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SAM International Case Studies: DPV Analysis in Mexico

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"International use of the NREL System Advisor Model (SAM) with case studies"

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Agenda

- SAM Mexico Case Studies
  - Customer impacts from changes to net metering and billing agreements
  - Potential benefits of PV for a) customers b) the Mexican Treasury and c) the environment
- Overview of International Utility Rate Database (I-URDB)
- International SAM next steps

Mexico Background

- In 2015, Mexico passed the Energy Transition Law (LTE) that required the energy regulator, CRE, to develop a fair compensation mechanism for distributed generation (DG)
- The LTE also required SENER, the Ministry of Energy, to examine the customer benefits of DG
- CRE reached out to NREL to look at impact of different compensation mechanisms on DPV customers
- In Mexico, there are different electricity tariff classes (1-1F) with tiered rates for electricity use
- There is a limit to electricity usage and if a customer goes over that usage in a 12 month rolling average, the customer is bumped into a high rate tariff class (DAC)
- The Mexican Treasury (Hacienda) subsidizes tariffs 1-1F to keep electricity rates low

Compensation Mechanism Analysis

- Based on three compensation schemes, determine the payback period for PV systems in 5 different locations
- Locations: Tijuana, Monterrey, Guadalajara, Merida, and Mexico City
- Mexico currently has Net Energy Metering (CM #1)

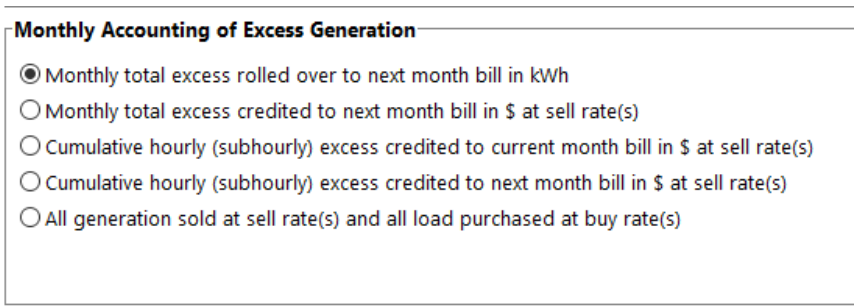
	M&B	Sell Rate	Retail Rate
CM #1	Net Energy Metering (NEM)	No compensation for net excess generation	*Low Consumption Customers*: Tariff 1 or 1C *High Consumption Customers*: Tariff DAC
CM #2	Net Billing (NB)	Real-time location marginal pricing (LMP) for all grid injections	
CM #3	Buy-all, Sell-all (BASA)	Real-time LMP for all production	

Source: NREL, forthcoming

SAM Modelling

- SAM Inputs
  - Mexico electricity tariffs
  - PV system costs
  - Customer consumption data
  - System size (sized to displace 100% of customer's load)

Compensation Mechanisms in SAM – 'Electricity Rates'



Results –Payback Period (years)

	Tariff 1/1C			DAC		
	#1 NEM	#2 NB	#3 BASA	#1 NEM	#2 NB	#3 BASA
TIJ	14	19	27	10	13	27
MON	16	20	24	14	16	24
GUAD	13	15	17	9	10	17
MER	16	17	18	14	15	18
MEX	13	16	19	11	12	19

Source: NREL, forthcoming

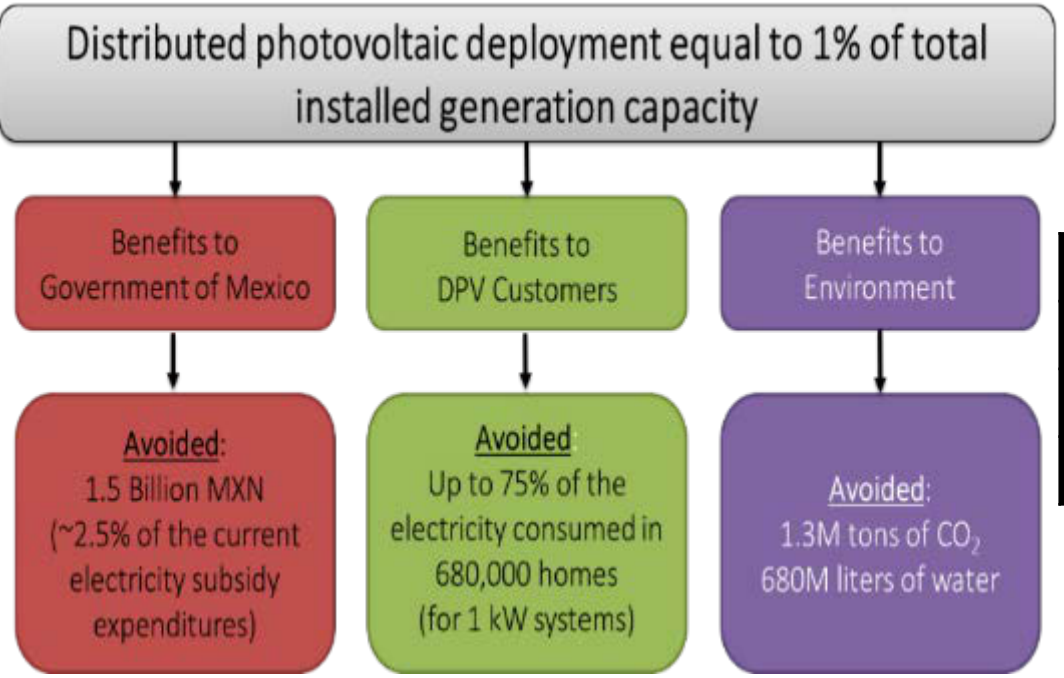
Multi-Perspective DPV Benefits Analysis

- SENER reached out to NREL to examine DG benefit's to:
  - Solar customers – annual customer bill savings and payback period
  - Mexican Government (Treasury) – avoided subsidy payments and decreased tax collection per kW DG
  - Environment – avoided CO_2, NOx, and SO_2 emissions per kW and avoided water withdrawal
- Analysis looked at 8 tariff classes (1 -1F and DAC) for each of the 16 tariff divisions in Mexico

