GRID MODERNIZATION BASELINE REPORT
OF NEW MEXICO’S ELECTRICITY SECTOR
UPDATED APRIL 2021

CONTENTS

LIST OF EXHIBITS

LIST OF ACRONYMS

AMI	Area Median Income
BA	Balancing Authority
CAA	Clean Air Act
CAIDI	Customer Average Duration Index
CBM	Condition-Based Maintenance
CCN	Certificate of Convenience and Necessity
CIP	Critical Infrastructure Protection
DER	Distributed Energy Resource
DERMS	Distributed Energy Resource Management System
DFM	Distribution Feeder Microgrid
DOE	Department of Energy (U.S.)
EIA	Energy Information Agency
EIM	Energy Imbalance Market
EMNRD	Energy, Minerals and Natural Resources Department
EPE	El Paso Electric Company
ETA	Energy Transition Act
EUEA	Efficient Use of Energy Act
EV	Electric Vehicle
FERC	Federal Energy Regulatory Commission
FPA	Federal Power Act
GHG	Greenhouse Gas
GMAG	Grid Modernization Advisory Group
HB	House Bill
IOU	Investor-Owned Utility
IRP	Integrated Resource Plan
ISO	Independent System Operator
ITC	Investment Tax Credit
KW	Kilowatt
MED	Major Event Days
MW	Megawatt
NARUC	National Association of Regulatory Utility Commissioners
NEM	Net Energy Metering
NERC	North American Electric Reliability Corporation
NMED	New Mexico Environment Department
NM EPSCoR	New Mexico Established Program to Stimulate Competitive Research
NTUA	Navajo Tribal Utility Authority
PNM	Public Service Company of New Mexico
PPA	Power Purchase Agreement
PRC	Public Regulation Commission
PTC	Production Tax Credit
PUA	Public Utility Act
PURPA	Public Utility Regulatory Policy Act
QF	Qualifying Facility
REC	Renewable Energy Credit
RETA	Renewable Energy Transmission Authority

RPS	Renewable Portfolio Standard
RTO	Regional Transmission Organization
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SPS	Southwest Public Service Company
TOU	Time of Use
TWh	Terawatt-hour
UNM	University of New Mexico
VVO	Volt/VAR Optimization
ZEV	Zero Emission Vehicle
ZNE	Zero Net Energy

INTRODUCTION

The New Mexico Energy, Minerals & Natural Resources Department (EMNRD), in conjunction with the University of New Mexico (UNM) School of Law prepared this Baseline Report for the Grid Modernization Advisory Group (GMAG), a group of experts convened by EMNRD in response to Energy Grid Modernization Roadmap Act (NMSA 1978 § 71-11-1).

In Technology Roadmapping,[1] there are three essential questions:

1) Where are we now?
2) Where do we want to go? (and why?)
3) How do we get there?

This Baseline Report (hereafter, “Baseline”) is intended to help begin to answer these questions. Part 1 of this Baseline provides a synopsis of the most recent and relevant policies that bear on grid modernization. Together these policies describe where we are now and point us in a certain direction, providing some, but perhaps not all, of the answer to question 1. Readers are encouraged to consider whether current policies are flexible enough to allow the cost-effective technical changes we want to happen.

Part 2 provides the best available (to us) data summarizing the state of New Mexico’s electric grid system and infrastructure, as framed by a set of nationally recognized objectives for a modern grid.[2] These data provided a foundation on which to ground conversations among the GMAG participants and will guide the next stage of implementation. Forward progress can be reported as the delta, or change, from these data points.

PART 1 POLICY OVERVIEW

Prepared by Gabe Pacyniak, Associate Professor, UNM School of Law

1.1. OVERVIEW OF STATE AND FEDERAL POLICIES BEARING ON THE DEVELOPMENT OF THE ELECTRICITY GRID IN NEW MEXICO

This section provides a brief overview of state, and to a more limited extent, federal policies that will bear on the modernization of electricity grids in New Mexico. It focuses on the modernization of the *distribution* grid but includes high-level descriptions of policies affecting the bulk power system—that is centralized power plants and high-voltage transmission lines—as well.[3] It begins with a brief overview of the laws that regulate the construction and improvement of electricity infrastructure in New Mexico.

This section describes policies related to the deployment, integration, or implementation of the following grid components or characteristics, drawn from the Energy Grid Modernization Roadmap Act:[4]

- renewable energy and energy storage;

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[1] Phaal, R. *Roadmapping for strategy and innovation* (2015). Center for Technology Management, Institute for Manufacturing, University of Cambridge.

[2] USDOE, *Modern Distribution Grid, vol. 1* (2017). This list was compiled from a meta-analysis of state grid modernization legislative and regulatory documents.

[3] *Background: Bulk Power System*, Western Electricity Coordinating Council (WECC), https://www.wecc.org/epubs/StateOfTheInterconnection/Pages/The-Bulk-Power-System.aspx.

[4] NMSA 1978, § 71-11-1(G)(2) (2020). In some cases, there are no policies that directly address some of these components or characteristics.

- demand side management and energy efficiency;
- infrastructure and technology to support electric vehicle charging;
- microgrids;
- advanced metering infrastructure, automated control systems, and communications networks;
- hardening or resilience improvements to both the distribution and transmission grids;
- cybersecurity; and
- customer service and access to information.

Many of the policies described relate to the decarbonization of the electricity grid, which will be necessary to mitigate climate change. The list includes the Governor's executive order,[5] which establishes a GHG reduction target, as well as state policies that promote clean technologies or processes such as utility-scale and distributed renewable energy resources, energy efficiency and demand-response, and electric vehicles.

Some of these new technologies include distributed energy resources (DERs), which allow electricity consumers to increasingly serve as energy producers, managers, and market participants.[6] The growth of DERs represents a major change to both the physical function of the grid and the electricity business, and DERs bring both benefits and challenges to distribution grid operation.[7] Although it is unclear how large of a role DERs will play in the grid of a future—as this depends in part on federal, state, and local policy choices—DERs already play a significant role.[8] For example, in 2020, distributed solar generation made up 18% of all solar electricity generated in the state, and 4% of all renewable energy.[9]

To fully accommodate and take advantage of these new technologies, transitioning to a modern grid will require advances to distribution grid management, controls, and communications.[10] Advances in these areas can also benefit consumers by providing more information and control over how consumers interact with the grid.

Finally, the grid will face exacerbated or new challenges due to both climate change and cybersecurity threats. An improved grid will therefore need increased resilience to address these threats.

1.2. OVERVIEW OF LEGAL FRAMEWORK GOVERNING UTILITY INVESTMENT AND RESOURCE PLANNING

In the United States, regulatory authority over the electricity system is split between states and the federal government.[11] States—and sometimes local governments—are generally responsible for regulation of local distribution and retail sales of electricity within a state, as well as the siting and construction of generation, distribution system, and transmission facilities.[12] The federal government, through the Federal

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[5] Executive Order 2019-003 – Climate Change and Energy Waste Prevention

[6] Glen Andersen, Megan Cleveland & Daniel Shea, *Modernizing the Electric Grid: State Role and Policy Options* 55 5–7 (2019).

[7] *Id.*

[8] Ignacio Perez-Arriaga & Christopher Knittel, MIT Energy Initiative, *Utility of the Future* 2 (2016).

[9] Calculated by author from Electricity Data Browser, U.S. Energy Information Administration, https://www.eia.gov/electricity/data/browser/#/topic/0?agg=2 (comparing net generation in megawatt hours for New Mexico between "small-scale solar photovoltaic," "all solar," and "other renewables").

[10] *Id.*

[11] F.E.R.C. v. Elec. Power Supply Ass'n, 136 S. Ct. 760, 767 (2016).

[12] Kenneth L Wiseman et al., Electricity Regulation in the United States (2018), https://us.practicallaw.thomsonreuters.com/8-525-5799; *see also* Ark. Elec. Coop. Corp. v. Ark. Pub. Serv. Comm'n, 461 U.S. 375 (1983).

Energy Regulatory Commission (FERC), regulates wholesale electricity sales and interstate transmission of electricity.[13]

NEW MEXICO REGULATION OF ELECTRIC UTILITIES

PRC Regulation of Utility Rates, Infrastructure Investment, and Infrastructure Siting

The New Mexico Constitution established the Public Regulation Commission (PRC or Commission) and tasked it with regulating electric and natural gas utilities, among others, in accordance with laws enacted by the Legislature.[14] The Constitution provides that the PRC is composed of five elected members until 2023.[15]

Pursuant to a Constitutional amendment approved by voters in 2020, the PRC will transition in 2023 to a three-member body.[16] Members will be appointed by the Governor, with the consent of the Senate, from a list of qualified candidates identified by a seven-member nominating committee.[17] No more than two members of the Commission may be members of the same political party.[18]

Under the New Mexico Public Utility Act (PUA),[19] the state's three investor-owned electric utilities (IOUs)—Public Service Company of New Mexico (PNM), El Paso Electric (EPE), and Southwestern Public Service Company (SPS, a subsidiary of Xcel Energy)—are subject to a traditional monopoly-utility regulatory structure. These utilities have been granted a monopoly to provide electricity generation, transmission, and distribution service to a specific geographic area. They are required to provide "adequate and reliable" electricity service to customers in the service area at "fair, just and reasonable rates" that do not unreasonably discriminate between customers.[20] Electricity rate changes must be noticed to interested parties and authorized by the PRC. An IOU is allowed to set rates at a level to recover its "cost of service," which is defined as its annual operating and administrative expenses together with a reasonable rate of return on the utility's capital investments.[21] The Commission approves, modifies, or denies the rate changes after reviewing for reasonableness, typically after a public hearing.[22]

Nineteen rural electric distribution cooperatives also provide electricity distribution service to most of the rural territory of New Mexico.[23] These rural cooperatives are non-profit organizations that are owned by their customers.[24] Although these cooperatives are also subject to PRC regulation, they are regulated to a much lesser degree, reflecting their non-profit status.[25] For example, when new rates are proposed by a cooperative to the PRC, the rates automatically become effective without a hearing unless a protest is filed by a qualifying number of cooperative members.[26]

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[13] 16 U. S. C. §824(b)(1) (1920, as amended 2015).

[14] N.M. Const. art. XI, §§ 1, 2.

[15] N.M. Const. art. XI, § 1.A.

[16] N.M. Const. art. XI, § 1.B; *see* S.J.R. 1., 54th Leg., 1st Sess. (N.M. 2019), *available at* https://www.nmlegis.gov/Sessions/19%20Regular/resolutions/senate/SJR01.pdf.

[17] N.M. Const. art. XI, § 1.B; Public Regulation Commission Act, NMSA 1978 § 62-19-1 et seq. (1998, amended in 2020) (establishing membership of nominating committee and qualifications for PRC member nominees).

[18] N.M. Const. art. XI, § 1.B.

[19] NMSA 1978 § 62-3-1 et seq. (1967, amended in 2008).

[20] NMSA 1978 § 62-3-1 (1967, amended in 2008); § 62-8-7 (1991, as amended in 2011); § 62-8-6 (1941, as amended in 2008).

[21] See 17.9.530.7(I) NMAC.

[22] NMSA 1978 § 62-3-2(B)-(D) (1991, as amended in 2011).

[23] *About New Mexico's Rural Electric Cooperative Members*, New Mexico Rural Electric Cooperative Association (NMRECA), https://www.nmelectric.coop/coops.

[24] *Id. Id. Id.*

[25] NMSA 1978 § 62-3-2(A) (1967, as amended in 1985).

[26] NMSA 1978 § 62-3-2(H) (1991, as amended in 2011).

Rural electric distribution cooperatives generally do not own their own generation or transmission assets. In New Mexico, most rural electricity cooperatives are members of a generation and transmission cooperative, either Tri-State Generation and Transmission Association, Inc. or Western Farmers Electric Cooperative.[27] These generation and transmission cooperatives are "cooperatives of cooperatives" that provide generation and transmission service through long-term power supply contracts with their member distribution cooperatives.[28] For the most part, the PUA does not authorize the Commission to regulate generation and transmission cooperatives.[29] One exception is that the PRC may conduct a hearing into wholesale electricity rates if three or more members of a generation and transmission cooperative protest the rate.[30]

The state also has a number of municipally-owned utilities, including those of the cities of Farmington and Gallup and of Los Alamos County.[31] Under the PUA, these utilities are exempted from most regulation by the PRC, although municipal utilities may opt-into such regulation.[32]

Utilities regulated by the PRC must receive PRC approval for the construction of any new generation facility or other "operating unit or system" by demonstrating that facility is "necessary" for the purposes of providing utility service. Utilities receive this approval by filing an application for a "certificate of public convenience and necessity."[33] The PRC interprets this standard to require a net public benefit.[34] These utilities must similarly receive approval for the sale or abandonment of any facility.[35] Several laws described below may require or allow the PRC to approve certain types of infrastructure proposals if they meet statutory criteria—these include laws guiding investments to support energy storage, transportation electrification, and grid modernization.

In addition, PRC regulations require that utilities file reports describing any intended "extensions, system improvements, or additions" meeting certain criteria prior to constructing such infrastructure. This reporting is required for, among other infrastructure, any extension, improvement, or addition to a "distribution line … facility, or system" costing over $500,000 that the utility will seek to include in its rate base.[36] The filing of the report is for "informational purposes" and is not to be deemed "an application by the utility for authority [from the PRC] to engage in the reported undertaking," but the regulations also state that the PRC is not to be precluded "from taking any action which it deems appropriate with respect to the reported matter."[37]

All entities, including municipal utilities and generation and transmission cooperatives, must seek PRC "location control" approval before constructing any power plant over 300 megawatts (MW) in capacity along with any associated transmission lines.[38]

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[27] *About New Mexico's Rural Electric Cooperative Members*, *supra* note 17. About New Mexico's Rural Electric Cooperative Members, *supra* note 14.
[28] *Id. Id. Id.*
[29] NMSA 1978 § 62-3-2(B) (1941, as amended in 2003).
[30] NMSA 1978 § 62-6-4(D) (1941, as amended in 2003).
[31] *See* list of retail electricity utilities in New Mexico, EIA 2018 Utility Bundled Retail Sales- Residential, https://www.eia.gov/electricity/sales_revenue_price/.
[32] NMSA 1978 §§ 62-3-3(E) (2009); NMSA 1978 § 62-6-4(A) (2003).
[33] NMSA 1978 § 62-9-1(A) (1941, as amended in 2019).
[34] New Energy Econ., Inc. v. New Mexico Pub. Regulation Comm'n, 2018-NMSC-024, ¶ 14 (citing *In re Valle Vista Water Util. Co.*, 212 P.U.R. 4th 305, 309 (2001)).
[35] NMSA 1978 § 62-9-5 (2005)
[36] 17.5.440.9 (A) NMAC.
[37] 17.5.440.9 (B) NMAC.
[38] NMSA 1978 § 62-9-3 (1971, as amended in 2005).

Integrated Resource Planning Requirement for IOUs

IOUs are also required to develop and submit Integrated Resource Plans (IRPs), intended to identify the mix of energy resources that the utility can use to cost-effectively and reliably meet electricity demand while also achieving environmental mandates, such as the state's Renewable Portfolio Standard (see below). The 20-year plans are to "evaluate renewable energy, energy efficiency, load management, distributed generation and conventional supply-side resources" taking into account "risk and uncertainty of fuel supply, price volatility and costs of anticipated environmental regulations in order to identify the most cost-effective portfolio of resources to supply the energy needs of customers."[39] Where considering two resource options that are otherwise equal in terms of cost and service, utilities are directed to "prefer resources that minimize environmental impacts."[40] The IRP is to include a four-year "action plan" detailing specific actions that the utility will take to implement the plan.[41] Utilities are required to engage in a public advisory process in the development of plans, and the PRC conducts a review of the proposed IRP for compliance with IRP regulations.[42] Once an IRP is approved, utilities have an obligation to notify the PRC of any material events that would change the IRP and to describe how such events have changed the action plan. The acceptance of an IRP and included action plan do not supplant the need for the utility to go through required approval processes for constructing or abandoning utility infrastructure described above,[43] but the PRC will generally consider the IRP and action plan in their consideration of an application for a certificate of public convenience and necessity, abandonment, or location control.

Renewable Energy Transmission Authority (RETA) Role in Transmission and Storage Planning, Financing, Development

In 2007, New Mexico enacted the New Mexico Renewable Energy Transmission Authority Act.[44] The Act established the Renewable Energy Transmission Authority (RETA), and authorized it to "plan, finance, develop, and acquire high voltage transmission lines and storage projects in order to promote economic development in New Mexico."[45] The law authorizes RETA to act in a variety of ways to support or partner with transmission and energy storage developers, including by issuing bonds to finance projects, becoming a co-developer, and exercising eminent domain to secure a right-of-way.[46] RETA-sponsored projects must have at least 30% of power originating from renewable resources.[47] As described above, transmission projects associated with large power plants—including large renewable energy facilities—require PRC "location control" approval as described above, and projects developed by PRC-regulated utilities also require a certificate of public convenience and necessity. RETA-sponsored projects additionally require a PRC determination that the projects will not diminish electric service reliability if eminent domain is exercised.[48]

In addition, in 2020 RETA published a New Mexico Renewable Energy Transmission and Storage Study that identified transmission system alternatives that could support the interconnection of up to 11,500 MW

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[39] NMSA 1978 § 62-17-10 (2005).

[40] 17.7.3.6 NMAC.

[41] 17.7.3.9 (I) NMAC.

[42] If the PRC determines that a utility's IRP does not comply with PRC requirements, the Commission is to identify deficiencies and "return [the IRP] to the utility with instructions for re-filing." 17.7.3.9(h), 17.7.3.12 NMAC.

