Dominican Republic Net Energy Metering Analysis

DRAFT FOR DISCUSSION

James McCall, Riccardo Bracho

National Renewable Energy Laboratory

Technical Report
NREL/TP-
Month Year

Contract No. DE-AC36-08GO28308

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Table of Contents

INTRODUCTION

In 2011, the National Energy Commission (CNE) of the Dominican Republic, approved the regulation for distributed generation (DG) and the country's Net Energy Metering Program (PMN). Net metering was chosen as the compensation mechanism estimated to best promote the deployment of self-supply of energy with the use of renewable energy technologies in the Dominican Republic. The PMN applies to residential consumers with a limit of 25 kW systems and commercial and industrial consumers with systems of up to 1MW. As of April, 2020, the PMN was responsible for 5,541 customers with PV systems installed, representing a capacity of 146.60 MW (ONUDI, 2020).

With the continued decline of PV costs and increased deployment of DPV for self-generation, utilities and regulators around the world are analyzing the effectiveness of net metering programs and whether these programs cause economic concerns to distribution companies. In many countries many programs are developing rates based on the value of rooftop solar power to the grid, including reduction of losses and environmental benefits, often called "value of solar" rates. Others are reducing the compensation for excess generation by instituting net billing or total sales compensation mechanisms. In this report, we analyze the economic metrics of net metering in the Dominican Republic and compare that against net billing and total sales for a generic Dominican electric customer. This analysis does not include technical assessments of the benefits and costs to distribution companies from higher penetration of DPV in the electric grid. The purpose of this analysis is to inform the Ministry of Energy and Mines (MEM) in their review of the PMN.

When choosing a compensation mechanism for excess generation and other incentives to promote DG technologies, policy makers evaluate the possible impacts that these policies and incentives will impact the customers' choices to install distributed generation. Evaluating the customer economics for DG technologies is one of the first steps in identifying how many customers will be economically incentivized to adopt technology. In the case of the Dominican Republic, as it is the case in most developing nations, DG is mostly comprised by distributed photovoltaic (DPV) installations but can include other generation technologies. This analysis looks primarily at the customer economics of DPV installation for customers in the Dominican Republic, under different compensation mechanism and scenarios. The purpose of this analysis is to explore the economic incentives for customers to install DPV in order to provide information to decision makers in the Dominican Republic. As deployment grows, impacts to distribution companies have become an area of interest for policy makers as well. The analysis presented here also looks at high level impacts that DG deployment can create on distribution utilities and government finances.

Many factors impact the customer economics of DG technologies which include, but are not limited to, cost of installation, electric tariffs, resource potential, compensation mechanisms, public policies, and incentives. The high-level analysis approach for customer economics is shown in Figure 1below, adapted from (Dargouth et al. 2020).

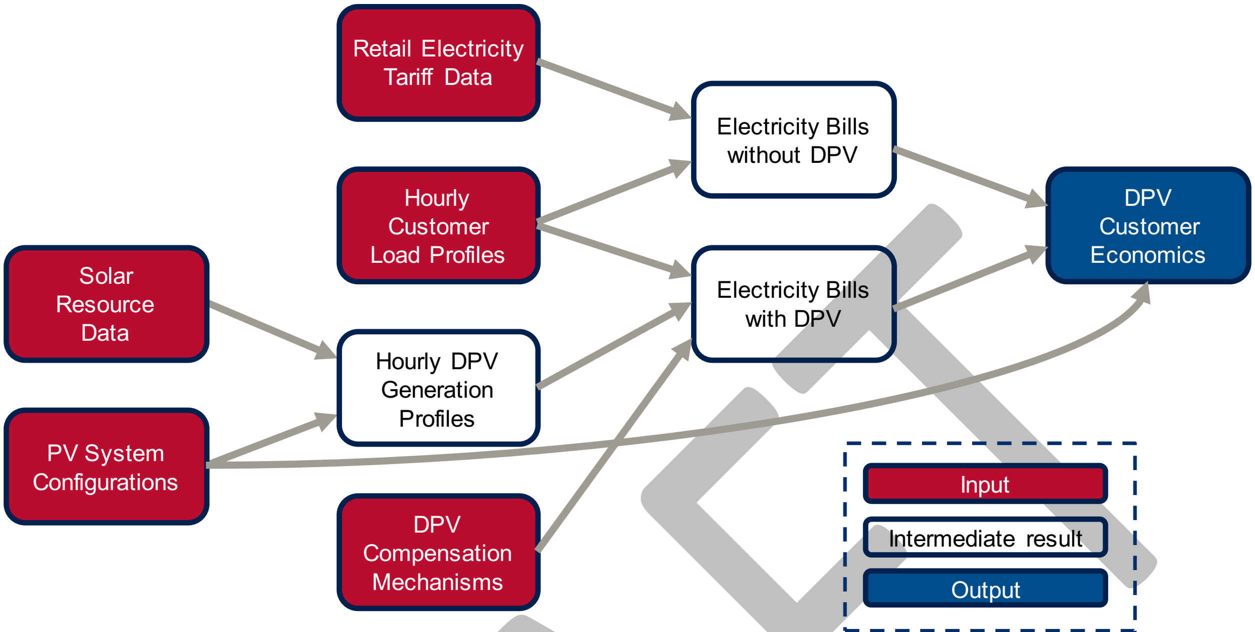

Figure 1: DPV customer economic analysis framework (from Dargouth et al. 2020)

Outside of system cost and performance, the DPV compensation mechanism has a large impact on customer economics. A DPV compensation mechanism sets how customers are compensated for any exported solar generation that is not self-consumed by the customer. There are three compensation mechanisms studied in this analysis: net energy metering (NEM), net billing (NB), and Buy-all-sell-all (BASA). The explanation for each compensation mechanism is adapted from Dargouth et al. 2020 and Zinaman et al 2017.

1. **Net energy metering** (NEM): As can be seen in Figure 2, "the utility provides kWh credits for grid injections (i.e., each kWh of DPV generation exported to the grid leads to a kWh credit). This credit can be used to offset future electricity consumption. This allows the customer to bank excess generation and reduce their overall electric bill; this is effectively a form of financial storage" (Dargouth et al. 2020).

