

Financing mechanisms for public, commercial, and domestic solar PV in the OECS Region

Investment mobilization for Solar PV and Sustainable Housing in the Caribbean

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ABOUT THE GLOBAL GREEN GROWTH INSTITUTE

The Global Green Growth Institute was founded to support and promote a model of economic growth known as “green growth”, which targets key aspects of economic performance such as poverty reduction, job creation, social inclusion, and environmental sustainability.

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Glossary of terms

Photovoltaic (PV): Relating to the production of electric current at the junction of two substances exposed to light.

Solar Cell: A device that directly converts the energy of light into electrical energy through the photovoltaic effect. A single solar cell can produce 0.5 volts to 0.6 volts. The solar cell is made of crystalline silicon which can be mono crystalline or poly crystalline.

Solar module: An assembly of solar cells framed into a weatherproof unit. Commonly called a "PV panel"

Solar Array: A group of PV (photovoltaic) modules (also called panels) arranged to produce the voltage and power desired.

Watts: Measures total electrical power. $\text{Watts} = \text{Voltage (measured in Volts)} \times \text{Current (measured in Amps)}$.

kilo Watts(kW): 1000 Watts

Watt peak (Wp)/ kilo Watt peak (kWp): The peak power that a solar cell/panel can produce.

Direct Current (DC): The type of power produced by photovoltaic panels and by storage batteries. The current flows in one direction and polarity are fixed, defined as positive (+) and negative (-).

Grid tied/Grid connected PV system: A solar system which is connected to the Grid of a Utility. The system requires the Grid to function which means that if there was a power outage the system would cease to distribute energy to the building. This function is controlled by a grid tied inverter.

Stand-alone/Off grid PV system: As the name implies, this system is not connected to the grid of a Utility and as such is coupled with a storage system in order to provide electrical power at all times of need.

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Executive Summary

The need for adequate financing products to enable investment into distributed solar PV has been clearly recognized and accepted across the OECS region. Reducing solar PV prices have contributed to greater uptake but this uptake is still relatively slow when compared to other regions and other Caribbean islands. Existing financing for solar PV is limited to cash purchases and loan financing. This makes solar PV accessible to only the wealthiest of end-users.

Solar PV has seen a significant reduction in cost over the past 10 years. This reduction is mainly due to the reduced cost of components. Prices for solar PV systems in the region are in the range of 4,000 XCD/kW and 7000 XCD/kW. System cost largely dependent on Hardware costs and soft costs (labor, markup, etc.). Although PV technology is regarded as mostly maintenance-free, the operational costs over the lifetime of the system must be added to the purchase price to determine the actual system cost.

Limiting the term “financing” to the initial investment cost of a solar PV system only, may have profound consequences for the widespread introduction of solar PV. Ignoring the operational costs, especially the additional costs caused by unexpected replacement of faulty components, has often led to difficulties in the execution of such programmes, to the disappointment of users, and as the final consequence of their unwillingness or inability to pay, to the collapse of financial schemes

Several Innovative financing mechanisms exist which can be adapted to finance solar PV systems in the residential, commercial, and public sectors. The financing mechanisms examined includes

Dealer Credit/Hire-Purchase: The PV supplier/dealer enters a credit arrangement with the end user who, depending on the arrangements, immediately becomes the owner of the system, or becomes the owner when all payments are made. This mechanism is characterized by relatively short terms (mostly between 6 months and one year), high down-payments and high interest rates. However, these credit systems can be popular due to their flexibility.

End-user Credit: In general, this model is the like the dealer credit model; only the division of roles between the stakeholders is different. In this case, the credit scheme is implemented by a separate credit organization.

Lease: The PV supplier/dealer or a financial intermediary, leases the PV system to the end-user: At the end of the lease period, ownership may or may not be transferred to the end-user, depending on the arrangements. During the lease period, the lessor remains the owner of the system and is responsible for its maintenance and repair.

Energy service performance contracting (ESPC): Also known as the ESCO model, energy service performance contracting mechanisms are structured to allow government agencies and commercial institutions to pay for renewable energy upgrades over time using money saved on energy bills resulting from energy-saving measures. Energy performance contracting structures are used extensively by federal agencies in the United States

Each of these mechanisms have been implemented in the OECS region to some extent however, except for ESPC they have not yet been applied to solar PV. As a next step, the willingness of companies and consumers to engage in these mechanisms should be examined along with a comprehensive look at the financial, technical, and infrastructural needs for successful implementation.



1 Introduction

1.1 Purpose

In May 2021, the OECS Commission launched the Eastern Caribbean Solar Challenge aimed at increasing the deployment of distributed solar energy solutions to increase the resilience of energy infrastructure of OECS Member Countries.

1.2 Background

Photo Voltaic (PV) technology requires substantial upfront capital. Although declining prices for PV technology have provided some level of respite, the problem remains. Virtually the whole energy cost for the lifespan of a PV system must be prepaid at the time of an investment which reaps the benefits over the next 10-20 years [1]. The OECS region is particularly vulnerable to these high upfront costs due to several factors which include, but are not limited to, reliance on imported technology, lack of suitably skilled companies in the market and an underdeveloped PV market. Despite the obvious challenges, there are clear opportunities for novel and innovative approaches to addressing the high upfront cost of solar PV, which is a requirement to achieve greater deployment of the technology. With the increasing popularity of solar PV, through increasing electricity prices, greater awareness on the part of consumers, global pressure, etc., some financing institutions have made strides in providing finance products tailored to solar PV. Such mechanisms, however, are few and the persistent slow gains in the uptake of solar PV present some questions. Are the available finance mechanisms adequate? Are the available finance mechanisms inclusive?

1.3 Limits of the report

This report focuses on financing for distributed solar PV systems at the residential scale, commercial scale and in the sphere of the public sector in the OECS region. Although it outlines several mechanisms it does not propose to identify any one as being the ideal option. Determining the most appropriate mechanisms depends on several factors which may be unique to each context and as such the context of the project must be considered when selecting an appropriate finance mechanism. There is also a recognition that some of the proposed mechanisms may not be readily available in the region. As such the report does not go into detail as to what is required to establish those mechanisms, however it seeks to identify the options which may be implemented for the purpose of the Eastern Caribbean Solar Challenge, which is to enhance the uptake of distributed solar PV in the OECS region.

Another important and related topic which is outside of the scope of this report is that of incentives and subsidies. Recognizing that some level of incentives or subsidies may be required to support the introduction and overall success of novel and existing financing mechanism, the level of such incentives and subsidies requires deeper investigation and stakeholder consultation. As such, the topic can be examined in a future report.

