payments counting from the date preceding the due date until the date on which EVN makes actual payment. The late payment interest is calculated based on a 1-month average interbank interest rate as announced by the State Bank of Vietnam at the time of EVN's payment.

Flowchart of Payment for Rooftop Solar Projects[39]

Figure 26 Flowchart of Payment for Rooftop Solar Projects

Responsible parties	Processing time	Flowcharts
EVN's relevant power companies (business division)		Carry out meter readings
EVN's relevant power companies (business division)	1 working day from the date of meter reading	Inform meter-reading results to the owners; Check the meter figures
Project owners	01 working day from the date of receiving the information	Confirm meter-reading results; Owners are households or individuals; Owners are enterprises; If not agreed; If agreed; If agreed
Project owners		Send invoices to EVN's power companies/units
EVN's relevant power companies (business division)	7 working days from the date of the owners' confirmation of the meter reading	Print the payment documents and get the owners' signatures for confirmation
EVN's relevant power companies (Finance-Accounting department)		Make payment to the owners

[39] Annex 1 of EVN Official Letter No. 1532.

A.3. Draft Decisions

First Draft dated January 2019

On support mechanism post applicability of the current Decision 11 (after 30 June 2019)

Table 14: Salient features of First Draft dated Jan 2019

Salient points	• Provide for new FiT mechanisms for application from 1 July 2019 to 30 Jun 2021 for grid-connected solar power projects, as well as new tariff mechanism guidelines for development of rooftop solar power projects in Vietnam. • The Draft Decision provides four rooftop solar power models
Definition of rooftop solar project	• The Draft Decision defines rooftop solar project as having solar PV panels installed on the roof or attached to civil buildings and installed capacity not more than 1MWp. This definition proposed by the MOIT serves the purpose of determining the tariffs and licensing requirements for these rooftop solar power systems. For "rooftop" solar power systems having an installed capacity of 1MWp or greater directly connected to the national grid, under the Draft Decision, they will be considered "Grid-connected solar power projects" (i.e., solar farms) for those purposes.[40]
Rooftop solar power models	The Draft Decision proposes 4 different models of rooftop solar systems: • **"Power Consumption" model**, which is defined as a model of rooftop solar power projects installed with a two-way metering system together with the household's power consumption system for directly consuming power generated from the household's rooftop solar power system, simultaneously receiving power directly from the grid of EVN/the Power Purchaser. Under this model, any excess energy output after self-consumption by the household will be backfed onto the grid. Payment and invoicing will be made separately between power output delivered/exported and power output received/imported by the household/business. This model is proposed following the recently issued Decision No. 02 of the Prime Minister on the new tariff mechanism for rooftop solar, which replaced the former net-metering scheme. • **"Entire power sale business" model** is defined as a model of rooftop solar power project installed and measured independently from the power consumption. This system is directly connected to the Power Purchaser's grid and selling the entire generated power output to the Power Purchaser, and the household/business does not directly consume any power generated from its rooftop solar power system. • **"Direct power sale and purchase" model**, which is defined as a model of rooftop solar power project under which individuals and organizations invest, generate and sell power from their rooftop solar power projects to other individuals and organisations not connecting or utilizing national grid systems. • **"Intermediary power sale and purchase" model**[41], which is defined as a model of rooftop solar power project under which individuals and organizations invest, generate and sell power from their rooftop solar power project through power distributing and retailing entities not belonging to EVN.

[40] It shall be discussed with the MOIT if rooftop solar power systems / projects with installed capacity of 1MWp only is considered "Rooftop solar power systems" or "Grid connected solar power projects". This is for the purpose of determining varying tariffs and licensing requirements (given that the drafting of the Third Draft appears to be conflicting with the current Circular No. 36/2018/TT-BCT on power operation licenses..

[41] The Third Draft has removed Intermediary Power Sale and Purchase model.