[43] 17.7.3.10 NMAC.

[44] NMSA 1978, § 62-16A-1 *et seq*. (2007);

[45] NMSA 1978, § 62-16A-1 (2007); *see also* presentation of Robert Busch, Chairman, NM RETA, in front of New Mexico Oversight Committee, Nov. 8, 2018, at 2, available at https://www.nmlegis.gov/handouts/WNR%20072618%20Item%208%20NM%20RETA%20Presentation.pdf.

[46] NMSA 1978, § 62-16A-4(B) (2007); NM RETA, Project Selection Policy (2017), https://nmreta.com/wp-content/uploads/2019/11/FINAL-Project-Selection-Policy-7.26.17.pdf.

[47] NMSA 1978, § 62-16A-2(D) (2007).

[48] NMSA 1978, § 62-16A-4(B)(8) (2007).

of renewable energy for delivery in New Mexico and export to areas of demand while maintaining system reliability requirements.[49]

CONTRACTUAL CONSTRAINTS ON SELF-OWNED GENERATION FOR RURAL ELECTRICITY COOPERATIVES

As described above, rural electricity cooperatives are regulated to a much lesser degree by the PRC. Rural electricity *distribution* cooperatives, however, are often constrained in the types of electricity resources that they can develop by their contractual relationship with their *power supply* cooperative. This bears on the degree to which rural distribution cooperatives can add renewable resources and energy storage to their distribution grids, and therefore has bearing on grid modernization.

Historically, generation and transmission cooperatives received federal financing to build out their generation and transmission assets. As a condition of this financing, these generation and transmission cooperatives were required to enter into long-term (e.g., 40 year) contracts with their member distribution cooperatives where the cooperatives would agree to have nearly all of their electricity demands met by the power supply cooperative. This guaranteed a stream of revenue to the power supply cooperative to repay its federal loans.[50] These contracts remain typical, even if a power supply cooperative is no longer a federal borrower and therefore not subject to conditions set by the federal Rural Utilities Service.

One effect of these contracts is that they limit the amount of local, distributed generation that a local distribution cooperative can own or control. For example, under Tri-State's historic power supply contracts, member distribution cooperatives could only own or control generation supplying up to 5% of their electricity needs.[51] This has become a source of contention for some of Tri-State's member cooperatives and was a factor in the Kit Carson Electric Cooperative choosing to leave Tri-State.[52]

In early 2020, Tri-State announced a change to its policies under its "Responsible Energy Plan" that would allow member distribution cooperatives to "build community solar to serve an additional 2 megawatts or 2% of their consumption" above the 5% self-generation limit.[53] In April of 2021, Tri-State further announced a process by which cooperatives could seek to additionally increase self-generation, with interested cooperatives being able to self-supply in aggregate up to 10% of Tri-State's system peak demand.[54]

FEDERAL REGULATION OF ELECTRIC UTILITIES

FERC Jurisdiction, Regulation of Wholesale and Transmission Rates

Under the Federal Power Act (FPA), FERC regulates the pricing of most wholesale energy transactions and interstate transmission.[55]

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[49] New Mexico Renewable Energy Transmission Authority, New Mexico Renewable Transmission and Storage Study (2020), https://nmreta.com/nm-reta-transmission-study/.

[50] *See generally,* Gabriel Pacyniak, *Greening the Old New Deal: Strengthening Rural Electric Cooperative Supports and Oversight to Combat Climate Change*, 85 Mo. L. Rev. 409, 458 (2020), available at https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3605515.

[51] *Id.*

[52] *See* Kit Carson Electric Cooperative, 2017 Annual Report (2017), *available at* https://kitcarson.com/wp-content/uploads/2018/06/2017-Annual-Report.pdf.

[53] Tri-State, Responsible Energy Plan 5 (2020).

[54] Press Release, Tri-State Generation and Transmission Association, Tri-State Takes Significant Step to Increase Member Flexibility, Sets Contract Termination Payment Methodology, (April 9, 2020), https://www.tristategt.org/tri-state-takes-significant-step-increase-member-flexibility-sets-contract-termination-payment.

[55] 16 U.S.C. § 824d.

Cooperatives are usually—but not always—exempt from FERC's jurisdiction in these areas. In particular, the FPA exempts cooperative utilities that receive financing under the Rural Electrification Act, sell less than 4 million megawatt-hours per year, or are exclusively owned by entities that meet either of these two prior criteria.[56] Tri-State, which serves many of New Mexico's rural distribution cooperatives, voluntarily submitted to FERC jurisdiction in 2020.[57]

State entities and political subdivisions of a state—including municipal utilities—are also exempt from FERC jurisdiction.[58]

As with state regulation of electricity rates, the FPA requires FERC to ensure that wholesale and transmission rates are "just and reasonable" and non-discriminatory.[59] With regard to transmission service, in order to ensure that transmission rates are non-discriminatory, FERC requires each utility transmission provider to provide open access transmission service.[60] This means that each transmission provider must offer a published rate available to any potential transmission customer.

FERC and DOE Role in Transmission Siting

Although siting of electricity transmission infrastructure has primarily been a state role, FERC and the federal Department of Energy (DOE) also play a role in siting of interstate transmission facilities.[61] Under its Order 1000, FERC requires transmission-owning utilities to participate in regional transmission planning processes that consider, among other things, state public policy requirements, and that result in transmission plans.[62] Order 1000 also requires that these transmission planning processes identify a cost allocation method that is intended to ensure that utilities split costs according to the benefits provided by the transmission infrastructure.[63] In certain circumstances, FERC may also play a "backstop" role in permitting the siting of transmission infrastructure;[64] however, this does not apply to New Mexico.[65]

ROLE OF WHOLESALE AND INTERSTATE ENERGY MARKETS

Beginning in 1996, FERC encouraged utilities engaged in interstate transmission and wholesale power sales to form Regional Transmission Organizations (RTOs) or Independent System Operators (ISOs) to

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[56] 16 U.S.C. § 824(f).
[57] Order Granting in Part and Denying in Part Petition, 170 FERC ¶ 61,224 at PP 82–92 (Fed. Energy Regulatory Comm'n 2020) (No. EL20-16-000).
[58] 16 U.S.C. § 824(f).
[59] 16 U.S.C. §§ 824d (a), (b).
[60] Order No. 888, FERC Stats. & Regs. ¶ 31,036 at 31,760-31,761.
[61] Adam Vann, *The Federal Government's Role in Electric Transmission Facility Siting* 17 (Congressional Research Service), Oct. 28, 2010.
[62] Order No. 1000 - Transmission Planning and Cost Allocation, FEDERAL ENERGY REGULATORY COMMISSION, https://www.ferc.gov/industries-data/electric/electric-transmission/order-no-1000-transmission-planning-and-cost (last visited Jul 20, 2020).
[63] *Id. Id. Id.*
[64] 16 U.S.C. § 824p.
[65] FERC has such authority in geographic areas designated by the federal Department of Energy as National Interest Electric Transmission Corridors. 16 U.S.C. § 824p. No part of New Mexico has been designated as part of such a corridor; certain counties in California and Arizona have been designated as part of the Southwest Area National Interest Electric Transmission Corridor. U.S. Department of Energy, *Fact Sheet: Designation of National Interest Electric Transmission Corridors, As Authorized by the Energy Policy Act of 2005* (2007), https://www.energy.gov/sites/prod/files/edg/media/NIETC_Fact_Sheet.pdf.

better coordinate, control, and monitor an interstate electricity grid.[66] Today there are seven RTOs/ISOs in the U.S., usually organized as non-profit organizations. These serve as independent entities—meaning they are not owned or directly controlled by utilities—that administer and plan interstate transmission in the regions that they cover.

These RTOs/ISOs also operate wholesale power marketplaces, where suppliers of wholesale power can compete to provide bulk electricity at lowest cost to meet demand, usually through day-ahead and real-time markets. In addition to RTOs/ISOs, the Western Energy Imbalance Market (Western EIM) also offers a real-time wholesale power market in the West.[67] In areas without RTOs/ISOs, wholesale power transactions take place through bilateral trading (i.e., through direct negotiation and contracting between buying and selling utilities).

Wholesale power markets can help promote the deployment of renewable energy, because they can more efficiently match electricity demand with excess supply. This is especially true of real-time markets, which can help efficiently accommodate the variable nature of renewable energy, as well as geographic diversity between renewable resources and load centers.[68] To the extent that RTOs can help expedite transmission planning and management, they can also help ensure sufficient transmission capacity to match renewable generation with electricity loads.

In New Mexico, SPS is a member of the Southwest Power Pool, an RTO that provides both oversight of the bulk electricity grid and a wholesale power market. El Paso Electric and the City of Farmington both use the SPP's Reliability Coordinating Services that are offered to utilities on the Western Grid. On April 1, 2021, PNM joined the Western EIM.[69]

1.3. STATE CLIMATE CHANGE POLICY: GOV. LUJAN GRISHAM EXECUTIVE ORDER AND CLIMATE STRATEGY

New Mexico's climate change policy establishes a greenhouse gas reduction target and identifies potential policies to achieve that target, including widespread vehicle electrification. These strategies have an impact on grid infrastructure development and modernization.

On January 29, 2019, Gov. Lujan Grisham issued an executive order aimed at building a "clean energy future" and "limit[ing] adverse climate change impacts."[70] The order included a number of directives, including the following:

- Establishing a goal of reducing statewide greenhouse emissions by at least 45% by 2030 as compared to 2005 levels;

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[66] *See* Promoting Wholesale Competition Through Open Access Non-discriminatory Transmission Services by Public Utilities and Recovery of Stranded Costs by Public Utilities and Transmitting Utilities, Order No. 888, 61 Fed. Reg. 21,540 (May 10, 1996); Regional Transmission Organizations, Order No. 2000, 65 Fed. Reg. 809 (January 6, 2000); *see also Electric Power Markets*, Federal Energy Regulatory Commission, https://www.ferc.gov/industries-data/market-assessments/overview/electric-power-markets.

[67] *Western EIM - About*, Wester EIM, https://www.westerneim.com/Pages/About/default.aspx.

[68] See e.g., M. MILLIGAN ET AL., *Examination of Potential Benefits of an Energy Imbalance Market in the Western Interconnection* (2013), http://www.osti.gov/servlets/purl/1071943/ (last visited Jul 21, 2020).

[69] Press Release, *LADWP and Public Service Company of New Mexico join the EIM*, Western Energy Imbalance Market, April 1, 2020, https://www.westerneim.com/Documents/LADWP-and-Public-Service-Company-of-New-Mexico-Join-the-EIM.pdf.

[70] Governor Lujan Grisham, Exec. Order on Addressing Climate Change and Energy Waste Prevention, No. 2019-003 (Jan. 29, 2019), https://www.governor.state.nm.us/wp-content/uploads/2019/01/EO_2019-003.pdf.

- Directing EMNRD and NM Environment Department (NMED) to work with stakeholders on legislation to increase the New Mexico Renewable Portfolio Standard (RPS) and increase New Mexico's energy efficiency standards for electric utilities (both of these were accomplished in 2019—see description below);
- Creating an interagency Climate Change Task Force (Task Force) and directing it to develop a strategy document with recommendations on how to reach the state's GHG targets. The Task Force was specifically directed to consider the following policies that may bear on grid modernization efforts:
  - a comprehensive market-based program that sets emission limits to GHG emissions;
  - adoption of Zero Emission Vehicle (ZEV) standards, which mandate car manufacturers to achieve a certain percentage of vehicle sales with electric vehicles or other vehicles that have zero or very low GHG emissions; and
  - collaboration with RETA to identify transmission corridors needed to transport the state's renewable electricity to market (this was accomplished in June 2020 through the publication of the New Mexico Renewable Energy Transmission and Storage Study).[71]

The Climate Change Task Force issued its initial recommendations and status update at the end of 2019,[72] and issued a further update and recommendations in 2020.[73]

1.4. POLICIES TO PROMOTE RENEWABLE ENERGY AND ENERGY STORAGE

The deployment of renewable energy and energy storage on the electricity grid is an important consideration for distribution grid modernization. A significant part of the growth of renewable energy and energy storage is through DERs, such as rooftop solar and customer-sited batteries. These DERs can provide benefits to the grid, such as providing supplemental and backup power to homes and businesses, reducing grid congestion, and potentially offsetting the need for additional generation and transmission capacity. But they can also create challenges by changing electricity loads in ways that may not be visible to grid managers, requiring distribution grid infrastructure upgrades, and raising equity issues related to cost shifting and access.[74]

As described below, a combination of federal and state policies helps drive deployment of renewable energy and energy storage in New Mexico. These include: New Mexico's renewable and zero carbon energy mandates; federal renewable energy tax credits; the federal Public Utility Regulatory Policy Act (PURPA) and state implementing regulations, which combine to mandate interconnection of small renewable resources and establish compensation policies including Net Energy Metering (NEM); the Community Solar Act; and PRC regulations for approving energy storage investments.

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[71] New Mexico Renewable Energy Transmission Authority, New Mexico Renewable Transmission and Storage Study (2020), https://nmreta.com/nm-reta-transmission-study/.

[72] New Mexico Interagency Climate Change Task Force, New Mexico Climate Strategy: Initial Recommendations and Status Update (2019),https://www.climateaction.state.nm.us/documents/reports/NMClimateChange_2019.pdf.

[73] New Mexico Interagency Climate Change Task Force, New Mexico Climate Strategy: 2020 Progress and Recommendations (2020), https://www.climateaction.state.nm.us/documents/reports/NMClimateChangeReport_2020.pdf.

[74] Andersen et al., *supra* note 4, at 5–6. Andersen, Cleveland & Shea*, supra* note 2 at 5–6.

RENEWABLE ENERGY AND ZERO CARBON ENERGY MANDATE (ETA)

Since 2004, New Mexico has required that IOUs and rural electricity cooperatives supply a specified portion of their electricity from renewable resources under a an RPS mandate.[75] In 2019, the state Legislature dramatically increased the level of renewable targets by enacting the Energy Transition Act (ETA), and also established a mandate requiring utilities to achieve a 100% zero carbon standard.

Under the ETA, IOUs must achieve the following targets:[76]

By 2020, at least 20% of retail sales must be from renewable energy
By 2025, at least 40% of retail sales must be from renewable energy
By 2030, at least 50% of retail sales must be from renewable energy
By 2040, at least 80% of retail sales must be from renewable energy
By 2045, 100% of retail sales must be from zero carbon resources

The ETA also established the following targets for rural distribution cooperatives:[77]

By 2020, at least 10% of retail sales must be from renewable energy
By 2025, at least 40% of retail sales must be from renewable energy
By 2030, at least 50% of retail sales must be from renewable energy
By 2050, 100% of retail sales must be from zero carbon resources (see footnote for caveats)

Public utilities are required to submit a procurement plan each year detailing how they plan to meet the standard in the coming year and reporting on renewable energy procurements in the prior year.[78]

Utilities demonstrate compliance with the RPS by submitting renewable energy credits (RECs) that represent the renewable energy attribute of each kilowatt-hour of electricity generated by renewable facilities.[79] RECs may be generated by any qualifying renewable energy generating facility in New Mexico or that delivers electricity into the state—including distributed renewable resources—or that is part of an "active regional market" for trading RECs as determined by the Commission.[80] Utilities may generate RECs from facilities they own, through electricity they contract for, or may procure RECs through trading. Utilities are also allowed to "bank" RECs for up to four years for compliance purposes.[81]

Prior to the 2019 enactment of the ETA, utilities were required to hold a "diversified portfolio" of renewable resources, meeting specific targets for different types of renewable resources such as solar or wind.[82] One of these diversity carve-outs was for distributed generation,[83] and therefore drove some of the deployment of renewable energy on the distribution grid. To meet this target, some utilities offered REC purchase programs that would compensate customers with distributed renewable resources for the RECs

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[75] 2004 N.M. Laws ch. 65; N.M. S.B. 43 (2004 Reg. Session). Prior to enactment of the Renewable Energy Act, the New Mexico Public Resources Commission (PRC) had established renewable energy targets by regulation in PRC Rule No. 573.

[76] NMSA 1978 § 62-16-4(A) (2004, as amended in 2019).

[77] 2050 target is effective "provided that" achieving the target is "technically feasible," can be achieved while providing reliable electric service, and will not cause service to become "unaffordable." NMSA 1978 § 62-15-34(A) (2007, as amended in 2019).

[78] NMSA 1978 § 62-16-4(G) (2004, as amended in 2019).

[79] NMSA § 62-16-5 (2004, as amended in 2019).

[80] 17.9.572.17 NMAC.

[81] NMSA § 62-16-5(B)(4) (2004, as amended in 2019).

[82] *See* 2011 New Mexico Laws Ch. 93 (S.B. 549)

[83] 17.9.572.11 NMAC.

generated by their resources.[84] The ETA eliminated the diversity requirement of the RPS, although the PRC has not yet updated its regulations governing RPS implementation.[85] The ETA also authorizes the PRC to approve incentives for utilities to exceed annual targets under the RPS.[86] The PRC is also required to report to the Legislature on efforts to meet the standard, benefits and challenges every four years; the first report was filed in 2020.[87]

FEDERAL AND STATE RENEWABLE ENERGY TAX CREDITS

Federal and state tax credits have been a primary driver of increased renewable energy deployment in the U.S. over the past two decades.[88]

Federal Investment Tax Credit and Production Tax Credit

Both of the major federal tax credit programs—the Investment Tax Credit and the Production Tax Credit—are in the process of being phased out, although the Biden Administration has proposed substantial extensions.

