PUTTING DEMAND BACK IN THE EQUATION: CUSTOMER CHOICE AND TARIFF DESIGN: OPPORTUNITIES IN MEXICO

AHMAD FARUQUI AND VERONICA IRASTORZA

PRINCIPALS
THE BRATTLE GROUP

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Electricity customers have become more demanding throughout the globe

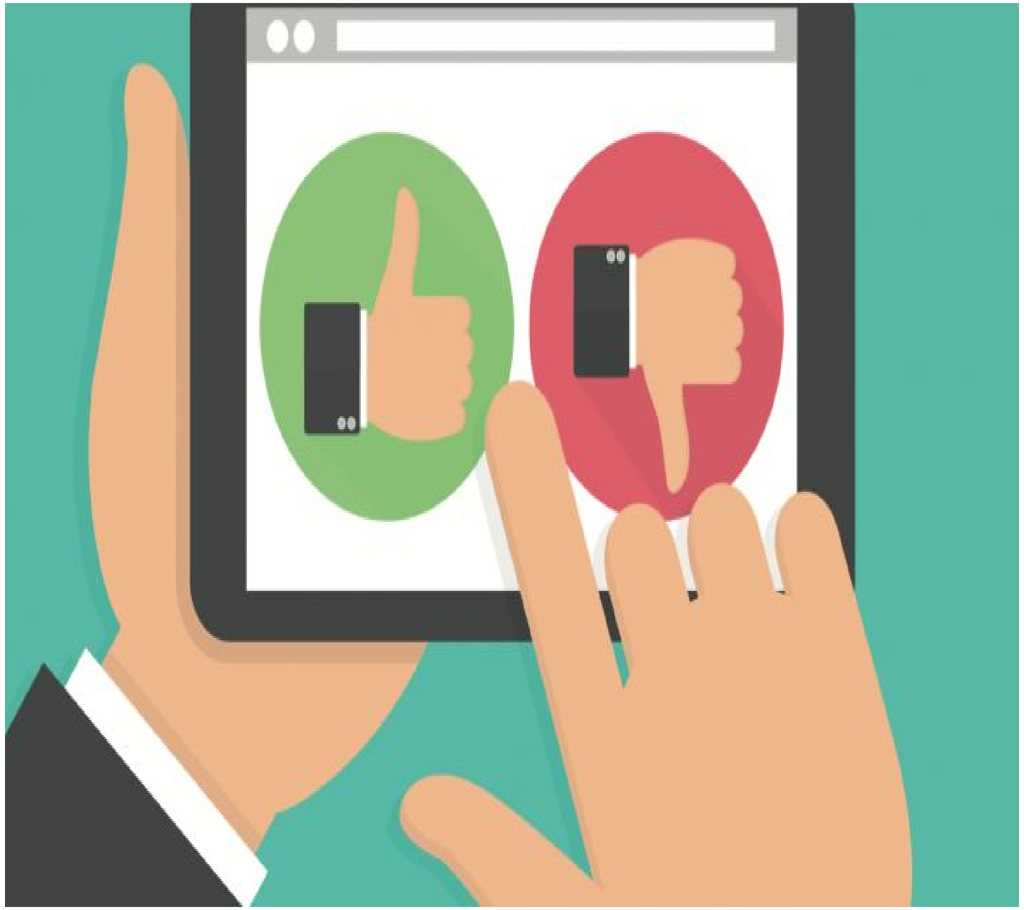
Everyone wants to lower their energy bills

The “Millennials” have gone organic

Some are looking into self-generation and microgrids

Builders are offering zero energy homes

Utilities need to modernize their tariffs or risk losing customers



Tech has entered the room

Appliances, light bulbs, and water heaters are much more energy efficient than they were just a decade ago

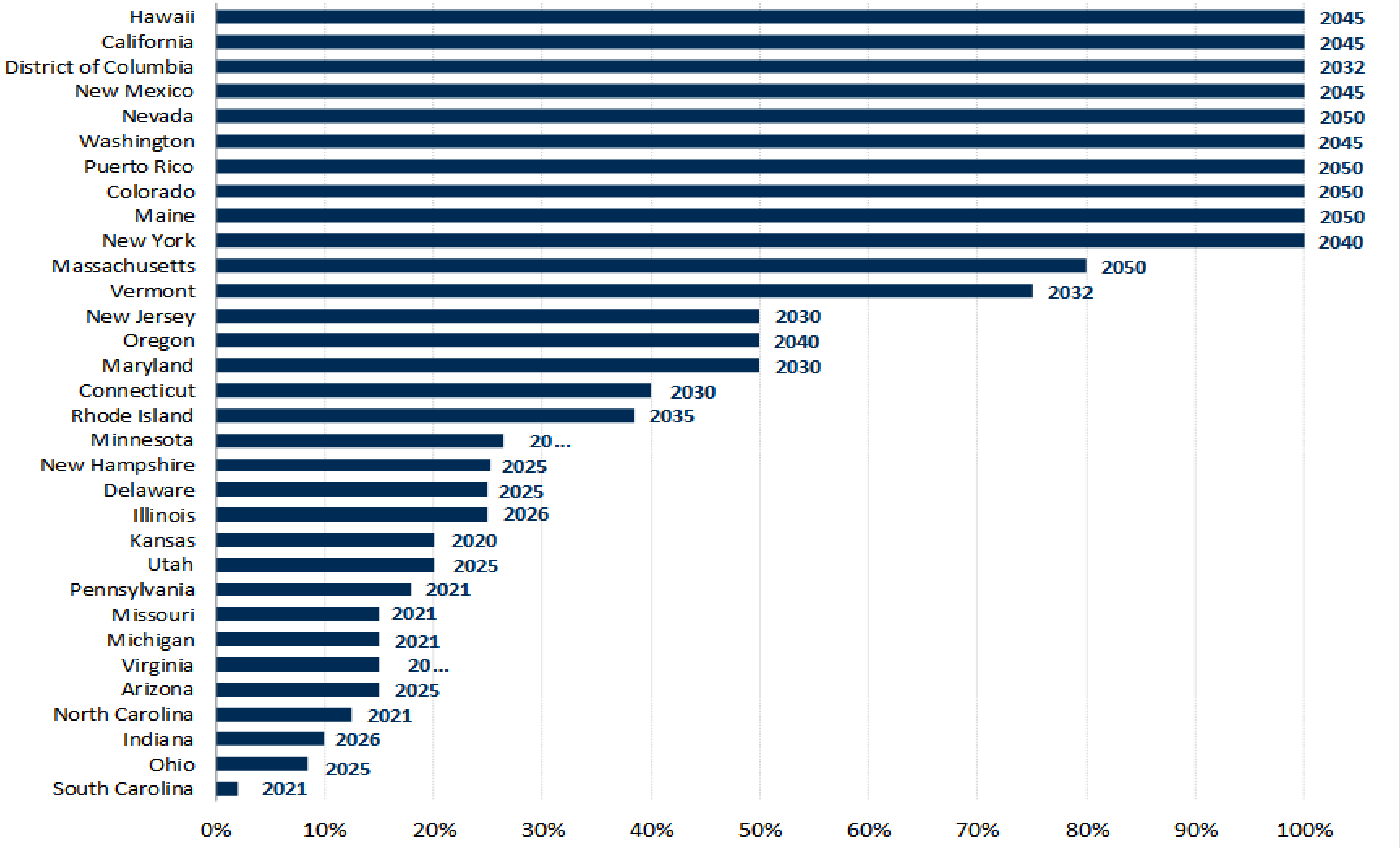
They often come with timers and are addressable via WiFi

Central air conditioners, heat pumps, and gas furnaces are also becoming more energy efficient

They are often paired with smart thermostats

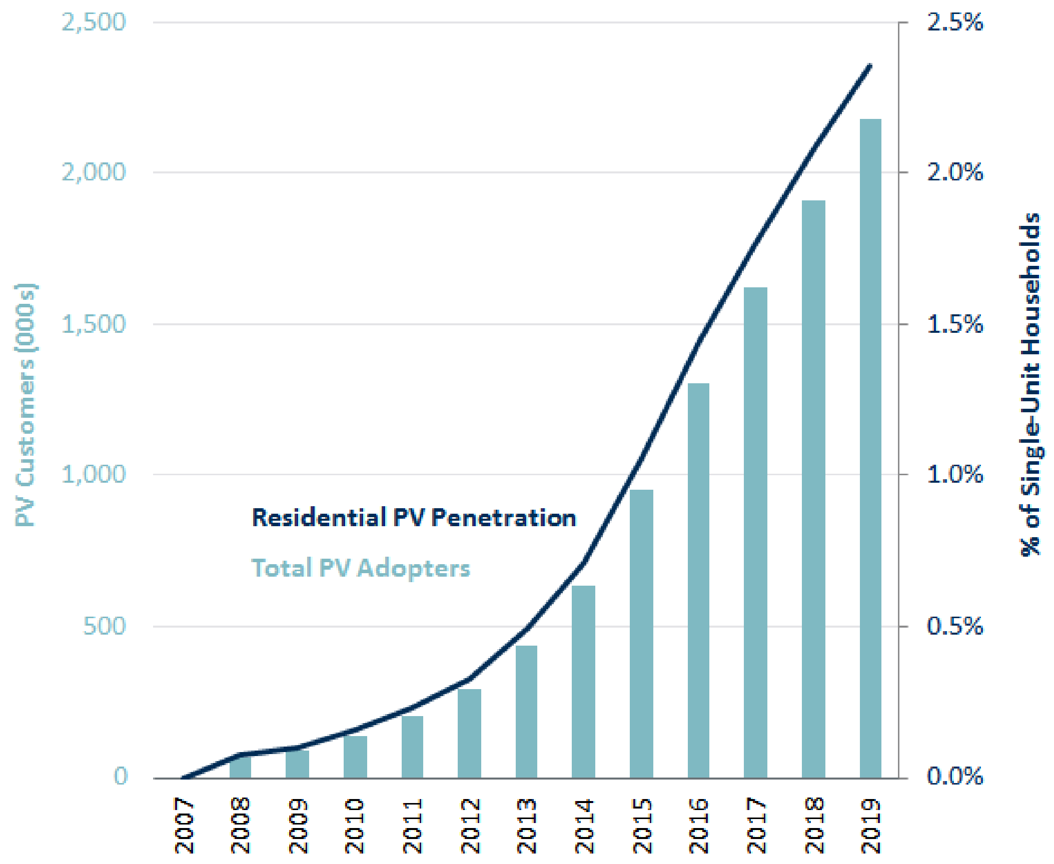
WiFi is nearly ubiquitous as are smart phones and apps, allowing remote control of equipment

