Puerto Rico Demand Response Impact and Forecast Tool (PR-DRIFT) – *beta version*

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Background

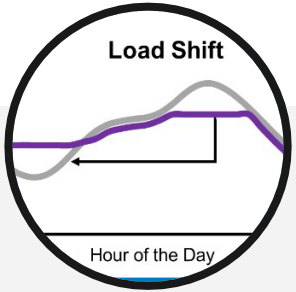
Demand Response Applications & Considerations

Demand Response (DR): "changes in utility-supplied electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity during a day and/or season, or to other economic compensation designed to induce change in the use of utility- supplied electricity, to provide a resource option for electric system planners and operators in balancing supply and demand." *(Puerto Rico Energy Bureau Definition in DR Regulation)*

Peak Shaving

DR can reduce peak load or net peak load in grids w/ high variable renewable energy (VRE) penetration by curtailing certain end-uses. This could reduce the required generation capacity that needs to be built.

Image Credit: Hummon et. al. (NREL)



Flexible Loads

DR can shift flexible loads from peak to off-peak hours to better align demand with supply. This could reduce VRE curtailment and the ramping requirements of thermal generators.

Image Credit: Neukomm et. al. (DOE)

Emergency Shedding

DR can enable targeted load shedding when grid is highly stressed (e.g., large industrial customers shift to backup generation during contingency events like severe weather or unplanned generator outages).

End-Uses

The following end-uses can be involved in DR programs: smart appliances, water heaters, residential/commercial thermostats, air conditioning, pool pumps, behind-the-meter generation w/ storage, electric vehicles (EVs), etc.

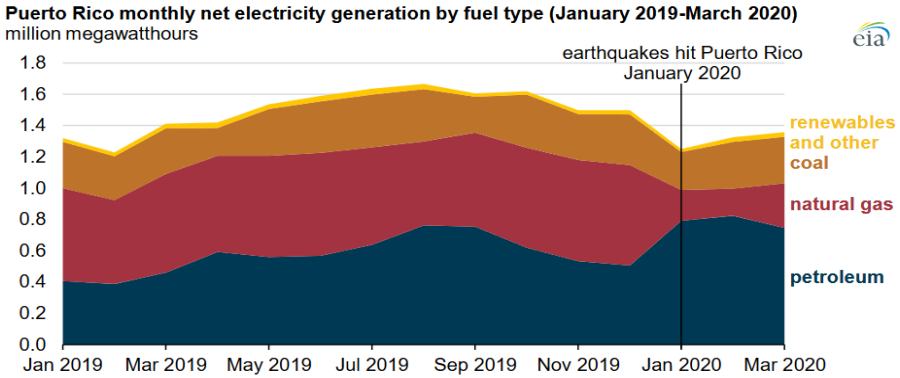
Photo Credit: Dennis Schroeder (NREL)

Programs

Participants in a DR program receive payments from utilities or DR aggregators when electricity consumption is curtailed or respond to time-of-use pricing to shift consumption to lower-cost periods.

Motivation for Demand Response in Puerto Rico

High Fossil Fuel Imports



- **DR reduces peak generation needs and can shift load to times of high VRE generation. This decreases Puerto Rico's reliance on fuel imports and accelerates the retirement of fossil-fuel peaker plants to meet PR goals.**

High Electricity Rates

Prices

Electricity	Puerto Rico	United States	Period
Residential	23.22 cents/kWh	13.85 cents/kWh	Jun-21
Commercial	24.17 cents/kWh	11.34 cents/kWh	Jun-21
Industrial	23.48 cents/kWh	7.27 cents/kWh	Jun-21

- **DR reduces customer electricity consumption and/or shifts consumption to times of lower rates, resulting in lower electricity costs. DR programs can also have financial incentives for participating ratepayers.**

100% Renewable Electricity Goal

"Puerto Rico Energy Public Policy Act"

Act. No. 17 of April 11, 2019

term. For such purpose, a Renewable Portfolio Standard is established in order to achieve a minimum of forty percent (40%) on or before 2025; sixty percent (60%) on or before 2040; and one hundred percent (100%) on or before 2050.

- **DR increases load flexibility and helps grid operators more efficiently match the supply of VRE (e.g., solar PV and wind turbines) to demand at each hour of the day in order to achieve Puerto Rico's 100% RPS goal by 2050.**

Electricity Grid Challenges and Severe Weather

- **DR contributes to system resiliency and reliability by giving system operators more flexibility to match demand with supply on a regular basis and conduct more targeted load shedding on an emergency basis.**

Source: Axios, Yacob Reyes, October 3 2021

Prior Applications of Demand Response in Puerto Rico

Puerto Rico Electric Power Authority (PREPA) 2019 Integrated Resource Plan (IRP):

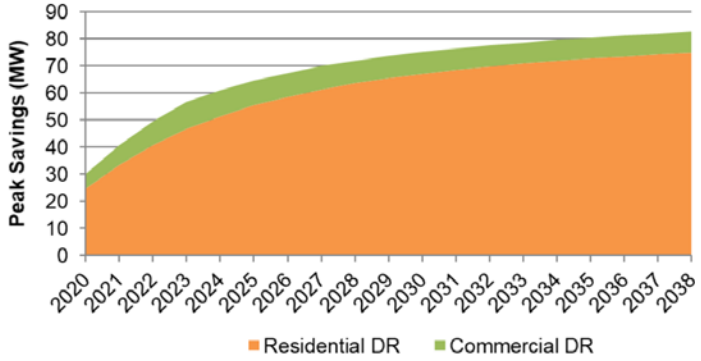
- Sets a goal to acquire 60 MW of DR by 2025 & 82 MW by 2038.
- Evaluates residential DR potential: load control of air-conditioning.
- Evaluates commercial DR potential: load control of air-conditioning and lighting.
- Excludes other end-uses & large commercial/industrial customers from DR program consideration.

PREB Final Resolution & Order on PREPA 2019 IRP:

- Some commercial & industrial customers have used backup generation during emergencies of inadequate centralized generation (e.g, January 2020 earthquake damage to Costa Sur plant) to maintain power quality and reliability by effectively reducing PREPA's net peak load.
- Estimated 200 MW of backup diesel generation may be currently available from industrial customers.