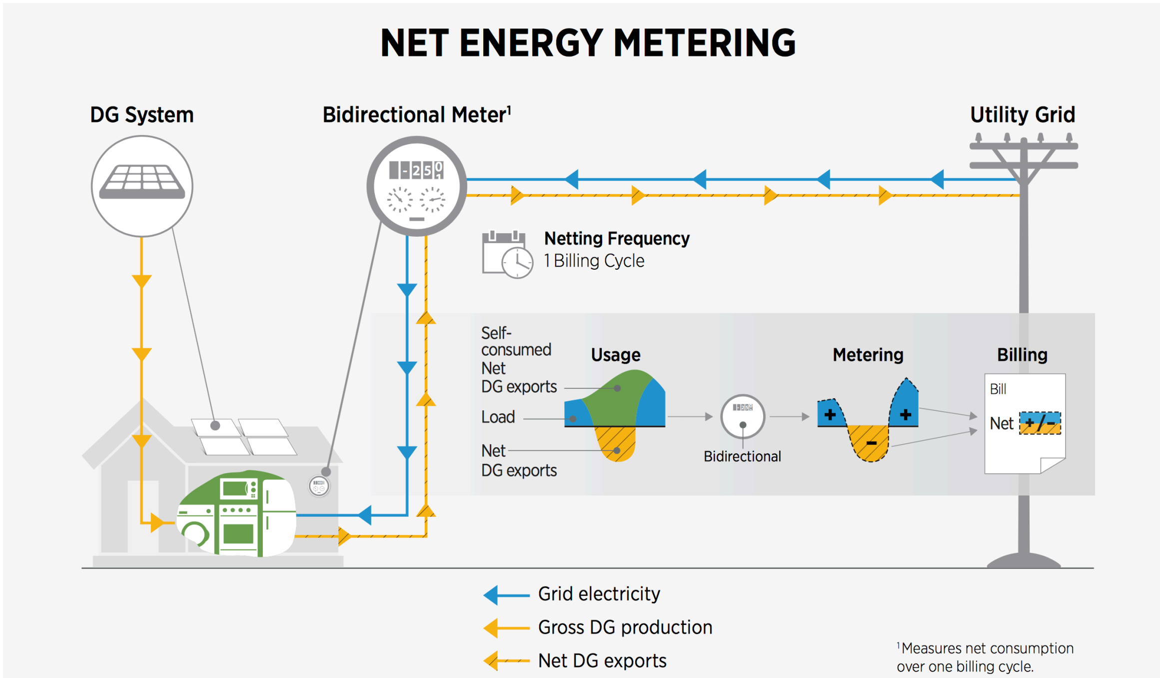

Figure 2: Net Energy Metering process diagram (Zinaman et al. 2017)

2. **Net billing (NB)**: As can be seen in Figure 3, "any grid injections are purchased by the utility at a predetermined sell rate. This price is often set at the avoided cost of generation of the utility but can be set at any value" (Dargouth et al. 2020).

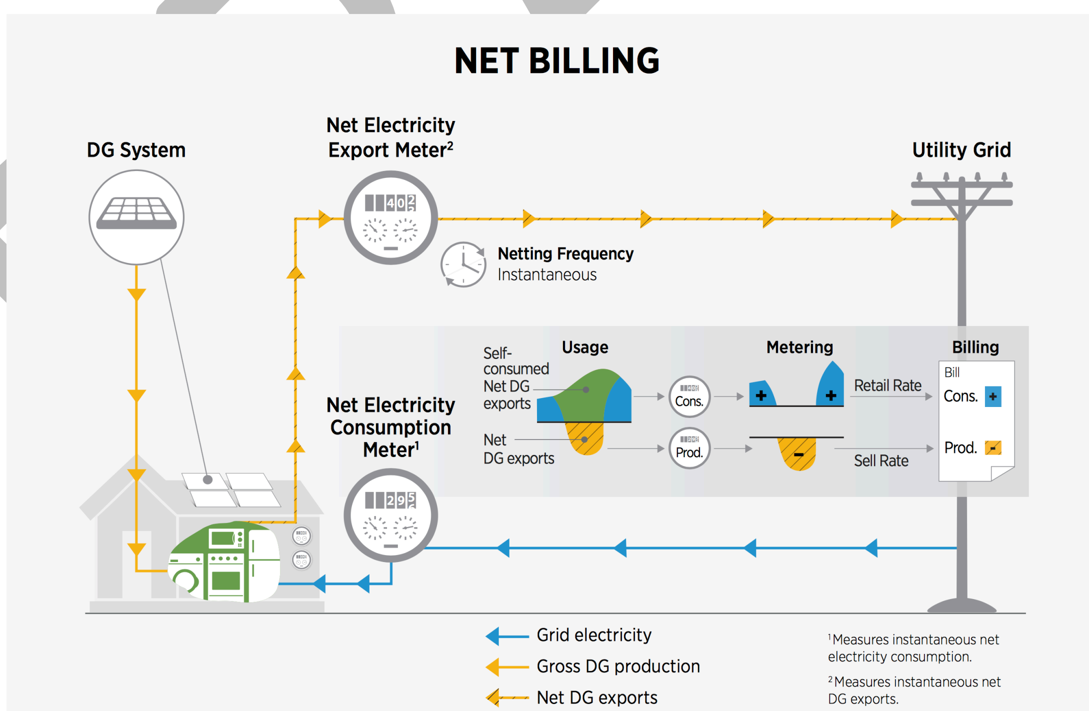

Figure 3: Net Billing process diagram (Zinaman et al. 2017)

3. **Total Sales also called Buy All, Sell All (BASA)**: As can be seen in Figure 4, "under BASA schemes, all DPV generation is purchased by the distribution utility at a pre-determined sell rate and self-consumption is not allowed. The customer continues to purchase the same amount of electricity from the utility at the applicable retail tariff and is provided a bill credit or cash payment for all DPV generation sold to the utility" (Dargouth et al. 2020).