In the US, States are going green with envy. In Mexico the goal is 35% (of clean energy, including nuclear and hydro) by 2024, and finally 50%by 2050



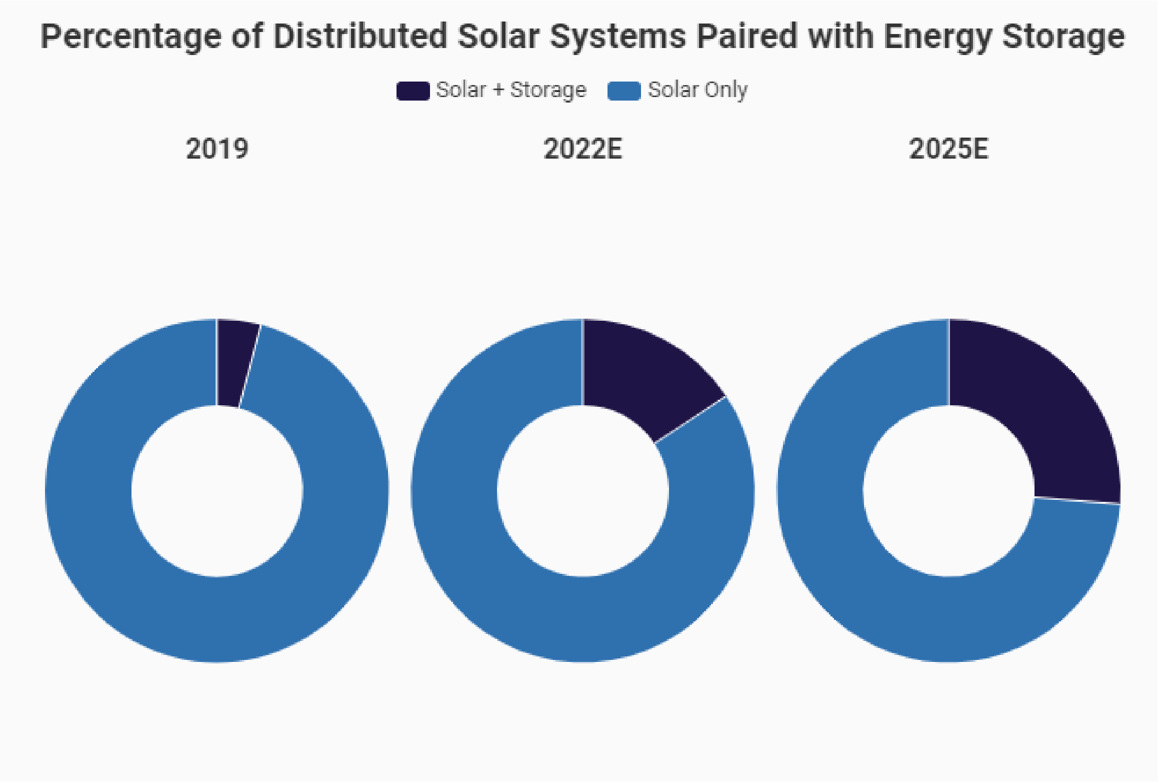
Notes: Targets for Hawaii, DC, and Maine specify 100% renewables, while other 100% targets allow for different forms of clean energy. New Jersey has also issued an Energy Master Plan targeting 100% clean energy by 2050. Targets for Colorado, Minnesota, Missouri, New Mexico, and North Carolina are specific to IOUs. Massachusetts' goal of 80% by 2050 is based on its Clean Energy Standard, while a separate Renewable Portfolio Standard has an implied target of 35% by 2030 (with Class I requirement growing by 1% per year thereafter).

Tired of paying high electric bills, US residential customers are turning into prosumers



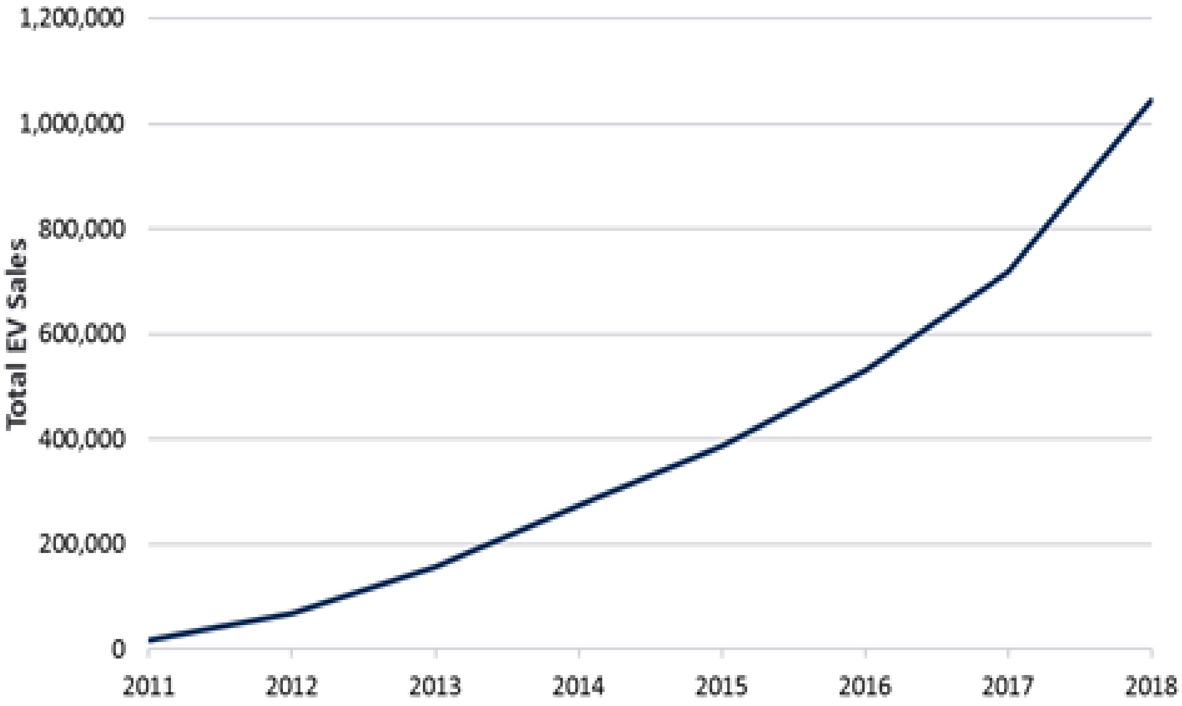
Source: Residential PV adopter counts from Form EIA-861, “Net Metering” data. Residential PV penetration calculated as Residential PV Adopters over total number of single-unit households, using U.S. Census data.

Prosumers are turning into prosumagers. By 2025, more than 25% of all behind-the-meter solar systems in the US will be paired with storage, compared to under 5% in 2019



Source: SEIA/Wood Mackenzie, “U.S. Solar Market Insight 2019 Year-in-Review,” https://www.seia.org/us-solar-market-insight

Consumers are also buying electric vehicles (EVs) in increasing numbers



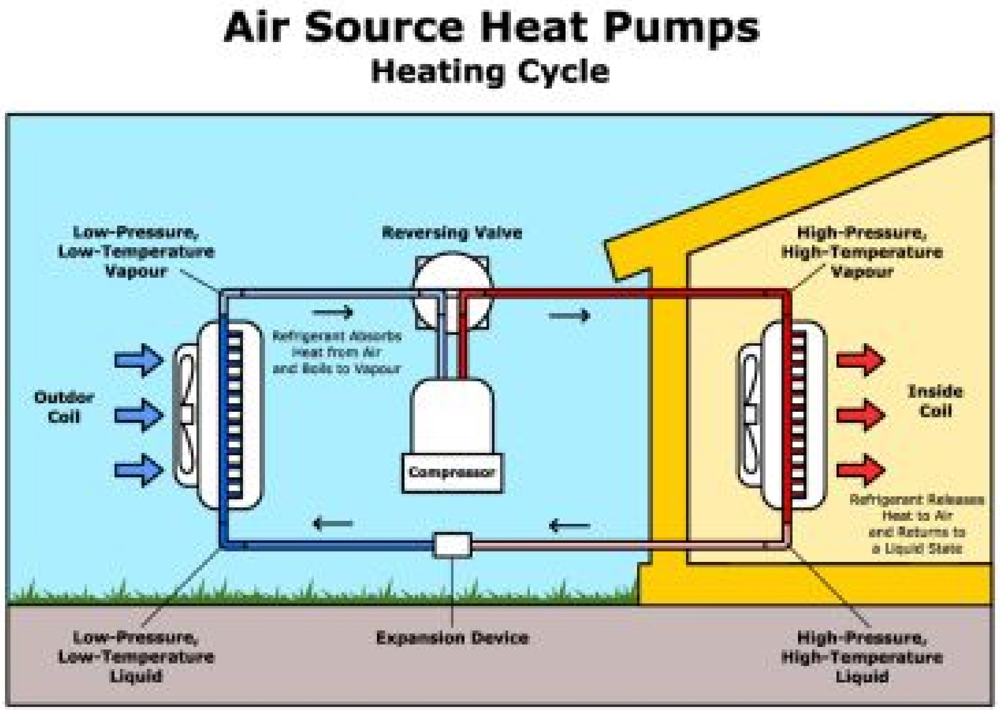
Source: EV sales from Atlas EV Hub

Building decarbonization is being encouraged through incentives and/or mandated in new construction

Utilities are encouraging the adoption of heat pumps for space heating and water heating

In a few cases, utilities are ensuring that new homes are built as all-electric homes