Exhibit 2-12. Annual Peak Energy Savings from DR Programs

Source: PREPA 2019 IRP, Appendix 4



Example of Backup Diesel Generator

Photo Credit: Teo DeVito (NREL)

PREB Regulations for Demand Response

PREB Final Resolution & Order on PREPA 2019 IRP:

- PREPA must **develop a demand response resource projection** for the next IRP and account for **distributed storage** resources as demand resources, part of a virtual power plant, or both.
- PREPA must promptly **develop programmatic costs** informed by engaging **commercial and industrial** customers and investigate interruptible load tariffs for these customers.
- PREPA must investigate the **potential for commercial and industrial self-generation during emergencies.**

PREB Regulation for Demand Response:

- PREPA must consider **all cost-effective DR measures** (technological and rate-based) and perform analysis of whether **DR programs could replace generation or other grid investments**.
- **Fossil-fuel backup generators may participate** in DR programs that call for dispatch **only in power supply or grid contingency situations** in which customers would lose electric service without the resources.
- PREPA must consider DR programs that include different technologies and dispatch with different frequencies, including those which might dispatch **daily** (ex. energy storage), **occasionally** (a few times per year), and only in **emergency situations**.

PR-DRIFT Features

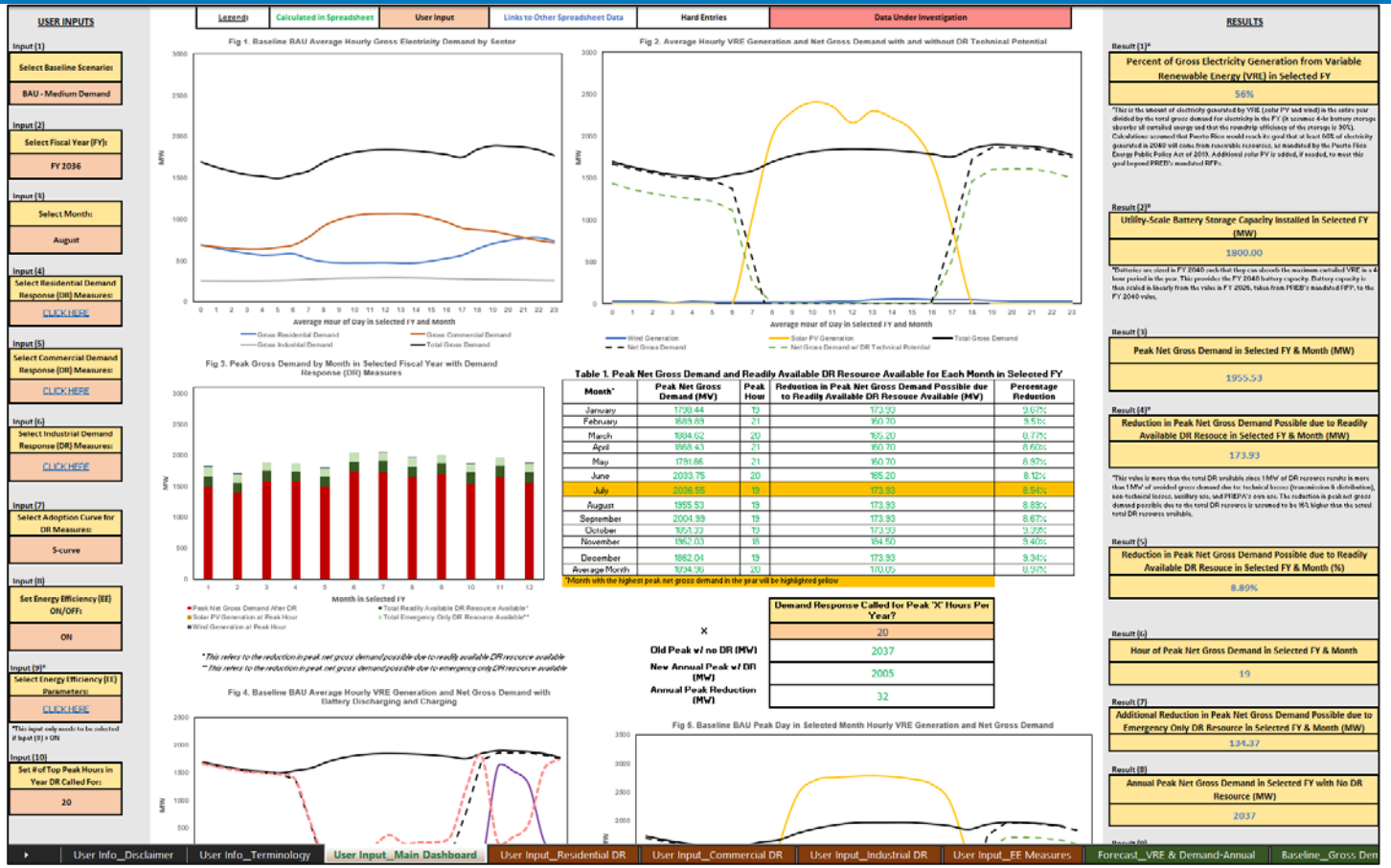
PR-DRIFT is a spreadsheet-based tool in which users can estimate the potential impacts to the load profile of demand response, energy efficiency, and variable renewable energy (VRE) and storage adoption in Puerto Rico from 2021 through 2040.

PR-DRIFT Overview and Main Dashboard

PR-DRIFT builds off the previously developed Puerto Rico Energy Efficiency Scenario Analysis Tool (PREESAT).

Goal: A user-customizable spreadsheet tool to roughly estimate the impact to the load profile of DR in Puerto Rico across sectors.

Audience: PREPA/LUMA & PREB (for developing DR resource projection) + other key stakeholders (ex. DR aggregators, researchers).