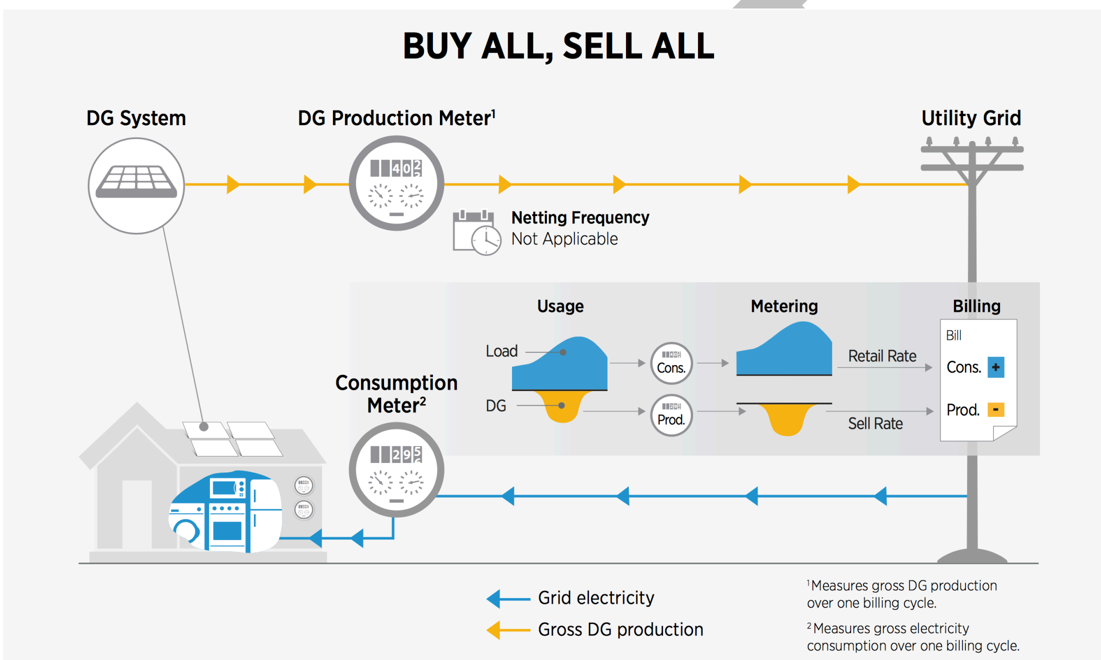

Figure 4: Buy All, Sell All process diagram (Zinaman et al. 2017)

1 Base Scenario and Inputs

A first step in the customer economic analysis is to build a base scenario to compare economic indicators for different customer types: residential and commercial and industrial (C&I). Each customer will have a different electric rate, annual load profile, and DPV system size. For this analysis we utilized NREL's System Advisor Model (SAM)[1] to calculate the energy production and the economic outputs for the DPV systems. SAM is a free to use tool developed for industry, researchers, and policy makers to calculate the technical and economic performance of renewable energy technologies. Regardless of the compensation mechanism, economic impacts to system owners are derived from how much energy the system produces, the current electric tariff, when DPV system production offsets customer load, the cost of building and maintaining the PV system, the financing

[1] https://sam.nrel.gov/

options and terms, and government incentives. The following section details all the inputs to the base scenario for each customer type.

1.1 Location and Solar Resource

For this analysis, the solar resource data came from Typical Meteorological Year (TMY) weather files, which were downloaded for several areas of the Dominican Republic. TMY files contain all relevant local solar irradiation, wind, temperature, and other weather-related metrics for calculating the performance of a DPV system. For the base scenario, a TMY file for Santo Domingo was downloaded from the National Solar Radiation Database (NREL 2020) and used for all customer classes.

1.2 System Design

For each customer type (residential or commercial and industrial [C&I]), a crystalline-silicon (c-si) DPV system was designed to produce enough electricity to meet 80% of the annual load for each tariff class. A system size of 80% of annual load was chosen as a starting point and based on actual system sizing information by customer class from the Dominican NEM program. The impact of system sizing is shown later in the sensitivity section. For the base scenario, the standard SAM inputs are shown in Table 1.

Table 1: System design SAM inputs

SAM Parameter	Input Value
Array type	Fixed open rack
Tilt	20 deg
Azimuth	180 deg
DC:AC ratio	1.2
System losses	14.08%*
System degradation	0.5%/year *
System life	25 years

* SAM defaults based on empirical observations for c-Si modules

1.3 Financial Parameters

DPV system costs have a significant weight on the decision to install or not a DPV system, regardless of the compensation mechanism. In this analysis, the costs are based on quotes from a solar installer provided by the GIZ Energy Transition Project, for residential customers and cost modeling for C&I customer from La Asociación para el Fomento de la Energía Renovable (ASOFER) (GIZ 2019; García Vilches 2019). Operations and maintenance (O&M) costs are based on U.S. averages (Fu et al. 2018). All costs are in Dominican Pesos (RD$). Financial inputs are shown in **Error! Reference source not found.**.

SAM Parameter	Input Value
System cost – residential	64 RD$/W
System cost – C&I	42.50 RD$/W
O&M cost	750 RD$/kW-yr
Value added tax (VAT)	18%

All DPV systems in this analysis are purchased using financing. The base scenario assumes that 80% of project costs are secured through a loan with term of 84 months at a 14% interest rate[2]. The customer paying the remaining 20% in cash up-front. The inflation rate was set at 4% (Banco Central República Dominicana 2019).

There are two incentives offered for DPV systems in the Dominican Republic. There is a tax credit for 40% of the module plus inverter capital costs and there is no VAT collected on module and inverter sales. Both incentives are modeled in the base scenario.

1.4 Electric Rates

In the Dominican Republic, the electric rates are established by the energy regulator, Superintendencia de Electridad (SIE), for customers served by the main three distribution companies (EdeSur, EdeNorte, and EdeEste). All tariff information in this section was downloaded from the SIE website (Superintendencia de Electridad 2018).

Residential customers are served by BTS1 and BTD tariffs and C&I customers are served by BTS-2, BTD, BTH, MTD-1, MTD-2, and MTH tariffs. Both BTS-1 and BTS-2 are tiered electric rates with fixed monthly charges, as shown in Table 2. BTD, MTD-1, and MTD-2 tariffs have demand charge with no hourly, time-of-use demand charge and BTH and MTH tariffs have demand charges and time-of-use demand charges as shown in Table 3. On-peak demand pricing is from 18:30-23:00 in the BTH and MTH tariff classes.

[2] These financing assumptions did not have a large impact on the results, likely due to the short loan period. Modeling results are not heavily impacted if the system is purchased with 100% up-front cash.