SAM Modelling

- SAM Inputs
  - Entered electricity tariffs (1-1F) and all 16 DAC regional tariffs into I-URDB
  - Confidential Treasury subsidization rates
  - Customer load data, by tariff class
  - PV system costs ($35 MXN/W)
  - Average Mexican generation fleet (for environmental)
    - Assumed a 1:1 ratio for DG offset average generation
  - System size (sized to displace 100% of customer's load)
- Calculated generation in each tariff division's three largest cities and averaged for yearly PV generation

Benefits Analysis Results



Payback period (years) per tariff class

	1	1a	1b	1c	1d	1e	1f	DAC
Min	21	17	18	16	16	16	15	4.5
Avg.	22	22	21	19	20	18	16	5.1
Max	26	27	26	22	27	21	17	6.0

- Analysis found that subsidized customers were unlikely to install PV (~20 year payback period)
- However, these customers would have the highest benefit to Treasury
- Policy intervention is likely needed to address these benefit differences

Source: https://www.gob.mx/sener/documentos/beneficios-de-la-generacion-limpia-distribuida-y-la-eficiencia-energetica-en-mexico

International Utility Rate Database (I-URDB)

- Developed by NREL for compiling different utility rates
- SAM can pull in rates automatically from website
- All relevant rate information (fixed charge, demand charge, electricity prices, tiers, etc.) is uploaded to the database and organized by utility
- Currently, rates for Mexico, Belize and a few Canadian utilities are available
- Rates can be added as needed and can occur for countries where NREL performs analyses
- Found at https://openei.org/apps/IURDB/

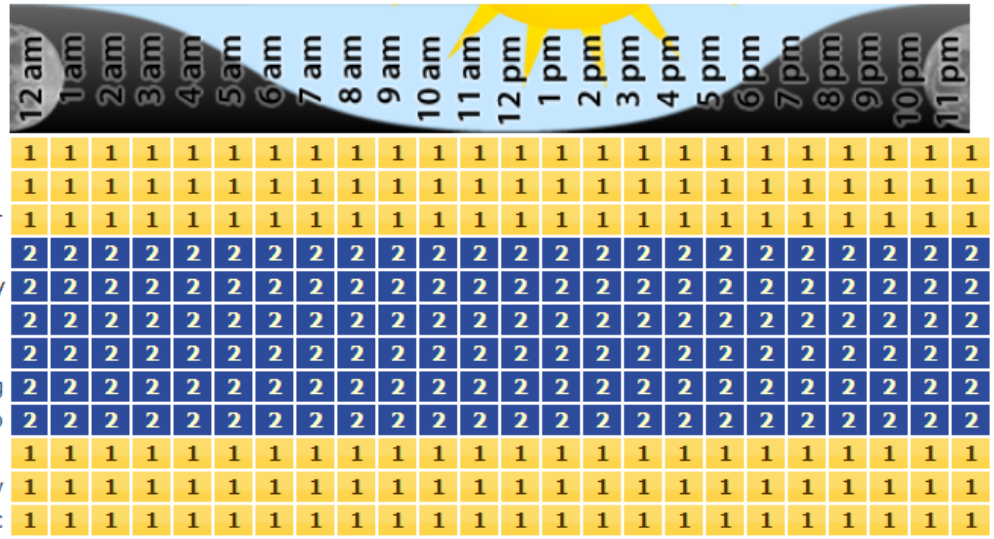
I-URDB: Tariff 1C

Period	Tier	Max Usage	Max Usage Units	Rate $/kWh	Adjustments $/kWh	S
1	1	75	kWh	0.793		
	2	175	kWh	0.956		
	3		kWh	2.802		
2	1	150	kWh	0.697		
	2	300	kWh	0.822		
	3	450	kWh	1.05		
	4		kWh	2.802		

Fuel Adjustments Monthly ($/kWh)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Weekday Schedule



Allows for tiered electricity rates

No fuel adjustments used in Mexico analysis

Seasonality and weekend/weekday rate entry available

Next Steps – International SAM

- Incorporate presentation into SAM International website to provide information on past analyses
- Creation of SAM Mexico Example file with standard data values in SAM
- DPV Analysis in Peru
  - Customer benefit analysis
  - Displaced diesel generation analysis

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Sources

- https://sam.nrel.gov/
- https://openei.org/apps/IURDB/
- http://www.dof.gob.mx/nota_detalle.php?codigo=5463923&fecha=02/12/2016
- https://www.gob.mx/tramites/ficha/interconexion-de-centrales-electricas-con-capacidad-menor-a-0-5-mw/CFE3143
- https://www.gob.mx/sener/documentos/beneficios-de-la-generacion-limpia-distribuida-y-la-eficiencia-energetica-en-mexico