The Investment Tax Credit ("ITC") provides a one-time credit of 26% of capital costs for qualifying renewable energy projects that commence construction prior to 2023. The credit is most frequently used for both commercial and residential solar photovoltaic projects but can also be used for other customer-sited renewable projects including small wind.[89] The program will step down to a 22% credit in 2023 and a 10% commercial credit in 2024 and continues until revoked by congress (the residential solar credit terminates in 2024).[90]

The Production Tax Credit ("PTC"), provides a per-kilowatt-hour credit for renewable electricity produced in a qualifying project.[91] The PTC is frequently used by utility-scale wind projects, because to qualify the electricity must be sold by the developer to another entity.[92] Developers receive the credit for 10 years once the project goes into service. Developers of qualifying wind projects that start construction in 2021 will receive 60% of the "full" credit of approximately 2.5 cents-per-kilowatt hour.[93] After 2021, the program will terminate unless extended by Congress.

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[84] *See, e.g.,* PNM Customer Solar REC Purchase Program, https://www.pnm.com/solar.

[85] *Compare* NMSA § 62-16-4(B) (2004, as amended in 2019) *with* 2011 New Mexico Laws Ch. 93 (S.B. 549) at (A)(4) (omitting requirement that "renewable portfolio shall be diversified as to the type of renewable energy resource.")

[86] NMSA 1978 § 62-16-4(D) (2004, as amended in 2019).

[87] NMSA 1978 § 62-16-4(B)(7) (2004, as amended in 2019).

[88] Trieu Mai et al., Impacts of Federal Tax Credit Extensions on Renewable Deployment and Power Sector Emissions iv (2016).

[89] 26 U.S.C. §§ 25D(a), 48(a)(3); *see also* DSIRE, Business Energy Investment Tax Credit, https://programs.dsireusa.org/system/program/detail/658.

[90] 26 U.S.C. §§ 25D(g), 48(a)(6),(7). The PTC phase down was most recently extended for certain technologies, including solar photovoltaic projects, by the Consolidate Appropriations Act, 2021, Pub. L. No. 116-260, 134 Stat. 3055, enacted in December of 2020. 26 U.S.C. §§ 25D(g), 48(a)(6),(7).

[91] 26 U.S.C. § 45.

[92] Molly F. Sherlock, *The Renewable Electricity Production Tax Credit: In Brief* 16 (Congressional Research Service), Apr. 29, 2020, at 1, 16.

[93] 26 U.S.C. §§ 45 (b)(5)(D), (d)(1); *see also* U.S. wind energy production tax credit extended through 2021, Energy Information Administration (EIA), Jan. 28, 2021, https://www.eia.gov/todayinenergy/detail.php?id=46576#:~:text=At%20the%20end%20of%20December,of%20the%20full%20credit%20amount.. *Id.*

President Joseph Biden proposed a 10-year extension to both the ITC and PTC in his “American Jobs Plan” legislative proposal for infrastructure investments.[94]

State New Solar Market Development Income Tax Credit

In 2020 the New Mexico Legislature reestablished a tax credit for customer-sited solar generation. Beginning in March 2020, customers who install solar systems on their residence, business, or agricultural enterprise are eligible for a one-time tax credit of 10% of the purchase and installation costs of the system, up to a maximum of $6,000. The credit is capped at $8 million a year and expires after 2027.[95]

PURPA AND STATE INTERCONNECTION, NET ENERGY METERING POLICIES

A combination of federal and state policies governs the right of renewable and alternative energy facilities to interconnect with the electricity grid and determine how those resources are compensated. PURPA requires utilities to interconnect qualifying energy facilities under 80 MW in capacity and to purchase electricity from these generator stations at an “avoided cost” rate, although many of the implementation details are left to the PRC, or to utilities where they are not subject to PRC jurisdiction. The NM interconnection and metering policies dictate how PURPA is implemented among utilities under PRC jurisdiction, and also applies to resources that are not qualifying facilities (QFs) for the purposes of PURPA.

For small, customer-sited renewable energy installations under 10 kilowatts (kW)—including many rooftop solar installations—NM PRC regulations require that utilities provide “net metering” to these customers, a policy that has helped drive rooftop solar adoption onto the distribution grid, although implementation varies by utility.

PURPA

PURPA’s Section 210—as implemented through FERC regulations—requires utilities to allow small alternative energy and co-generation facilities to interconnect with their grid.[96] It also requires that utilities purchase power from these QFs at an “avoided cost” rate, and that they sell power to these facilities at a non-discriminatory rate.[97] The avoided cost rate is intended to be the rate that the utility would otherwise have incurred to generate or purchase the incremental unit of power that it is instead procuring from the qualifying facility.[98] In July 2020, FERC finalized a major revision of PURPA regulations that provided more flexibility to states to determine how QFs are to be compensated, including the flexibility to use updated avoided cost rates that will provide less revenue certainty to QFs.[99]

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[94] *Fact Sheet: The American Jobs Plan*, The White House (March 31, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/31/fact-sheet-the-american-jobs-plan/ (last visited May 27, 2021).

[95] NMSA 1978 § 7-2-18.31 (2020).

[96] The cost of the interconnection—–including of any new transmission or distribution infrastructure—is borne by the QF but must be assessed at a non-discriminatory rate that the utility would provide to other customers as determined by the PRC or by a utility not subject to the PRC’s jurisdiction. 18 C.F.R. § 292.306.

[97] 16 U.S.C. § 824a-3(a) (1978 as amended in 2005). Avoided cost is the cost the utility would otherwise have incurred to generate or purchase the incremental unit of power that it is instead procuring from the qualifying facility – in economic terms, the marginal cost. Regulations Implementing Section 210 of PURPA, 45 Fed. Reg. 12214, 12216 (Feb. 25, 1980).

[98] 18 C.F.R.CFR § 292.304.

[99] FERC, Fact Sheet - Final Rule: Qualifying Facility Rates and Requirements (July 16, 2020), https://www.ferc.gov/news-events/news/ferc-modernizes-purpa-rules-ensure-compliance-reflect-todays-markets.

States typically establish regulations for the calculation of the avoided cost rate and the terms of contracts offered to QFs under PURPA for utilities under their jurisdiction.[100] Utilities not subject to PRC jurisdiction for the purposes of PURPA establish their own avoided cost rates and contract terms.

In order to be designated a PURPA QF, facilities greater than 1 MW must file either a self-certification or an application at FERC. Facilities smaller than 1 MW in capacity—including most residential- and commercial-rooftop solar facilities—do not need to file with FERC in order to qualify as a QF.[101]

State Regulations for Interconnection of Generating Facilities

PRC regulations generally require utilities subject to PRC jurisdiction to interconnect new generation facilities—including customer-sited renewable energy resources, such as rooftop solar—with utility electricity grids if they meet certain criteria.[102] The process and criteria differ based on the size of the system; systems under and over 10 MW are governed by two different regulations.[103]

Smaller systems may qualify for simpler technical reviews and application processes. Projects under 10 kW, including many residential rooftop solar projects, may qualify for a “Simplified Interconnection” process. Projects between 10 kW and 2 MW, including larger residential and many commercial rooftop solar projects, may qualify for a “Fast Track” process with or without supplemental review. Projects between 2 MW and 10 MW must conduct a full-interconnection study, and projects over 10 MW undergo a case-specific review.[104] The current New Mexico Interconnection Manual, which together with PRC regulations establishes interconnection requirements and processes, was created in July of 2008. In 2021, the PRC began an inquiry to revise the manual and associated regulations, with a particular focus on how such policies “affect the deployment of small-scale behind the meter (BTM) distributed generation, including but not limited to solar photovoltaics (PVs), and energy storage systems (ESS).[105]

State Net Energy Metering Policies

Net energy metering (NEM or “net metering”) refers to the practice of allowing utility customers who both consume and produce electricity to be billed on a “net energy” use basis, meaning that how much they owe, or are owed, by the utility is based on the difference between the amount of energy they consume and the energy they produce during a given period of time.

PRC metering regulations treat small and large systems differently. For customer-sited systems less than 10 kW, PRC regulations require net metering to be provided by the utility, although customers may opt-out of net metering. The utility is allowed a choice in how to credit the net contribution of electricity from the customer-sited system. The utility may either credit the customer for the net kilowatt-hours of energy supplied—effectively the retail electricity rate—or may credit the customer at the avoided energy rate filed by the utility (a lower, wholesale electricity rate).[106] The three IOUs have chosen to implement this requirement in different ways.

For QFs over 10 kW, the regulations provide for three metering options that must be offered by utilities, including net metering. Under this net metering option, any excess energy sold by the QF to the utility is

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[100] 18 C.F.R. §§ 292.302(e), 292.304(e).
[101] 18 C.F.R. §§ 292.203(a)(3), (d)(1).
[102] 17.9.568.13(A) NMAC; 17.9.569.8(A) NMAC. Note that the PRC interconnection regulations apply to both QF and non-QF facilities. 17.9.568.2(A) NMAC; 17.9.569.2(A) NMAC.
[103] 17.9.568.2(B) NMAC; 17.9.569.2(B) NMAC.
[104] NEW MEXICO INTERCONNECTION MANUAL, 5 (2008), http://nmprc.state.nm.us/utilities/docs/NMInterconnectionManual2008.pdf.
[105] Initial Order Establishing and Providing Notice of Inquiry and Requesting Written Public Comments, Case No. 20-00171-UT (filed Jan. 13, 2021).
[106] 17.9.570.14 NMAC.

billed at the avoided energy rate.[107] Utilities are also authorized to recover the cost of ancillary and standby services through rate riders.[108] Riders are mechanisms for utilities to recover costs ahead of the ability to raise rates. They also help keep track of money collected for specific programs.

COMMUNITY SOLAR ACT

Some utility customers, such as renters or residents of multi-family buildings, are not able to invest in on-site renewable energy such as rooftop solar. Since many of these individuals are lower-income, that means that lower-income people are less able to access the economic and environmental benefits that more affluent residential customers are able to access through distributed energy, and which are facilitated or subsidized through policies like net-energy metering and tax credits.

Community or shared-energy policies seek to provide these customers an opportunity to access the benefits of distributed energy investment by authorizing individuals to participate in larger, community-sized projects that may not be located on their dwelling but can provide some of the same economic (bill savings) and environmental benefits.[109]

In 2021, the New Mexico Legislature enacted the Community Solar Act, authorizing community solar projects in New Mexico.[110] The Act requires the PRC to promulgate rules to establish a community solar program in investor-owned utility service territories. Under the statute, community solar projects are to be owned and operated by a subscriber organization, to be 5 MW or less in size, to have at least 10 subscribers, and to reserve at least 30% of subscriptions for low-income customers and low-income service organizations.[111] The Act caps community solar projects in investor-owned utility service territories at 200 MW of capacity until November 1, 2024, after which they will be subject to a cap established by the PRC. The cap is to to be proportionally allocated among investor-owned utilities.[112] Rural electricity distribution cooperatives may opt-in to the program.[113] Community Solar projects sited on the lands of Indian nations, Tribes, or Pueblos and owned or operated by native entities receive greater flexibilities under the Act.

The rules that PRC is required to promulgate must also establish a rate mechanism governing how utilities are to provide bill credits to community solar projects. The bill credit is to be based on the utility's "total aggregate retail rate on a per-customer-class basis," minus costs associated with electricity distribution as approved by the PRC. Under the statute, a utility's non-subscribers are not to subsidize costs attributed to subscribers, unless the PRC determines such subsidization is in the public interest, in which case costs to be subsidized by non-subscribers are capped at no more than three percent of the non-subscribers' aggregate retail rate on an annual basis.[114]

ENERGY STORAGE

Energy storage can help reduce peak loads and manage variable energy resources such as wind and solar, and in some cases, provide backup power to homes and businesses.[115] Energy storage can be

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[107] 17.9.570.10(C) NMAC.
[108] NMSA 1978 62-13-13.2 (2010).
[109] See JENNY HEETER, KAIFENG XU & EMILY FEKETE, National Renewable Energy Laboratory, *Community Solar 101* 3 (2020), https://www.nrel.gov/docs/fy20osti/75982.pdf.
[110] Community Solar Act, S.B. 84, N.M. Leg. (2021 Reg. Sess.) (enacted); 2021 N.M. Laws Ch. 34.
[111] Community Solar Act, S.B. 84, N.M. Leg., § § 4, 6, 7, (2021 Reg. Sess.) (enacted); 2021 N.M. Laws Ch. 34.
[112] Id. at § 7.
[113] Id. at § 8.
[114] Community Solar Act, S.B. 84, N.M. Leg., § 7, (2021 Reg. Sess.) (enacted); 2021 N.M. Laws Ch. 34.
[115] Andersen et al., *supra* note 4, at 8–9.

implemented at utility scale (often in conjunction with renewable generation), as part of a microgrid, or as a customer-sited resource (again, often in conjunction with distributed renewable generation). Recent reductions in battery electric storage technology prices have dramatically accelerated the deployment of both customer- and utility-owned battery storage technology. As with other DERs, one important factor in distribution grid management is whether the utility operating the grid has information about, and potentially control over, battery storage resources to help manage the grid.

ETA Criteria for PRC Approval of Energy Storage Investments

The 2019 ETA legislation required the PRC to approve utility investment in energy storage systems under specified conditions. In particular, the Commission is required to approve a certificate of public convenience and necessity for energy storage systems that meet the following criteria, among others: proposed systems must reduce costs by avoiding or deferring the need for new generation, transmission, or distribution infrastructure; reduce the use of fossil fuels during peak load periods; assist with grid reliability; and represent the most cost-effective choice among feasible alternatives.[116]

FERC Order 841 on Energy Storage in RTOs

In 2019 FERC issued an order that required RTOs to develop tariffs and rules that accommodate energy storage resources in wholesale energy markets. The RTOs are required to specifically accommodate "the physical and operational characteristics of electric storage resources" and to facilitate their participation in RTO markets.[117]

1.5. POLICIES TO PROMOTE DEMAND REDUCTION: ENERGY EFFICIENCY AND DEMAND RESPONSE

Policies that promote electricity demand reduction can be tools in a more dynamic distribution grid. Energy efficiency policies promote technologies and practices that reduce customer need for electricity, potentially avoiding the need for increased generation or transmission resources and providing environmental benefits. Demand Response refers to technologies and practices that allow customers, utilities or third-party actors to reduce customer electricity usage at times of peak demand.

NEW MEXICO EFFICIENT USE OF ENERGY ACT (ENERGY EFFICIENCY RESOURCE STANDARD)

The Efficient Use of Energy Act (EUEA) establishes a policy that utilities will include "all cost-effective energy efficiency and load management programs in their energy resource portfolios."[118] Energy efficiency programs reduce overall electricity demand, including peak load demand; load management programs decrease peak electricity demand and may shift demand to non-peak times.[119] Both programs can reduce the need to build additional generation and transmission infrastructure. Load management programs in particular can reduce the need to upgrade both distribution and transmission capacity.

The EUEA requires that the state's electric and natural gas IOUs achieve energy savings of at least 5% by 2025 from 2020 levels and authorizes utilities to charge ratepayers 3–5% of customer bills to fund

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[116] NMSA 1978 § 62-9-1 (1941, as amended in 2019).

[117] Electric Storage Participation in Markets Operated by Regional Transmission Organizations and Independent System Operators, Order No. 841, 83 Fed. Reg. 9,580 (2018); Order No. 841-A, 84 Fed. Reg. 23,902 (2019).

[118] NMSA § 62-17-3 (2005, as amended in 2008).

[119] *See* respective definitions, NMSA § 62-17-4 (2005, as amended in 2019).

such programs.[120] Utilities may recover these costs through a tariff rider or in base rates.[121] At least 5% of a utility's efficiency program funds are required to be "directed to energy efficiency programs for low-income customers."[122]

The EUEA and the PRC's implementing regulations require that utilities each file a plan for approval of their energy efficiency portfolios every three years.[123] Utilities are also required to submit an annual report describing actual efficiency expenditures and evaluating the cost-effectiveness of the expenditures.[124]

A 2019 amendment to the EUEA included provisions requiring the PRC to "decouple" utility rates from sales, with the goal incentivizing utilities to promote energy savings instead of increased sales of electricity or natural gas. The PRC is specifically required to approve rate mechanisms for each utility to accomplish this goal.[125] PNM filed an application to the PRC in 2020 to have a decoupling rate-adjustment mechanism approved, and proceedings in the matter are pending.[126]

Under the EUEA, rural electricity cooperatives are not required to meet any specific energy savings target or to invest a portion of efficiency funds in low-income households. They are authorized to spend up to 1% of their overall revenues on a renewable energy and conservation fee.[127] Rural electricity cooperatives are required to provide an annual report detailing all of the utility's efforts to "promote energy efficiency, conservation or load management."[128] They were also required to submit energy efficiency and load management targets by January 1, 2009.[129]

1.6. POLICIES TO PROMOTE ELECTRIC VEHICLE DEPLOYMENT AND INFRASTRUCTURE

Achieving rapid decarbonization of the transportation sector will require a rapid shift to electric vehicles (EVs),[130] and such a shift would have a significant impact on the distribution grid. EVs can bring both benefits and challenges to the distribution grid, although much will depend on vehicle charging practices and technologies. Where EV ownership or charging locations are relatively dense, the distribution grid may require infrastructure upgrades. In addition, if EV charging occurs at the same time, EV charging has the potential to increase peak demand. At the same time, EVs may have the potential to provide services to the grid, including energy storage or ancillary services such as frequency regulation.[131] EVs also have the potential to serve as load management devices, shifting charging to non-peak times and utilizing excess energy from renewable generation.