A few cities have banned the use of gas for cooking in restaurants



Among commercial customers, data centers are emerging as giant consumers of energy

Tech giants want to get all their power from renewable resources

They are setting the pace for all commercial customers

Big Box stores such as Best Buy, Kroger, and Walmart are going green

Cities, colleges, state governments, and universities are joining the green parade

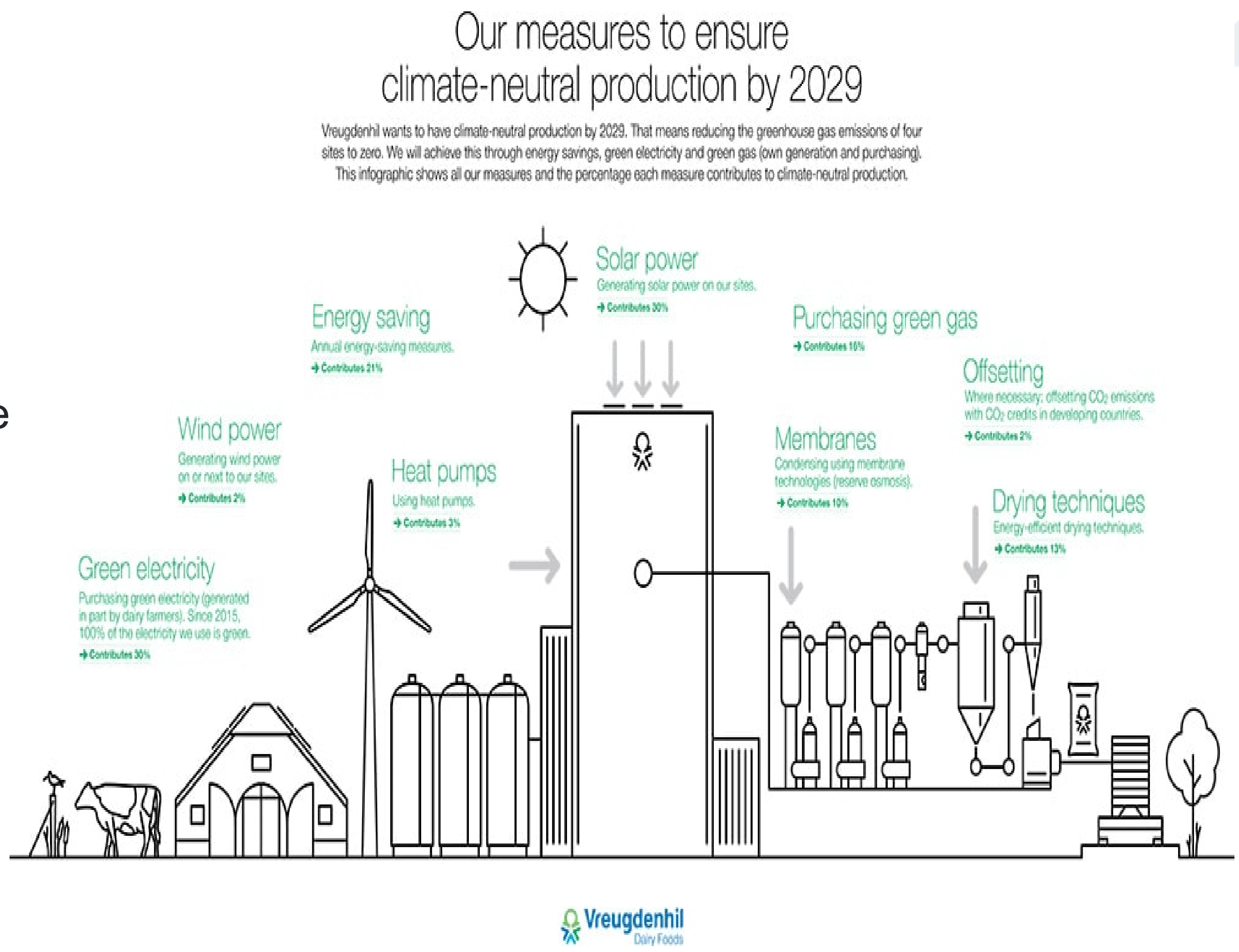
Source: https://www.epa.gov/greenpower/green-power-partnership-national-top-100

Industrial customers are shopping for the best deals

Manufacturing plants are installing flexible manufacturing systems and investing heavily in process modernization

Many are installing co-generation systems, some are installing microgrids, and still others are installing on-site solar generation

Customers are negotiating aggressively for the be prices, often threatening to move elsewhere



The tariffs of yesterday will not work tomorrow. They hardly work today because customers want more choices

Flat volumetric rates with low fixed charges

Inclining or declining block rates with low fixed charges

Seasonal rates with low fixed charges

The tariffs of tomorrow are beginning to take shape before our eyes

TOU rates with significant price differential and shorter peak periods (SMUD)

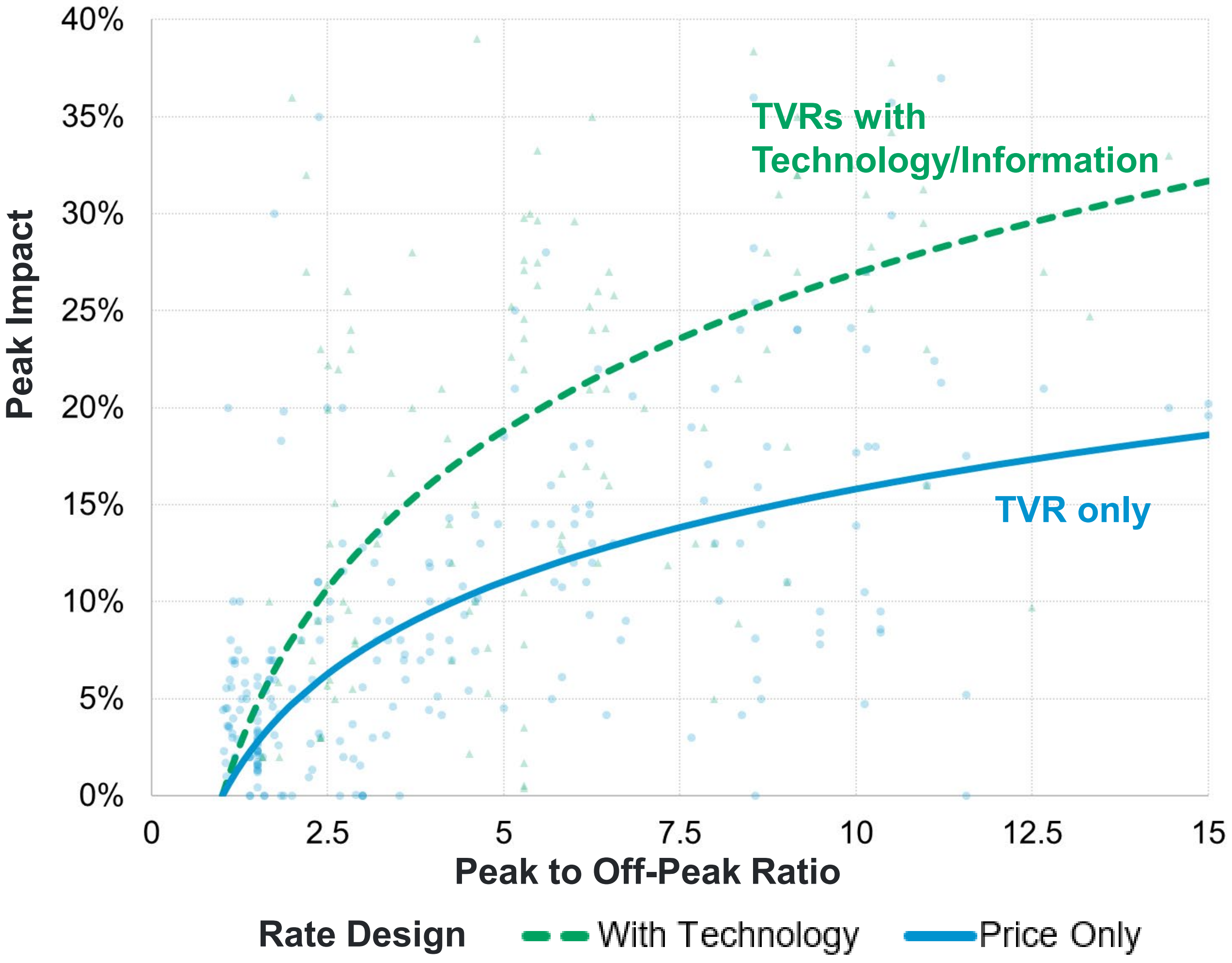
Three-part rates with demand charges (Ameren, Arizona Public Service, Georgia Power and Salt River Project)

Dynamic pricing rates with higher fixed charges (OGE)