2 Solar PV in the OECS Region

2.1 Technical description of Solar PV Systems

A Solar PV system is an assembly of electrical components which enables the conversion of sunlight to electricity. The modularity of these systems allows them to be used in several applications and configurations. The solar PV system can be integrated into the entire electrical system of a building or can be used to power a specific load such as a light or an air conditioning unit.

A solar system in its simplest form consists of solar modules which form a solar array, the solar inverter, racking system, electrical cables, and connectors. The inverter can be a grid tied inverter in the case of a grid tied system or a battery inverter in the case of an off-grid system. Off grid systems also require a battery controller unit and a storage battery. The solar array produces DC power which is converted to AC power in the inverter which is used to power the electrical equipment in the building as illustrated in Figure 1.

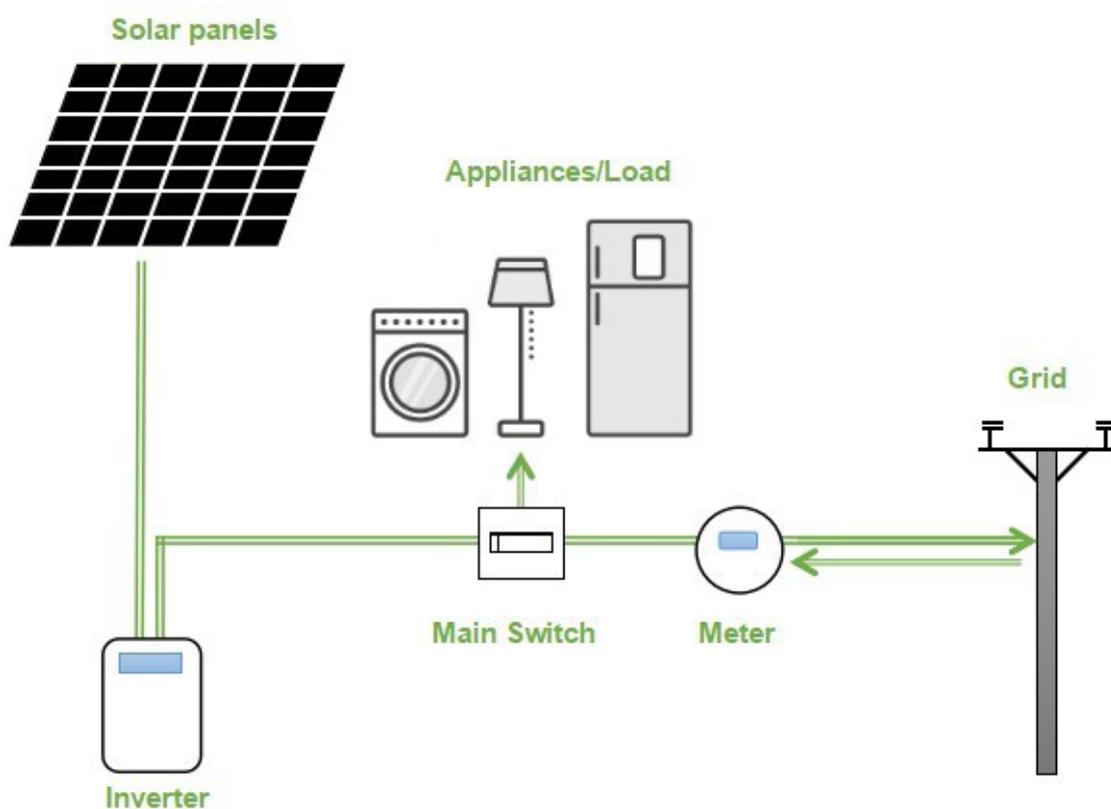


Figure 1: Grid Tied Solar PV System

The size of the system is determined by the size of the load that needs to be powered and the availability of adequate space. Due to the relatively low efficiency of solar modules, usually in the range of 15% to 22%, solar systems tend to require a large amount of space to achieve the desired system size. However, advancements in solar PV technology have significantly reduced this space requirement. Singular solar PV modules can now be purchased with ratings of over 600 W, compared to an average rating of 340 W in 2015.

The technical life of most of the components of a solar system is upwards of 10 years, with the solar panels themselves estimated to last up to 25 years under normal operating conditions. This makes a solar PV system a long-term investment opportunity which, if properly maintained, will generate profit more than its overall value. This, however, depends on utilizing quality products which meet industry standards, such as Underwriters Laboratories (UL) standards. It is also dependent on installing the system in accordance with International best practices or in accordance with local codes. It is simple to determine if a piece of PV equipment has been deemed to meet the necessary international standards. This information is indicated on the equipment name plate, the specification sheet and the manufacturer's website. Some jurisdictions also supply a list of approved equipment.

An example of name plate information for a solar PV module is shown in Figure 2.

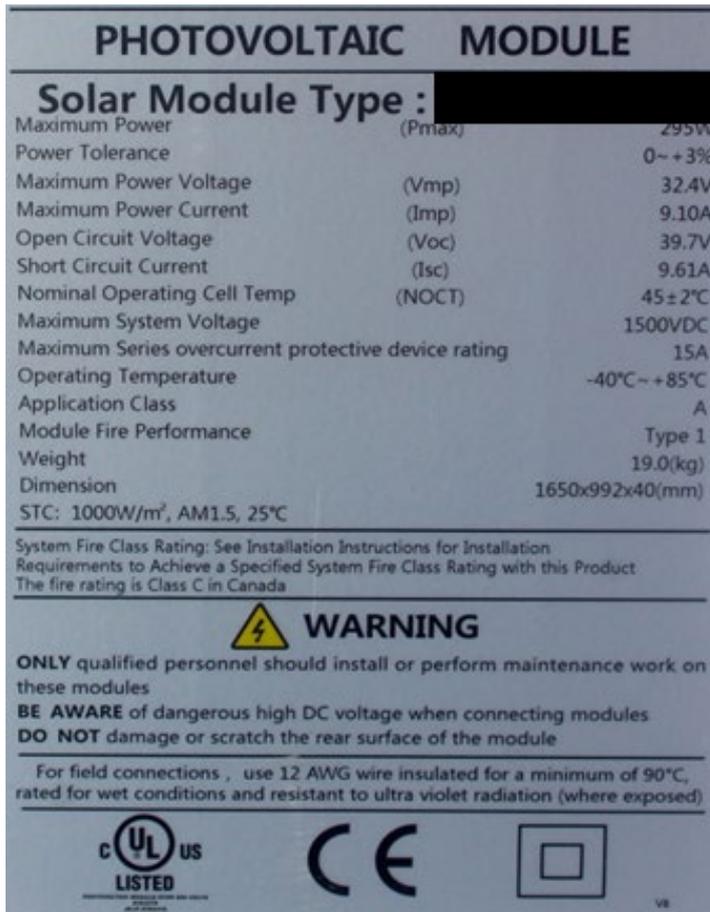


Figure 2: Solar module name plate

Name plate information is very important as it is often used by utilities, and regulators to determine the operating parameters of the PV system. Table 1 outlines some of the UL standards applicable to solar PV system components. The standards may vary depending on the region of origin of the equipment, what is important is to ensure that the equipment meets the requirements of local authorities.