One important consideration for the buildout of an EV transportation system is who will build and operate public EV charging stations. Public fast-charging stations are important to combat "range anxiety" and

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[120] NMSA §§ 62-17-5, 62-17-6. EUEA costs to large customers are capped at $75,000.
[121] NMSA §§ 62-17-5, 62-17-6 (A) (2005, as amended in 2019)
[122] NMSA § 62-17-6 (B) (2005, as amended in 2019)
[123] NMSA § 62-17-5 (E); 17.7.2.8 NMAC.
[124] 17.7.2.14 NMAC.
[125] NMSA § 62-17-5 (F).
[126] In the Matter of the Petition of PNM, Pursuant to the EUEA, For Approval of a Rate Adjustment Mechanism to Remove Regulatory Disincentives and Original Rider No. 52, Case No. 20-00121-UT (filed May 28, 2020).
[127] NMSA § 62-17-11 (requiring rural electricity cooperatives to establish an efficiency target and submit report, but not requiring any specific energy savings target); NMSA § 62-15-36 (limiting energy and conservation fee to no more than one percent).
[128] NMSA § 62-17-11 (b).
[129] NMSA § 62-17-11 (a).
[130] The White House, *United States Mid-Century Strategy for Deep Decarbonization* (2016), https://unfccc.int/files/focus/long-term_strategies/application/pdf/mid_century_strategy_report-final_red.pdf.
[131] Andersen et al., *supra* note 4, at 10. Andersen, Cleveland & Shea, *supra* note 2 at 10.

make point-to-point travel possible and convenient. Specialized EV charging businesses, EV manufacturers, and utilities have all engaged in developing EV charging infrastructure across the country.[132]

STATE ACTIONS TO PROMOTE ELECTRIC VEHICLE DEPLOYMENT

Commitment to Adopting Zero-Emission Vehicle Standards

Gov. Lujan Grisham has committed to implementing “Clean Car Standards” that states can adopt under special authority in the federal Clean Air Act (CAA). These standards include a “Zero-Emission Vehicle” (ZEV) mandate that requires manufacturers to ensure that an increasing percentage of their sales are made up of zero emissions vehicles—such as battery electric vehicles—or plug-in hybrids. Rule-making is planned for 2021.

States may adopt these regulations under a CAA provision that allows states to adopt regulations that have been adopted by the state of California, which has unique authority to enact more stringent air pollution standards for motor vehicles.[133] Twelve other states have adopted California’s “Clean Car Standards,”[134] which combine standards for conventional pollutants and GHG emissions and also include the ZEV program.[135] California’s ZEV program requires manufactures to comply by meeting an increasing percent target through 2025 with “percent credits.” Manufacturers receive percent credits for each vehicle sold, with a higher credit for vehicles with a higher electric driving range. California anticipates that “about 8% of California new vehicle sales in 2025 will be ZEVs and plug-in hybrids.”[136]

VW Clean Air Act Settlement Investments

In 2016 and 2017, the federal government entered into settlement agreements with car manufacturer Volkswagen AG (VW) over VW’s use of “defeat devices” in diesel cars to cheat emissions testing under the Clean Air Act. As part of these settlement agreements, VW agreed to provide approximately $3 billion to states and tribal governments to mitigate emissions of nitrogen oxides (NOx). Eligible uses for this funding include purchasing electric trucks and buses, and to a more limited extent, investing in EV charging infrastructure for light duty vehicles.[137] New Mexico is eligible for $18 million of funding. The state committed to using 15% of this funding to develop EV charging stations, the largest percentage possible under the settlement.[138] In 2020 the New Mexico Environment Department announced $2.7 million in awards for EV charging stations, meeting this 15% commitment.[139]

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[132] *See* Nick Nigro et al., Strategic Planning to Implement Publicly Available EV Charging Stations: A Guide for Businesses and Policymakers (2015).

[133] 42 U.S.C. § 7543(b) (1955, as amended in 2005).

[134] 42 U.S.C. § 7507 (1955, as amended in 2005).

[135] Advanced Clean Cars Program, California Air Resources Board, https://ww2.arb.ca.gov/our-work/programs/advanced-clean-cars-program (last visited Jul 21, 2020).

[136] California Air Resources Board, *ZEV Regulation Fact Sheet* (2018), https://ww2.arb.ca.gov/resources/fact-sheets/zev-regulation-factsheet.

[137] OECA US EPA, *Volkswagen Clean Air Act Civil Settlement*, Overviews and Factsheets, US EPA (California, Feb. 13, 2019), https://www.epa.gov/enforcement/volkswagen-clean-air-act-civil-settlement.

[138] VW Settlement, New Mexico Environment Department, VW Beneficiary Mitigation Plan for the State of New Mexico (2019), https://www.env.nm.gov/wp-content/uploads/sites/26/2019/07/VW-Revised-BMP-07.12.19-Final.pdf.

[139] New Mexico Environment Department, 2020 VW LDZEV Charging Station Funding Awardees (2020), https://www.env.nm.gov/vw-settlement/wp-content/uploads/sites/26/2020/04/VW-Project-Selection_22Apr20_LDZEV.pdf.

As part of these settlements, VW also agreed to invest $2 billion in brand-neutral deployment of EV infrastructure and ZEV promotion through a subsidiary created for this purpose, Electrify America. VW's national investment plan includes fast charging stations in New Mexico along major highways.[140]

REV West Participation and Grant to Support Western EV Deployment

In 2017, Gov. Susana Martinez joined Governors of seven other western states in signing a memorandum of understanding (MOU) agreeing to develop a regional electric vehicle plan for the west.[141] In 2019, Gov. Lujan Grisham joined Governors of those same states in a subsequent MOU agreeing to expand work on the regional plan.[142] The REV West signatory states, along with other partners received a 2019 grant of $1.2 million to support EV deployment along rural corridors in the region.

PRC Application For Vehicle Electricity Act

In 2019, the Legislature enacted the PRC Application or Vehicle Electricity Act, which requires IOUs to submit applications by January 2021 to "expand transportation electrification." The applications may include "investments or incentives to facilitate the deployment of charging infrastructure and associated electrical equipment that support transportation electrification," rate designs, and programs that encourage charging, among others.[143] In considering the applications for approval, the PRC is to consider whether the proposals are reasonable and prudent. The PRC is also required to consider specific criteria, including whether the application is "reasonably expected to improve the public utility's electrical system efficiency, the integration of variable resources, operational flexibility and system utilization during off-peak hours."[144]

1.7. POLICIES BEARING ON ADVANCED GRID CONTROL, COMMUNICATION, AND METERING INFRASTRUCTURE INVESTMENTS

The growth of DERs and demand response means that the distribution grid is becoming more dynamic. As opposed to electricity flowing in one direction from centralized generation stations to customers, electricity now flows in both directions as customer-sited resources like rooftop solar and batteries contribute electricity to the grid. These power flows can also change much more quickly than conventional flows, for example as clouds pass overhead.

New technologies that improve grid control, communication, and metering can provide more information and control to grid managers over these two-way power flows. These technologies "improve grid operations, prevent outages and provide customers with energy-management services."[145] However, to capture such advantages, extensive grid modernization will be needed.

ENERGY GRID MODERNIZATION ROADMAP ACT

The Energy Grid Modernization Roadmap Act also amended the PUA to explicitly authorize utilities to apply to the PRC for grid modernization investments and created a grid modernization grant program.

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[140] Our Zero Emission Vehicle investment plan, ELECTRIFY AMERICA, https://www.electrifyamerica.com/our-plan/ (last visited Jul 21, 2020).
[141] 2017 REV WEST MOU, NASEO (2017), https://www.naseo.org/Data/Sites/1/revwest_mou.pdf.
[142] 2019 REV WEST MOU NASEO, https://www.naseo.org/Data/Sites/1/revwest_mou_2019_final.pdf.
[143] NMSA 1978 § 62-8-12(A) (2019).
[144] NMSA 1978 § 62-8-12(B) (2019).
[145] Andersen et al., *supra* note 4, at 8. ANDERSEN, CLEVELAND, AND SHEA, *supra* note 2 at 8.

The enactment of these provisions followed the PRC's 2018 denial of an $87 million PNM proposal to install over 500,000 smart meters in its service territory.[146] At the PRC's direction, PNM included a smart meter pilot proposal in its 2021 plan for energy efficiency and load management but did not recommend approval of the pilot due to "the expected limited value to PNM's energy efficiency programs."[147]

In 2017, the PRC did approve the extension of a 25-year power purchase agreement (PPA) for PNM to purchase electricity from the NM Wind Energy Center that included an automatic generation control upgrade, a technology that automates control of output from the facility.[148]

Specifically, the Act authorizes IOUs to file on their initiative, or at the PRC's request, applications for grid modernization projects. Such projects are broadly defined to include:

- advanced metering infrastructure and associated communications networks;
- intelligent grid devices for real time or near-real time system and asset information;
- automated control systems for electric transmission and distribution circuits and substations;
- high-speed, low-latency communications networks for grid device data exchange and remote and automated control of devices;
- distribution system hardening projects for circuits, not including the conversion of overhead tap lines to underground service and substations designed to reduce service outages or service restoration times;
- physical security measures at critical distribution substations;
- cybersecurity measures;
- systems or technologies that enhance or improve distribution system planning capabilities by the public utility;
- technologies to enable demand response;
- energy storage systems and microgrids that support circuit-level grid stability, power quality, reliability or resilience or provide temporary backup energy supply;
- infrastructure and equipment necessary to support electric vehicle charging or the electrification of community infrastructure or industrial production, processing, or transportation; and
- new customer information platforms designed to provide improved customer access, greater service options and expanded access to energy usage information.[149]

Proposals may include not only investments, but also "incentives to facilitate grid modernization, rate designs or programs that incorporate the use of technologies, equipment or infrastructure associated with grid modernization and customer education and outreach programs."[150] The PRC is to consider proposals for reasonableness, and are to include in their consideration whether the proposal is:

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[146] Final Order, In the Matter of the Application of PNM for a Variance from Rule 560 and Case No. 2124 Order Approving Meter Testing Program, Case No. 15-00312-UT (filed Sep. 25, 2015). The hearing examiner recommended denial in part because of an "insufficient demonstration of need." The PRC cited rate increases, an "excessive opt-out fee," and projected layoffs of meter readers as reasons for the denial. *See* Pamela Largue, *PNM rejected smart meter rollout by New Mexico regulators*, Smart Energy International (Apr. 13, 2018), https://www.smart-energy.com/industry-sectors/pnm-smart-meters/.

[147] Application for Approval of 2021 Electric Energy Efficiency and Load Management Program Plan, Profit Incentive, and Revisions to Tariff Rider No. 16, Case No. 20-00087-UT (filed Apr. 15, 2020).

[148] Application for Approval of PNM's Renewable Energy Act Plan for 2018 and Proposed 2018 Rider Rate under Rate No. 36 with Advice Notice 541 at 106, Case No. 17-00129-UT (filed June 1, 2017).

[149] NMSA 1978 § 62-8-13(F) (2020).

[150] NMSA 1978 § 62-8-13(A) (2020).

- reasonably expected to improve the public utility's electrical system efficiency, reliability, resilience and security; maintain reasonable operations, maintenance and ratepayer costs; and meet energy demands through a flexible, diversified and distributed energy portfolio, including energy standards established in Section 62-16-4 NMSA 1978;
- designed to support connection of New Mexico's electrical grid into regional energy markets and increase New Mexico's capability to supply regional energy needs through export of clean and renewable electricity;
- reasonably expected to increase access to and use of clean and renewable energy, with consideration given for increasing access to low-income users and users in underserved communities;
- designed to contribute to the reduction of air pollution, including greenhouse gases;
- reasonably expected to support increased product and program offerings by utilities to their customers; allow for private capital investments and skilled jobs in related services; and provide customer protection, information or education;
- transparent, incorporating public reporting requirements to inform project design and commission policy; and
- otherwise consistent with the state's grid modernization planning process and priorities.[151]

The utility is allowed to recover costs through either a tariff or in base rates, although if the project only benefits the distribution grid, then the utility is prohibited from recovering costs from industrial or commercial customers that are only interconnected through the transmission grid.[152]

GRID MODERNIZATION GRANT PROGRAM

The Energy Grid Modernization Roadmap Act also established a grid modernization grant program that would fund grid modernization projects proposed by municipal, county, or tribal governments; by state agencies; or by a variety of education institutions. Grants are to be awarded by EMNRD according to criteria similar to the criteria to be considered by the PRC in utility applications. EMNRD is to strive to fund applicants in diverse categories, including a tribal government, rural communities served by both a cooperative and an IOU, an urban community, and an education institution.[153] This program is as of yet unfunded.

1.8. MICROGRIDS: NEW MEXICO SMART GRID CENTER

Microgrids combine the components of an electricity grid—generation, grid control, and end-use—within a self-sustaining unit. Microgrids can be implemented at different scales, such as a building, campus, or distribution grid section, and typically make use of distributed generation and storage. Microgrids can be connected to the larger electricity grid or stand alone. They can provide an important resilience benefit, in that they can continue to operate even if the bulk power system fails.

In 2018, New Mexico's Established Program to Stimulate Competitive Research (NM EPSCoR) received a $20 million, 5-year grant to establish the New Mexico SMART Grid Center. The goal of the Smart Grid Center is "developing research capacity and education programs to support a modern electric grid built on the principles of Distribution Feeder Microgrids (DFMs), with a focus on architecture, networking, decision-support, and deployment, and by empowering a future workforce through industry partnerships, education, and public outreach." The Center engages researchers from the University of New Mexico, New Mexico State University, and New Mexico Institute of Mining and Technology. The Distribution

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[151] NMSA 1978 § 62-8-13(B) (2020).
[152] NMSA 1978 §§ 62-8-13(C), (D) (2020).
[153] NMSA 1978 § 71-11-1 (2020).

Feeder Microgrid concept is based around retrofitting existing utility transmission and distribution grid infrastructure into a "SMART (Sustainable, Modular, Adaptive, Resilient, Transactive) grid." This would be a utility-connected microgrid that would allow the microgrid to operate with or without power supplied by a central utility.[154]

1.9. FEDERAL POLICIES RELATED TO CYBERSECURITY

New energy devices or microgrids tied to the internet will face increased threats, both cyber and physical. The distribution grid is already changing to include more sources of data and digital communication, including data from advanced meters, appliances, DERs, grid monitoring devices, and markets.[155] While these advanced communications tools can provide important benefits for grid communication and control, they also increase vulnerability to cyberattacks.

There are a variety of federal efforts to address cybersecurity in the electricity grid, although these are mostly focused on the bulk power system. FERC oversees the reliability of the bulk power system, and FERC has tasked the North American Electric Reliability Corporation (NERC) with developing "cybersecurity guidelines and standards for critical infrastructure protection (CIP)."[156] FERC approved the most recent CIP Reliability Standards in February 2020.[157] These standards, however, only apply to infrastructure under FERC's jurisdiction—i.e., the bulk power system. According to some estimates, the CIP standards only cover 10–20% of the grid's assets.[158]

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[154] *NM SMART Grid Center Annual Report Year 1* (NM EPSCoR 2019).
[155] Ignacio Perez-Arriaga & Christopher Knittel, MIT Energy Initiative, *Utility of the Future* 3 (2016).
[156] Andersen et al., *supra* note 4, at 17. ANDERSEN, CLEVELAND, AND SHEA, *supra* note 2 at 17.
[157] Critical Infrastructure Protection Reliability Standard CIP–012–1, 85 Fed. Reg. 8161 (Feb. 13, 2020).
[158] Andersen et al., *supra* note 4, at 17. ANDERSEN, CLEVELAND, AND SHEA, *supra* note 2 at 17.

PART 2 BASELINE OF NEW MEXICO'S ELECTRIC GRID

Prepared by Daren Zigich and Jacqueline Waite, Energy Conservation and Management Division, ENMRD

In this section, we describe the current state of New Mexico's electricity system as organized by key objectives of grid modernization.[159] We define the objectives and identify common or reasonable metrics for assessing current status and change over time. The data collected and presented here serve as an important starting point for measuring progress relative to grid modernization activities over the next ten years.

Data primarily come from two main sources: 1) the 2018 EIA-861 Annual Electric Power Industry Report generated from utility[160] input and 2) responses from an EMNRD Utility Questionnaire that was administered in June of 2020 to all jurisdictional IOUs, rural cooperatives and municipally-owned utilities.[161] Additional data were collected from state agencies, utility tariffs and other publicly available sources.

As described in Part 1, New Mexico's electric grid extends through several utility service territories. Of three main IOUs, only PNM's customer base is entirely contained within New Mexico (**Exhibit 1**). SPS, a subsidiary of Xcel, serves 14 communities in southeast New Mexico. EPE, based in Texas, serves Las Cruces and surrounding areas.

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[159] List adapted from the U.S. Department of Energy's (2017) *Modern Distribution Grid*, vol I. DOE compiled this list from multiple state legislative and regulatory documents describing these states' visions for grid modernization. DOE notes a "high-degree of commonality across states."

[160] The Form EIA-861 is to be completed by electric industry distributors including electric utilities, wholesale power marketers (registered with the Federal Energy Regulatory Commission), energy service providers (registered with the States), and electric power producers. Responses are collected at the business level (not at the holding company level).

[161] Two of New Mexico's jurisdictional IOUs and seven rural cooperatives and municipally-owned utilities responded to this questionnaire.