New FiT mechanisms

- The proposed tariffs for sale of power output from rooftop solar power systems to the national or EVN grids[42] are as follows:

Timeline for COD	Zone 1		Zone 2		Zone 3	
	VND/kWh	USD/kWh	VND/kWh	USD/kWh	VND/kWh	USD/kWh
1 July 2019 - 30 June 2020	2,448	9.85	1,933	8.47	1,697	7.43
1 July 2020- 30 June 2021	2,203	8.86	1,740	7.62	1,527	6.69

Danang is included in Zone 2 and HCMC is in Zone 3.

- The proposed tariffs for sale of power output to EVN will apply to part or the whole of rooftop solar power systems achieving an actual commercial operation date during the specific period as indicated in the table above for a PPA term of 20 years from the commercial operation date.
- These proposed tariffs are exclusive of VAT and are subject to adjustments based on the fluctuation of USD in accordance with the central exchange rate between the USD and the VND as announced by the State Bank of Vietnam on the last day of the previous year to calculate the power payment for the following year. The involved parties are responsible for complying with the regulations on taxes and fees.

Technical Requirements

- Rooftop solar power projects directly or indirectly connected with the national grid must register their grid connections with the provincial-level Power Corporations/Utility.
- With respect to the **"Power Consumption" model**:
  - A rooftop solar power project under this model will have its grid connection point in front of the EVN/Power Purchaser's meter.
  - The relevant Power Corporation/Utility of the relevant province or city under central government will coordinate with the investor/power generator to install a bi-directional meter to record power output consumed and power output generated from the solar power system on a monthly basis. Costs of investments and installation of bi-directional meters shall be borne by the Power Corporation/Utility.
- With respect to the **"Entire power sale business" model**:
  - Under this model, the Power Seller/generator and EVN/Power Purchaser may freely reach an agreement for the connection point to be either in front of, or behind, the Power Purchaser's meter.
  - The provincial-level Power Corporation/Utility will coordinate with the investor/power generator to install a bi-directional meter to record power

[42] For the "Direct power sale and purchase" model, under the Third Draft, the tariff and the terms of the direct power purchase agreement (DPPA) between the power seller/developer and private power consumers/ purchasers shall be "implemented in line with the current regulations" (which we understand mainly including: Civil Code, Commercial Law and other relevant implementing regulations). It implies that the parties to this DPPA may not be subject to the FiT for rooftop solar power systems or the standard terms of model PPA template regulated by the MOIT.

	output consumed and power output generated from the solar power system on a monthly basis. Under this model, costs of investments and installation of meters and costs for upgrading interconnection systems/facilities shall be borne by the Power Seller. • With respect to **"Direct power sale and purchase" model**: The Draft Decision proposes two options: • If the Power Seller does not use the national grid at all, the Power Seller and the private Power Purchaser may freely reach an agreement on metering and interconnection arrangements in accordance with applicable regulations on civil and commercial transactions. • If the rooftop solar power system is indirectly connected to the national grid, the Power Seller must reach an agreement with the provincial-level Power Corporation/Utility for installing a bidirectional meter to record power output consumed and power output generated from the solar power system on a monthly basis. Under this option, costs of investments and installation of meters and costs for upgrading interconnection systems/facilities shall be borne by the Power Seller. In addition, the Draft Decision requires the MOIT to formulate detailed regulations on the procedures and formalities for grid connection registration, grid connection agreements, technical requirements for interconnection facilities and examination of conditions of grid connection for operation.

Second Draft dated February 2019

To revise and update the provisions of the First Draft.