Table 1: UL standards for solar PV system components.

Standard	Description
UL 1699	For Arc-Fault Circuit-Interrupters
UL 1699B	For DC Arc-Fault Circuit Protection
UL 1703	For Flat-Plate Photovoltaic Modules and Panels
UL 1741	Inverters, Converters, Controllers, and Interconnection System Equipment for Use with Distributed Energy Resources
UL 2703	Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels

2.2 Economic considerations for Solar PV

In the OECS region, the cash price for a typical grid tied solar system is in the range of 4000 XCD to 7000 XCD per kW. System cost is dependent several factors including system size, origin of components, country-specific taxes and duties, installation costs, etc. A significant portion of the costs associated with a PV system can be attributed to hardware costs (modules, inverter, racking and balance of system (BOS)). In its report “U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020”, the National Renewable Energy Laboratory (NREL) outlined these costs over a time series spanning 2010-2020. From 2010 to 2020, NREL recorded a 64% and 69% reduction in the cost of residential and commercial rooftop systems in the US [2]. This reduction is largely due to a decrease in component costs. Soft costs make up a large proportion of system costs at all scales. Figure 3 provides a summary of these costs over the period 2010-2020. This is significant for the OECS region as since the region is a net importer of PV technology, any reduction in supplier markets will lead to a reduction in the region. However, the value of the reduction will vary due to other important costs such as shipping.

Although PV technology is regarded as mostly maintenance-free, the operational costs over the lifetime of the system must be added to the purchase price to determine the actual system cost. Typical operation and maintenance risk factors in the OECS region include corrosion, damage to panels due to hurricane debris, Sahara dust reducing system output, to name a few. Some of these factors are seasonal in the case of hurricanes and Sahara dust, while corrosion is a constant concern. According to the NREL benchmarking study, as it relates to operation and maintenance costs, the benchmarks are US\$28.94/kWDC/yr (residential), US\$18.55/kWDC/yr (commercial; roof mount), US\$18.71/kWDC/yr (commercial; ground mount) [2]

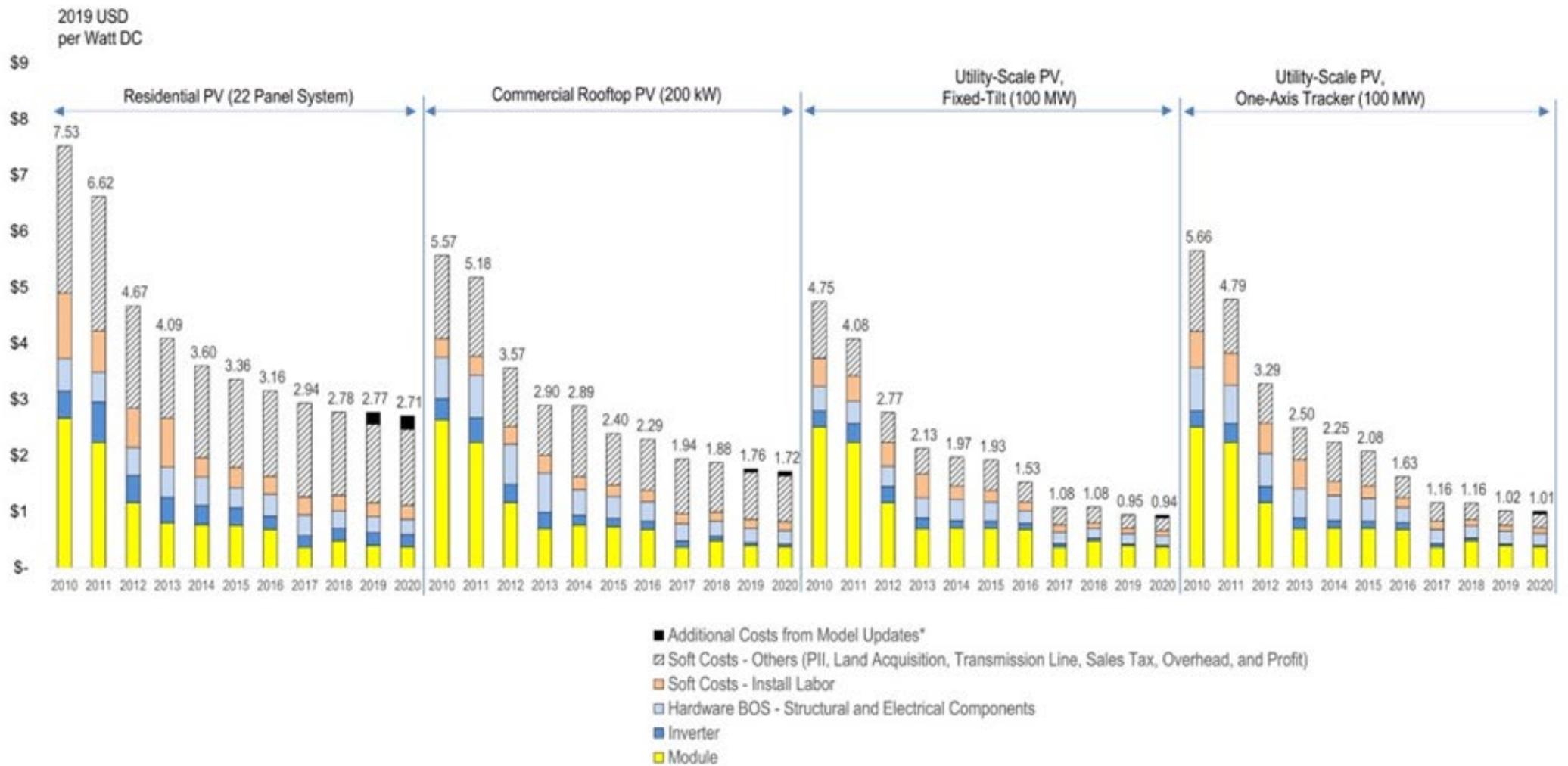


Figure 3: NREL PV system cost benchmark summary (inflation -adjusted), 2010-2020 [2]

The economics of a solar PV system must consider the life cycle cost of the system which includes all capital costs as well as annual operation and maintenance costs (this may also include the cost of insurance coverage) and cost of any unexpected replacement of components. For the private user, the re-sale value of the system is normally not of much interest, except in the case of sale of a property with an included solar system. However, for financial intermediaries it can be an important figure if it is used as collateral by a financial service provider. The resale value of a solar PV system is determined by its market value, which may be estimated by the present value of the expected (net) cash flow generated during its remaining lifetime. Another issue is whether this value can be liquidated. If there are no functioning secondary markets for used solar PV systems, the resale value may be close to zero, i.e., the investment costs are sunk.