Table 2: Tiered electric rates - BTS-1 and BTS-2

Tariff	BTS-1	BTS-2
Fixed monthly charge (RD$) - average monthly consumption less than 100 kWh	37.95	-
Fixed monthly charge (RD$) - average monthly consumption greater than 100 kWh	137.25	-
Fixed Monthly Charge (RD$)	-	137.67
Energy Tiers (monthly usage)	**Energy Charge (RD$/kWh) for BTS-1**	**Energy Charge (RD$/kWh) for BTS-2**
0-200 kWh	4.44	5.97
201-300 kWh	6.97	8.62
301-700 kWh	10.86	11.30
>701 kWh	11.10	11.49

Table 3: Electric tariffs with demand charges: BTD, MTD-1, MTD-2, BTH, and MTH

Tariffs	BTD	MTD-1	MTD-2	BTH	MTH
Fixed Monthly Charge (RD$)	224.53	224.53	224.53	224.53	224.53
Energy Rate (RD$/kWh)	7.37	7.81	7.38	7.26	7.26
Off-peak Demand Charge (RD$/kW)[3]	993.99	485.98	340.39	253.35	97.33
On-peak Demand Charge (RD$/kW)	0	0	0	1412.74	985.26

For the different compensation mechanisms, injected DPV generation is treated differently. For NEM, any generation creates a 1:1 kWh credit that can be used to offset future generation. Any unused credits expire at the end of the year and are compensated based on regulation Law 57-07 that "75% of accumulated credits will be credited at first level of BTS1 tariff." (Comisión Nacional de Energía 2012). For this analysis, any unused NEM credits are compensated to the customer at 3.33 RD$/kWh. For NB, injected DPV generation is compensated at a rate set by the energy regulator and is generally based on the avoided cost of generation for the utility. The NB rate has not been set by the energy regulator in the Dominican Republic, but for this analysis, we used EdeSur's average energy purchase price for January to August of 2019, which was 5.75 RD$/kWh (EDESUR 2019b). This value was used for any injected DPV generation for NB and for all DPV generation under BASA.

[3] In the Dominican Republic, the demand charge is based on the larger of peak energy use (kW) for the month OR peak DPV production (kW) exported to the grid. SAM cannot currently model a tariff that includes an energy export demand charge, so this analysis assumes that the peak demand is always higher that peak DPV energy exported and is consistent with sizing the DPV system to meet 80% of the customers' annual load.

1.5 Customer Electricity Demand

For this analysis, EdeSur provided hourly load data (in kW) for 10 customers for each tariff class from June through October of 2019 (EDESUR 2019a). After removing the zero load values, an average hourly load profile from all 10 customers was created over the June to October time frame. Assuming a non-seasonal demand load shape, this average hourly data was looped over an entire year to create an hourly, 8760 load profile for each customer class. The annual load values are shown in Table 4and an example of BTS-1 and MTD-2 load profiles are shown in Figure 5and Figure 6, respectively.

Table 4: Annual load by tariff class

Tariff Class	Annual Load (kWh)
BTS-1	11,770
BTS-2	33,157
MTD-1	100,165
MTD-2	136,813
BTH	46,256
MTH	116,106
BTD	49,928

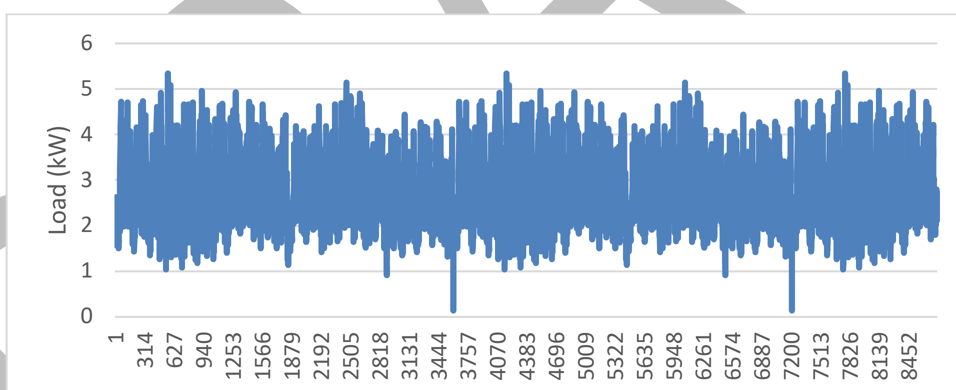

Figure 5: BTS-1 annual load profile

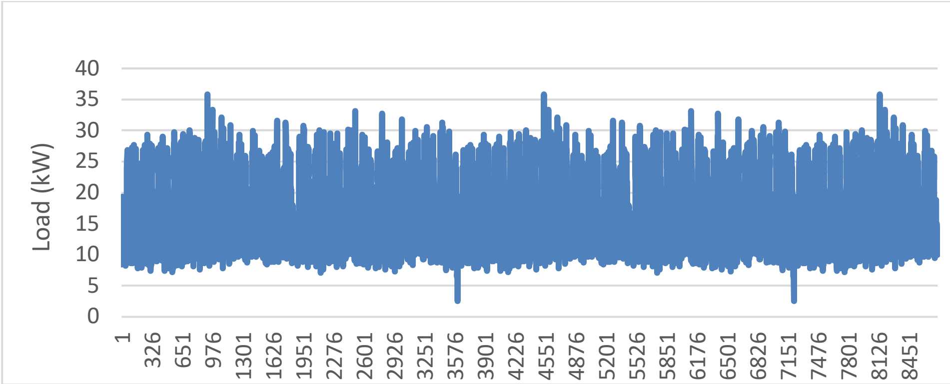

Figure 6: MTD-2 annual load profile

For each customer tariff class, a DPV system was designed to generate enough electricity to 80% of the annual electric load based on Santo Domingo irradiation data. The calculated DPV system sizes in the analysis are shown in Table 5. Data for actual customers who installed DPV and utilize NEM from EDESUR were used to validate the system sizes (Ministry of Energy and Mines 2019).

Table 5: DPV system size by tariff class

Tariff Class	DPV system Size (kW)
BTS1	6.25
BTS2	17.60
MTD1	53.14
MTD2	72.58
BTH	24.54
MTH	61.59
BTD	26.49

2 Results

For each customer class in the base scenario, this analysis calculated both the simple payback period in years for DPV investment and the year one bill savings in Dominican Pesos ($RD) for each of the three compensation mechanisms: NEM, NB, and BASA. Even though a shorter payback signifies a more attractive investment, some customers may make an investment decision based on other economic or social benefits. As an example, for some customers and depending on the local tariff structure, a DPV system may help them reduce their electricity consumption from the utility enough to place them in a lower electricity tariff that makes the investment worthwhile.