Baseline Load Curves: Net Load & Variable Renewable Energy (VRE)

Fig 1. Baseline BAU Average Hourly Gross Electricity Demand by Sector

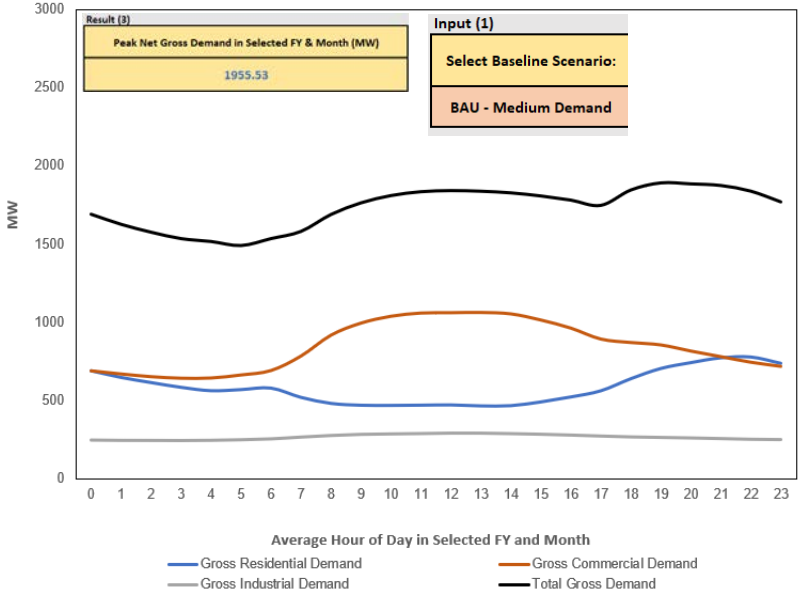
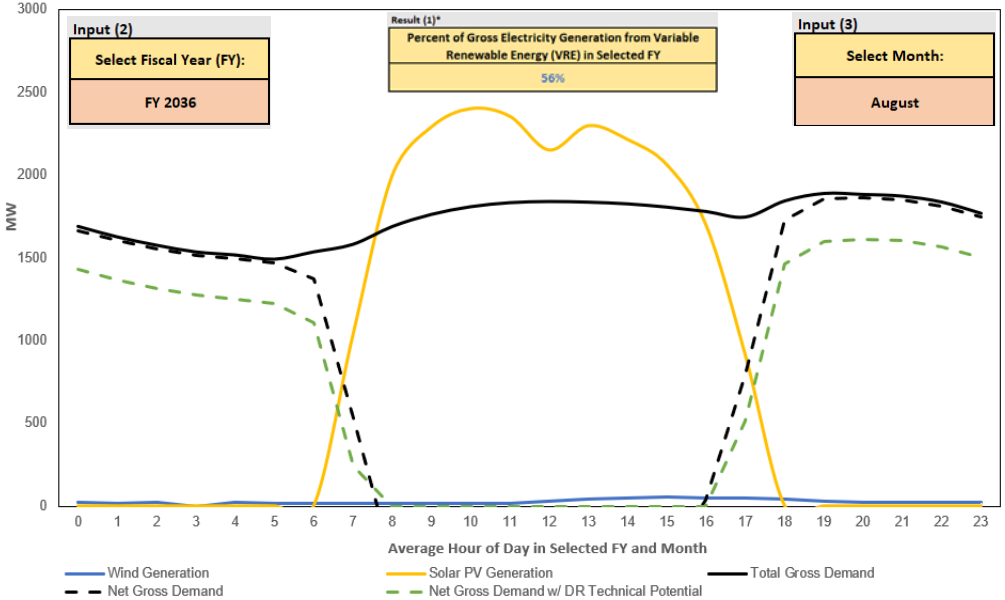


Fig 2. Average Hourly VRE Generation and Net Gross Demand with and without DR Technical Potential



- Baseline business as usual (BAU) 8760 load profiles were developed for the residential, commercial, and industrial sectors from FY21 – FY40, based on PREPA-provided data from FY16 and scaled according to the IRP projections.
  (Detailed assumptions on the "Baseline_Gross Demand-8760" and "Forecast_Gross Demand-8760" tabs)

- Solar PV adoption is phased in according to the mandated procurement schedule in "PREB Resolution on PREPA 2019 IRP" and the RPS of 60% VRE generation by 2040 in "P.L.17-2019", in order to create a baseline net load profile. The PV load profile is modeled via PVWatts, and the wind turbine load profile is modeled via SAM.
  (Detailed assumptions on the "Forecast_VRE Built-Annual" and "Forecast_Net Gross Demand-8760" tabs)

Baseline Load Curves: Energy Efficiency & Storage

Energy Efficiency (EE)

(Detailed assumptions on the "User Input_EE Measures" tab)

- EE can be turned ON or OFF from the "User Input_Main Dashboard" tab.
- User inputs for energy efficiency can be taken directly from PREESAT results if desired.
- EE impacts are incorporated into the baseline load profiles if EE is turned ON.

Input (8)

Set Energy Efficiency (EE) ON/OFF:
ON

Input (9)*

Select Energy Efficiency (EE) Parameters:
CLICK HERE

*This input only needs to be selected if Input (8) = ON

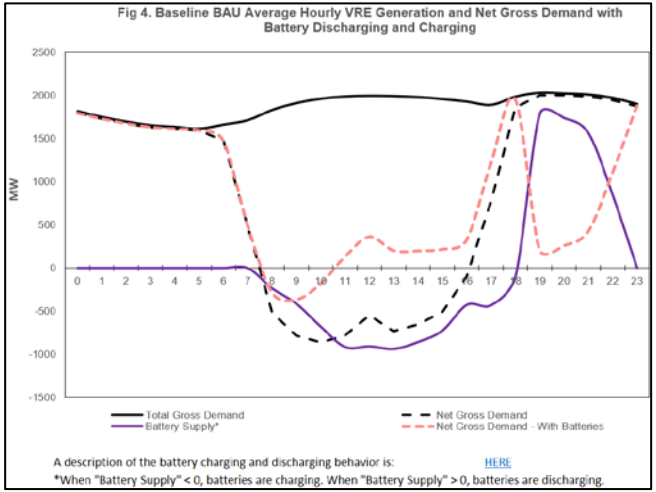
		Percent Reduction in Electricity Consumption from Baseline BAU Scenario in FY 2040 (or by end of 3 year program if that option is selected)	GWh reduction in FY 2040
Input (1)	Residential	30%	2024
Input (2)	Commercial	25%	2603
Input (3)	Industrial	10%	277
Input (4)	Public Lighting	50%	210
Input (5)	Agriculture	0%	0
Input (6)	Other	0%	0
	Total	25%	5114
Input (7)	First Year of EE Prog.	FY 2023	
Input (8)	Adoption Curve	Straight-line	