Limiting the term “financing” to the initial investment cost of a solar PV system only, may have profound consequences for the widespread introduction of solar PV. Understating or even ignoring the operational costs, especially the additional costs caused by unexpected replacement of faulty components, has often led to difficulties in the execution of such programmes, to the disappointment of users and, as the final consequence of their unwillingness- or inability-to-pay, to the collapse of financial schemes [3].

2.3 Current State of PV financing in the OECS Region

The need for increased PV uptake, especially distributed PV, has been widely accepted in the OECS region. However, this need is curtailed by the lack of suitable financing to facilitate this uptake. A recent (2022) report by Benise Joseph entitled “Situation Analysis and Needs Assessment in OECS Member States on Increasing the Diffusion of Solar Energy” identifies financing as a common constraint to the uptake of solar PV in the region. The high upfront cost of systems and the lack of instruments which can reduce this cost to a significant degree, proves to be a recurring issue.

Several Solar PV companies have emerged in the region in recent years. These companies mainly offer cash purchases of PV systems. Companies may also direct customers to loan products offered by various commercial banks. The emergence of “Green” (loans aimed at increasing customer resilience to climate change or reducing customer carbon footprint) loan products has been slowly increasing in the region, with several commercial and development banks now offering loans for solar PV systems.

3 Financing Models for Residential, Commercial and Public Distributed Solar PV

3.1 Focus sectors for distributed solar PV

For the purposes of the Eastern Caribbean Solar Challenge, focus will be given to three sectors, namely, the residential sector, commercial sector (including hotels) and public sector (including educational institutions). For each sector, a brief description is given below

Residential: This sector typifies the nature of distributed solar PV to be a catalyst for change by capitalizing on the modularity of solar PV and democratizing the generation of electricity. The advantages of the residential sector are:

- The consumer is also the owner of the building (in most cases).
- The roof space is usually more than adequate for the required system size
- System design and installation are usually simple.

The disadvantage of this sector is that system cost tends to be higher due to the small system sizes. This leads to longer payback periods when compared to the other sectors. Also, electricity consumption is lower during daytime hours when persons are at work and PV production is high, and peaks at night when residents return home and there is no PV production. This leads to a timing mismatch of demand and solar generation and can lead to low solar self-consumption rates, often between 20-30%

Commercial: This sector can be looked at in terms of buildings which have one tenant or buildings which have multiple tenants. In the case of hotels, electricity consumption patterns vary based on seasonal occupancy. The advantages are that this sector has high electricity demand and can achieve high solar self-consumption rates of up to 90%; and system sizes are larger, which leads to lower system costs and a higher level of interest from vendors. Also, peak PV productions tend to align with operating hours. Disadvantages include the fact that the building owner may not be the electricity consumer, and that, if the space is being rented, there may be little incentive for the owner to include solar PV.

Public (including Educational Institutions): The public sector presents the widest range of system sizes due to a variety of building types. From residences to large office buildings, this diversity presents a unique situation. The advantages of this sector include a clear policy, which in most cases is articulated on the international stage, the ability to attract grant funding and the ability to bundle many buildings to attract investor interest. Disadvantages include

Political risks: a change in political leadership may lead to a shift in priorities which may result in loss of funding for existing projects, significant delays in project implementation and contractual issues among others

General poor quality of infrastructure: Tight public budgets mean that maintenance of buildings is often time low priority, leading to an aged building stock which includes critical components such as roof structure and electrical wiring.

Building ownership issues: Public building stock tends to include varying ownership models such as rented, leased and government owned. Rented and leased buildings present uncertainty for long term investments and require approval from the building owner. Government owned buildings tend to be the most feasible for long term public projects.

3.2 Financing Mechanisms

Several financing mechanisms exist for solar PV at various scales. Some of these mechanisms can scale depending on the amount of funding required while others are only financially viable at certain scales. From the point of view of the consumer these mechanisms can be grouped as follows:

Consumer ownership in which case the Consumer becomes a prosumer (consumer and producer of electricity)

Third Party ownership, where a third party owns and maintains the systems.

It is important to note that the ownership modality can have implications for system integration. Particularly in the OECS context, third-party ownership has not been given enough consideration in regulatory frameworks for solar PV. However, there may be a segment of the population who prefer to not own the assets but benefit from the power it generates. Table 2 outlines the financing mechanisms considered for the various sectors.

Table 2: Financing mechanisms by sector and ownership modality

Sector	Finance Mechanism	System Ownership
Residential	Cash Purchase	Consumer
	Dealer Credit/Hire Purchase	Consumer
	Loan (including special purpose)	Consumer
	Lease	Third Party/Consumer
Commercial	Cash Purchase	Consumer
	Lease	Third Party/Consumer
	Loan (including special purpose)	Consumer
	Energy Service Performance Contract/ESCO model	Third Party
	Grant	Consumer
Public	Lease	Third Party/Consumer
	Energy Service Performance Contract/ESCO model	Third Party
	Green Bonds	Consumer
	Grant	Consumer

Some of these financing mechanisms such as cash purchase, loans, and grants. As such, focus will be on those mechanisms which typically have not been used for solar PV in the OECS region but have the potential to significantly impact the sector. However, cash purchase is kept for comparative purposes.

Cash Purchase

This is the simplest implementation model. A PV system is sold directly or via a dealer to the end-user. The end-user pays cash for their system. The end-user immediately becomes owner of the system. The operation and maintenance of the system is the responsibility of the end-user. In many cases, the consumer pays for the full installation of the system.