2.1 Residential Customers

Modeling results for residential customers with base scenario assumptions are shown in Table 6. The payback period for BTS-1 customers is less than BTD customer most likely due to the demand charge in the BTD tariff which solar generation is unlikely to impact (peak demand is from 18:30-22:00 during which the DPV system is unlikely to produce much electricity). The only way the demand charge could be impacted is for solar generation to coincide with peak demand that month, which is unlikely. For all three of the compensation mechanisms analyzed, the payback period is lower than seven years. However, for NEM customers of both tariff classes, the payback period is below 5 years, which is considered an attractive investment.

Table 6: Residential customer economic impact results

	BTS-1		BTD	
Compensation Mechanism	Simple Payback	Bill Savings	Payback	Bill Savings
NEM	3.7	97,530	4.7	315,498
NB	4.6	78,890	5.2	282,178
BASA	6.7	54,200	6.5	229,725

2.2 Commercial and Industrial (C&I) Customers

Modeling results for C&I customers with base scenario assumptions are shown in Table 7and Table 8. All three of the compensation mechanisms for all of the different tariffs analyzed resulted on payback periods lower than five years. BTS-2 customers experience the lowest payback period of 2.1 years for all NEM customers, which corresponds with real NEM customer data in which BTS-2 customers have the most installed DPV systems. The other four tariffs have very similar payback periods and trends to one another. Even though the payback period for these customers is longer than BTS-2 customers, a payback period of three years is still considered an attractive investment. As with residential customers, the BASA compensation mechanism showed the longest payback but is still considered an attractive investment with a payback period under 4.5 years.

Table 7: BTS-2, MTD-1, MTD-2, and BTD customer economic impact results

	BTS-2		MTD-1[4]		MTD-2	
Compensation Mechanism	Payback	Bill Savings	Payback	Bill Savings	Payback	Bill Savings
NEM	2.1	304,056	3.1	638,353	3.3	820,835
NB	2.9	224,383	3.6	553,568	3.7	730,352
BASA	4.4	152,543	4.4	460,837	4.4	629,422

Table 8: BTH and MTH customer economic impact results

	BTH		MTH	
Compensation Mechanism	Payback	Bill Savings	Payback	Bill Savings
NEM	3.3	279,441	3.3	685,506
NB	3.6	253,596	3.8	610,682
BASA	4.4	212,817	4.4	534,118

3 Sensitivities

At the request of project partners, sensitivity runs were performed to examine the impacts of key modeling inputs on DPV system economics.

3.1 Solar Insolation

To study the impact from solar irradiation differences in the country on the payback period, TMY files for Punta Cana and Santiago de los Caballeros were downloaded from the NSRDB and the same customer economic analysis was performed. The change in generation, the system capacity factor, and the payback period for a BTS-1, NEM customer with base scenario assumptions are shown in Table 9. There is minimal to no impact (<3% difference in the payback period) on customer economics from the solar insolation in the three locations.

Table 9: Location sensitivity results

Location	**Annual generation (kWh)**	**Capacity factor (%)**	**Payback (yrs)**
Santo Domingo	1,508	17.1	3.7
Punta Cana	1,556	17.8	3.6
Santiago de los Caballeros	1,525	17.4	3.65

[4] Residential customers can also utilize the MTD-1 tariff. Results for residential customers will not vary from results for C&I customers.

3.2 CEPM Tariff

This sensitivity looks at the impact of electric tariffs on customers in a concession area named "Consorcio Enregético Punta Cana" (CEPM). Residential customers (BTS-1) in the micro-grid region of Punta Cana experience a different electric tariff from the other Dominican customers. In addition, CEPM customers that install a DPV system and sign up for NEM utilize a separate tariff. This electric tariff is shown in Table 10. All other values are kept consistent with the base scenario. This sensitivity analyzes the impact of changing the electric tariff by calculating the payback period for two customers in CEPM who install a DPV system: one on the current CEPM tariff rate and one with the CEPM NEM tariff. As shown in the table below, the reduction of energy charge value but inclusion of a demand charge causes the payback period for DPV to increase by 67%. Note, this is only applicable for customers in the base scenario and customers could shift load to reduce the demand charge impact.

Table 10: CEPM sensitivity results

Tariff fees	Current CEPM Tariff	NEM Tariff
Energy Charge (RD$/kWh)	14.98	8.75
Demand Charge (RD$/kW)	-	1,324
Payback Period (yrs)	*2.4*	*4*

3.3 DPV System Sizing

In the base scenario, DPV systems were sized to generate 80% of the annual electric load. This sensitivity looks at the impact of system sizing on the payback period for three customers with different electric tariff structures: BTS-1 MTD-1, and BTH. A DPV system was sized to meet 10% to 100% of annual electric load in increments of 10% and the payback periods are shown in Figure 7, Figure 8, and Figure 9. For all customers, NEM and NB customers have similar payback periods when the system is sized to meet less than 50% of the load, likely due to all solar generation offsetting building load and not exporting solar generation. As the system size increases, there is a divergence with payback periods, with NB rising. This is due to increased solar exports to the grid; in NB, the sell rate is often less than the price of offsetting electric purchases from NEM credits (for an MTD-1 customer, a NEM credit is worth the sell price of 7.81 RD$/kWh while the NB price is worth 5.75 $RD/kWh). Across all scenarios, BASA has the highest payback period.