Exhibit 1 PNM Service Territory

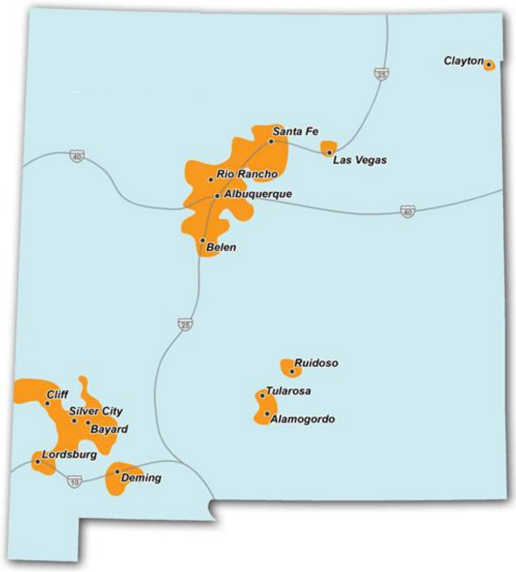
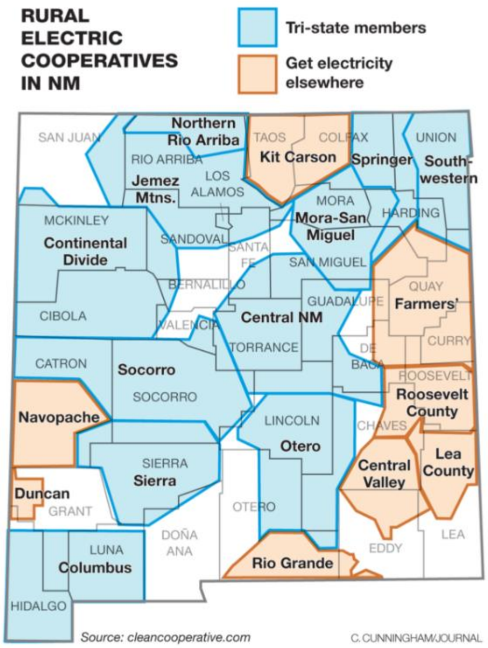


Exhibit 2 Rural Cooperative Territories



Source: cleancooperative.com

C.CUNNINGHAM/JOURNAL

Exhibit 2 describes the geography of New Mexico's rural cooperative territories. Cooperatives primarily serve as energy distributers. Cooperatives supplied by Tri-state Generation and Transmission cooperative are noted. Farmers, Roosevelt County, Central Valley, and Lea County Electric Cooperatives are members of the Western Farmers Generation and Transmission cooperative. Navopache, Duncan and Rio Grande cooperatives are based out-of-state but serve some New Mexico customers. Finally, Kit Carson Electric Cooperative is charting its own path toward becoming both an energy distributer and producer.

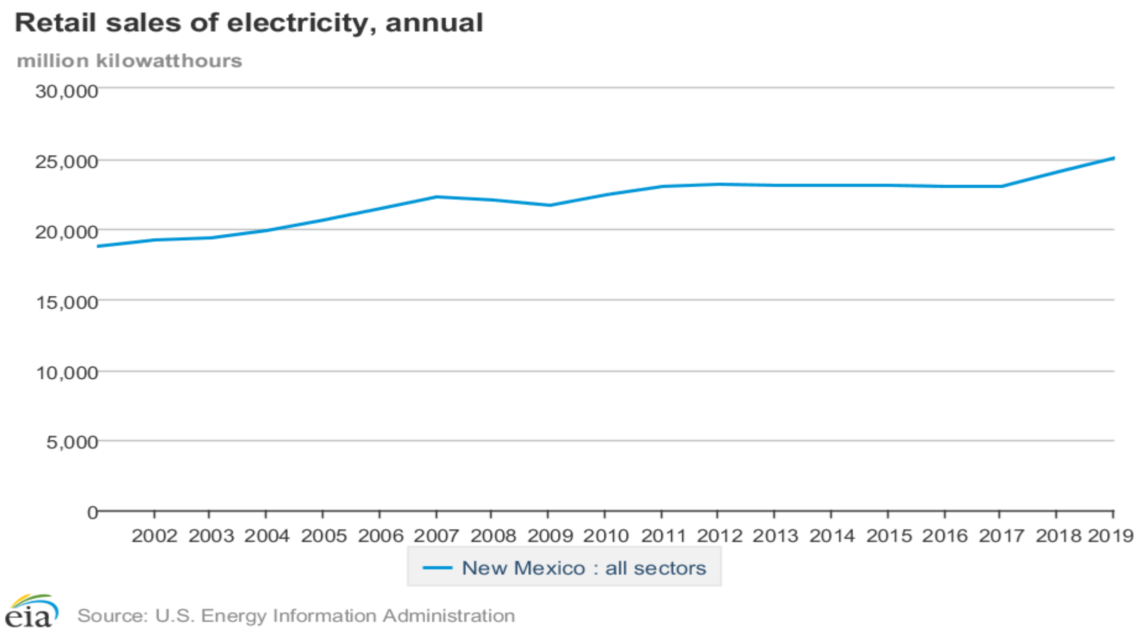
2.1. ADAPT TO CHANGING LOAD

This objective refers to the ability of the grid to anticipate increasing or changing demand due to a multitude of drivers. Historically, customer demand grew with new and expanding businesses and residences. Recently, New Mexico has seen new drivers, such as the move to electrify more building and transportation systems. This section examines trends in electricity demand growth and utilities' ability to plan for future growth. This section looks at historic load growth and growth potential as well as the tools used by utilities to plan for growth.

Utility Planning for Annual Growth

While load growth for New Mexico utilities has been relatively flat during the previous decade, load growth across New Mexico over the last two years has been roughly 5% annually (see **Exhibit 3**), with SPS reporting an almost 20% increase from 2018 to 2019 due almost exclusively to demand growth from the Permian Basin energy sector.

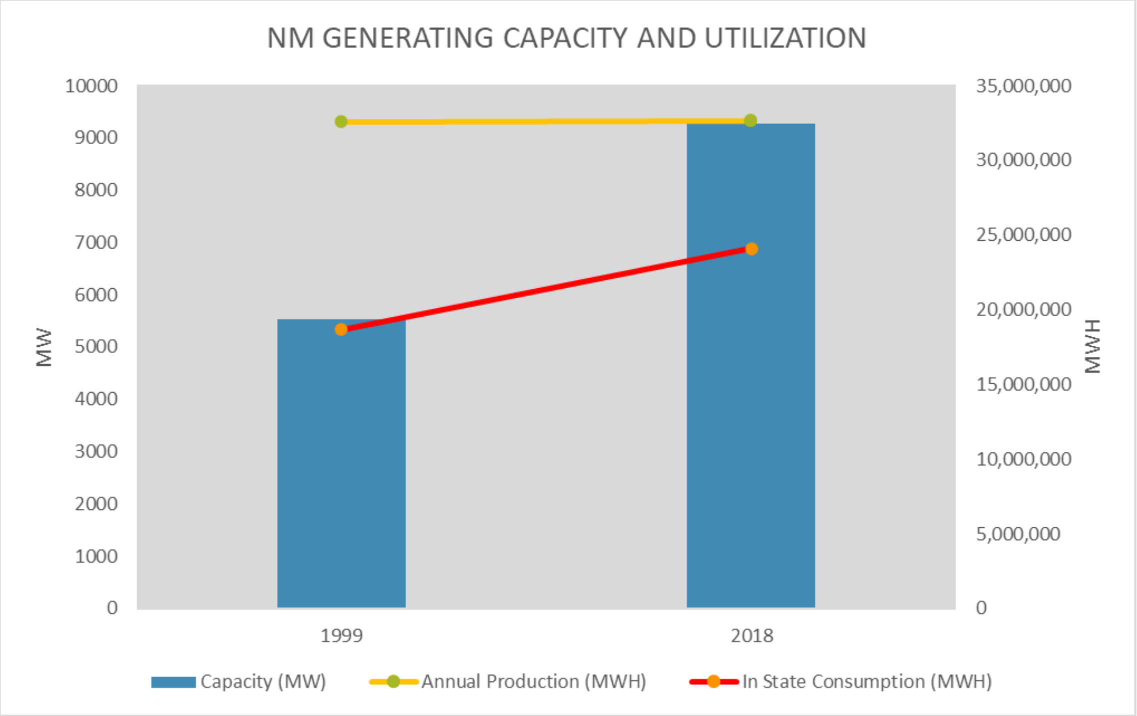
Exhibit 3 - Retail sales of electricity in New Mexico for all sectors



Source: U.S. Energy Information Administration

In the recent past, the rapid buildout of renewable generation coupled with the slow-to-moderate retirement of legacy generation created a large surplus of generation capacity (**Exhibit 4**). Between 1999 and 2018, New Mexico saw a buildout of new generation that equaled an over 67% increase in generation capacity within the state. Yet annual generation from 1999 to 2018 only increased 0.2%. With a 2018 installed generating capacity of over 9,200 MW, New Mexico was generally well positioned to handle all load demands including instantaneous summer peak demand. However, between 2015 and 2018 the overall growth of generation capacity flat-lined. While renewable energy generation capacity grew by over 1,000 MW, retirements in the fossil fuel generation fleet offset the gains in renewables, which presents new challenges during a period of substantial demand growth From 1999 to 2018, annual load growth (shown in **Exhibit 4** as in-state consumption) increased 29.2% from 18.7 terawatt-hours (TWhs) to 24.1 TWhs. Between 2018 and 2019, New Mexico's annual in-state electricity consumption jumped again approximately 4% and now sits at over 25 TWhs for the first time in state history. If load growth continues at the rate seen in the past few years and legacy generation continues to shutter, the once more-than-ample generation reserves will become depleted.

Exhibit 4 – NM generating capacity and utilization



Source data: from EIA

While load growth can vary greatly from year to year and from one electric utility to another, all three New Mexico IOUs have predicted modest future demand growth (1–2%) in their most recent IRPs (PNM-2017, SPS-2018, and EPE-2018).

Peak Load Changes from Decarbonization/Beneficial Electrification

With the electrification of heating and transportation, peak demand may also change. Given the temperature differential between outdoor winter temperatures and an indoor temperature of 65 degrees (i.e., the benchmark for heating degree days), it is expected that winter will become the new peak electricity demand season. **Exhibit 5** below shows a 2018 snapshot of peak demand by season for the three major IOUs operating in New Mexico. EMNRD will continue to track these data.

Exhibit 5 – Peak Demand by Season

			Peak Demand (MW)	
IOU	State Based in	NERC Region	Summer	Winter
Public Service Co of NM	NM	WECC	1,956	1,438
El Paso Electric Co*	TX	WECC	1,929	1,163
Southwestern Public Service Co*	TX	SPP	4,648	3,705

* Note: Only a portion of this demand can be attributed to New Mexico consumers

Data Source: EIA (2018) Utility Operational Data

Utility Ability to Forecast Distribution Load Growth

Traditionally, load growth, and thus demand on the distribution grid, has been driven by new customers connecting to new distribution, or current customers operating existing equipment for extended hours due to weather or other factors. A new question is: how are New Mexico utilities positioned to forecast and adapt to large demand swings across all reaches of their grid systems, due in part to other factors such as widespread electrification of transportation and buildings, and growth of distributed energy resources? Some of that question can be answered by looking at what planning tools (defined in **Exhibit 6**) New Mexico utilities are currently using or are planning to implement soon (i.e., 5 years or less). **Exhibit 6** describes these planning tools as identified by those New Mexico utilities that responded to an EMNRD-administered survey. EMNRD can continue to track the use of these tools.

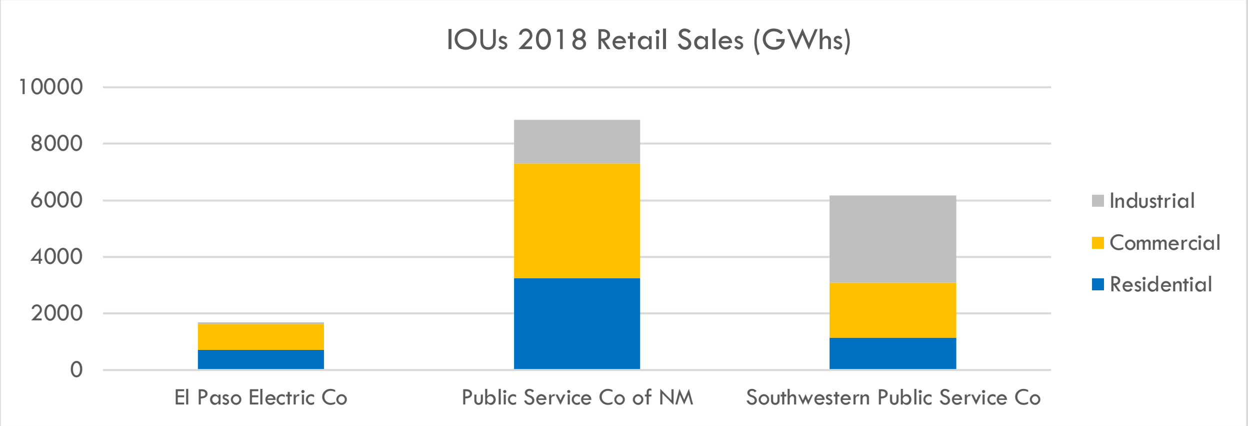
Exhibit 6 – NM utility forecasting tools

Technology or Tool (see 2017 DOE Modern Distribution Grid: Vol. II, pages 10 and 18-31 for more information)	**Used technology or conducted task in last 5 years or plan to use in next 5 years for distribution system? (Y/N)**
DER Forecasting - DER operational forecasting tools are software solutions that can be used for near-term operational forecasts. This tool assesses the "hidden load" challenge faced today, which hinders operational ability to distinguish between supply resources (distributed generation and storage) and gross demand to accurately forecast impacts under various operating conditions, such as routine switching or outage restoration.	COOPs & MUNIS **Y=29%** IOUs **Y=0%**
Load Forecasting - Load forecasting for the distribution grid involves the use of computer software that integrates mathematical models, statistical analyses such as linear regressions, and artificial intelligence techniques such as neural networks and fuzzy logic. The data inputs to a load forecasting tool include weather, geographic, economic, demographic, DER and DR data. The load forecast tool must be capable of providing load profiles across circuits, banks, and sub-sections of the circuit, with the necessary temporal and spatial granularity in order to consider the impacts from various scenarios over the planning horizon.	COOPs & MUNIS **Y=100%** IOUs **Y=100%**

The results represent the percent of responding utilities that answered in the affirmative. We are not able to report the degree to which each technology/tool is deployed, and given the broad definitions provided, the actual scope of the tool deployed by each utility may vary. Source: 2020 EMNRD Utility Questionnaire, IOU N=1, Coop and Muni N=7

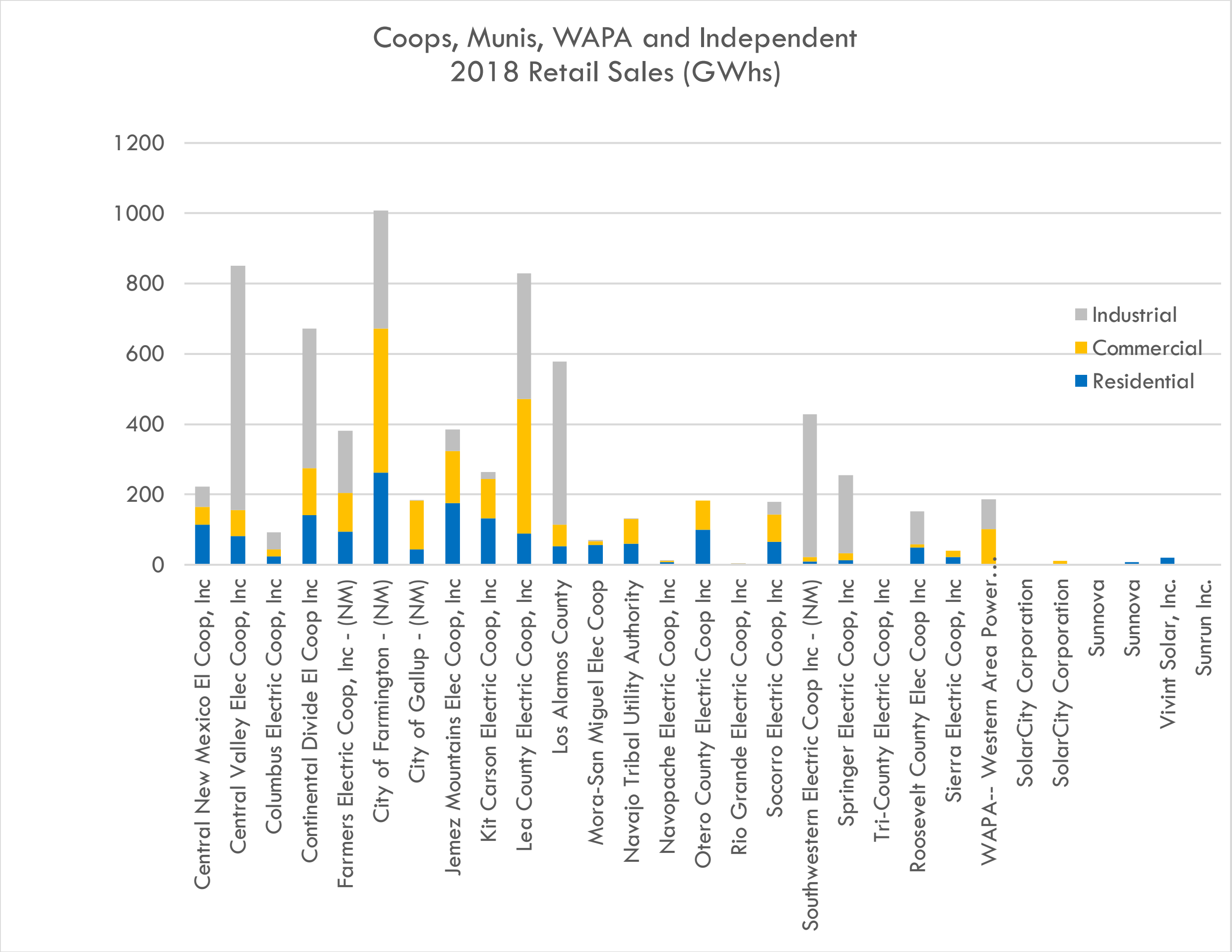
Even with some utilities reporting usage of these planning tools, the information modeled by these tools can, due in part by a utility's customer load base, be quite different. Where one utility may be greatly influenced by new housing and service industry jobs, another utility's demand growth may be highly coupled with the growth in the industrial sector. **Exhibits 7 and 8** show the 2018 electricity sales for each electricity provider in New Mexico by customer class.