Legend
User Input
Calculated in Spreadsheet
25% total reduction by FY 2040

Storage

(Detailed assumptions on the "Forecast_Storage Built-Annual" and "Forecast_Storage Charge-8760" tabs)

- Batteries are sized in FY40 to absorb maximum curtailed VRE in a 4-hour period of the year.
- Battery capacity is linearly phased in from FY26-FY40 (FY26 capacity is based on PREB mandated procurement schedule in its IRP resolution).
- PR-DRIFT accounts for round-trip efficiency, battery duration, and the minimum state of charge (all user-customizable if desired).



Note: Figure 4 is not intended to display variable renewable energy generation (this information is displayed in Figure 2 – see Slide 9). These data are also for August in FY2036

Result (2)*
Utility-Scale Battery Storage Capacity Installed in Selected FY (MW)
1800.00

Demand Response Inputs (Residential and Commercial)

Residential and Commercial Sectors *(Detailed assumptions on the "User Input_Residential DR" and "User Input_Commercial DR" tabs)*

- Users can select "% of [Residential/Commercial] Customers Participating in DR program" and "Max Percent of Participating Load Reduced at Any Given Time" for each DR measure in these sectors. These values are set for FY40 and scaled in based on the selected adoption curve in Input (7) on the dashboard (straight-line, S-curve, logarithmic).

- Each measure has a load profile based on its expected DR resource at each hour of the day (from various sources including EPRI).

Input (4)
Select Residential Demand Response (DR) Measures:
CLICK HERE

Input (5)
Select Commercial Demand Response (DR) Measures:
CLICK HERE

Input (6)
Select Industrial Demand Response (DR) Measures:
CLICK HERE

Input (7)
Select Adoption Curve for DR Measures:
Straight-line
S-curve
Logarithmic

Input (10)
Set # of Top Peak Hours in Year DR Called For:
20

Residential Demand Response Measures

Legend: | Calculated in Spreadsheet | User Input | Links to Other Spreadsheet Data | Hard Entries | Data Under Investigation

Return to Dashboard

Year of Analysis (Selected on Dashboard)
FY 2036

Reduction in Residential Gross Demand Possible at System Peak due to DR Resouce Available in FY 2036
3.15%

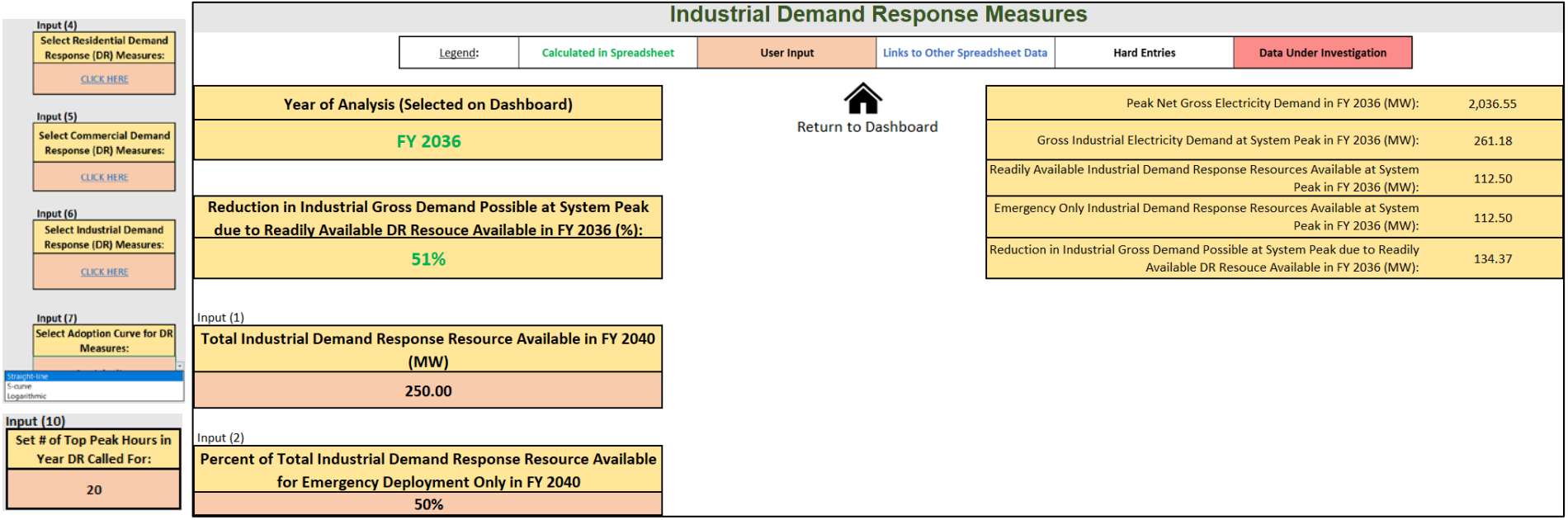
Peak Net Gross Electricity Demand in FY 2036 (MW):	2,036.55
Gross Residential Electricity Demand at System Peak in FY 2036 (MW):	747.15
Residential Demand Response Resources Available at System Peak in FY 2036 (MW):	19.72
Reduction in Residential Gross Demand Possible at System Peak due to DR Resouce Available in FY 2036 (MW):	23.56