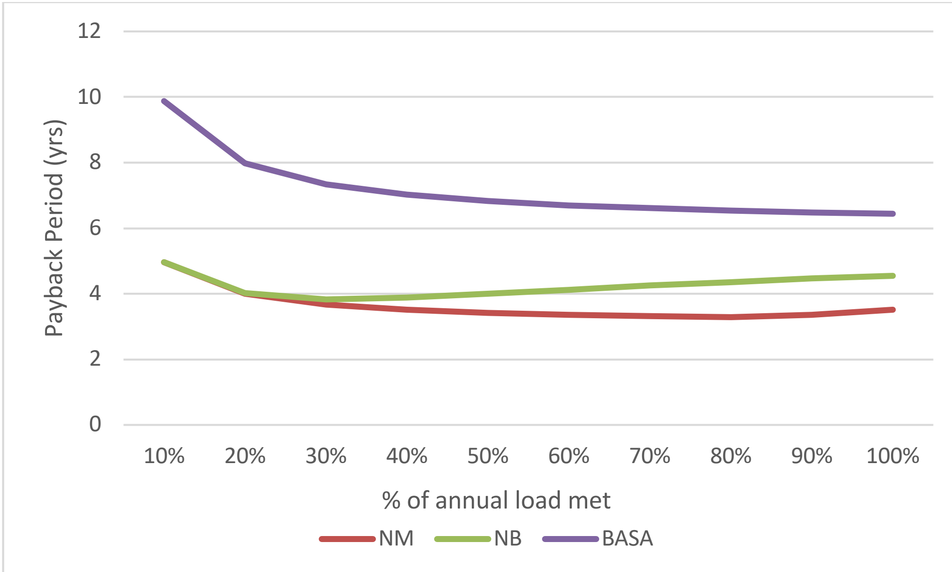

Figure 7: BTS-1 sizing sensitivity results

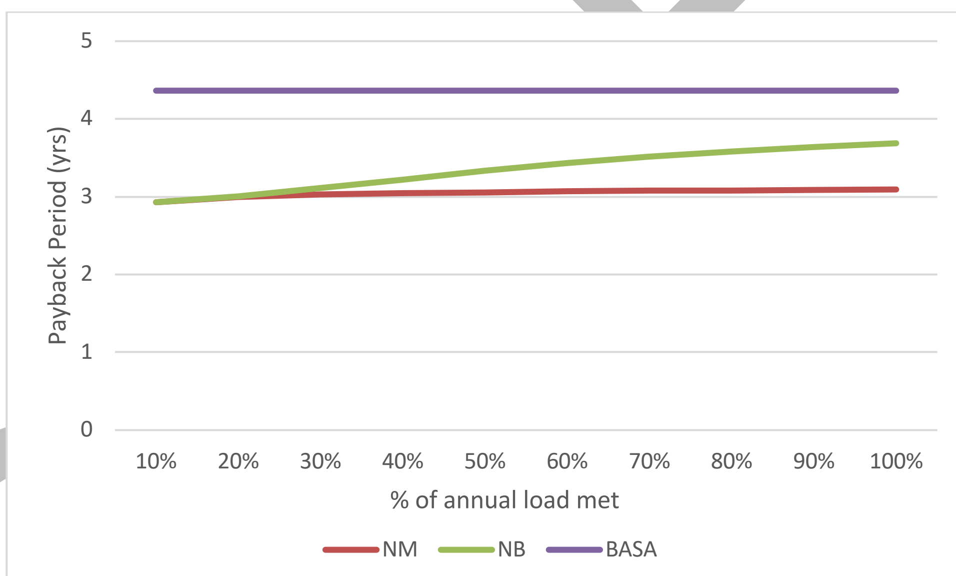

Figure 8:MTD-1 sizing sensitivity result

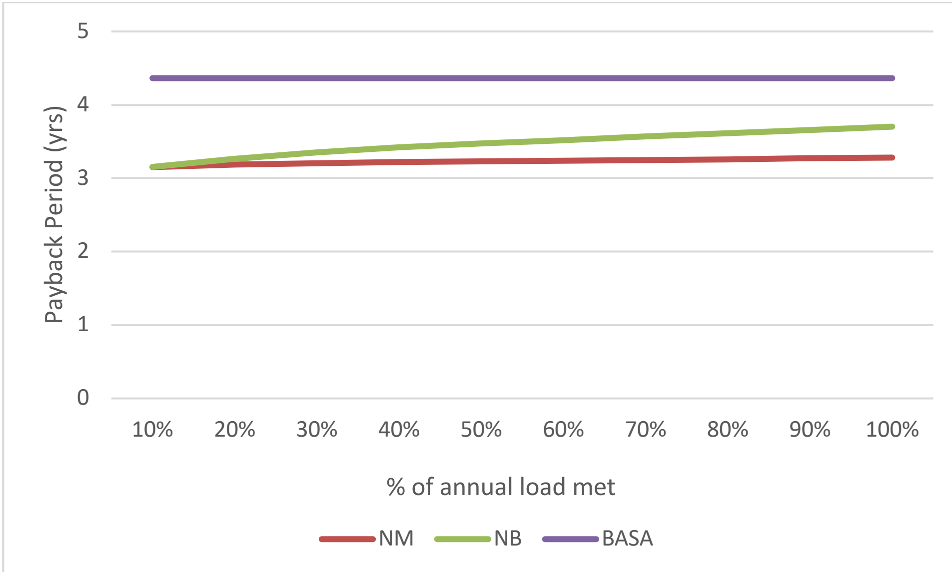

Figure 9: BTH sizing sensitivity results

3.4 Net Billing Sell Price

The base scenario assumed a NB sell price of RD$ 5.75/kWh and was based on the cost of wholesale electricity purchases provided by EdeSur. Many countries are now adapting NB as the compensation mechanism, because the sell price can be adjusted to various conditions. If a NB regulation was enacted, the energy regulator, SIE, would set the sell price for any excess generation. This sensitivity looks at the impact of the NB sell price on the payback period for BTS-1, base scenario customer shown in Table 9. A change in one RD$ per kWh for the NB sell price results in a 0.2 year change in payback period. These values will change depending on the amount of DPV generation injected to the grid.

Table 11: Net billing sale price sensitivity results for a BTS-1 customer

NB sale price (RD/kWh)	Payback
2.75	3.6
3.75	3.3
4.75	3.1
5.75	2.9
6.75	2.7
7.75	2.6

3.5 Change in CAPEX

In this sensitivity run, the impact of CAPEX on DPV system payback period was examined. For a BTS-2 customer (chosen as the most current NEM customers are in this tariff class), the CAPEX cost for DPV system was both increased and decreased by 20%. The impacts of CAPEX changes by compensation mechanisms are shown in Table 12. Note that the payback periods changed by 20% either direction, so the correlation between CAPEX and payback period is linear.