Table 15: Salient features of Second Draft dated Feb 2019

<table>
<tr><td>Salient points</td><td>• The Second Draft updates the irradiance regional classification of new FiT mechanisms and application timeline of the tariff rates for rooftop solar power projects in Vietnam.
• The Second Draft updates the definition of rooftop solar power models</td></tr>
<tr><td>New FiT mechanisms</td><td>• The Second Draft updates the tariff rates for Rooftop PV and adds one new irradiance regional classification as follows:
<table>
<tr><th colspan="2">Region 1</th><th colspan="2">Region 2</th><th colspan="2">Region 3</th><th colspan="2">Region 4</th></tr>
<tr><td>VND/kWh</td><td>USD/kWh</td><td>VND/kWh</td><td>VND/kWh</td><td>USD/kWh</td><td>USD/kWh</td><td>USD/kWh</td><td>USD/kWh</td></tr>
<tr><td>2,486</td><td>10.87</td><td>2,139</td><td>9.36</td><td>1,916</td><td>8.38</td><td>1,803</td><td>7.89</td></tr>
</table>
**Kindly note that Danang is included in Region 2 and HCMC is in Region 3.*
• The proposed tariffs for sale of power output to EVN shall apply to part or the whole of rooftop solar power systems achieving an actual commercial operation date between 1 July 2019 and 30 June 2021[43] for application for a PPA term of 20 years from the commercial operation date.</td></tr>
<tr><td>Rooftop solar power models</td><td>The Second Draft updates the definition of 4 different models of rooftop solar systems</td></tr>
</table>

[43] The Third Draft extends the timeline of FiT to 31 Dec 2021.

	• **"Power Consumption" model**, which is defined as a model of rooftop solar power projects installed with connection point between the metering system and the household's power consumption system. The model uses two-way meter. • **"Entire power sale business" model**, which is defined as a model of rooftop solar power project installed with connection point between the metering system and the Power Purchaser's grid. • **"Direct power sale and purchase" model**, which is defined as a model of rooftop solar power project under which individuals and organizations invest, generate and sell power from their rooftop solar power projects to other individuals and organisations (i.e., not EVN) without connecting or utilizing national grid systems. • **"Intermediary power sale and purchase" model**, which is defined as a model of rooftop solar power project under which individuals and organizations invest, generate and sell power from their rooftop solar power project to the Power Corporation through power distributing and retailing entities not belonging to EVN.

A.4. License requirement and Approvals for Rooftop PV

License Requirement[44]

The license requirement of Rooftop PV project depends upon the capacity of the project.

a) If the installed capacity is less than 1MWp

i. Mandatory Registration for interconnection with EVN's provincial-level power company.

- The information to be provided for registration include: the estimated capacity, technical parameters / specifications of the solar PV panels, specifications and parameters of inverters. This procedure for rooftop projects with an installed capacity of less than 1 MWp is much more simple than rooftop projects with installed capacity of 1 MWp or higher.[45]

ii. Power Generation License is not required for rooftop projects with installed capacity less than 1 MWp. Specifically, under Articles 3.1 and 3.2 of Circular No. 36/2018/TT-BCT, power operation/generation license requirement is exempt for: *"power generation with an installed capacity of less than 1MWp for a solar power project installed in one location and one connection point for sale of power to other organizations and individuals"*.

b) If the installed capacity is 1MWp or larger

i. Under Circular No. 16/2017, for rooftop projects with installed capacity of 1 MWp or larger, the developers are required to apply for, among other things:

- Approval for inclusion of the project in the relevant Power Development Plan, and
- Power Generation License.

ii. In relation to the Approval for inclusion of the project in the relevant Power Development Plan

- Under Circular No. 16/2017 and the Law on Master Planning, this approval is required to be obtained from the MOIT and/or Prime Minister before applying for investment and construction of the project.[46]

iii. In relation to Power Generation License

- Responsible Authority-
  - For capacity >=1 MW and < 3 MW:- Provincial-level People's Committee or Department of Industry and Trade (DOIT) of the relevant province or city
  - For capacity >=3 MW:- Electricity Regulatory Authority of Vietnam (ERAV)
- Timeline-
  - As per Circular No. 36, power developers are required to submit the full application dossier for the Power Generation License no later than 15 working days before the expected official COD of the power plant. This applies to all types of power projects in Vietnam.
- Required document as per Appendix A.3

Key Approvals

[44] As per Circular No. 36/2018/TT-BCT - Procedures for Issuance and Revocation of Electricity Licenses dated Oct 2018
[45] Article 11.1 of Circular No. 16.
[46] Article 9 of Circular No. 16.