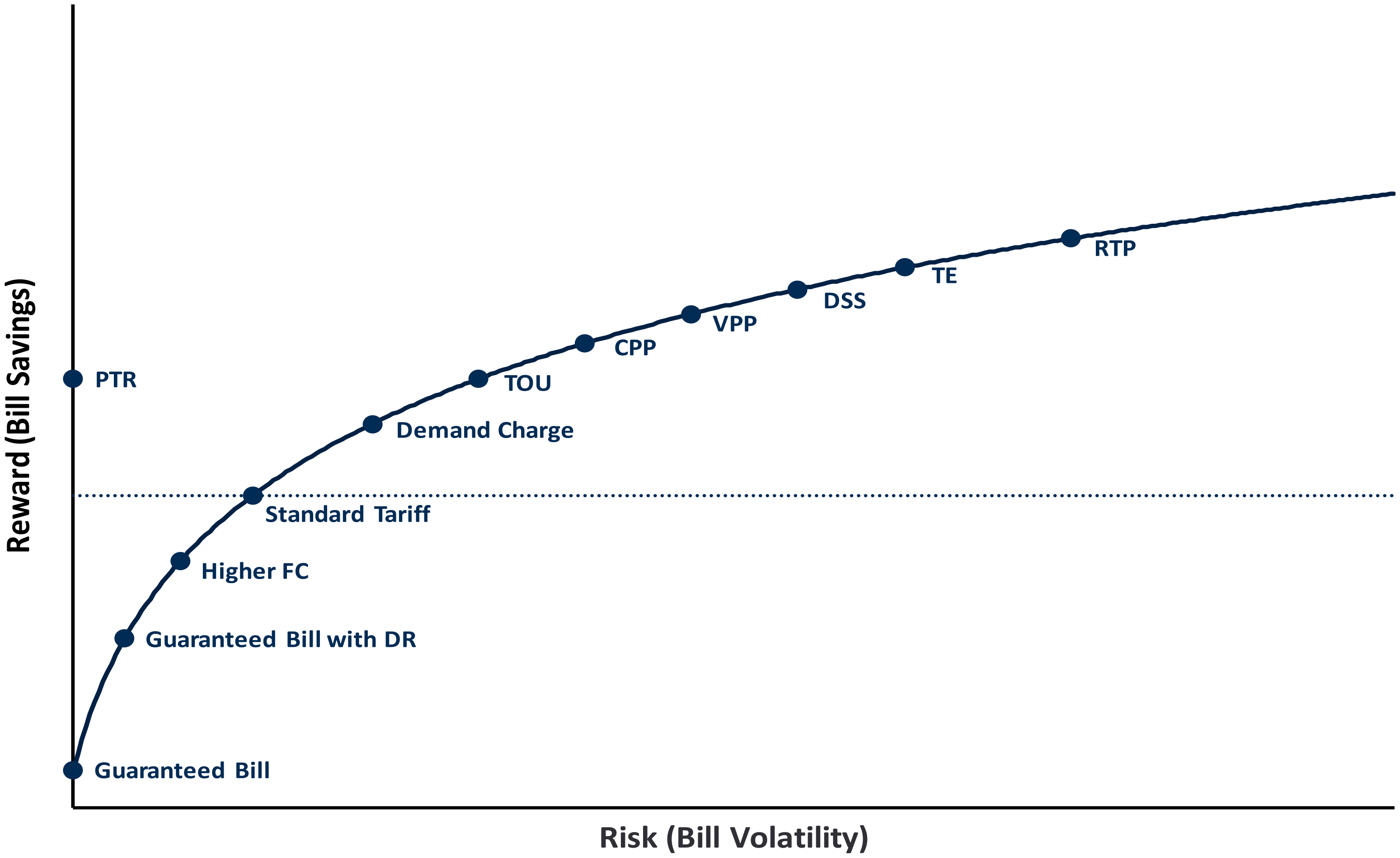
Real-time pricing (RTP) rates with day-ahead and hour-ahead frequency (Georgia Power)

RTP which flows directly to devices

Results from nearly 400 deployments around the globe show that customers respond to time-varying rates (TVR)



Utilities should begin offering choices to customers along the frontier of rate design

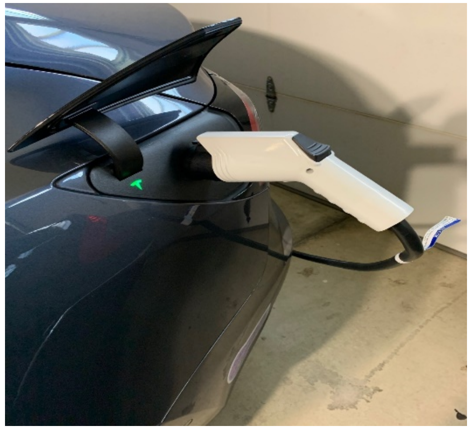


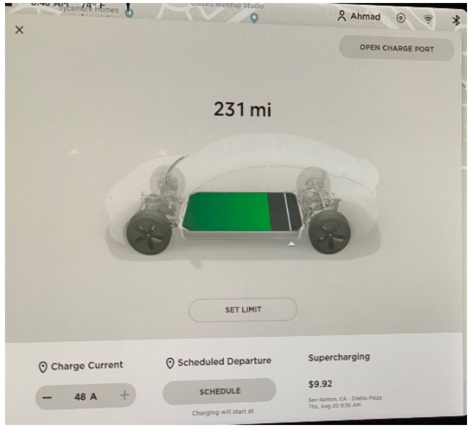
Residential TVRs are being deployed around the world

	Type of Rate	Applicability	Participating Customers
Oklahoma (OGE)	Variable Peak Pricing (VPP)	Opt-in	20% (130,000)
Maryland (BGE, Pepco, Delmarva)	Peak Time Rebate (PTR)	Default	80%
Ontario, Canada	Time-of-Use (TOU)	Default	90% (3.6 million)
Great Britain	Time-of-Use (TOU)	Opt-in	13% (3.5 million)
Hong Kong (CLP Power Limited)	Peak Time Rebate (PTR)	Opt-in	27,000
Arizona (APS, SRP)	Time-of-Use (TOU)	Opt-in	APS: 57%, SRP: 36%
California (PG&E, SCE, SDG&E)	Time-of-Use (TOU)	Default (2020)	TBD – 75-90%*
California (SMUD)	Time-of-Use (TOU)	Default	75-90%*
Colorado (Fort Collins)	Time-of-Use (TOU)	Mandatory	100%
Illinois (ComEd, Ameren IL)	Real Time Pricing (RTP)	Opt-in	50,000
Michigan (Consumers Energy)	Time-of-Use (TOU)	Default (2020)	TBD – 75-90%*
France	Time-of-Use (TOU)	Opt-in	50%
Spain	Real Time Pricing (RTP)	Default	40%
Italy	Time-of-Use (TOU)	Default	75-90%*

*Estimated participation based on historical trends

Customers install solar panels to lower their bills, to promote decarbonization, and improve resilience





Is there a need to reform tariffs for customers with rooftop solar panels?

In Australia and Hawaii, about a third of customers have installed solar panels

- In California, the number is one out of ten, representing half of the entire US population of homes with solar panels

Utilities are concerned that their business model is being turned upside down when customers install solar panels and in several instances, pair them with battery energy storage systems

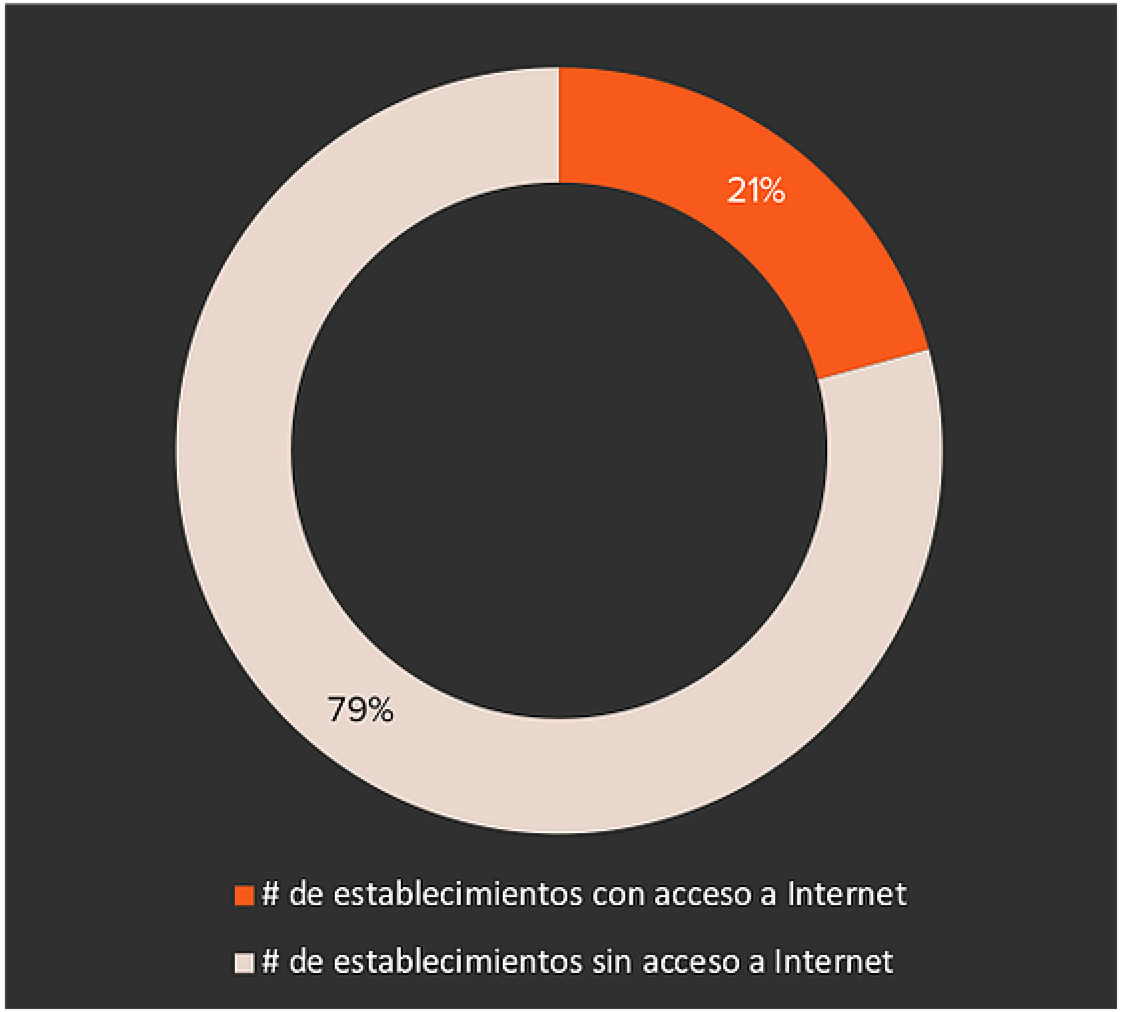
States in the US have been seeking to reform net energy metering (NEM) and replace it with successor tariffs that reduce the cost-shift that occurs when prosumers reduce their usage drastically

Progress toward successor tariffs is gradually beginning to occur in jurisdictions with a high percentage of prosumers

The options being implemented include minimum monthly bills, higher fixed charges, time-of-use rates, and lower prices for exporting power to the grid

Mexico

Many small and medium companies are not digitalized.