Table 12: CAPEX sensitivity results

	CAPEX (RD$/W)		
Compensation Mechanism	*34*	*(Current)* *42.5*	*51*
NEM	1.7	2.1	2.5
NB	2.3	2.9	3.5
BASA	3.5	4.4	5.2

3.6 Impact of Subsidies

This sensitivity looks at the impact of government subsidies on customers' economics, in each tariff class under NEM and NB shown in Table 13. Values in "No Subsidy" column removed both the tax credit and VAT exemptions available today. There were varying levels of change across the customer class, but the impact of subsidies results in a 15-25% increase in payback period across all customers, showing that government subsidies are reducing the lifetime cost of DPV systems and sending positive economic signals for DPV deployment. Some customers do not pay taxes so cannot take advantage of the 18% CAPEX tax credit, but would be able to take advantage of the 8% in VAT. For these customers, the impacts would scale linearly with the cost reduction.

Table 13: Impact of government subsidies sensitivity results

	Payback (yrs) - NM		*Payback (yrs) - Net Billing*	
Tariff	Base Scenario	No Subsidies	Base Scenario	No Subsidies
BTS1	3.7	4.8	4.6	6
BTD	4.7	6.2	5.2	6.9
BTS2	2.1	2.6	2.9	3.4
BTH	3.3	4	3.6	4.3
MTD1	3.1	3.7	3.6	4.2
MTD2	3.3	4	3.7	4.4
MTH	3.3	4.1	3.8	4.5

4 Government Perspective

This section looks at potential high-level impacts to the Dominican government. The deployment of distributed generation at scale with and without direct government incentives has an impact on the Dominican Treasury finances and can have significant environmental impacts. For governments where the electricity service is subsidized to certain consumers, deployment of distributed generation can reduce the subsidies paid to the distribution companies for these consumers. The Dominican government subsidizes electric rates to keep rates low and pays a set RD$/kWh for every kWh sold. A reduction in electric sales from DPV offsetting load will reduce the amount of subsidy payments to distribution companies. However, in many places, the electric tariff structures may encourage non-subsidized customers to install DPV to reduce consumption and fall into a subsidized tariff rate.

There will also be a reduction of tax collection from DPV customers that self-generate and reduce their electricity purchases. In the Dominican Republic, the government has two tax related incentives; first the government does not collect VAT on the sale of inverters and PV panels. and second, there is a reduction in tax collection from the 40% tax credit offered for the purchase of modules and inverters. This reduction in tax collection will be balanced by the reduction in electric rate subsidy payments to distribution companies.

The reduction in tax collection from tax incentives are a onetime cost to the government at the time of system purchase. For a BTS-1 customer, the removal of VAT collection results in a RD$5,266/kW (8% of CAPEX) reduction of tax collection, while the tax credit results in a RD$11,704/kW (18% of CAPEX). Both these reductions results in a year one total of RD$16,970 per kW installed in avoided tax collection from these incentives.

In the Dominican Republic, for every tariff except MTD-1, the government pays a subsidy for the electric tier charge (not fixed monthly charge) portion of electric rates, as shown in Table 14. Using the base scenario for each customer and the subsidy reduction value in Table 14below, this analysis calculated the year one bill savings shown in Table 15, which represents the reduction in electric subsidy payments from the government. These savings will continue to accrue over the 25-year life of the system. For a BTS-1, NEM customer, the year one avoided subsidy payments are RD$1,105/kW. Calculating the 25-year savings (if all values stay constant), this results in a total lifetime savings of RD$27,625. Converting this lifetime savings to the present value in year one with a 10% discount rate results in a present value of RD$ 10,030/kW. This lifetime subsidy payment reduction balances a portion of the reduction in up-front tax collection and can potentially pay for the incentives over the life of the system. This analysis does not take into account future increase in electricity prices and subsidization rates by tariff class, but that would have an impact on the lifetime cost-benefits analysis for the government.

Table 14: Government electric rate subsidies by tariff class, from (Superintendencia de Electridad 2018.) [5]

Tariff		Tariff index (RD$/kWh)	Applicable tariff (RD$/kWh)	Subsidy (%)	Subsidy Reduction (RD$/kWh)
	0-200 kWh	9.56	4.44	53.56%	5.12
	201-300 kWh	9.56	6.97	27.09%	2.59
	301-700	11.78	10.86	7.81%	0.92
BTS1	>700	11.78	11.1	5.77%	0.68
	0-200 kWh	9.56	5.97	37.55%	3.59
	201-300 kWh	9.56	8.62	9.83%	0.94
	301-700	11.78	11.3	4.07%	0.48
BTS2	>700	11.78	11.49	2.46%	0.29
BTD		7.65	7.37	3.66%	0.28
BTH		7.51	7.26	3.33%	0.25
MTD1		7.65	7.81	-2.09%	-0.16
MTD2		7.65	7.38	3.53%	0.27
MTH		7.51	7.26	3.33%	0.25

[5] Note that these were the subsidy values available at the time of analysis. SIE has since updated these values for each of the different distribution companies and the subsidy values will change over time. The out of date subsidy are presented to assist analysis findings validation, but more accurate benefit assessment would need to use the updated subsidy values.

Table 15: Avoided electric subsidy payment per kW installed analysis results

	Annual Avoided Electric Subsidy Payment ($RD/kW Installed)	
Tariff	**NM**	**NB**
BTS1	$1,105	$509
BTD	$422	$205
BTS2	$464	$206
BTH	$377	$203
MTD1	-$241	-$117
MTD2	$407	$201
MTH	$558	$357

Another possible economic impact to the Dominican Government includes how foreign exchange reserves are used in the import of fuels to the country. In the Dominican Republic, the generation matrix relies primarily from imported fossil fuels and an increase in solar and wind generation would substitute the purchase and use of these imported fuels. The latest electricity generation figures by source (Table 17) show that generators rely on fuel sources that need to be imported to the country. The total cost of these fuel sources placed in the country, include the cost of fuel, transportation by sea, and storage facilities needed to maintain an adequate fuel supply. Each of these costs have its own price volatility and some costs (fuel, transportation, etc.) are contracted in USD. The Dominican government needs to maintain a supply of USD within its Treasury to facilitate the trade of goods and services that require USD. In times of volatile exchange rates this can have a large impact on the government's foreign currency reserves.