Column 1	Column 2 (User Input)	Column 3	Column 4	Column 5 (User Input)	Column 6	Column 7 (User Input)	Column 8
Measures by End-Use	ON/OFF	% of Total Residential Load by End-Use in FY2040 (MWh/MWh)	Maximum Residential Load Available in FY2040 (MW)	% of Residential Customers Participating in DR Program in FY2040	Max Available DF Load in FY2040 (MW)	Max Percent of Participating Load Reduced at Any Given Time in FY2040	Peak Hour of Day (Based of EPRI End Use Load Shapes)
Appliance Group							
Direct Control of AC Units	ON	7.0%	20.61	4.11%	0.85	100%	18.00
Direct Control of Electric Water Heaters	ON	33.0%	136.95	5%	6.85	100%	9.00
Smart Thermostats - Preconditioning	OFF	7.0%	20.61	30%	6.18	100%	1.00
Smart Thermostat Peak Event Control	ON	7.0%	20.61	7%	1.44	100%	18.00
Smart lightbulbs	OFF	13.0%	42.55	15%	6.38	50%	1.00
Smart plugs and smart power strips	OFF	25.0%	186.79	5%	9.34	10%	1.00
Clothes Washer	OFF	0.3%	0.16	15%	0.02	100%	1.00
Clothes Dryer	OFF	0.8%	0.11	15%	0.02	100%	1.00
Behavioral/Pricing Group							
TOU Pricing	OFF	15.0%	112.07	20%	22.41	100%	1.00
New Technology and Reserve Margin Control		Percentage of Total Storage in Residential Sector in FY2040	Total Projected Residential Storage on System in FY2040 (MW)	% Available for DR Programs at Peak in FY2040			
Battery Storage Systems for Load Flexibility	OFF	45.5%	817.39	10%	81.74	25%	1.00

Demand Response Inputs (Industrial)

Industrial Sector *(Detailed assumptions on the "User Input_Industrial DR" tab)*

- Users can select "Total Industrial Demand Response Resource Available by FY 2040 (MW)" and "Percent of Total Industrial Demand Response Resource Available for Emergency Deployment Only".
- This represents the available or expected industrial self-generation capacity that PREPA is ordered to investigate via the PREB Resolution on the 2019 IRP.



Demand Response Example Calculation

Demand Response Measure	×	Per Customer Reduction Potential at Peak Hour	×	Program Participation Rates	×	Max. % of Participating Load Reduced at Any Given Time	×	Number Residential Customers	=	DR Resource Available in FY40
Res. Electric Water Control	×	5.5 kW/ customer	×	10% of residential customers opt-in	×	System operator allows 50% of participant load at any given time	×	1.3m res. customers in Puerto Rico	=	358 MW of DR resource available*

Note: The values shown here are for illustrative purposes only (e.g., there is no assumption being made that 50% of residential customers will participate in this demand response measure). This calculation could apply for the commercial and industrial sector as well.

* This refers to feasible technical potential based on user inputs, not economic or market potential.

Results: Demand Response Resource Potential (1 of 2)

Note: The values shown here are for illustrative purposes only and are not definitive forecasts of the DR potential in Puerto Rico. Users can customize inputs based on the design of DR programs to view the impacts for each month from FY21 – FY40.
(Detailed assumptions on the "Forecast_Peak Demand-Annual" and "Forecast_DR Resource" tabs)

Table 1. Peak Net Gross Demand and Readily Available DR Resource Available for Each Month in Selected FY

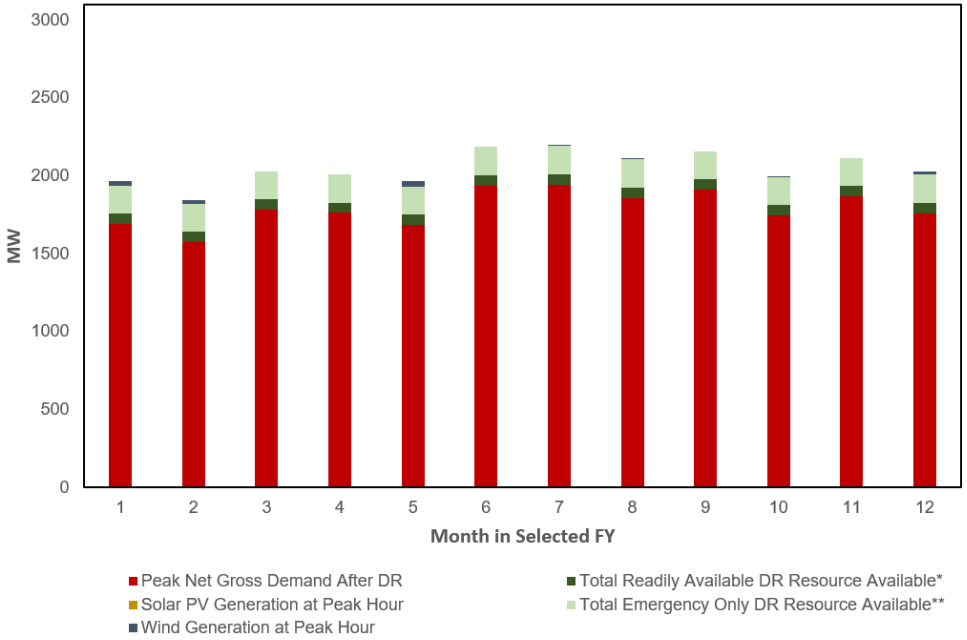
Month*	Peak Net Gross Demand (MW)	Peak Hour	Reduction in Peak Net Gross Demand Possible due to Readily Available DR Resouce Available (MW)	Percentage Reduction
January	1798.44	19	173.93	9.67%
February	1689.89	21	160.70	9.51%
March	1884.62	20	165.20	8.77%
April	1868.43	21	160.70	8.60%
May	1791.86	21	160.70	8.97%
June	2033.75	20	165.20	8.12%
July	2036.55	19	173.93	8.54%
August	1955.53	19	173.93	8.89%
September	2004.99	19	173.93	8.67%
October	1851.33	19	173.93	9.39%
November	1962.03	18	184.50	9.40%
December	1862.04	19	173.93	9.34%
Average Month	1894.96	20	170.05	8.97%

*Month with the highest peak net gross demand in the year will be highlighted yellow