This model is most prone to the ‘initial investment barrier’, resulting in a small market for wealthier consumers. The cash purchase model requires the fewest preconditions to set up, although the viability of a PV business obviously depends largely on the economic situation and availability of clientele. The limited clientele able to engage in this model means that companies are competing for a very small market

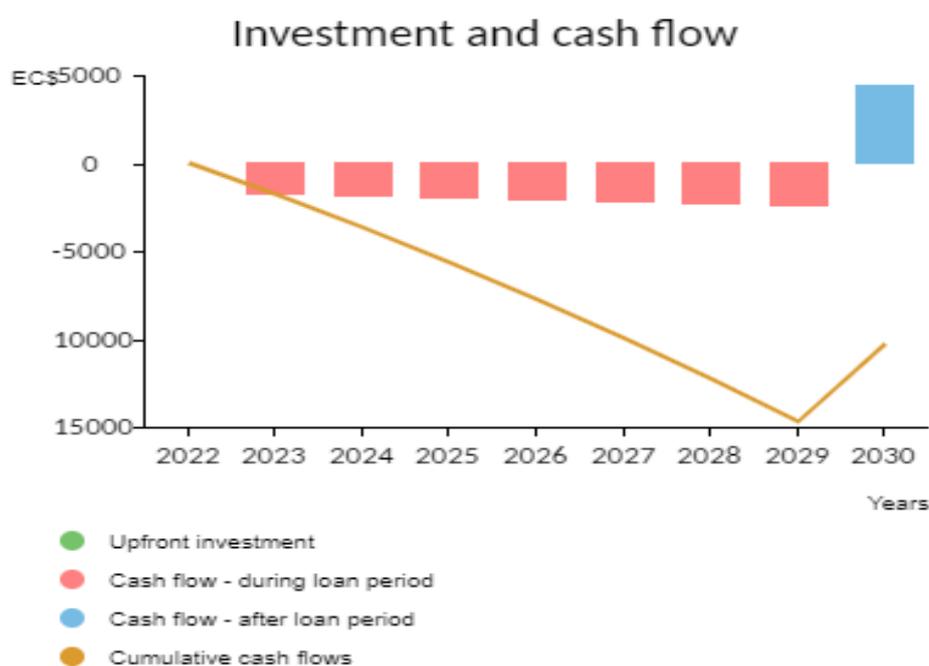
The above cash flow chart models a 25kW PV system in the OECS region using the cash purchase mechanism. The following assumptions were used. System cost 250,000 XCD, electricity inflow and outflow costs are equal (as would be the case under a net-metering policy). Annual production of 41656 kWh/year (modeled using the PVWatt online tool). From the chart, the break-even point (BEP) for this system is 6 years with a cumulative savings of 1,223,855 over a 30-year period. It is important to note that this does not include the cost of system replacement, which may be required. Also, it is important to note that the entire investment is

made in year zero and from year one savings will contribute to system payback unlike the models which are examined below.

Loan Finance

The Consumer receives finance for the purchase of the of the solar system from a financing institution, typically a bank. The loan may be a dedicated loan, specific to investment in PV and, as such, may attract more favorable terms. The consumer may become the owner of the system intermediately or the lender may retain rights to the system until the loan is repaid. Loans are subject to terms and conditions which may include collateral or a guarantee of some sort. Solar-specific loans provide a pathway to direct ownership, which offers the benefit of free or low-cost electricity after the loan is paid off, and spreads the system cost out over several years (usually 5-10, depending on the loan terms), reducing upfront costs. Solar loans are an ownership model where the consumer is paying for the PV system, not for the electricity production, thus the risk of poor performance falls to the consumer. Figure 5 models the cash flow for a solar specific loan using the IRENA Solar City Simulator tool (Castries Saint Lucia). The tool which is currently available for 3 OECS islands allows any user to model a solar PV system on a select rooftop in the coverage area. The assumptions were the following, system size 5.13 kW, 31% self-consumption (default), electricity tariff 1.108 XCD, Average annual consumption 2000 kWh (default), system price 41513.47 XCD, 100% financing at an interest rate of 4.5% for a period of 7 years. The payback period for the investment is 10.3 years.

Figure 5: Modeled cash flow for solar loan



Solar-specific loans are being implemented in the region, with varying levels of success. CIBC First Caribbean and Bank of Saint Lucia both offer solar specific/Renewable Energy loans, as well as a several other commercial and development banks in the region. An assessment of these facilities and their level of uptake is recommended to determine the current state of these loan facilities and what may be required to enhance or replicate them. Credit unions may also be a useful avenue for providing such loans as their customer base is significant in the region, ranging from 169.06% in Dominica to 82.58% St. Kitts and Nevis. In the case of Dominica, this means that persons are members of multiple credit unions. Table 3 below outlines various loan options for solar PV available in the OECS region.

Table 3: Available loan financing for solar PV in the OECS

Country	Institution	Terms	Use	Sector
Dominica	Dominica Agricultural Industrial and Development Bank	<ul style="list-style-type: none"> • Loan limit: from EC\$3,000- EC\$267,000.00 • Competitive Interest rate: 5% on reducing balance • Maximum Repayment period: up to 6 years (Inclusive of grace period) • Optional grace period on principal: 6 - 12 months 	Electric Power Measures, Solar Power Heating, Air-conditioning Measures, Lighting, Renewable Energy, Water Conservation, Alternative Fuels and Building Envelope	Commercial (Micro, Small and Medium Sized Enterprises)
	Republic Bank Dominica	<ul style="list-style-type: none"> • Flexible Repayment Terms • Attractive Low Rates 	Solar Products, Hybrid & Electric Vehicles	NA
Grenada	Grenada Development Bank	<ul style="list-style-type: none"> • Maximum loan amount of XCD \$405,000 • Interest rate of 4.99% • Repayment period maximum of eight (8) years • Up to 100% project financing. 	Lighting, Cooling Equipment, Building Envelope, Renewable Energy	Commercial and Residential Buildings
	Republic Bank Grenada	<ul style="list-style-type: none"> • Up to 100% financing available owners of the Interconnection Agreement. • Competitive interest rates. • Flexible repayment terms interest only up to a maximum of 6 months; thereafter repayable over 7 years. 	Renewable Energy	NA
Saint Lucia	St Lucia Development Bank	<ul style="list-style-type: none"> • 20% Grant Funding and Loan Interest rate as low as 4.5% 	Lighting, Cooling Equipment, Building Envelope, Renewable Energy	Residential, commercial / private (including tourism and manufacturing) / Agricultural Sectors, with a focus on buildings.
	Bank of Saint Lucia	<ul style="list-style-type: none"> • 100% financing • Up to 10 years to repay • Competitive interest rate 	Solar Products, Hybrid & Electric Vehicles	Residential
	Republic Bank Dominica	<ul style="list-style-type: none"> • Flexible Repayment Terms • Attractive Low Rates 	Solar Products, Hybrid & Electric Vehicles	NA

Note: The following cashflows are indicative and are meant to illustrate the investment associated with the respective mechanism and to aid in visualizing the mechanism.