Exhibit 7 – NM IOU retail electricity sales



Source: 2018 EIA 861 Annual Electric Power Industry Report

Exhibit 8 – NM Non-IOU retail electricity sales



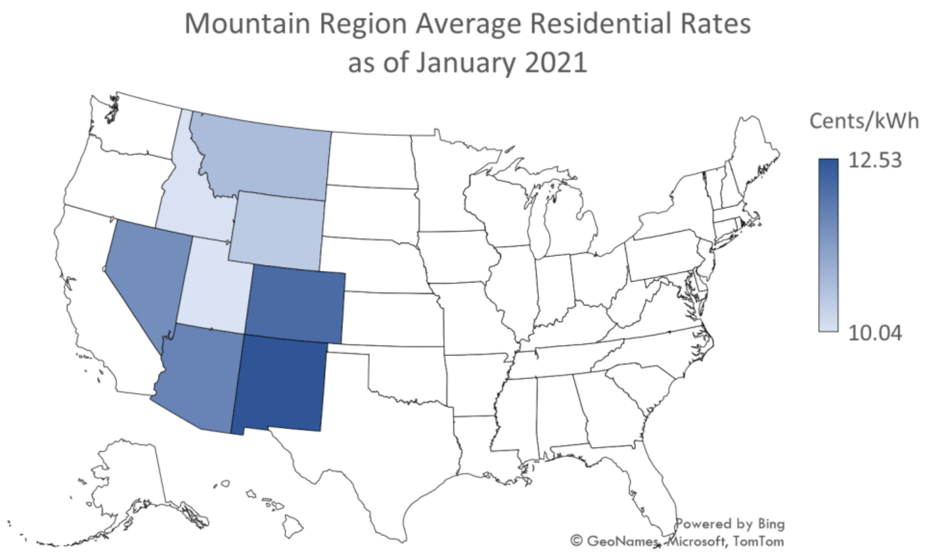
Source: 2018 EIA 861 Annual Electric Power Industry Report

2.2. AFFORDABILITY

This section explores the extent to which the grid allows for the delivery of cost effective and accessible electric service and platforms. Affordability includes a fair and reasonable allocation of costs to rate-payers with particular attention to historically underserved and underrepresented populations. This is tracked by consumers' ability to pay for energy (e.g. households carrying an energy burden) and/or the thresholds that might exist for customers to consider self-generation.

According to EIA 2019 summary statistics, the average retail price of electricity in New Mexico (8.99 cents/kWh) is below the national average of 11.26 cents/kWh.[162] However, looking at residential rates only, New Mexico's average is the highest in the Mountain region as seen in **Exhibit 9** below.) Mountain states' rates are similar; however, and can be directly contrasted with California's noticeably higher average residential electricity rate of $0.21/kWh

Exhibit 9 - Average Residential Rates of Mountain West States



Data Source: U.S. Energy Information Administration, Form EIA-861M (formerly EIA-826), Monthly Electric Power Industry Report. EIA

Over the most recent two decades, the cost of electricity to end-users has diverged, with industrial rates staying fairly flat, commercial rates rising slightly, and residential rates diverging more from commercial over time. **Exhibits 10** and **11** describe national and New Mexico profiles.

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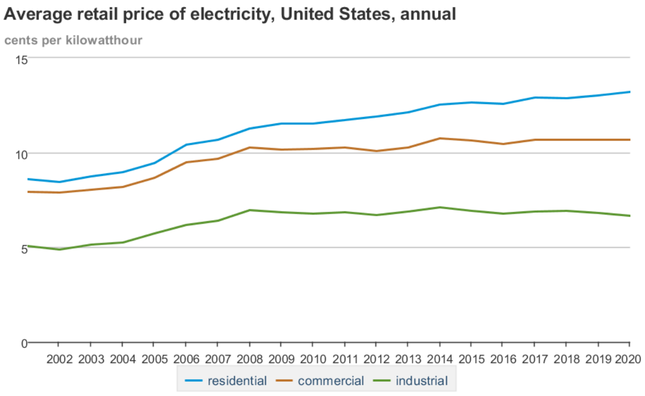
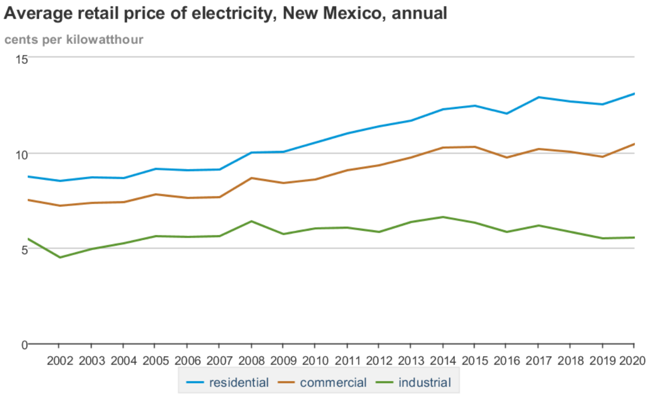
[162] EIA State Electricity Profiles, November 2020, https://www.eia.gov/electricity/state/

Exhibit 10 - Retail Price of Electricity by Sector (U.S.)



Data source: U.S. Energy Information Administration

Exhibit 11 - Retail Price of Electricity by Sector (NM)



Data source: U.S. Energy Information Administration

Cost of energy is one part of a customer's monthly electric bill for a New Mexico consumer. The total cost passed to the consumer is a function of several elements. At minimum, bills include: a base service or connection fee, also called an "Availability Fee" or "Customer Charge"; a fuel/energy cost adjustment, which is a surcharge covering energy costs that the utility could not account for; state and local taxes; and an energy charge that is tiered based on volume. There may be additional riders (e.g., Renewable Portfolio Standard Recovery rider), and a franchise fee imposed by the local jurisdiction.

Commercial, and industrial customers also pay a demand charge. The demand charge is a measure of the stress put on generation, transmission and distribution. Utilities apply demand charges based on the maximum amount of power that a customer used in any interval (typically 15 minutes) during the billing cycle. To determine the demand charge for a given month, the maximum power demand is multiplied by the demand charge rate. For customers with high maximum demand, demand charges can be a significant portion of their bill.[163]

Energy Burden

Household energy burden is a measure of affordability that describes the portion of household income spent on utilities.[164] "Energy poor" households are defined as those spending more than 6% of household income on energy costs. Scholars have gone further to classify "energy stressed" households with energy burdens of 4–7%, "energy burdened" households with 7–10% energy burdens, and "energy impoverished" households with energy burdens greater than 10%.[165]

The map (**Exhibit 12**) shows the average electricity burden by county, with 24 counties showing an average energy burden of six percent or more. **Exhibit 13** shows the average energy burden (for electricity costs only) for New Mexican households with low-to-moderate incomes. New Mexicans making less than 60% of the Area Median Income (AMI) (approximately 30% of households statewide)[166] carry an energy burden or are energy stressed.

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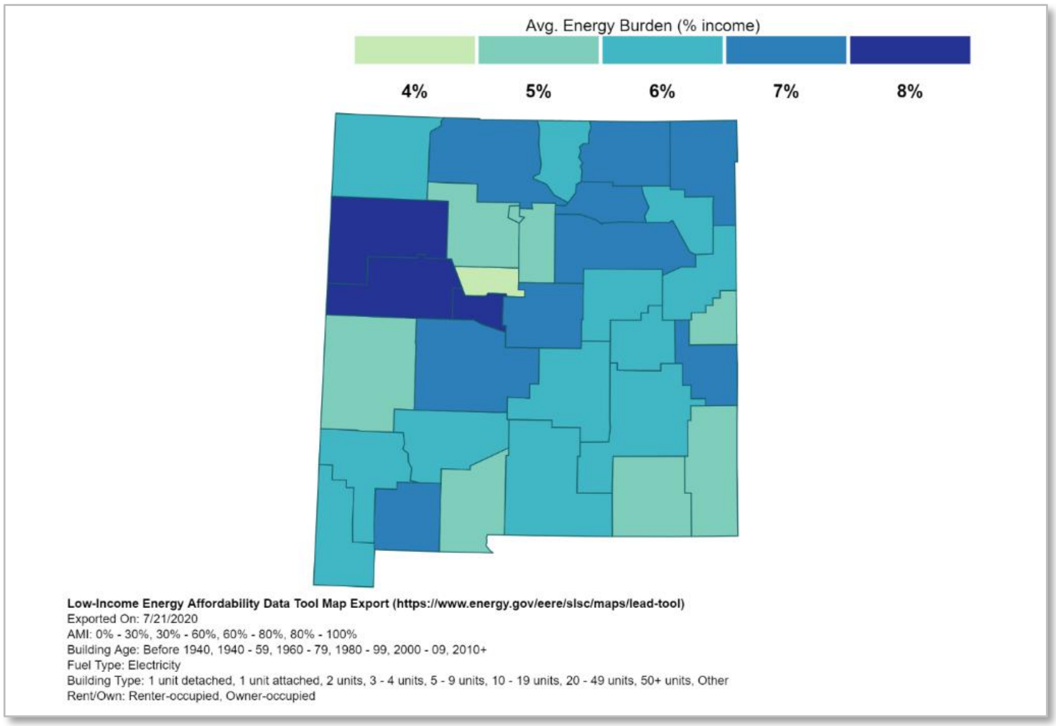
[163] For a sample bill, see https://www.renewableenergyworld.com/2017/06/06/making-sense-of-demand-charges-what-are-they-and-how-do-they-work/#gref

[164] Drebohl & Ross (2016); cited by ORNL (2020)

[165] Cook and Shah (2018a)

[166] Per https://www.census.gov/library/visualizations/interactive/2018-median-household-income.html
The median income in NM in 2018 was $47,169, 60% of that is $28,301; 27.8% of households make less than $25,000 and another 11% make between $25K and $34,999.

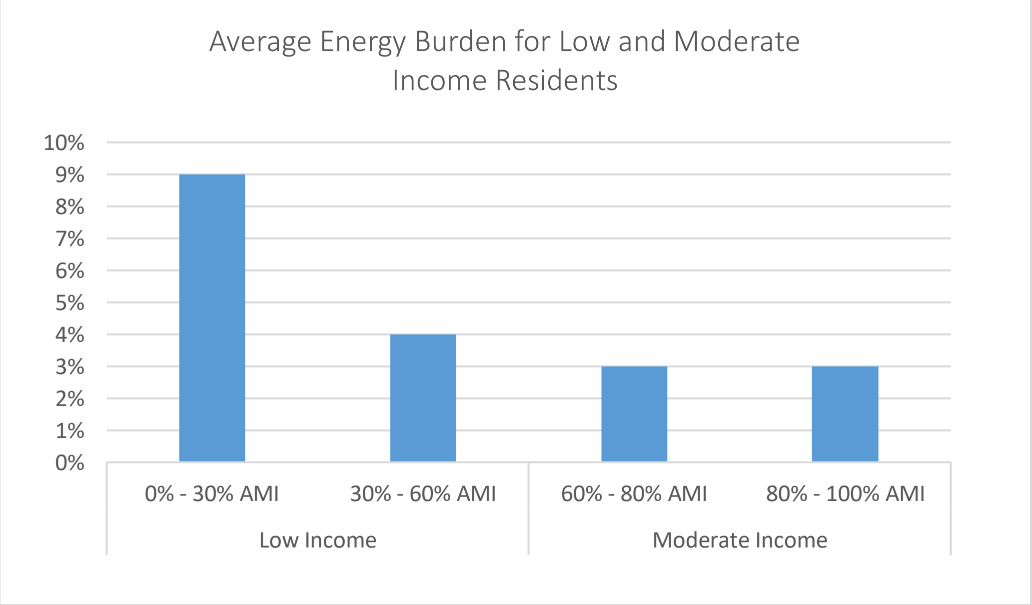
Exhibit 12 - Average energy burden by county (electricity)



Low-Income Energy Affordability Data Tool Map Export (https://www.energy.gov/eere/slsc/maps/lead-tool)
Exported On: 7/21/2020
AMI: 0% - 30%, 30% - 60%, 60% - 80%, 80% - 100%
Building Age: Before 1940, 1940 - 59, 1960 - 79, 1980 - 99, 2000 - 09, 2010+
Fuel Type: Electricity
Building Type: 1 unit detached, 1 unit attached, 2 units, 3 - 4 units, 5 - 9 units, 10 - 19 units, 20 - 49 units, 50+ units, Other
Rent/Own: Renter-occupied, Owner-occupied

Source: U.S. DOE LEAD Tool

Exhibit 13 - New Mexico energy burden (electricity)



Source: U.S. DOE LEAD Tool

In the time of COVID-19, energy security should also be considered. Energy security refers to the potential inability to make utility bill payments, which can ultimately result in being disconnected from energy services either permanently or temporarily.[167] This has implications for both the households impacted and for utility operations.

Cost of Rooftop Solar

The cost of solar PV decreased 62% from 2010 to 2018,[168] as the production cost became less expensive, and panels became more efficient. As described in other sections of this report, utilities are considering not only the technological and security implications of two-way energy flow, but the financial consequences of customers becoming more energy independent. This independence is still limited, in part, by the upfront cost of solar installations and the cost of storage.

Nationwide, rooftop systems have been seen as largely inaccessible to low-income residents who either live in multi-unit housing, rent a home or apartment, or own their homes but do not have the upfront capital to invest in a system. A recent report from Lawrence Berkeley National Laboratory provides evidence that solar adoption has shifted toward lower-income households, possibly due to falling PV prices; greater range of financing options; programs targeting low- or moderate-income households; and maturing PV markets.[169] Community solar is one of these programs.

New Mexico's solar market development tax credit is one way to mitigate the upfront expense barrier for single-family homeowners with a tax liability. Combined with the federal tax credit (see Part 1 of this report), this additional state credit reduces the overall cost. We see this in the decreased time it takes to pay back the installation costs in terms of energy costs saved (**Exhibit 14**).

Exhibit 14 – Solar tax credits and average payback time for solar systems in New Mexico

Tax Year	Individual Tax Credit (total %)	Explanation	Payback period*
2019	30%	Federal Credit (30%)	9.5 years
2020-22	36%	Combined federal (26%) and state (10%) credits	9 years
2023	32%	Combined federal (22%) and state (10%) credits	9.5 years
2024-2027^	10%	State credit only; federal credit expires in 2023	12 years
2028	0%	All credits expired	13+ years

Source: Positive Energy Solar

^It is difficult to predict into the future and the 12-year figure holds only if costs remain fixed. On the contrary, costs are likely to fall as solar becomes more efficient. In addition, permitting and inspection costs may fall as they are standardized across jurisdictions.

*Based on an average size (6kW) ballasted system on a flat roof sold in Albuquerque. These scenarios do not include financing.

A ballasted system is a racking system that is designed for flat roofs using weights to secure the system to the roof. Flat roofs in NM represent about 40-60 percent of homes installing solar.

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[167] Berry et al., 2018; Verclas and Hsieh, 2018

[168] NREL US Solar Photovoltaic System Cost Benchmark Q1 2018 https://www.nrel.gov/docs/fy19osti/72399.pdf

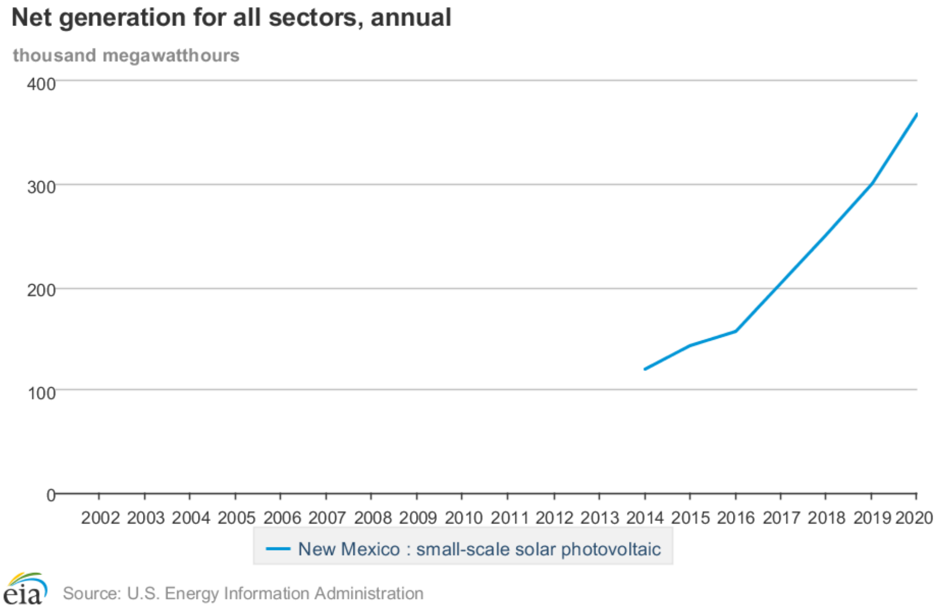
[169] Barbose, G. et al., *Income Trends among U.S. Residential Rooftop Solar Adopters* (2020)

The dollar amount of ranges depends on many factors, availability of continuous roof space, solar access, roof structure, condition of electrical panel, solar equipment, etc. The price range for simplest straightforward system could be between $3.20 to 3.60 per Watt.