Results: Demand Response Resource Potential (2 of 2)

Note: The values shown here are for illustrative purposes only and are not definitive forecasts of the DR potential in Puerto Rico. Users can customize inputs based on the design of DR programs to view the impacts for each month from FY21 – FY40.
(Detailed assumptions on the "Forecast_Peak Demand-Annual" and "Forecast_DR Resource" tabs)

Fig 3. Peak Gross Demand by Month in Selected Fiscal Year with Demand Response (DR) Measures



Result (4)*

Reduction in Peak Net Gross Demand Possible due to Readily Available DR Resouce in Selected FY & Month (MW)
173.93

*This value is more than the total DR available since 1 MW of DR resource results in more than 1 MW of avoided gross demand due to: technical losses (transmission & distribution), non-technical losses, auxillary use, and PREPA's own use. The reduction in peak net gross demand possible due to the total DR resource is assumed to be 16% higher than the actual total DR resource available.

Result (5)

Reduction in Peak Net Gross Demand Possible due to Readily Available DR Resouce in Selected FY & Month (%)
8.89%

Result (6)

Hour of Peak Net Gross Demand in Selected FY & Month
19

Result (7)

Additional Reduction in Peak Net Gross Demand Possible due to Emergency Only DR Resource in Selected FY & Month (MW)
134.37

Results: Reduction in Peak Net Gross Demand

Note: The values shown here are for illustrative purposes only and are not definitive forecasts of the DR potential in Puerto Rico. Users can customize inputs based on the design of DR programs to view the impacts for each month from FY21 – FY40.
(Detailed assumptions on the "Forecast_Peak Demand-Annual" and "Forecast_DR Resource" tabs)

Fig 6. Projected Solar PV, Wind, and Battery Capacity on Grid with Percentage of Total Electricity Generation from VRE + Batteries from FY 2021 - FY 2040

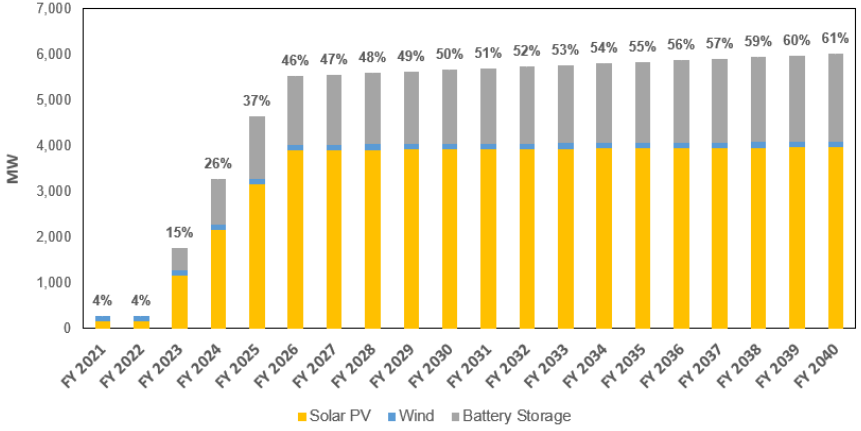
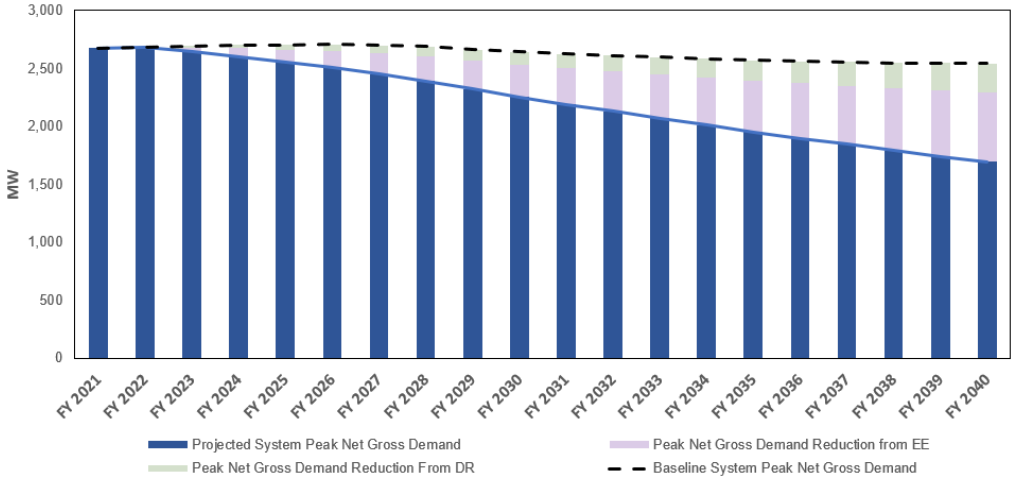


Fig 7. Projected Annual Peak Net Gross Demand from FY 2021 - FY 2040



Result (8)
Annual Peak Net Gross Demand in Selected FY with No DR Resource (MW)
2037

Result (9)
Reduction in Annual Peak Net Gross Demand in Selected FY if DR Resource Called for Peak 20 Hours of Year (MW)
32

- IRP forecasted annual peak demand used as a baseline.
- Baseline peak net gross demand reduced due to projected EE and DR (net demand already accounts for VRE such as solar PV and wind).
- Results have implications for reduced generation capacity (either avoided new builds or early retirement).

Questions PR-DRIFT Could Help Address

- What is the estimated potential impact on the peak net gross demand (annually or for each month) of technical policies that provide demand response incentives to different sectors?
- For demand response measures that are incentivized in each sector, what is the estimated level of adoption by FY40 needed to achieve specific demand response resource targets?
- In which sector and for which end-uses could DR programs be most effectively targeted in order to have the most benefit to the grid?
- What is the projected VRE and storage capacity needed to meet Act-17 goals, with or without EE and DR?

PR-DRIFT Limitations

- PR-DRIFT does not consider the impact of economic policies or incentive programs on DR adoption (ex. the impacts of a financial incentive from the utility for DR program enrollment); it only considers technical measures.
- PR-DRIFT does not consider the cost of each demand response measure or optimize for the most cost-effective measure.
- PR-DRIFT does not determine the duration of demand response events.