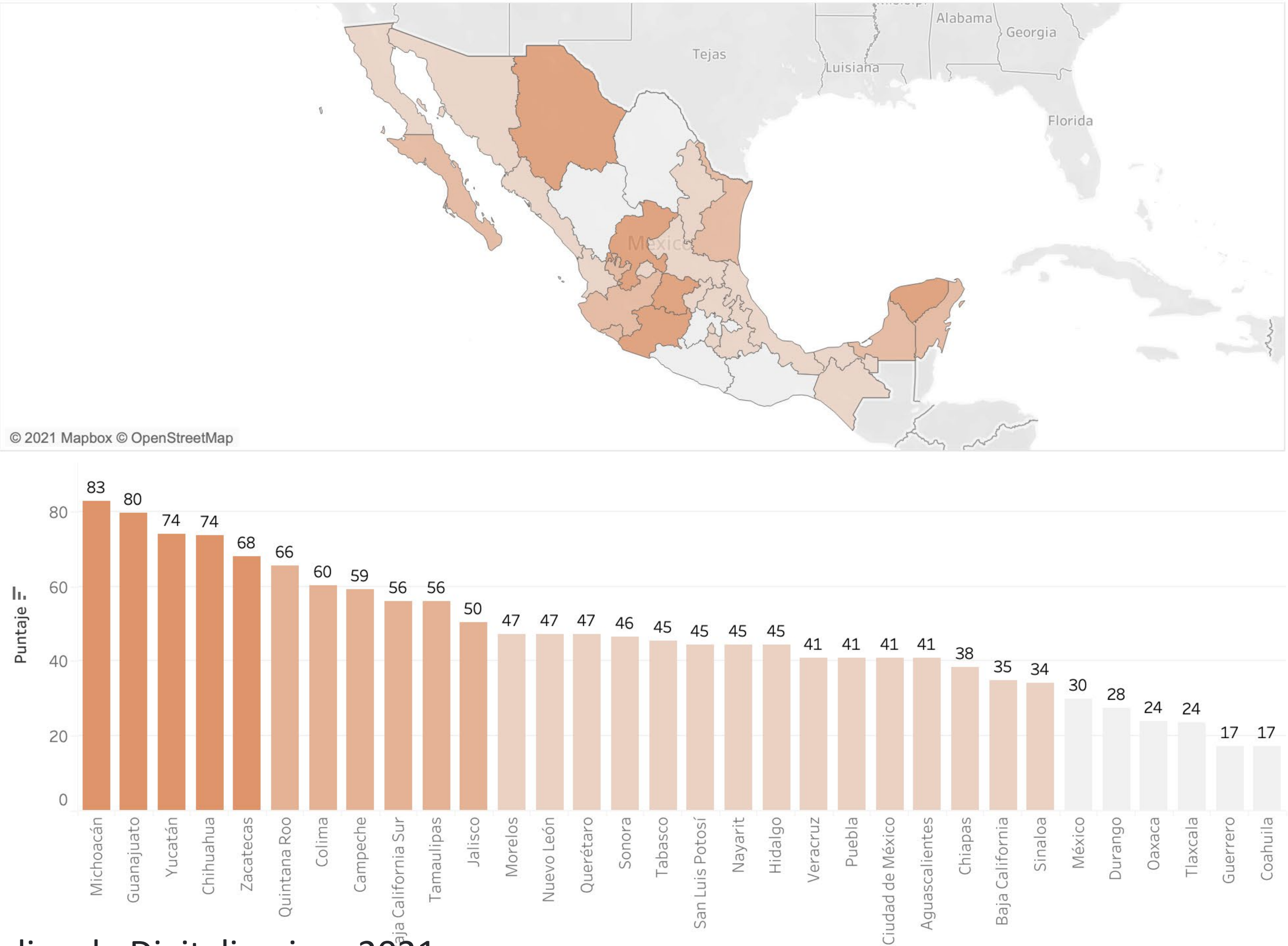


Adoption of new technologies by State

Indicators

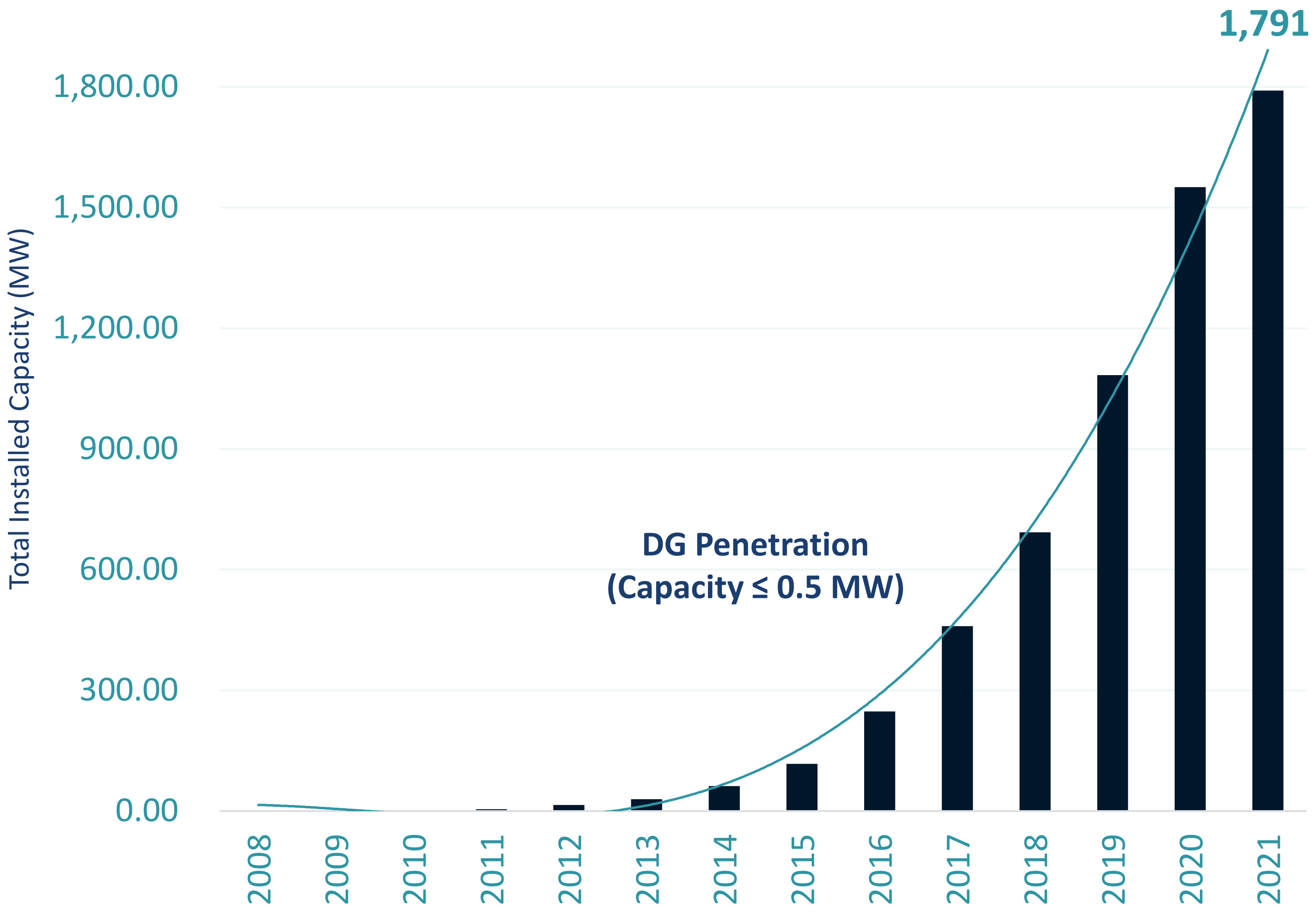
- Personnel with basic technological tools
- Companies with basic technological tools
- Companies with intermediate technological tools
- Companies with advanced technological tools
- Companies with innovative technological
- Use of internet

Subpilar de Adopción de nuevas tecnologías



Source: Centro Mexico Digital, Indice de Digitalizacion, 2021

Some Mexican residential users are becoming prosumers

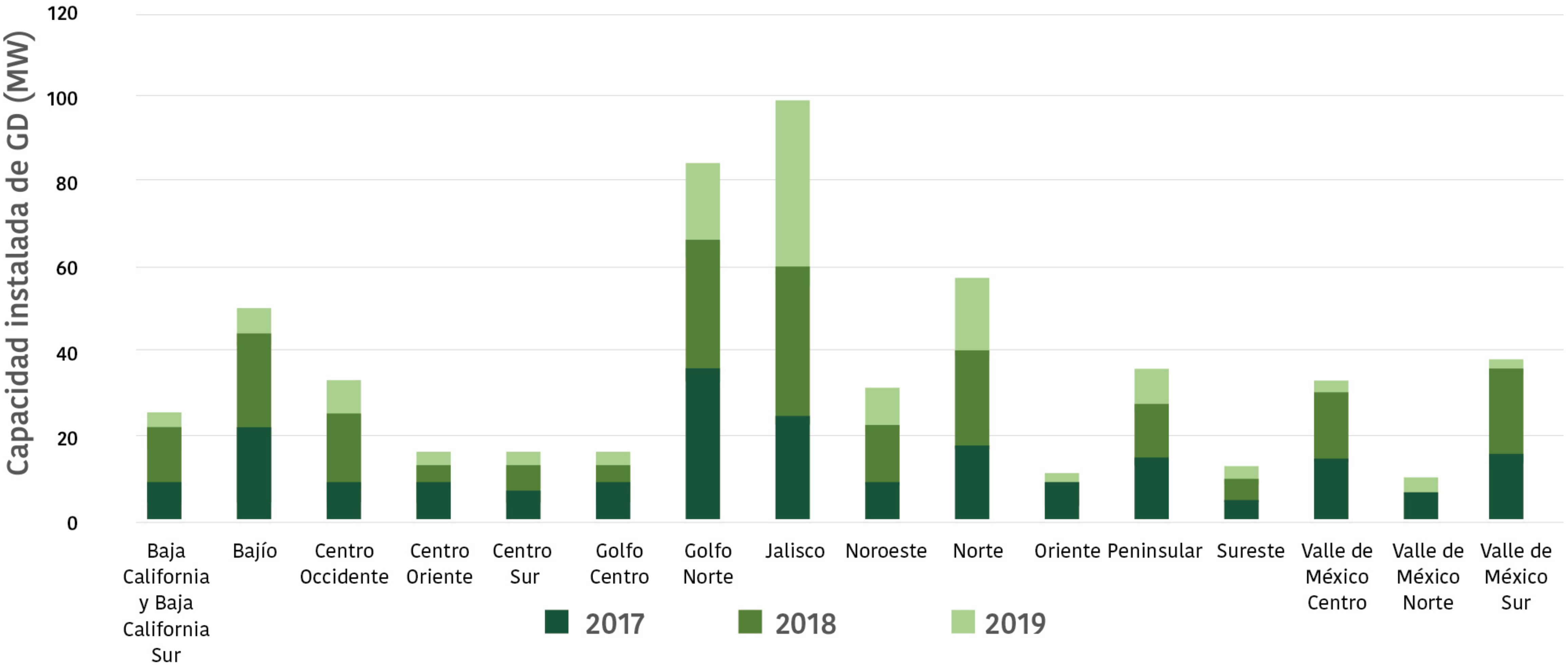


Source: CRE, Mexico.