Dealer Credit/Hire-Purchase

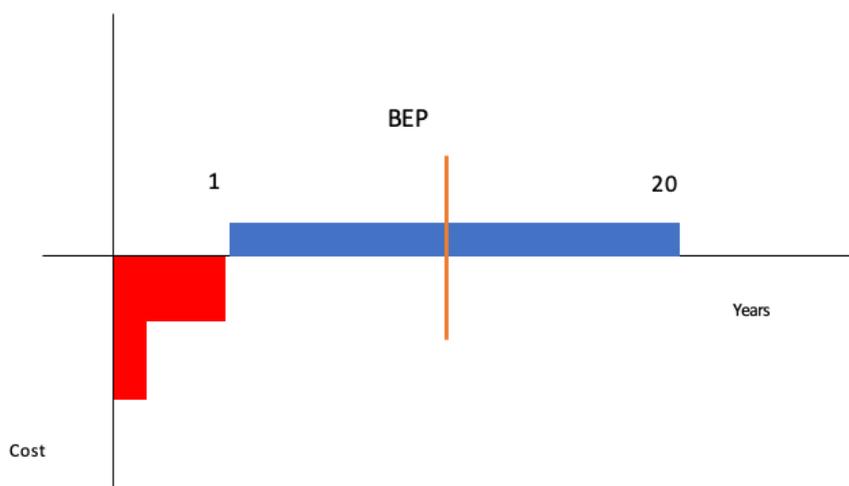
The PV supplier/dealer sells the PV system to the end-user, who enters a credit arrangement with the PV dealer. Depending on the arrangements, the end-user immediately becomes the owner of the system, or becomes the owner when all payments are made. This mechanism reduces the high initial investment barrier for the end-use, which is the main disadvantage of the cash sales model. The cost of the system is spread out over several installments which can be tailored to the needs of the consumer. The payments can be made monthly or adapted to income cycles.

Usually, these kinds of end-user credit are characterized by relatively short terms (mostly between 6 months and one year), high down-payments and high interest rates. However, these credit systems can be popular due to the flexibility.

The main risk of this model lies with the PV company. Non-payment by the consumer or late payments negatively affect the cash flow of the dealer and their ability to service their own debts. This can be mitigated by using the system as collateral, with retrieval of the system on non-payment. The company would have to conduct thorough credit checks on their clients to ensure that they will be able to meet the required payments.

Market Applicability

Figure 6: Indicative cash flow for dealer credit/hire purchase mechanism



While Dealer Credit or hire-purchase financing is common in the region it is usually applied to household appliances. It may be applied to solar PV systems through special arrangements with installers and hire-purchase institutions where the institution supplies the equipment while the installers handle the installation and maintenance of the system. The modularity of a solar system means that it can be repossessed in cases of defaulted payments. In this model the resale value of the system is important. As discussed earlier, the existence of a market for used PV plants adds to the success factor of this model. If such a market does not exist, then it presents a risk of stranded assets for the dealer.

End-user Credit

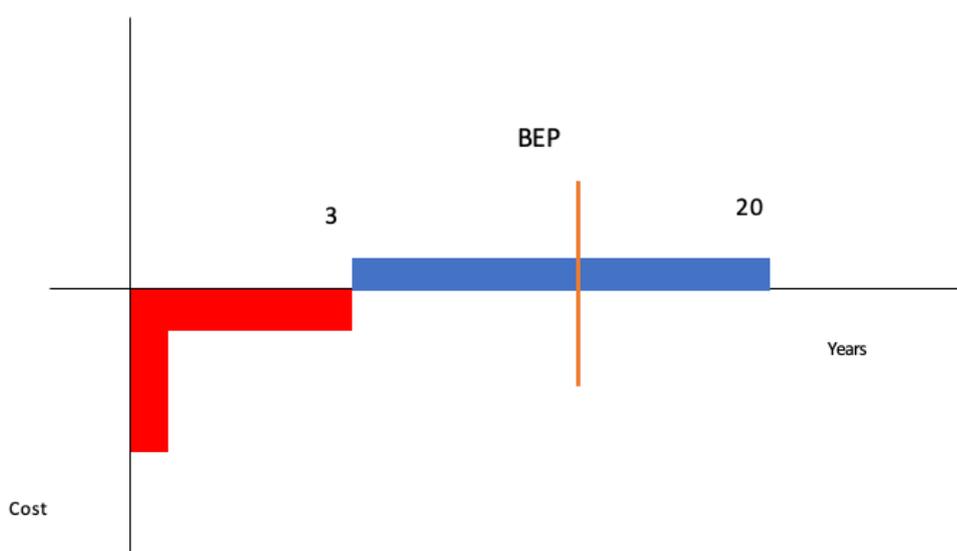
In general terms, this model is the same as the dealer credit model; only the division of roles between the stakeholders is different. In this case, the credit scheme is implemented by a separate credit organization. The

PV supplier/dealer sells the PV system to the end-user, who obtains consumer credit from a third-party credit institution. Usually, the end-user becomes the owner of the system immediately, but this can be delayed until all payments are made. The PV system can be used as collateral against the loan.

The PV company remains responsible for the sales and installation of the PV system. The end-user usually makes a down-payment (either directly to the company or to the credit institution), and the remaining payments are collected by the credit institution. The credit institution usually takes responsibility for the loan and pays the complete price to the PV company (for the company, it is like a cash sale). The end-user is the owner of the system and responsible for maintenance and repair, although most credit institutes will state in their credit terms that they remain owner till the last payment is made. The PV system can be used as collateral for the model same as above.