PR-DRIFT Applications

Example Scenario: Inputs

Note: This scenario is based off PREPA 2019 IRP assumptions on DR resource potential for the residential and commercial sectors and PREB assumptions for the industrial sector. This is example is meant to illustrate the PR-DRIFT's functionality.

Sector	PREPA/PREB Forecast	PR-DRIFT Inputs
Residential	4.11% of all customers will be participating in AC DR program (direct control) by 2040[1].	Column 1: Measures by End-Use = *Direct Control of AC*; Column 2 (User Input): ON/OFF = ON; Column 5 (User Input): % of Residential Customers Participating in DR Program in FY2040 = 4.11%; Column 7 (User Input): Max Percent of Participating Load Reduced at Any Given Time in FY2040 = 100%; Input (1): Select Baseline Scenario: BAU - Medium Demand
Commercial	1.01% of all customers will be participating in AC & lighting controls DR program by 2040[2].	Column 1: Measures by End-Use = *HVAC Direct Control*; *Lighting Controls: "LED fixture*; Column 2 (User Input): ON/OFF = ON; ON; Column 5 (User Input): % of Commercial Customers Participating in DR Program in FY2040 = 1.01%; 1.01%; Column 7 (User Input): Max Percent of Participating Load Reduced at Any Given Time in FY2040 = 100%; 100%; Input (7): Select Adoption Curve for DR Measures: Straight-line; Input (8): Set Energy Efficiency (EE) ON/OFF: ON
Industrial	200 MW of DR resource will be available[3].	Input (1): Total Industrial Demand Response Resource Available in FY 2040 (MW) = 200.00; Input (2): Percent of Total Industrial Demand Response Resource Available for Emergency Deployment Only in FY 2040 = 75%

[1] PREPA 2019 IRP calculations. Assumptions: 85% of residential customers eligible for AC DR program, number of eligible customers increases by 0.7% annually, 80% of enrolled customers remain enrolled the following year, 1% of new eligible customers enroll in program annually. NREL extrapolated calculations from 2038 to 2040.

[2] PREPA 2019 IRP calculations. Assumptions: 100% of commercial customers eligible for AC and lighting DR program, 0.4% of new eligible customers enroll in program annually for first 5 years, 0.2% of new eligible customers enroll in program annually after first 5 years, 80% of enrolled customers remain enrolled the following year. NREL extrapolated calculations from 2038 to 2040.

[3] PREB Resolution on 2019 IRP estimate on DR resource potential from industrial customers with self generation capacity.

Example Scenario: Results (1 of 3)

Reduction in Residential Gross Demand Possible at System Peak due to DR Resouce Available in FY 2040 (%):
0.56%

Reduction in Commercial Gross Demand Possible at System Peak due to DR Resouce Available in FY 2040 (%):
0.41%

Reduction in Industrial Gross Demand Possible at System Peak due to Readily Available DR Resouce Available in FY 2040 (%):
23%

Result (4)*

Reduction in Peak Net Gross Demand Possible due to Readily Available DR Resouce in Selected FY & Month (MW)
67.14

Result (5)

Reduction in Peak Net Gross Demand Possible due to Readily Available DR Resouce in Selected FY & Month (%)
3.71%

Result (7)

Additional Reduction in Peak Net Gross Demand Possible due to Emergency Only DR Resource in Selected FY & Month (MW)
179.15

Table 1. Peak Net Gross Demand and Readily Available DR Resource Available for Each Month in Selected FY

Month*	Peak Net Gross Demand (MW)	Peak Hour	Reduction in Peak Net Gross Demand Possible due to Readily Available DR Resouce Available (MW)	Percentage Reduction
January	1659.90	19	67.14	4.04%
February	1563.16	19	67.14	4.29%
March	1744.54	20	66.19	3.79%
April	1725.73	21	65.38	3.79%
May	1657.62	21	65.38	3.94%
June	1878.67	20	66.19	3.52%
July	1882.93	19	67.14	3.57%
August	1810.02	19	67.14	3.71%
September	1856.10	19	67.14	3.62%
October	1712.32	19	67.14	3.92%
November	1819.53	18	68.02	3.74%
December	1723.26	19	67.14	3.90%
Average Month	1752.82	19	66.76	3.81%

*Month with the highest peak net gross demand in the year will be highlighted yellow

Example Scenario: Results (2 of 3)

Reduction in Residential Gross Demand Possible at System Peak due to DR Resouce Available in FY 2040 (%):
0.56%

Reduction in Commercial Gross Demand Possible at System Peak due to DR Resouce Available in FY 2040 (%):
0.41%

Reduction in Industrial Gross Demand Possible at System Peak due to Readily Available DR Resouce Available in FY 2040 (%):
23%

Result (4)*

Reduction in Peak Net Gross Demand Possible due to Readily Available DR Resouce in Selected FY & Month (MW)
67.14

Result (5)

Reduction in Peak Net Gross Demand Possible due to Readily Available DR Resouce in Selected FY & Month (%)
3.71%

Result (7)

Additional Reduction in Peak Net Gross Demand Possible due to Emergency Only DR Resource in Selected FY & Month (MW)
179.15

Fig 3. Peak Gross Demand by Month in Selected Fiscal Year with Demand Response (DR) Measures

Example Scenario: Results (3 of 3)

Note: Figure 5 shows the solar PV generation in 2040 assuming that Puerto Rico will meet its renewable portfolio standard (RPS) goal of 60% of electricity generation from variable renewable energy (VRE) by 2040.