- **51.7%** of all DG generators are in the range of 0.1 – 10 kW of installed capacity.
- **99.2%** is Solar PV.[1]
- Mexico's capacity is about 80,000 MW (DG about 2.25 %)

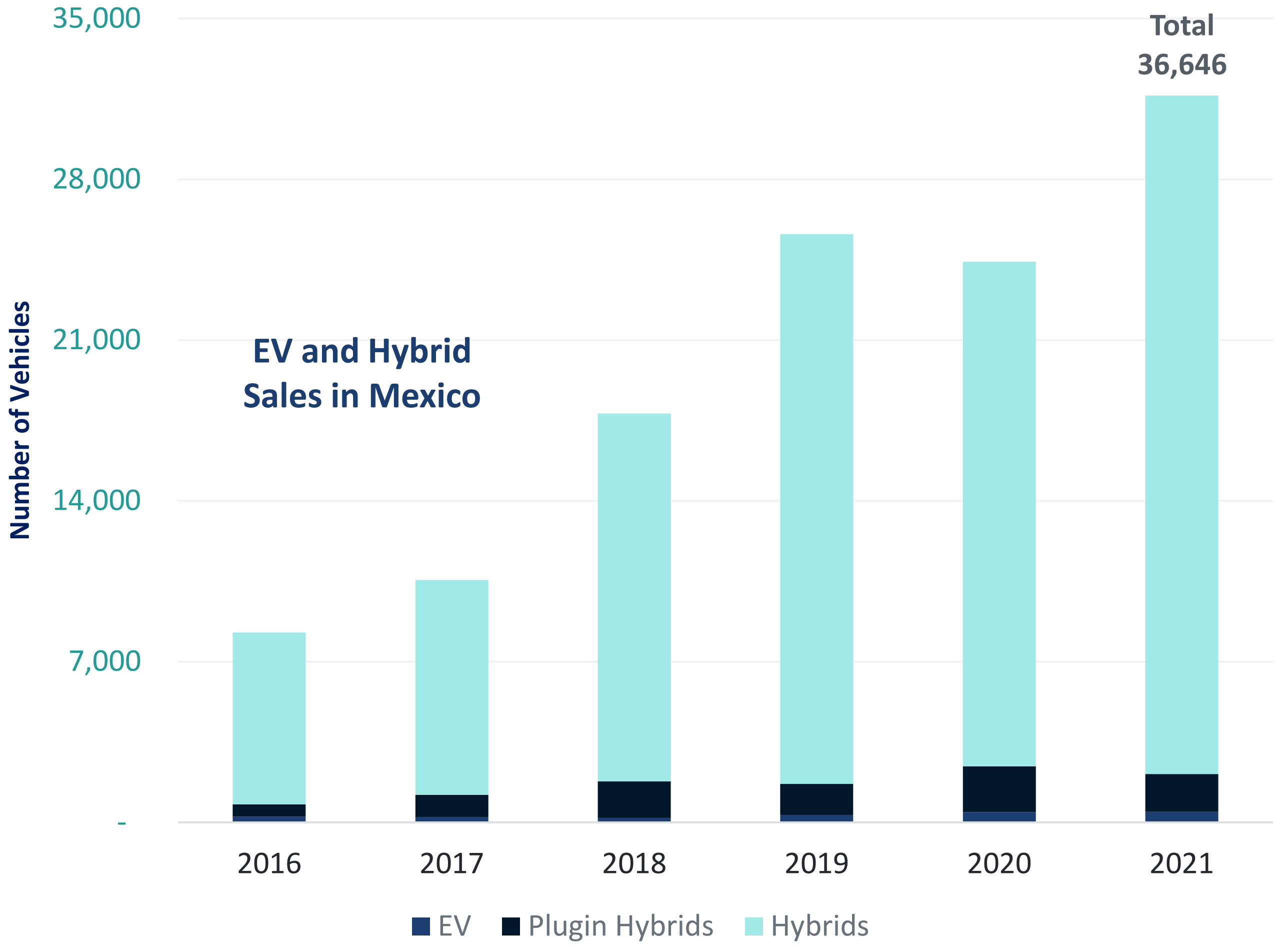
[1] Biomass, wind, and cogeneration concentrate the remaining capacity.

Some regions are moving faster than others

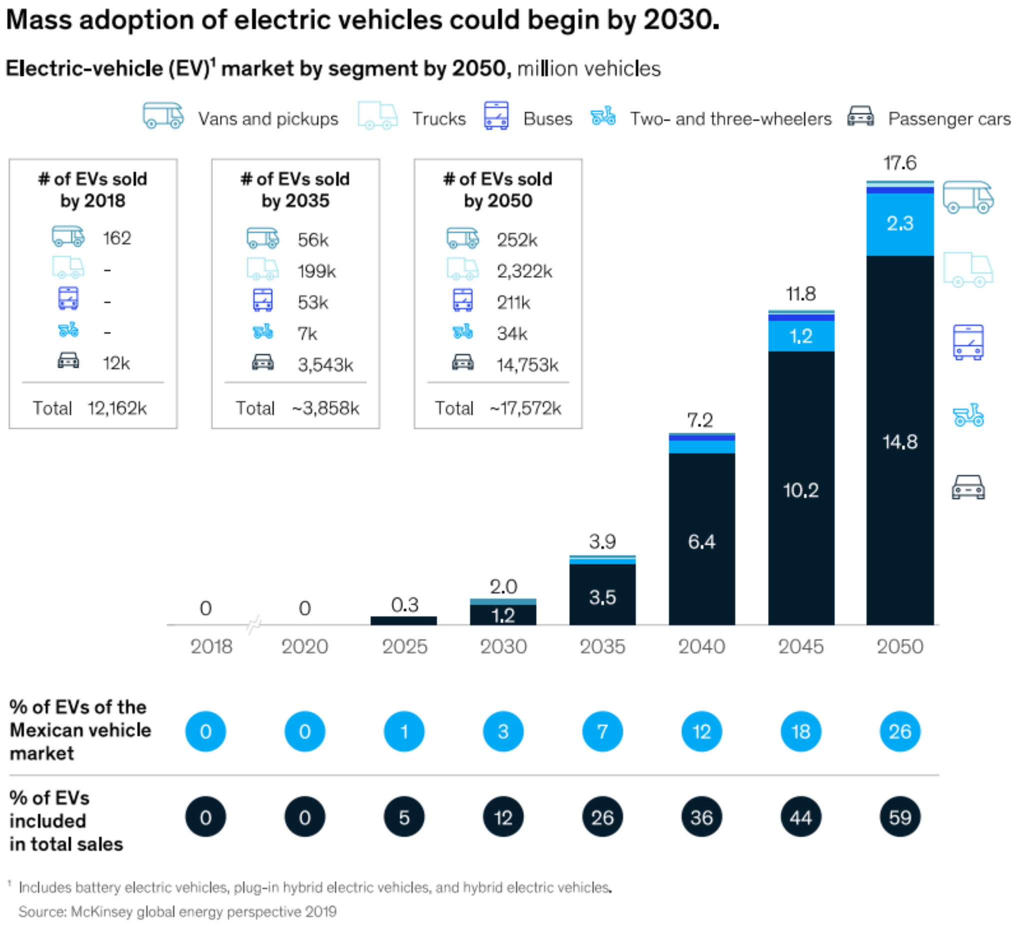


Source: Monitor de información comercial e índice de precios de Generación Solar Distribuida en México, March 2020

EV and hybrid sales are growing at a slow pace (around 1% of total cars)