The specific approvals for Rooftop PV will depend on the business models and investment structures of corporate vehicles deploying rooftop solar power. A general list of key permits and approvals for rooftop solar power projects is provided below

Documentation required to obtain Power Generation License

1. The application form (according to Form No. 01 provided in the Appendix enclosed to Circular No. 36);
2. A copy of the applicant's Enterprise Registration Certificate;
3. The list of technical managers and shift leaders/operators of the power plant made using Form No. 3b provided in the Appendix enclosed to Circular No. 36; copies of academic degrees, diplomas or qualifications, electrical safety card and operation certificates, which are issued by the in-charge power load dispatch agency according to the National Load Dispatch Procedure issued by the Ministry of Industry and Trade, of each of listed shift leaders/operators; the power plant lease agreement, service contract signed with the organization that is hired to manage and operate the power plant or the written authorization granting power to an organization to manage and operate the power plant in case the power plant is leased from or let out to a third party or a third party is hired or authorized to manage and operate the power plant;
4. A copy of the investment policy decision of the power plant issued by a competent authority;
5. A copy of the decision on approval for the environmental impact assessment report or the written certification of the environmental protection plan for the power plant investment project issued by a competent authority;
6. The list of equipment which must meet strict occupational safety requirements and be inspected in accordance with applicable laws;
7. A copy of the document verifying the fire safety system; the copy of the acceptance test report on the installed fire safety system;
8. A copy of the acceptance test report on the installed generating unit or solar panel system; a copy of the document indicating primary specifications of the power plant (including units, generators and main transformer);
9. A copy of the acceptance test report on the installed IT infrastructure system and/or telecom infrastructure system serving the operation of electricity market; a copy of the acceptance test report on the installed SCADA system serving the operation of electricity network and electricity market. This item will not be required if a power plant or generating unit is not connected to the grids and generates electricity for supply in case of the national grid's failure only; and
10. If electricity generated by a power plant is retailed directly to consumers, the application must also include the list of consumers who buy electricity and the electrical grid diagrams.

A.5. List of Key Approvals, Licenses and Authorizations for Solar Power Systems / Projects

Table 16: List of Licenses and approvals required for Solar Power Projects

No.	Key Licenses and Approvals[47]	Authority in Charge
A.	**In relation to Planning, Corporate and Investment**	
1.	Approval for Inclusion of the Project into the Power Development Plan (if applicable)[48]	MOIT, PPC and Prime Minister (if applicable)
2.	Investment Policy Decision (if applicable)	PPC
3.	Investment Registration Certificate of the Project (if applicable)	PPC, DPI
4.	Enterprise Registration Certificate of the Project Company (if applicable)	DPI
B.	**In relation to Environmental Protection**	
5.	Approval for Environmental Impact Assessment (EIA) report or Environmental Protection Commitment or Certificate of Registration of Environmental Protection Plan (if applicable)	Department of Natural Resources and Environment
C.	**In relation to Fire Prevention and Fighting**	
6.	Approval for Fire Prevention and Fighting System	Police Department
D.	**In relation to Construction and Design**	
7.	Appraisal for Feasibility Study (FS) Report (including Basic Design) (if applicable)	DOIT
8.	Appraisal for Technical Design (if applicable)	Department of Industry and Trade
9.	Construction Permit(s) (if applicable)	Department of Construction
E.	**In relation to Grid Connection and Power/ Electricity Sale and Purchase with EVN (*as detailed in Flowchart below*)[49]**	
10.	Registration of rooftop solar power installation requests by investors with EVN	EVN's relevant entity
11.	Grid connection survey and agreement	EVN's relevant entity
12.	Application for power sale from rooftop solar PV projects	EVN's relevant entity
13.	Checking of technical specifications / parameters and installation of bidirectional meters for rooftop solar PV project	EVN's relevant entity
14.	Execution of power purchase agreement between EVN's relevant power company and rooftop solar PV project owner	EVN's relevant entity
15.	Power Generation License (exempt for rooftop solar projects with installed capacity of less than 1MWp)	PPC/DOIT or MOIT

[47] This is a general list of key permits and licenses which may be applicable, but the specific approvals for rooftop solar power projects will need to be determined on a project-by-project basis depending on various factors, including but not limited to the business models and investment structures of corporate vehicles deploying rooftop solar power. In addition, the legal feasibility and licensing requirements of rooftop solar projects largely depend on the installed capacity of the solar PV system for each project (i.e., whether it is less than 1MWp or from 1MWp). This is a list of approvals, but the application for these approvals are not necessarily in the order of this table, but given that the life of development of rooftop solar power projects is short.