Table 17: Electricity Generation Breakdown by Technology

Technology	**Capacity (MW)**	**Percentage**	**Generation (GWh)**	**Percentage**
Conventional Thermal	3,740.0	76.0%	1,237.4	83.8%
Hydro	623.0	12.7%	91.1	6.2%
Wind	365.0	7.4%	112.9	7.6%
Solar PV	163.0	3.3%	24.5	1.7%
Biomass	30.0	0.6%	11.3	0.8%
Total	4,921.0	100%	1,477.2	100%

Source: Corporación Dominicana de Empresas Eléctricas Estatales (CDEEE) - February 2020

As utility scale and distributed renewable generation increases, there will be an offset of generation from power plants on the island. If enough renewable generation offsets fossil fuel generators there will be a reduction in fuel purchases and imports needed. This can lead to a reduction in the foreign currency reserves used by the energy generators on the island and potentially reduce currency volatility. A detailed analysis is outside of the scope of this project. To fully estimate the impact of renewable generation, including DPV on the import of fuels and the use of foreign reserves, much more detailed data such as: fuel contracts, shipping costs, fuel use and efficiency for each generator, unit commitment and economic dispatch, distribution companies' contracts with generators, size and how foreign exchange reserves are used, would be needed to determine the full economic impact to the government from renewable energy and DPV deployment.

4.1 Distribution Company Perspective

An important perspective to consider when analyzing the full impact of a DG compensation mechanisms is that of the distribution companies – EdeSur, EdeNorte, and EdeEste. A more detailed analysis is needed to determine the true impacts to distribution companies and was outside the scope of this report. For initial consideration, we chose to include perspectives from a past report (Dargouth et al. 2020) that looked at the impacts of DG on utility revenues in Indonesia. For more information, data required for the analysis, and methodology please see Chapter 3 in the report located here.

Any government policy or program to promote DG will need to balance the benefits of DG installation to consumers with potential impacts on the distribution company revenue. Increased DG penetration will have both costs and benefits for distribution companies, as shown below (Dargouth et al. 2020).

- Costs
    - Reduced revenue and electricity sales from DG generation offsetting load
    - Potential cross-subsidization or change in electric rates due to a decrease in rate base recovery costs that are passed onto non-DG customers
    - At high feeder penetrations of DG, increased investments to integrate DG resources
- Benefits
    - Decreased T&D losses from local grid injections from DG
    - Avoided capital investments due to a reduction in load
    - A reduction in fuel imports that leads to lower variable generation costs from fuel purchases

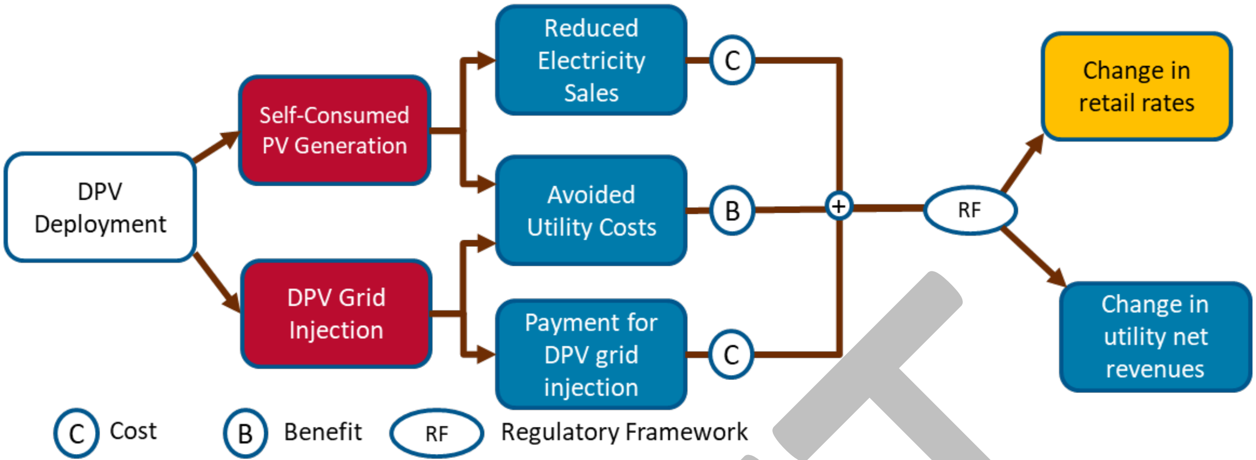

Figure 10: Utility revenue analysis framework from Dargouth et al. 2020

The different compensation mechanisms will also have a different impact on consumers and the distribution utilities. NEM benefits consumers who essentially use the grid as a battery for any injected generation that is compensated at the full retail tariff rate. Distribution companies argue that this mechanism reduces electricity sales and therefore revenue that leads to NEM customers not fully paying for access to the grid. There is the potential for cross-subsidization of NEM customers by non-NEM customers, that might cause rates to increase in order to cover the cost of grid maintenance and incorporation of DPV. On the other spectrum, a BASA mechanism tends to benefit the distribution company. Utilities still sell the same amount of electricity to BASA customers and take advantage of the DPV injected to reduce wholesale electricity purchases and provide local grid support at lower feeder DPV penetrations. Finally, a NB mechanism likely shares the value between the customer and distribution utility by compensating the consumer at the avoided cost of generation of the utility. The NB customer still pays for access to the grid but is compensated at the value to the distribution company. However, more detailed data and modeling is needed to determine the full impacts on Dominican distribution companies and how different compensation mechanisms would impact their economics.

KEY FINDINGS

In the Dominican Republic like many other countries, a net metering compensation mechanism was chosen as a way to incentivize the deployment of distributed generation systems with renewable technologies, mainly DPV. Since its inception, the growth of DPV systems in the country has increased as technology costs have declined, and customers have become familiar with the technology. With the growth of DPV in the world, many countries, like the case of the Dominican Republic, are seeking a way to best evaluate the value of DPV to the grid. This includes a deeper analysis of externalities like environmental benefits, and the costs and benefits to the distribution companies.

The analysis in this report was targeted to review the economics of net metering, net billing and total sales, mainly for the customer and under the current local conditions. The results show that the economics of net metering, compared to net billing and total sales mechanisms, is the most favorable compensation mechanism for residential, commercial and industrial customers. The other two mechanisms, however, appear to provide reasonable investment payback periods, when considering the current tariffs and wholesale electricity costs. Further analysis is needed to determine the full impact on distribution companies to balance the economic and social benefits of DPV to customers, distribution companies, and the gird.

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