Result (8)
Annual Peak Net Gross Demand in Selected FY with No DR Resource (MW)
1883

Result (9)
Reduction in Annual Peak Net Gross Demand in Selected FY if DR Resource Called for Peak 20 Hours of Year (MW)
30

Input (10)
Set # of Top Peak Hours in Year DR Called For:
20

	Demand Response Called for Peak 'X' Hours Per Year?
x	20
Old Peak w/ no DR (MW)	1883
New Annual Peak w/ DR (MW)	1852
Annual Peak Reduction (MW)	30

Fig 5. Baseline BAU Peak Day in Selected Month Hourly VRE Generation and Net Gross Demand

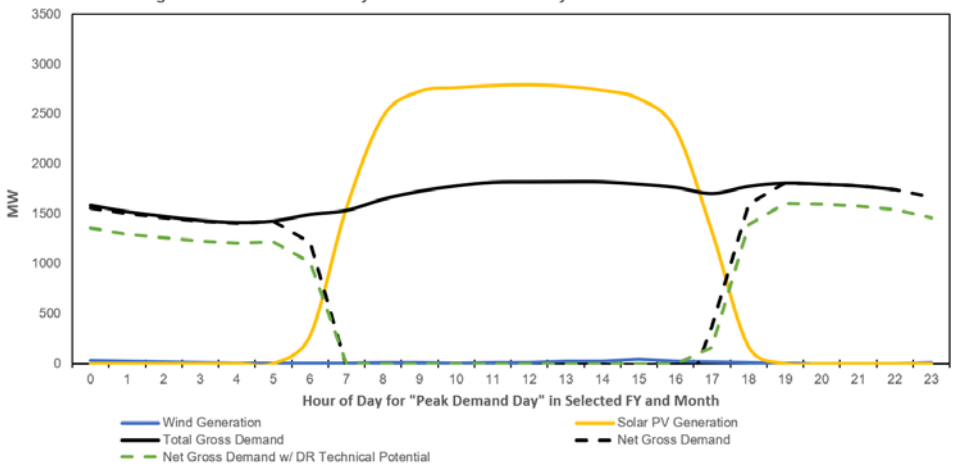
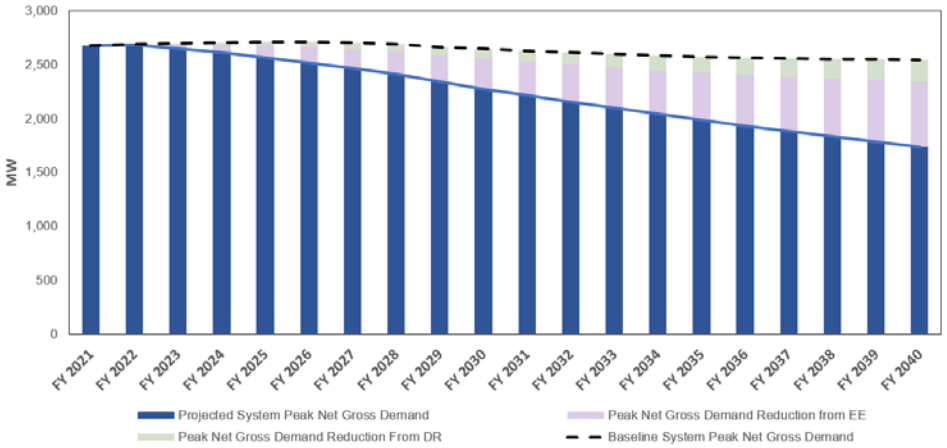


Fig 7. Projected Annual Peak Net Gross Demand from FY 2021 - FY 2040



Key Takeaways

- The example scenario, based on the PREPA 2019 IRP, is considered a “baseline” scenario with low DR adoption.
  - PR-DRIFT allows for forecasts that result in more DR resource by FY40 and thus the DR impact on load profiles can vary based on user inputs.

- By default, the percentage of each sector load from each end use remains constant throughout the time period analyzed (ex. AC load set to 7% of total residential load).
  - These values can be adjusted by the user to reflect a different percentage breakdown in FY40 (ex. An increased percentage of residential households with AC).

Column 1	Column 2 (User Input)	Column 3
Measures by End-Use	ON/OFF	% of Total Residential Load by End-Use in FY2040 (MWh/MWh)
Appliance Group		
Direct Control of AC Units	ON	7.0%

- In general, PR-DRIFT contains standard user inputs and default values. The default values (ex. end-use % of load, end-use profiles, load forecasts, etc.) can also be modified by the user.

Call for Input and Data

We are interested in collaborating with local experts in Puerto Rico and other demand response/load flexibility subject matter experts.

Please reach out with any feedback, questions, or comments.

We are also looking for additional good data sources or references on energy use in Puerto Rico and for estimating the demand response peak shaving/load shifting potential from further measures. Please reach out if you can be of assistance.

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Future Work

- Incorporate improved Puerto Rico data
  - Survey of residential and commercial end users
  - Data gathering on existing and potential industrial/large commercial back up generator
- Add hourly marginal price forecasts to determine most expensive hours when DR would be most valuable
  - This could also be used to value DR and design incentive programs
  - Could coordinate with ongoing Argonne modeling efforts or upcoming NREL work
  - Locational marginal prices can help determine *where* DR might be most effective
- Add costs and benefits
  - System implementation costs (administrative and technical)
  - Incentives
  - Avoided generation
  - Value of lost load from load shedding or emergency situations
- Determine hours of the year with largest grid net load ramp rates when DR would also be more valuable
- Direct stakeholder feedback and input from LUMA, PREB, DR administrator, or DR aggregators
- Add Puerto Rico specific end use load curves
  - Can coordinate with ongoing PNNL Puerto Rico building energy modeling
- Estimate impacts of microgrids and implications for specific location of DR resources
- Improve DR estimation to include optimal windows for DR events/Optimize DR dispatch
- Improve battery charge and discharge model
- Add regional granularity

Thank You

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Appendix

Acronyms

BAU: business-as-usual
DR: demand response
EE: energy efficiency
EPRI: Electric Power Research Institute
FY: fiscal year
IRP: integrated resource plan
PR-DRIFT: Puerto Rico Demand Response Impact and Forecast Tool
PREB: Puerto Rico Energy Bureau
PREPA: Puerto Rico Electric Power Authority
PREESAT: Puerto Rico Energy Efficiency Scenario Analysis Tool
PV: photovoltaic
RPS: renewable portfolio standard
SAM: system advisor model
VRE: variable renewable energy