A 6kW system will generate about 240,000kWh over its 25 year warranty period including degradation of the solar module. If a system costs $3.6 per watt and the total price is $21,600, then that translates to 9 cents per kWh ($21,600/240,000). Refer to the Grid Modernization Baseline report for utility rates. Subtract the tax credit from the price to get the net cost after tax. Financing costs depends on the interest rate which will be dictated by the homeowners credit score.

The combined state and federal tax credits may be clouding the true market value of distributed solar generation, but the trend is unmistakable. **Exhibit 15** shows the upward trend in small-scale solar adoption, including the interim period between New Mexico's two solar tax credit periods. As of March of 2021, the 2020 Solar Market Development Tax Credit program had awarded $5 million in credits representing $51 million in small-scale solar development.

Exhibit 15 - Small-Scale Solar Generation in NM 2014-2020



2.3. CUSTOMER ENABLEMENT

Customers are enabled when the distribution grid is designed to provide the customers data, tools and choices they need to manage energy use and costs. This is tracked by the numbers of customers enrolled in utility energy management programs. One way for utilities to enable customers is to allow customer-supplied resources to interconnect to the distribution grid. The technical terms of this interconnection are determined by 17.9.568 NMAC New Mexico Interconnection Manual. The financial mechanism for crediting customer-generated energy is net metering. Net Metering, which is mandated in New Mexico, likely provides a market-based incentive for the majority of the more than 21,000[170] electricity customers who as of 2018 have installed on-site generation. **Exhibit 16** describes the capacity by customer type for distributed energy resources for reporting utilities.

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[170] Source: 2018 EIA 861 Annual Electric Power Industry Report

Exhibit 16 – Net-metered capacity of all technologies and percentage of solar

Capacity of Net-Metered Energy 2018 in MW for All Technologies

Investor-Owned Utility	Residential	Commercial	Industrial	Total	Solar Only Total	Solar Percent of Total
Public Service Co of NM	81.6	50.4	0.0	132.0	132.0	100.0
El Paso Electric Co	16.2	3.9	0.0	20.1	20.1	99.9
Southwestern Public Service Co	0.6	7.0	0.5	8.1	8.1	100.0
Cooperatives						
Central New Mexico El Coop, Inc	1.5	0.4	0.0	1.9	1.8	92.8
Central Valley Elec Coop, Inc	0.1	0.0	0.0	0.1	0.1	99.3
Columbus Electric Coop, Inc	0.2	0.1	0.2	0.5	0.5	99.6
Continental Divide El Coop Inc	-	-	-	-	-	-
Farmers Electric Coop, Inc - (NM)	0.2	0.1	0.0	0.3	0.2	64.3
Jemez Mountains Elec Coop, Inc	1.1	0.3	0.0	1.4	1.4	100.0
Kit Carson Electric Coop, Inc	2.0	0.7	0.0	2.6	2.5	95.9
Lea County Electric Coop, Inc	-	-	-	-	-	-
Mora-San Miguel Elec Coop	0.6	0.0	0.0	0.6	0.6	100.0
Navopache Electric Coop, Inc	0.0	0.0	0.0	0.0	0.0	86.0
Otero County Electric Coop Inc	3.5	1.3	0.0	4.8	4.8	99.8
Rio Grande Electric Coop, Inc	-	-	-	-	-	-
Roosevelt County Elec Coop Inc	-	-	-	-	-	-
Sierra Electric Coop, Inc	0.2	0.0	0.0	0.3	0.3	100.0
Socorro Electric Coop, Inc	0.4	0.4	0.0	0.8	0.8	100.0
Southwestern Electric Coop Inc - (NM)	0.1	0.0	0.0	0.1	0.1	50.0
Springer Electric Coop, Inc	0.0	0.0	0.0	0.1	0.1	100.0
Tri-County Electric Coop, Inc	-	-	-	-	-	-
Public Utilities						
City of Farmington - (NM)	0.5	0.1	0.0	0.7	0.7	100.0
City of Gallup - (NM)	0.1	0.1	0.0	0.2	0.2	100.0
Los Alamos County	0.6	0.0	0.0	0.6	0.6	100.0
Navajo Tribal Utility Authority	-	-	-	-	-	-

Source: 2018 EIA 861 Annual Electric Power Industry Report. Technologies include solar, wind and “other”.

Distributed solar is a popular choice for many residential and commercial customers, who wish to participate in the generation of clean energy. As described in Southwest Public Service Company’s latest IRP,

> *self-generation (PV) and storage technologies (batteries) could enable customers to bypass their local utility provider. Cost-based alignment of utility-based services and rate design will be crucial (even more than it is today), to ensure that all customers pay for services from which they depend upon and to prevent cost shifting from one customer or customer segment to another customer or group of customers.*[171]

SPS acknowledges that customers are becoming more empowered and discerning about their energy choices.

> *With the cost of solar continuing to decrease further relative to SPS rates, at some point reaching parity with SPS system rates, DG penetration could increase as compared to where it is today. Generally, customers are increasingly interested in various types of*

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[171] SPS IRP 2018, p. 83

> *self-generation – specifically solar PV. Growth in solar across all market segments is driven by several forces. Namely, its economics are improving through state and federal incentives and manufacturing advancements. Customers are increasingly interested in new energy choices, including the option to install solar on their homes and businesses to produce their own energy; and state and federal policies are promoting solar as a way to reduce GHG emissions and support local economic development.*[172]

Another element of customer enablement is the ability to influence energy use as it relates to billing. Below we describe the state of dynamic pricing mechanisms in New Mexico, including a description of the programs and the numbers of customers enrolled (as of 2018 EIA-861). Dynamic pricing options are designed to incentivize customers to consume energy during times when the cost of generating electricity is less expensive, and to disincentive energy consumption when the cost of generating electricity is more expensive. In New Mexico, the only reported dynamic pricing option was Time-of-Use (TOU) pricing. Utilities administer TOU pricing by breaking the day into two or three categories such as off-peak, partial peak, on peak, and charge different rates for energy used in these periods. Pricing times may also very by season, weekday versus weekend days, and holidays, etc.

As of 2018, of the utilities reporting to EIA (**Exhibit 17**), very few customers were participating in dynamic pricing, with the Central New Mexico Electric Cooperative having the highest rate of participation at nearly 12%. As seen in **Exhibit 18**, Southwestern Public Service Company limited this option to only 50 residential customers.

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[172] SPS IRP 2018, p. 84

Exhibit 17 - Dynamic pricing data (TOU)

	Customers Enrolled in TOU Pricing 2018					
Investor-Owned Utility	**Residential**	**Commercial**	**Industrial**	**Total**	**Total Customers**	**Per Total**
Public Service Co of NM	116	4977	61	5154	526346	0.98
El Paso Electric Co	22	105	8	135	98984	0.14
Southwestern Public Service Co	6	1	0	7	121604	0.01
Cooperatives						
Central New Mexico El Coop, Inc	2082	11	0	2093	17852	11.72
Central Valley Elec Coop, Inc	-	-	-	-	-	-
Columbus Electric Coop, Inc	-	-	-	-	-	-
Continental Divide El Coop Inc	-	-	-	-	-	-
Farmers Electric Coop, Inc - (NM)	-	-	-	-	-	-
Sierra Electric Coop, Inc	291	122	0	413	4208	9.81
Jemez Mountains Elec Coop, Inc	257	30	0	287	9634	2.98
Lea County Electric Coop, Inc	-	-	-	-	-	-
Mora-San Miguel Elec Coop	-	-	-	-	-	-
Navopache Electric Coop, Inc	-	-	-	-	-	-
Otero County Electric Coop Inc	-	-	-	-	-	-
Rio Grande Electric Coop, Inc	-	-	-	-	-	-
Roosevelt County Elec Coop Inc	-	-	-	-	-	-
Springer Electric Coop, Inc	45	5	0	50	3042	1.64
Kit Carson Electric Coop, Inc	342	92	0	434	31026	1.40
Southwestern Electric Coop Inc - (NM)	-	-	-	-	-	-
Socorro Electric Coop, Inc	151	12	0	163	12725	1.28
Tri-County Electric Coop, Inc	-	-	-	-	-	-
Public Utilities						
City of Farmington - (NM)	-	-	-	-	-	-
City of Gallup - (NM)	0	1	1	2	9634	0.02
Los Alamos County	-	-	-	-	-	-
Navajo Tribal Utility Authority	-	-	-	-	-	-

Source: 2018 EIA 861 Annual Electric Power Industry Report

Exhibit 18 - TOU definitions and rate differences

Utility	Definition of Peak and Off-Peak	Difference Peak and Off-Peak		Savings per 500 kWh	Difference Non-TOU and Off-Peak per kWh
Public Service Co of NM	**On-Peak:** 8:00 am to 8:00 pm Monday through Friday (60 hours per week).	June, July August	All other Months		
		$ 0.13	$ 0.09	$ 64.32	$0.02
El Paso Electric Co	**On-Peak:** 12:00 P.M. to 8:00 P.M., Mountain Daylight Time, Monday through Friday, for the months of May through October. **Off-Peak:** All other hours not covered in the On-Peak period.		**$ 0.09**	$ 43.48	$0.02
Southwestern Public Service Co	**On-Peak:** 12 p.m. through 6 p.m., Monday through Friday during the months of June through September. **Off-Peak**: All other hours not covered in the On-Peak period. Availability limited to a maximum of 50 customers that qualify for service under Residential Service. Customers must contract for service under this experimental tariff for a minimum of 12 consecutive calendar months.		**$ 0.14**	$ 68.38	
Central New Mexico El Coop, Inc	**On Peak:** Winter Months (Oct 1 to March 31) between the Hours of 6:30AM to 9:00AM and 4:30 PM to 10:30 PM Summer Months (April 1 to Sept 30) between the Hours of 4:30PM to 10:30PM		**$ 0.09**	$ 44.00	$0.07
Sierra Electric Coop, Inc	**On-Peak:** Winter (MST) 4:00 p.m. to 10:00 p.m. Summer (DST) 5:00 p.m. to 11:00 p.m. **Off-Peak:** Winter (MST) 10:00 p.m. to 4:00 p.m. Summer (DST) 11:00 p.m. to 5:00 p.m. In addition to rate differential, the system charge fee goes up from $25 per month to $27.50 per month		**$ 0.07**	$ 33.29	$0.03
Jemez Mountains Elec Coop, Inc	**On-Peak:** Monday through Friday 6:00 AM to 1:00 PM and 4:00 PM to 9:00 PM **Off-Peak:** Monday through Friday 1:00 PM to 4:00 PM and 9:00 PM to 6:00 AM		**$ 0.06**	$ 30.50	$0.02
Springer Electric Coop, Inc	**On-Peak:** between 7 a.m. and 8 p. m. MST **Off-Peak:** between 8 p.m. and 7 a. m. MST		**$ 0.07**	$ 33.91	$0.04
Kit Carson Electric Coop, Inc	**On-Peak:** During the hours from 6:00 A.M. to 1 :00 P.M. During the hours from 4:00 P.M. to 9:00 P.M. (MST) **Off Peak:** During the hours from 1: 00 P.M. to 4:00 P.M. During the hours from 9:00 P.M. to 6:00 A.M. (MST)		**$ 0.09**	$ 43.55	$0.04
Socorro Electric Coop, Inc	**On Peak:** 6:00 A.M. TO 9:00 P.M **Off-Peak:** 9:00 P.M. TO 6:00 A.M		**$ 0.08**	$ 37.50	$0.05

^In this table, the PNM difference rate is calculated for Peak-of-Peak, i.e., On-Peak time during the months of June, July or August. Accessed from utility tariffs and/or websites, June–July 2020.

It is assumed that utilities have designated peak rates based on historical analysis of when the cost of producing energy is highest. **Exhibit 18** lists residential TOU definitions for a sample of New Mexico utilities. In all cases, customers must opt-in to TOU pricing by actively enrolling. On-Peak and Off-Peak are delineated differently across the sample. Some utilities vary rates seasonally, some vary rates daily, and some, such as PNM have four different rates based on time-of-day and season. In addition, the differences in rates vary, producing *potential* savings per 500 kWh, ranging from $30.50 to $68.38. Savings depend on customers being educated about TOU rates and able to take advantage of off-peak times for all energy consumption. Jemez Mountains Electric Cooperative stands out by including the following note for customers on its website:

> *In order to benefit from Time of Use you MUST be able to coordinate most of your electric usage during the Off-Peak Hours. This means using your major appliances such as Electric Thermal Storage Heating Units, baseboard heating (if possible), electric clothes dryers, electric ovens, irons, compressors, power tools, etc. during the Off-Peak hours. Also*

> *placing timers on electric appliances like water heaters, hot tubs, saunas and freezers to only use power during Off-Peak hours will help. Any appliance you can operate during the Off-Peak hours will lower your electric utility bill. Please use the time of use charts below for schedule of On Peak and Off Peak rates.*

In addition to Dynamic Pricing, EIA collects data from utilities on enrollment and energy savings in demand response programs. Demand Response Programs encourage a temporary reduction in demand for electricity at certain times in response to a signal from the grid operator or market conditions. Examples are the dimming of lights, turning on backup generators, or shutting down industrial processes.

Exhibit 19 displays the data from two IOUs in New Mexico that reported having Demand Response Programs to EIA in 2018. In the case of PNM, customers may opt into a program that allows the utility to turn off customers' air conditioning units during peak demand times. Customers who participate, therefore, give up control over their air conditioning units for a few afternoons per year for a small cost savings incentive.

Exhibit 19 – New Mexico demand response program enrollment as of 2018

	Number of Customers Enrolled				**Energy Savings (MWh)**			
Utility Name	Residential	Commercial	Industrial	Total	Residential	Commercial	Industrial	Total
Public Service Co of NM	37131	6592	110	43833	464	91	509	1064
Southwestern Public Service Co	4888	0	0	4888	4	0	0	4

	Potential Peak Demand Savings (MW)				**Actual Peak Demand Savings (MW)**			
Utility Name	Residential	Commercial	Industrial	Total	Residential	Commercial	Industrial	Total
Public Service Co of NM	33.1	8.7	21	62.8	32.6	8	15.2	55.8
Southwestern Public Service Co	5.5	0	0	5.5	2.3	0	0	2.3

Potential peak demand savings refers to the total demand savings that could occur at the time of the system peak hour assuming all demand response is called. **Actual peak demand savings** is demand reduction actually achieved by demand response activities and is measured at the time of the company's annual system peak hour.
Source: 2018 EIA 861 Annual Electric Power Industry Report.

The data in **Exhibit 20** come from the EMNRD 2020 utility survey and describes the percentage of respondents that are using or plan to use technologies or tools that enable customers.

Exhibit 20 – NM utility use of customer enabling technologies

Technology or Tool (see 2017 DOE Modern Distribution Grid: Vol. II, pages 13-14 and 33-63 for more information)	**Used Technology or conducted task in last 5 years or plan to use in next 5 years for distribution system? (Y/N)**
Distribution Resource Management	
Distributed Energy Resource Management Systems (DERMS) - A DERMS is a software solution that incorporates a range of operations to adjust the production and/or consumption levels of disparate DER directly or through an aggregator. The visibility of a DERMS within the distribution grid is typically from the substation downward (or outward) to the low-voltage secondary transformer, and includes different levels of aggregation, such as at the substation bank, individual feeders, segments comprising a feeder, and distribution transformers. A DERMS may individually address disparate DER at the edge of the distribution grid by communicating directly with smart inverters, DC converters, or other equipment, or communicating with third-party providers who have aggregated DER in an operational area and are presenting the aggregated DER as a combined controllable resource.	COOPs & MUNIS **Y=29%** IOUs (PNM) **Y=100%**
Demand Response Management System (DRMS) - The DRMS may potentially interact with the EMS or DMS operational systems, responding to a request for reduction in demand. However, today that is rare and more typically involves a human operator interface. The DRMS also relies on the customer information contained within the Customer Information System (CIS) for customers enrolled in DR programs, so that it may communicate with commercial, industrial, and residential customers, and with aggregators, to deliver the results required by the operational systems.	COOPs & MUNIS **Y=29%** IOUs **Y=100%**
Microgrid Interface - A microgrid is a group of interconnected loads and DER within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in grid-connected mode or island mode.46 As such, the microgrid interface includes load disconnect/reconnect capability; measurement; communications; protection devices that can enable seamless interoperability between interconnected, islanded modes; and synchronized reconnection.	COOPs & MUNIS **Y=29%** IOUs **Y=0%**

The results represent the percent of responding utilities that answered in the affirmative. We are not able to report the degree to which each technology/tool is deployed, and given the broad definitions provided, the actual scope of the tool deployed by each utility may vary. Source: 2020 EMNRD Utility Questionnaire, IOU N=1, Coop and Muni N=7

2.4. DER INTEGRATION

DERs include distributed energy sources, sinks and energy monitoring and management systems including distributed generation, storage, and demand response mechanisms. DER integration means that DERs are physically integrated into the utility grid and viewed as resources that provide grid services. To enable all types of DERs, the operation and design of the modern grid must allow multi-directional flows of energy. One aspect of this is ensuring that the grid can *physically* integrate or host DERs, and the second aspect is ensuring that the necessary communication and cyber and physical security protocols and tools are in place. DER integration is tracked by the adoption of AMI and edge-of-grid visibility tools.