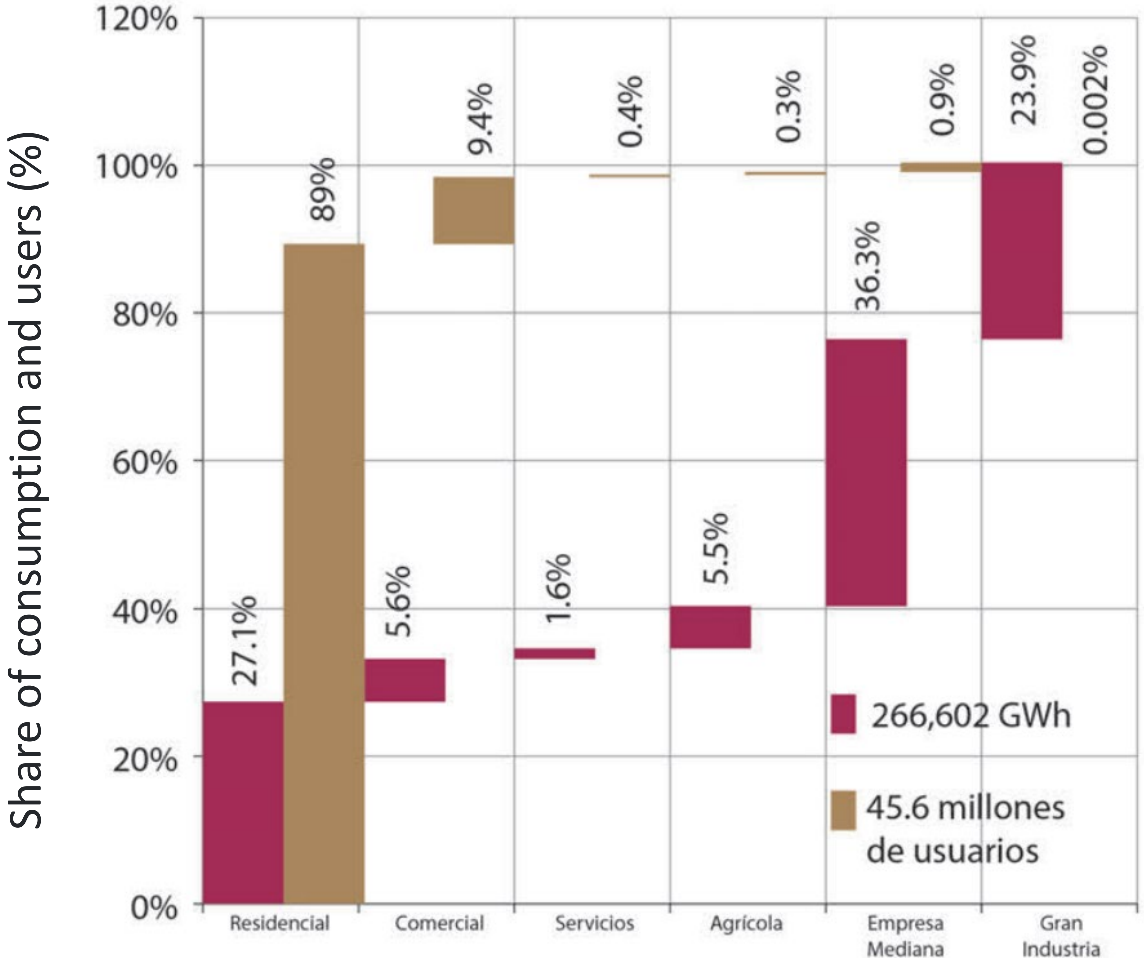
Source: INEGI, Mexico.



Source: McKinsey & Co.

In Mexico, residential users concentrate 27% of consumption

Electricity consumption by user, Mexico, 2020



Source: PRODESEN 2021.

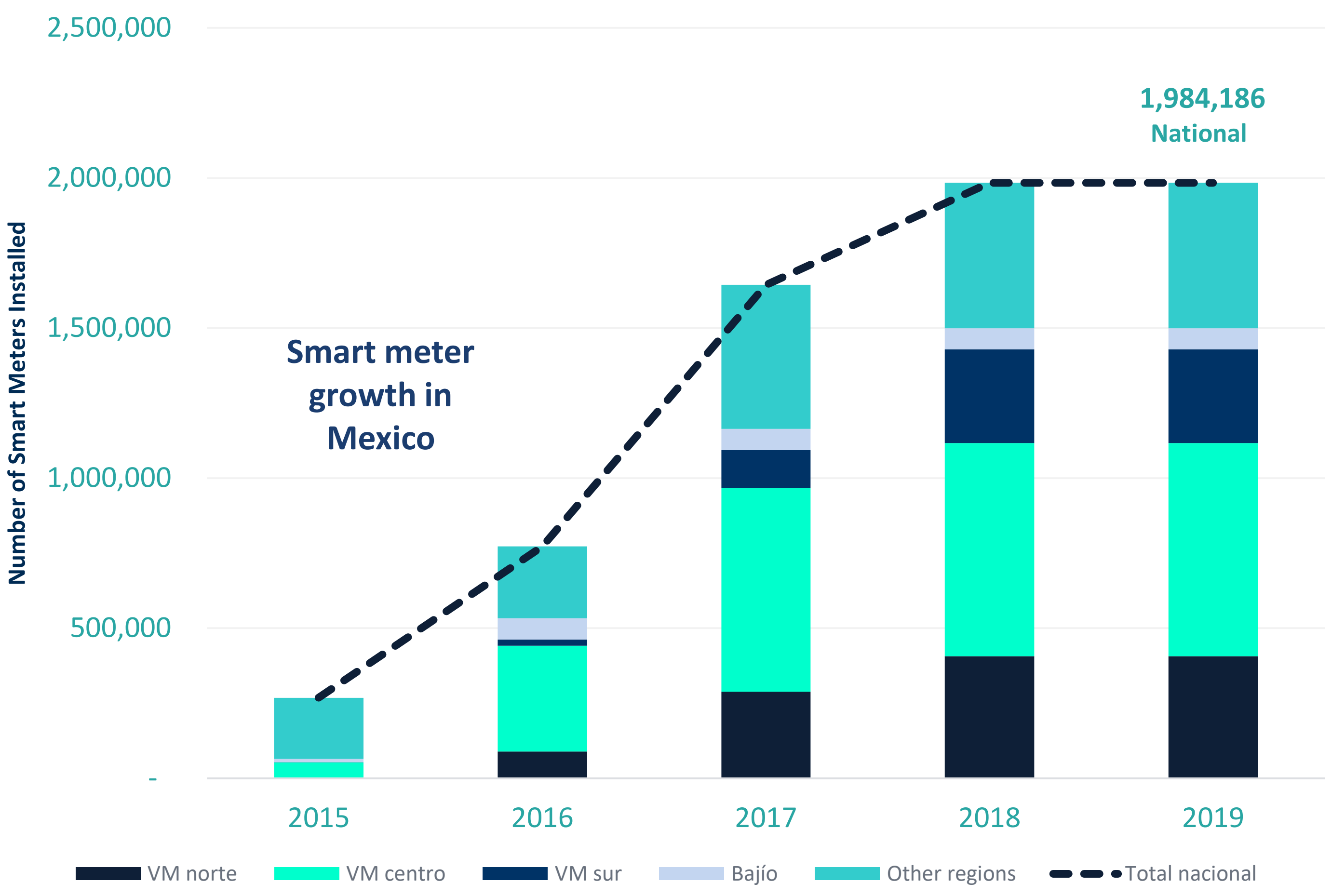
CFE’s Rate structure

FIGURA 1. CARGOS FIJOS Y VARIABLES

Tarifa – Cargo				DB1, DB2	PDBT	GDBT	RABT	RAMT, GDMTO	APBT, APMT	GDMTH, DIST, DIT
Fijo				✓	✓	✓	✓	✓	✓	✓
Variable	Capacidad	Medición simple		✓	✓		✓		✓	
Variable	Capacidad	Medición de demanda				✓		✓		✓
Variable	Generación	Cargo plano		✓	✓	✓	✓	✓	✓	
Variable	Generación	Cargo horario	Base							✓
Variable	Generación	Cargo horario	Intermedio							✓
Variable	Generación	Cargo horario	Semipunta1/							✓
Variable	Generación	Cargo horario	Punta							✓

1/ El cargo de semipunta se aplica únicamente en la división de Baja California.
Fuente: CRE

Smart meters remains a nascent technology in Mexico…



- About 4% of all meters installed were smart meters by 2019.
- Most large users have smart meters

Source: CFE Distribución.

CFE is behind in providing options

Mexico introduced retail choice (Suministro Calificado) for large users with the 2013 reform

CFE as a basic service supplier does not have many tariff options for users. In many cases there is just one.

Existing tariffs have components variable components (transmission) that could become a problem.

What is next?

A suggested, five-point agenda for policy makers in Mexico

1. CFE should begin the journey of giving customers choices by reforming its tariffs
2. CFE should conduct pilots with new tariffs to test their acceptance by customers and to measure how much they reduce peak load and overall energy costs and to what extent they promote the integration of demand with renewable supply resources
3. CFE should roll out smart meters at a faster pace, to allow such tariffs to be offered, besides providing many other benefits to the distribution system such as faster outage detection and doing automated metering
4. Mexico should assess the need for customers to install solar panels and to consider modifying its net energy metering rules when the time is ripe for making such reforms

APPENDIX A

Additional readings

Selected references on pricing, customer-centricity and customer choice

"Refocusing on the consumer," *Regulation*, Spring 2020.

"Customer centricity: Lynchpin of strategy," *Public Utilities Fortnightly*, November 1, 2019.

"The Tariffs of Tomorrow: Innovations in Rate Designs," *IEEE Power and Energy Magazine*, vol. 18, no. 3, pp. 18-25, May-June 2020.

"2040: A Pricing Odyssey," *Public Utilities Fortnightly*, June 1, 2019.

"Rate Design 3.0 – Future of Rate Design," *Public Utilities Fortnightly*, May 2018.

"Innovations in Pricing: Giving Customers What They Want," *Electric Perspectives*, September/October 2017.

Customer Choice: Finding Value in Retail Electricity Markets, co-edited with J. Robert Malko, PUR Press, 1999.