Market Applicability

Figure 7: Indicative cash flow for end-user credit mechanism

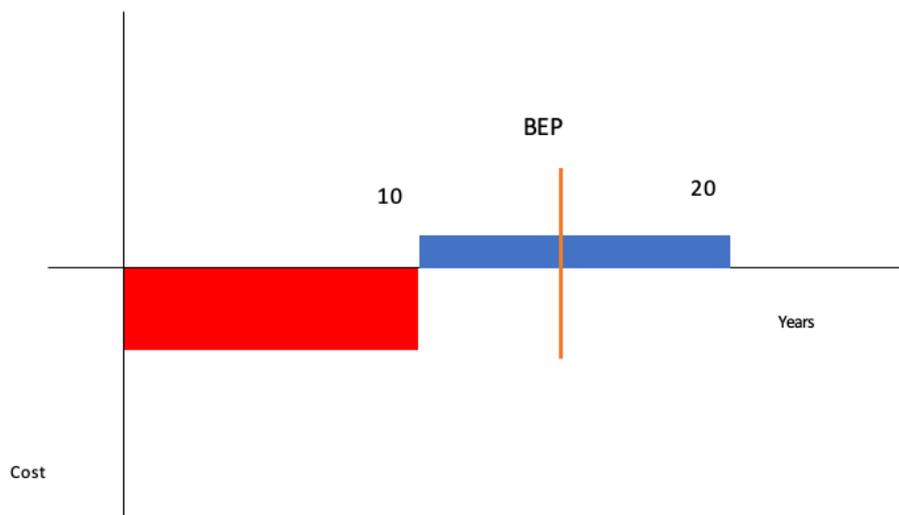


End-user credit is common in the region and several credit agencies exist that provide financing facilities which have relatively short approval times and low requirements. The tradeoff, however, is that interest rates tend to be very high. One example of this is the quick loan offered by the “Courts” company in the Caribbean region. The financing mechanism dubbed “Courts ready cash” is a quick loan of up to \$20,000 XCD (in the OECS). This loan is characterized by its same day approval and no collateral requirements.

Lease

The PV supplier/dealer or a financial intermediary, leases the PV system to the end-user: At the end of the lease period, ownership may or may not be transferred to the end-user, depending on the arrangements. During the lease period, the lessor remains the owner of the system and is responsible for its maintenance and repair. Solar leases mirror other common lease arrangements, such as an automobile lease. Generally, a solar consumer leases a solar PV system from a third party for a monthly rate over a predetermined contract period (typically 10-20 years). The defining characteristic of a solar lease is that the consumers are making fixed payments every month rather than paying for the power generated. Because monthly costs are fixed, leases typically include production guarantees where a system may be guaranteed to produce a certain amount of kWh per month based on ideal conditions. Lease terms and prices vary depending on several factors, including physical location, PV system size, roof specifications (for rooftop installations), and the consumer’s credit worthiness, among others. Depending on how the lease is structured, consumers may also have the option of making a down-payment of a portion of the lease to reduce monthly payments.

Figure 8: indicative cash flow for the leasing mechanism



Market Applicability

Leasing is not uncommon to the region but is usually used in the automotive industry. As solar leasing is like a typical automotive lease, the same mechanisms could be applied to enable solar leasing. Like automotive leasing, the leasing company may not be the dealer but may have a special relationship by which the leasing company pays the upfront cost and takes ownership of the asset. They are then free to lease the assets. This could be a lease to own arrangement where ownership transfers to the customer at the end of the lease or ownership may remain with the leasing company.

Energy Service Performance Contract

Energy service performance contracting mechanisms are structured to allow government agencies and commercial institutions to pay for renewable energy upgrades over time using money saved on energy bills resulting from energy-saving measures. Energy performance contracting structures are used extensively by federal agencies in the United States and are also open to the private sector. The company providing energy efficiency or renewable energy service guarantees reduced energy expenditures resulting from energy-saving projects (potentially including solar PV systems). The Energy Services Company (ESCO) or utility as it pertains to the Integrated utility services contracting model (IUSC) typically conducts a building energy audit, identifying specific energy conservation measures. Once the ESCO or utility and the building owner agree on the course of action, the ESCO or utility arranges project financing and makes the upgrades. The building owner then repays the ESCO or utility over time using its normal operating budget and the freed-up money from reduced energy costs stemming from the energy conservation measures. ESPC is typified by long contract periods typically up to 20 years or the life of the system. The savings sharing is dependent on the contract. ESCOS may require a higher share of savings initially and reduce that share over time or savings may be shared equally over the life of the project. The goal is to ensure a reduced cost of electricity that the consumer is comfortable with.

Market Applicability

Energy Service Performance Contracting and Integrated Utility Services Contracting are novel concepts to the region. There are few examples of successfully implemented projects implemented in the region using these models. At least one regional project has attempted to create the environment for an ESCO market. The integrated utility service model IUS is being piloted in Barbados, Jamaica, Belize and Guyana by the Caribbean Center for Renewable Energy and Energy Efficiency (CCREEE) in collaboration with the local utilities. These pilots have been implemented to varying levels of success, the main factors being the level of regulatory oversight, the source of capital for investments (utility funded or using other funding sources) and the level

of importance the utility places on the system. The primary function of a utility is the generation and supply of electricity, as such other ventures usually are not prioritized.

3.3 Advantages, disadvantages, and risk factors

The implementation of each of the financing mechanisms described above presents distinct advantages and disadvantages, as well as risks. These are outlined in Table 4 below. Note that in most cases the creditor or PV company carries the risk. They are not only more suited to bearing these risks but there is also an opportunity to reduce the risk to creditors and PV companies through government incentives. Incentives at this level are easier to implement, monitor their success and to make necessary adjustments.

The characteristics of each mechanism are outlined in Table 5. It is important to understand these characteristics when determining if any of the mechanisms examined are suitable for the region. Given that the main goal of the Eastern Caribbean Solar Challenge is to increase the uptake of solar PV, it is also important to understand to what level lower income households can benefit from each mechanism

Table 4: Advantages, disadvantages, and risk factors

Model	Advantages	Disadvantages	Risks	Possible Institution/s
Cash Purchase	<ul style="list-style-type: none"> Minimal number of parties involved in the transaction Lowest transaction cost Potentially the lowest demand for capital for the PV company No need for explicit government or programme support 	<ul style="list-style-type: none"> Limited market because of the high up-front investment needed Often no control on how the systems is installed Potential for low quality components and installation standards Often minimal end-user training is provided which can lead to a lack of on-going maintenance Competition with cheap, low-quality products is a problem 	<ul style="list-style-type: none"> No risks for the PV company and dealers beyond the warranty and this is frequently difficult to enforce Risk lies with the end-user 	PV Suppliers
Dealer Credit	<ul style="list-style-type: none"> For the end-user, the main barrier of the high initial investment is lowered In most cases, one institution handles both the financial and the technical work In many countries formal or informal credits are widespread and understood Little government or other external involvement is required 	<ul style="list-style-type: none"> The payment facility scheme absorbs working capital for the PV supplier / dealer High interest rates due to expensive capital through dealer re-finance Lack of knowledge of consumer credit with the end-users in some countries PV companies are usually not experienced / equipped / capable of administering a credit scheme, as this requires extra skills and is time consuming 	<ul style="list-style-type: none"> The main risk lies with the PV company / dealer from non-payment of the credit from the end-user. This can be mitigated by using the PV module as collateral, with retrieval of the module on non-payment The dealer re-finance funding source / credit institution carries the risk of non-payment of credit from the dealer. The credit institutions will mitigate their risk by requiring detailed business plans and personal warranties from the dealers The risk to the end-user is the loss of the PV system and down payment if they are unable to keep up credit repayments. 	PV Suppliers