[48] Under the current regulations, this requires only for projects with installed capacity of 1MWp or larger. It is exempt for projects with installed capacity of less than 1MWp. However, we note that the Law on Master Planning is not entirely clear on this issue and it will need to be further clarified under upcoming legal regulations for implementation of the Law on Master Planning, especially in relation to the power sector.

[49] EVN Official Letter No. 1532, Item I.4.

16.	Testing, Commissioning and confirmation of Commercial Operation Date	EVN's relevant entity
17.	Settlement of payments	EVN's relevant entity

A.6. Supply from Thermal sources of Energy in HCMC

HCMC currently has 2 thermal power plants (TPP): Hiep Phuoc (375MW) and Thu Duc (279MW) to cater the demand. Hiep Phuoc TPP, developed by Taiwan-based Central Trading & Development Group, commissioned in Jul 1998 but has ceased feeding power to the grid since 2011 due to financial losses[50]. The power plant accounted for USD 120 million losses during 2005-2010 due to high fuel costs and low retail electricity sale price. Hiep Phuoc TPP's main gas supplier, PV Gas, has suspended the supply to the power plant since April 2010 due to limited availability of gas. Thus, the power plant had to import fuel with a higher price to maintain its operation, escalating the fuel cost to around US 15 cents/kWh. Meanwhile, 50% of Hiep Phuoc TPP output was sold at US 5 cents/kWh to Hiep Phuoc Industrial Park, Tan Thuan Export Processing Zone and the South Sai Gon urban area, and the remaining output was sold to EVN at US 17 cents/kWh[51]. As Hiep Phuoc TPP did not receive any price support from the Government, the power plant management had proposed the People Committee of HCMC a triple price increase to improve its financial position. The Government did not approve this proposal, leading to Hiep Phuoc TPP remaining in a maintenance stage since 2011 and its grid handed over to EVN HCM. In 2019, Hai Linh Ltd., a Vietnamese company in oil and gas business, has acquired Hiep Phuoc TPP to upgrade the plant for gas-fired power generation[52].

Meanwhile, Thu Duc TPP had its first gas-fired generating unit installed and commissioned in 1965, and continued adding more gas-fired and steam generators until 1992 to expand its capacity to 279MW. Hence, the power plant has been generating power for more than 50 years and is still in operation under EVN's management. Thu Duc TPP does not have a long-term planning for electricity output, and is currently generating to meet the demand following NLDC's dispatching order. Its electricity output in 2015, 2016, 2017, and 2018 is 0.45 mn kWh, 28.56 mn kWh, 0.47 mn kWh, and 11.8 mn kWh, respectively, below its designed capacity[53].

The two power plants were able to meet only 15.8% of the city's peak demand in 2018. Further, the PDP VII has scheduled discontinuance of Hiep Phuoc TPP operation in 2019 and Thu Duc TPP in 2020[54]. Also, setting up of new large scale power plants in the city will be a challenge due to its limited land bank. Thus, majority of the demand is likely to be met from other regions through high voltage transmission lines making it dependent on the grid to meet its energy requirement.

[50] https://www.vir.com.vn/burnt-power-generator-energises-new-plan-21096.html
[51] https://vietnamnews.vn/economy/208805/hcmc-electrical-firm-proposes-200-rate-hike.html#GAbTfArBudkp1HFI.97
[52] https://baodautu.vn/hai-linh-mua-lai-nha-may-dien-hiep-phuoc-de-cai-tao-phat-dien-bang-khi-d102002.html
[53] http://www.thuductpc.com.vn/
[54] Although PDP VII planned for discontinuance of these 2 TPPs, PDP VII - Revised did not mention their scheduled status. Further discussion with EVN and local authorities shall be conducted to update the reasoning and details of these power plants' termination plan.

Thank You!