APPENDIX B

A pocket history of rate design

A Pocket History of Rate Design

Year	Author	Contribution
1882	Thomas Edison	• Electric light was priced to match the competitive price from gas light and not based on the cost of generating electricity
1892	John Hopkinson	• Suggested a two–part tariff with the first part based on usage and the second part based on connected kW demand
1894	Arthur Wright	• Modified Hopkinson's proposal so that the second part would be based on actual maximum demand
1897	Williams S. Barstow	• Proposed time-of-day pricing at the 1898 meeting of the AEIC, where his ideas were rejected in favor of the Wright system
1946	Ronald Coase	• Proposed a two-part tariff, where the first part was designed to recover fixed costs and the second part was designed to recover fuel and other costs that vary with the amount of kWh sold
1951	Hendrik S. Houthakker	• Argued that implementing a two-period TOU rate is better than a maximum demand tariff because the latter ignores the demand that is coincident with system peak
1961	James C. Bonbright	• Published "Principles of Public Utility Rates" which would become a canon in the decades to come

A Pocket History of Rate Design (Concluded)

Year	Author	Contribution
1971	William Vickrey	• Proffered the concept of real-time-pricing (RTP) in *Responsive Pricing of Public Utility Services*
1976	California Legislature	• Added a baseline law to the Public Utilities Code in the *Warren-Miller Energy Lifeline Act*, creating a two-tiered inclining rate
1978	U.S. Congress	• Passed the *Public Utility Regulatory Act (PURPA),* which called on all states to assess the cost-effectiveness of TOU rates
1981	Fred Schweppe	• Described a technology-enabled RTP future in *Homeostatic Control*
2001	California Legislature	• Introduced *AB 1X,* which created the five-tier inclining block rate where the heights of the tiers bore no relationship to costs. By freezing the first two tiers, it ensured that the upper tiers would spiral out of control
2001	California PUC	• Began rapid deployment of California Alternative Rates for Energy (CARE) to assist low-income customers during the energy crisis
2005	U.S. Congress	• Passed the *Energy Policy Act of 2005*, which requires all electric utilities to offer net metering upon request

Presenters Information

AHMAD FARUQUI, PH.D.
Principal | San Francisco, CA
Ahmad.Faruqui@brattle.com
+1.925.408.0149

Dr. Faruqui provides expert advice and testimony on rate design, load flexibility, energy efficiency, demand response, distributed energy resources, demand forecasting, decarbonization, and electrification. He has worked for over 150 clients on five continents and appeared before regulatory bodies, governments, and legislative councils.

He has authored or coauthored more than 100 papers in peer-reviewed and trade journals and co-edited books on industrial structural change, customer choice, and electricity pricing. His work has been cited in *Bloomberg, Business Week, The Economist*, and *Forbes*, in addition to *The New York Times* and the *Washington Post*, and he has appeared on NPR and Fox Business News.

Dr. Faruqui has taught economics at San Jose State, UC Davis and the University of Karachi and delivered guest lectures at Carnegie Mellon, Harvard, Idaho, MIT, New York, Northwestern, Rutgers, Stanford, and UC Berkeley. He obtained an MA in Agriculture Economics and a PhD in Economics from UC Davis, and a BA and an MA in Economics from the University of Karachi.

Presenter Information

VERONICA IRASTORZA
Principal | San Francisco, CA
Veronica.Irastorza@brattle.com

Veronica Irastorza has 20 years of experience in regulatory and strategic issues concerning energy. Ms. Irastorza assists clients with issues related to regulation and contracts, markets, damages, valuations, disputes and arbitration. She has worked on several competition cases related to transportation, financial and the food industry.

Ms. Irastorza leverages her experience as former Undersecretary of Energy Planning and Transition in Mexico, a position she held until December 2012, to help her clients navigate long-term energy project planning, as well as renewable energy and energy efficiency policies. Her planning work as Undersecretary included developing the Mexican National Energy Strategy and producing energy outlooks. She also coordinated the activities relative to national energy statistics and geographic information.

In electricity, Mrs. Irastorza has advised governments, regulators, energy companies, investors and large users on industry structure, regulation, sector reform, evaluation of assets, market design, tariffs, planning and forecasting in many countries around the world including Argentina, Canada, Chile, Colombia, Ireland, Mexico and the United States (California and New England). She has worked on matters related to all aspects of the electric power sector, including generation, transmission, ancillary services, distribution, and retailing

Additional Slides

Rate structure is different depending on the demand fo C&I users

Rate with 2 charges — ***Example: PDBT / División Baja California***

Not High Demand Users
No Demand Charge

67. 24		**2. 253**
S	+	***T + D + ISO + AS + G (C & E)***
Pesos MXN / mes		***Cargo en pesos / kWh***

Rate with 3 charges — ***Example: GDBT / División Baja California***

High Demand Users
Includes Demand Charge

672. 39		**1. 155**		**375. 42**
S	+	***T + ISO + AS + G (E)***	+	***D + G (C)***
Pesos MXN / mes		***Cargo en pesos / kWh***		***Cargo en pesos / kW***

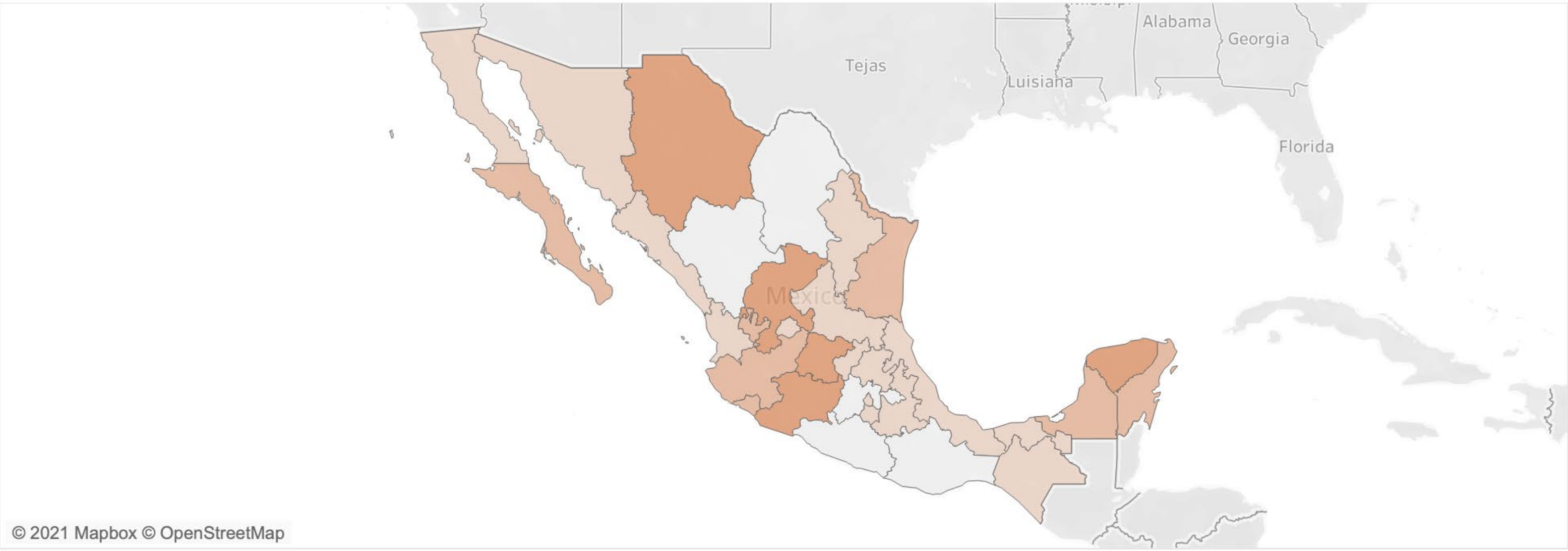
Source: A/074/2015, CRE

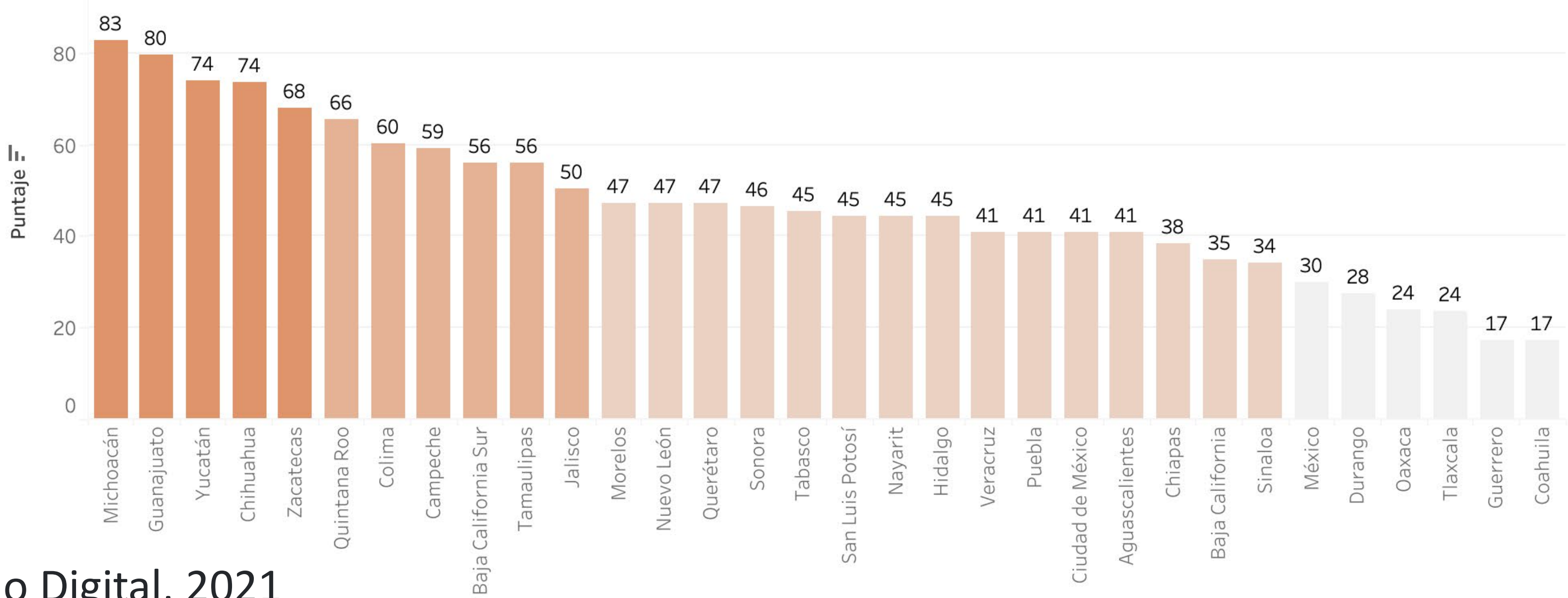
Adoption of new technologies by State

Indicators

- Personal con herramientas tecnológicas básicas
- Empresas con herramientas tecnológicas básicas
- Empresas con herramientas tecnológicas intermedias
- Empresas con herramientas tecnológicas avanzadas
- Empresas con herramientas tecnológicas innovadoras
- Usos de Internet en las empresas

Subpilar de Adopción de nuevas tecnologías





Source: CMD, Indice de Desarrollo Digital, 2021