End-user Credit	<ul style="list-style-type: none"> • The main barrier of the high initial investment is lowered or removed allowing the end-user to pay for the system gradually over time • The PV company does not need to allocate budget to run the credit scheme, thereby avoiding financial risks and allowing it to concentrate on sales and after-sales services • The credit institutions - if available - are much better equipped to manage a credit scheme • Little government or other external involvement required 	<ul style="list-style-type: none"> • Two separate structures may be needed to handle the financial and the technical work, resulting in additional costs, although it is possible for one structure to handle both financial and technical work • High interest rates and down-payments. In some cases, the credit institutions may be supported by donors or government programmes to keep interest rates low. These credit schemes are characterized by more favorable terms than commercial consumer credits • The market is restricted to customers that the credit institution deems creditworthy – generally those with salaried incomes, those with a guarantor or those who have the required collateral 	<ul style="list-style-type: none"> • Most of the risk is carried by the credit organization from the non-payment of the credit repayments. This is mitigated using the PV module as collateral. • The PV company / dealer risks are passed to the credit institution. • The end-user risks losing their PV system and their down payment if they are unable to keep up their repayments 	<p>Courts Unicomer,</p>
Lease	<ul style="list-style-type: none"> • The main barrier of the high initial investment is removed, more so than with the other credit models, as the initial down payment is further reduced, and the repayment period is prolonged. In general, the payment system can also be designed to fit the income cycle of the client. • One single structure can handle both the financial and the technical work: the fee collection as well as the maintenance, training, and other after-sales services 	<ul style="list-style-type: none"> • Leasing is not a well-known concept in most countries • End-users may not treat the systems with care, as initially the maintenance and ownership do not lie with them • PV companies are usually not equipped / capable of running a leasing programme as it requires additional financial administration skills and can be time-consuming. • This model can be restrictive because of the extensive infrastructure needed for the collection of the payments and the maintenance and repair of the systems. 	<ul style="list-style-type: none"> • The lease provider takes most of the risk. However, if the end-user stops repayments, the lease provider owns the system and can retrieve it 	<p>Simpson finance</p>

<p>Lease</p>	<ul style="list-style-type: none"> • Maintenance can be kept at a high standard because of the professional care for the system • Good-quality products are selected because of the long repayment period. 			
<p>Energy service performance contract</p>	<ul style="list-style-type: none"> • End-user does not have to invest in a solar system • End-user is not responsible for maintenance and repair. By organizing this centrally, the costs for maintenance and repair are lowered while high quality maintenance can be provided • High-quality systems, components and installation are encouraged because of the inevitable long-term agreements • Proper collection and recycling of components (e.g., batteries) is possible because of the centralized responsibility; 	<ul style="list-style-type: none"> • Low rate of return, long payback period, high financial risks • The end-user is not the owner of the system and may therefore not treat the system as carefully as they would otherwise. • As 'serious' companies like ESCOs or utilities provide the service, end-user expectations are often high, while the system may under-perform in certain circumstances, even though the client paid a monthly fee. This may cause disappointment • There is less flexibility in the case of missed or late payments 	<ul style="list-style-type: none"> • The ESCO carries all the risk as owners of the systems and for collecting the fees • The credit institution providing the finance to the ESCO takes the risk on the success of the ESCO 	<p>Green Technology -Eco Carib</p> <p>Solife (St Vincent & the Grenadines)</p>

Table 5: Summary of main characteristics of financing mechanisms

Model	Capital need for PV company	Access for low income clients	Infrastructure need	Implementing Partners	Installation and maintenance	Risk allocation	Ownership
Cash Purchase	Low	Low	Low Sales points only	PV Companies	User is responsible. The dealer can be responsible if a maintenance contract is in place	Risk remains with end-user. Risk for dealer until warranty period expires.	Transferred to end user at point of sale.
Dealer credit	Medium/High, consumer credit expertise is needed.	Medium/low	High. Technical and financial infrastructure needed.	PV Companies	User is responsible. The dealer can be responsible if a maintenance contract is in place	Risk is distributed among all parties. Highest risk is with dealer.	Ownership depends on actual credit arrangement between user and dealer.
End-user credit	Low. (Provided credit institution has capital).	Medium /low.	High. Technical and financial infrastructure needed.	Financial institutions PV companies	User is responsible. The dealer can be responsible if a maintenance contract is in place	Risk is distributed among all parties.	Ownership will be with user or credit provider depending on the credit arrangement.
Lease	High expertise in leasing needed.	Medium/high.	High. Technical and financial infrastructure separate or combined.	Leasing companies. PV companies	Leasing companies.	Most of the risk is with the lessor	During the lease period ownership remains with the lessor. Ownership transfers to user at end of lease period if hire purchase, or stays with the lessor if commercial lease
ESCO	High if the PV supplier/dealer creates the ESCO.	High /medium.	High. technical and financial infrastructure combined	Financial institution ESCO. Utility	Full responsibility of the ESCO.	All the risk is with ESCO.	Ownership remains with the ESCO.

Conclusion

The main financing issue for solar PV in the region is that of adequate options which can serve a wide cross section of the public. Existing financing only serves those at a certain financial level who can meet certain strict requirements. Having options at each level will allow greater participation and greater uptake in the solar industry. However, it is important to understand the advantages and disadvantages of each of these options as well as the characteristics of the market in the OECS region to ensure success. The main goal of any financing mechanism is to encourage the end-user to make the investment, and this is best achieved through de-risking the investment on their end. It is also very important to understand the resale value of solar PV and ensure that a secondary market exists or can be developed which will decrease the risk of stranded assets and sunken investments. As a next step, the willingness of companies and consumers to engage in these mechanisms should be examined along with a comprehensive look at the financial, technical, and infrastructural needs for successful implementation.

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The Global Green Growth Institute

19F Jeongdong Building, 21-15, Jeongdong-gil,
Jung-gu, Seoul, Korea 04518

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