Flexibility is the ability for system managers to deploy resources, including DERs, as needed, to meet demand. One question is: to what extent are Distributed Energy Resources deployed statewide and by service territories (customer-deployed residential, commercial, industrial, and utility-deployed)? We do not have a complete picture of this but present the available evidence as a foundation for this conversation.

The main question for consideration is: what is the desired or allowable extent of DER penetration of the distribution grid? This is a consideration for grid modernization, as it relates directly to grid function and grid architecture. Customer-generated energy resources have been growing in NM as a result of market forces that have made systems more affordable, coupled with policy incentives that help customers with capital investments. Small-scale solar PV, over the past five years, has been responsible for between 14.6% to over 18% of total statewide solar PV electricity generation. Over the last two years, small-scale solar generation represented 75% of the total statewide solar PV generation increase from 2018 to 2019.[173]

A technical challenge for utilities is the ability to see and monitor energy that is being used and generated on the distribution system in order to balance the system as a whole. Smart meters or Advanced Metering are essential for creating a flexible system with which to efficiently meet demand with renewable energy inputs on both the transmission and distribution grids. **Exhibit 21** describes the extent to which utilities had adopted advanced metering tools as of 2018. The data seem to show that these meters are not optimized for their full potential use, especially as a direct means for controlling load.

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[173] Calculated from EIA Data Browser

Exhibit 21 - Advanced Metering

	Number AMI- Advanced Metering Infrastructure					Customers with Daily Digital Access				Customers with Direct Load Control			
	Residential	Commercial	Industrial	Total	Total No. of Meters	Residential	Commercial	Industrial	Total	Residential	Commercial	Industrial	Total
Investor-Owned Utility													
Public Service Co of NM	0	0	0	0	541639	-	-	-	-	-	-	-	-
El Paso Electric Co	0	0	0	0	111450	0	0	0	0	390	5	0	395
Southwestern Public Service Co	0	1	0	1	117768	-	-	-	-	4088	-	-	4088
Cooperatives													
Central New Mexico El Coop, Inc	16205	1765	11	17981	17981	-	-	-	-	-	-	-	-
Central Valley Elec Coop, Inc	5719	5133	4496	15348	15352	5719	5133	4496	15348	-	-	-	-
Columbus Electric Coop, Inc	-	-	-	-	4652	-	-	-	-	-	-	-	-
Continental Divide El Coop Inc	-	-	-	-	24130	-	-	-	-	-	-	-	-
Farmers Electric Coop, Inc - (NM)	-	-	-	-	13169	-	-	-	-	-	-	-	-
Jemez Mountains Elec Coop, Inc	7015	700	.	7715	30796	-	-	-	-	-	-	-	-
Kit Carson Electric Coop, Inc	21758	121	.	21879	28984	-	-	-	-	-	-	-	-
Lea County Electric Coop, Inc	-	-	-	-	11595	-	-	-	-	-	-	-	-
Mora-San Miguel Elec Coop	10372	205	32	10609	11069	0	0	0	0	0	0	0	0
Navopache Electric Coop, Inc	1	-	-	1	1615	-	-	-	-	-	-	-	-
Otero County Electric Coop Inc	15822	3657	-	19479	19486	15822	3657	-	19479	0	0 -		0
Rio Grande Electric Coop, Inc	238	67	13	318	318	76	5	4	85	-	-	-	-
Roosevelt County Elec Coop Inc	3777	739	1494	6010	6010	-	-	-	-	-	-	-	-
Sierra Electric Coop, Inc	-	-	-	-	4445	-	-	-	-	-	-	-	-
Socorro Electric Coop, Inc	6149	1506	20	7675	12725	-	-	-	-	-	-	-	-
Southwestern Electric Coop Inc - (NM)	-	-	-	-	2532	-	-	-	-	-	-	-	-
Springer Electric Coop, Inc	2440	585	5	3030	3042	-	-	-	-	-	-	-	-
Tri-County Electric Coop, Inc	4	3	-	7	7	-	-	-	-	-	-	-	-
Public Utilities													
City of Aztec	-	-	-	-	3145	-	-	-	-	-	-	-	-
City of Farmington - (NM)	-	-	-	-	44828	-	-	-	-	-	-	-	-
City of Gallup - (NM)	-	-	-	-	10743	-	-	-	-	-	-	-	-
Los Alamos County	1707	0	-	1707	8544	1707	0	.	1707	0	0	-	0
Navajo Tribal Utility Authority	9617	897	143	10657	10657	-	-	-	-	-	-	-	-

Source: 2018 EIA 861 Annual Electric Power Industry Report

An outgrowth of sensing technologies is also the ability to monitor and control load, including the ability to manipulate power levels at the edges of the grid. Many appliances will function on lower power, and the flexibility to decrease power, especially at times of peak load is an important “non-wires” solution to meeting policy-directed efficiency measures (i.e., EUEA).

From the 2018 EIA Annual Electric Power Industry Report, we see the extent to which utilities are employing voltage optimization technologies on their existing circuits (see **Exhibit 22**).[174] As defined in the EIA-861 survey instructions, voltage or Volt/VAR Optimization (VVO) is a process used by electric distribution companies to actively manage voltage levels and reactive power on distribution circuits in order to reduce energy losses and improve reliability and power quality. VVO is typically achieved through the use of real-time information and controls that activate capacitor banks, voltage regulators, and transformer load tap changers. In some cases, distribution circuit managers use distributed generation to adjust voltage and VAR levels on the primary and secondary distribution circuits.

Exhibit 22 - Percentage of circuits with voltage optimization by NM utility

Distribution Circuits			
Investor-Owned Utility	No. Circuits	Circuits with Voltage Optimization	Percent Circuits with Voltage Optimization
Public Service Co of NM	476	302	63
El Paso Electric Co	59	54	92
Southwestern Public Service Co	181	-	unknown
Cooperatives			
Central New Mexico El Coop, Inc	35	-	unknown
Central Valley Elec Coop, Inc	94	94	100
Columbus Electric Coop, Inc	21	-	unknown
Continental Divide El Coop Inc	20	-	unknown
Farmers Electric Coop, Inc - (NM)	45	45	100
Jemez Mountains Elec Coop, Inc	56	-	unknown
Kit Carson Electric Coop, Inc	33	21	64
Lea County Electric Coop, Inc	59	-	unknown
Mora-San Miguel Elec Coop	8	-	unknown
Navopache Electric Coop, Inc	5	0	0
Otero County Electric Coop Inc	34	0	0
Rio Grande Electric Coop, Inc	5	-	unknown
Roosevelt County Elec Coop Inc	40	40	100
Sierra Electric Coop, Inc	6	-	unknown
Socorro Electric Coop, Inc	21	0	0
Southwestern Electric Coop Inc - (NM)	9	0	0
Springer Electric Coop, Inc	16	0	0
Tri-County Electric Coop, Inc	1	1	100
Public Utilities			

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[174] EIA, 2018, Annual Electric Power Industry Report, Form EIA-861/861s.

City of Farmington - (NM)	65	-	unknown
City of Gallup - (NM)	18	0	0
Los Alamos County	9	0	0
Navajo Tribal Utility Authority	28	-	unknown

Source: 2018 EIA-861/861s

The flow of information to and from the edge of the grid to utilities is increasingly tied to the internet. This real-time data and control can greatly benefit the integration of DER, both energy sinks and sources. However, increased interconnection with the world wide web also poses potential cybersecurity risk. **Exhibit 23** describes the extent to which a sample of utilities are implementing or planning to implement advanced tools for Operational Communications Infrastructure, Sensing and Measurement and Field Automation, as reported to us. EMNRD can continue to track the use of these tools.

Exhibit 23 – NM utility plans to use advanced tools for Operational Communications Infrastructure, Sensing and Measurement and Field Automation

Technology or Tool (see 2017 DOE Modern Distribution Grid: Vol. II, pages 13-14 and 33-63 for more information)	Used Technology or conducted task in last 5 years or plan to use in next 5 years for distribution system? (Y/N)
Operational Communications Infrastructure	
Wide Area Network - There is generally a business (enterprise) WAN as well as an operations WAN. The business network transport infrastructure may overlap with the operations WAN. Material differences exist between business and operational networks related to performance quality, reliability and cybersecurity. This volume is focused on operational networks. Within the context of the distribution grid, the WAN spans up to an entire service area, linking substations, and operating or control centers. Older implementations of WAN may consist of multiple networks. The WAN may also provide the two-way network needed for SCADA, and points of presence for interconnection of FANs and specific high bandwidth and/or low latency applications.	COOPs & MUNIS **Y=86%** IOUs (PNM) **Y=0%**
Field Area Network - As with WAN, a FAN may be multiple siloed purpose-built networks. FAN connects the NAN with the WAN by providing backhaul services for NAN concentrators or access points to WAN points of presence. Interconnection between substations is provided by the WAN. Substations may provide the physical location of a WAN point of presence used by the FAN. FAN services also include low latency and peer-to-peer (P2P) communications for protection and control.	COOPs & MUNIS **Y=29%** IOUs **Y=0%**
Neighborhood Area Network - A NAN supports information flow for grid edge devices (e.g., smart meters or DA devices) and the FAN. It enables data collection from customers in a neighborhood for transmission to a control center. NAN enables a range of smart grid applications, such as smart metering, service disconnect switches, and power outage notification messages. The typical technology deployed for NAN is narrowband mesh radio supporting	COOPs & MUNIS **Y=29%** IOUs **Y=0%**

P2P connection among edge devices to route information to access or collection points with FAN communication.	
Communications Network Management System - Communication Network Management Systems provide insight into the touch points between power and communications equipment to configure networks, monitor performance, and manage behavior. In addition to managing network devices, the same tools can manage and view multiple networks.	COOPs & MUNIS **Y=57%** IOUs **Y=100%**
Sensing and Measurement	
Advanced Customer Metering – 'Smart meters' are typically digital, solid-state meters that are used to measure a customer's consumption during configured time intervals through a periodic polling mechanism. Advanced customer metering consists of technologies that can measure and communicate customer energy use or production, power characteristics, operational events, and notifications at time intervals sufficiently granular and latent to support grid and market operations. Advanced meters may include other capabilities such as real and reactive power measurement and power quality (harmonic distortion) measurement. These advanced smart meters can be used as grid sensors to support more complex field automation and DER integration.	COOPs & MUNIS **Y=100%** IOUs **Y=100%**
Production Metering - Production meters provide the telemetry, software and tools necessary for the metering and monitoring of DER assets that supply power to the grid.	COOPs & MUNIS **Y=86%** IOUs **Y=100%**
Grid Asset Sensors - Grid asset sensing technologies are health monitoring devices that automatically measure and communicate characteristics related to the health and maintenance of the equipment, such as temperature, dissolved gas and loading. These devices can also automatically generate alarm signals if the equipment characteristics reach critical or dangerous levels.	COOPs & MUNIS **Y=57%** IOUs **Y=0%**
Environmental Sensors - Environmental sensors are devices that provide real-time data on a variety of environmental factors ranging from solar irradiance, temperature, humidity, wind, geomagnetic disturbances and earthquakes to the presence of chemicals such as methane and hydrogen. Sensors may also monitor coronal discharge and capture thermal images from infrared cameras trained on substation transformers. Sensors also provide physical and cybersecurity situational awareness via measuring and monitoring parameters, including cell phone signals, presence of drones, sensor network cyber intrusion attempts, and physical intrusion detection. This information can then be fed back into the operations systems over the appropriate communications channels.	COOPs & MUNIS **Y=43%** IOUs **Y=0%**
Grid Sensors - Grid sensors (usually called line sensors) are devices that provide real-time visibility into the operation and performance of the grid, including DER operations, thus allowing for the quick identification of normal, abnormal or emergency situations and preventing interruptions of power. The two primary types of grid sensors are voltage sensors and current sensors. Coupling these sensors with analytical tools enables observability into normal	COOPs & MUNIS **Y=57%** IOUs **Y=0%**

operation, while also improving the ability to locate and de-energize fault locations, such as live electrical wires, which could create public and worker safety risks.	
Field Automation	
Distributed Automation - Distribution automation enables the monitoring, coordination, and operation of distribution system components in real-time mode, while adjusting to changing loads and failure conditions of the distribution system, usually without interventions. These functions require telemetry, analytics, and control, which in turn, require communication and computational resources.	COOPs & MUNIS **Y=57%** IOUs **Y=0%**
Volt-var Management - The objectives of a Volt-var management system include minimizing distribution system and customer voltage variation, reducing system-wide losses, reducing maintenance costs, and increasing the power delivery hosting capacity of existing equipment.	COOPs & MUNIS **Y=43%** IOUs **Y=100%**
Power Flow Controllers - The power flow controller is an electrical device comprised of power electronics, control software and communication interfaces used for providing fast-acting reactive power compensation. The controllable parameters of the power flow controller are reactance in the line, phase angle and voltage. The power flow controllers can also provide harmonic cancellation, power quality functions and typically include sensing and measurement capability.	COOPs & MUNIS **Y=14%** IOUs **Y=0%**

The results represent the percent of responding utilities that answered in the affirmative. We are not able to report the degree to which each technology/tool is deployed, and given the broad definitions provided, the actual scope of the tool deployed by each utility may vary. Source: 2020 EMNRD Utility Questionnaire, IOU N=1, Coop and Muni N=7

Another critical technological element for integrating distributed energy resources is the ability to plan for increases in load and variable generation as described in other sections of this report. **Exhibit 24** describes the extent to which utilities in New Mexico have already integrated or will integrate modeling and forecasting tools in the next 5 years.

Exhibit 24 – NM utility plans to integrate modeling and forecasting tools

Technology or Tool (see 2017 DOE Modern Distribution Grid: Vol. II, pages 10 and 18-31 for more information)	Used Technology or conducted task in last 5 years or plan to use in next 5 years for distribution system? (Y/N)
Advanced Optimization	

Integrated Resource, Transmission and Distribution Planning - Advanced optimization tools are used to identify and select the optimal sizes and locations for interconnection of DER to the distribution grid, within acceptable accommodation limits, to meet economic objectives. Optimized DER can mitigate load relief needs on a circuit by transmission and distribution (T&D) capital infrastructure deferral, resolve power quality issues, reduce emissions impacts, and provide societal and other benefits while maintaining acceptable voltage profiles along the feeder with minimized costs. Such optimization tools can capture the economic potential and size of DER planners may build a portfolio of DER to provide grid services, or identify locational value, or to enable policy makers and planners to assess policy options in relation to DER adoption and locational deployment.	COOPs & MUNIS **Y=71%** IOUs (PNM) **Y=100%**

The results represent the percent of responding utilities that answered in the affirmative. We are not able to report the degree to which each technology/tool is deployed, and given the broad definitions provided, the actual scope of the tool deployed by each utility may vary. Source: 2020 EMNRD Utility Questionnaire, IOU N=1, Coop and Muni N=7

New distributed energy resources, such as rooftop solar or solar and storage systems hinge at least partially on the ability for these systems to be connected to the grid. Interconnection requirements and the ability of the grid operator to accept DER can either provide an avenue for rapid expansion of DER or be a roadblock to further development. **Exhibit 25** describes interconnection acceptance rates as reported by a sample of utilities as of July 2020.

Exhibit 25 – NM utility interconnection acceptance rates

Distributed Energy Resource Interconnections	Size Class	Number of Interconnections Application Reviews in 2019	Number of Interconnections Applications Approved in 2019	Primary Reason for Denial of Interconnection Applications in Size Class
	≤10 KW	COOPs & MUNIS 127 IOUs (PNM) >1100	COOPs & MUNIS 127 IOUs (PNM) Appr. 1100	A denial of interconnection for small systems is due to it being out of code or oversized; the application has to be modified
	10 KW to 2 MW	COOPs & MUNIS 25 IOUs (PNM) part of number above	COOPs & MUNIS 25 IOUs (PNM) part of number above	Same as above
	2 MW to 10 MW	COOPs & MUNIS 0 IOUs (PNM) Appr. 10 to 20	COOPs & MUNIS 0 IOUs (PNM) Appr. 5 to 10	Depends on demand or RFP process
	> 10 MW	COOPs & MUNIS 0 IOUs (PNM) Appr. 10 to 20	COOPs & MUNIS 0 IOUs (PNM) Appr. 5	Same as above

2.5. MARKET ANIMATION

This section explores both retail and wholesale markets. Retail market animation involves establishing transparent distribution operational markets to enable viable market development for grid services with deep participation, to achieve a more efficient and secure electric system including better utilization of distribution system, as well as transmission system and bulk generation.[175] Retail markets are those that monetize DER services, reduce barriers for DER integration, and provide greater opportunities for realizing economic benefits of distributed energy resources through the provision of grid services. **Exhibit 26** reports responses from utilities in regard to retail markets. As seen in these data, there is no evidence that retail markets exist now or will in the immediate future.

Retail Market Animation

Exhibit 26 – NM utility distribution market technologies[176]

Distribution Operational Market Technologies (see 2017 DOE Modern Distribution Grid: Vol. II, pages 15 and 62-64 for more information)	**Exists Currently or is Being Looked at for Future Role-Out? (Y/N)**
Market Settlement - The settlement process will include calculating payment determinants based on performance, contract or tariff terms, and any charges for non-performance. The scale of these complex structured transactions may grow to a large quantity and involve accounting for relatively small units (micro-transactions) that sum to large dollar values. Traditional CIS billing systems and wholesale settlement systems do not support the potential transaction scale and diversity of pricing schemes and tariff/contract terms. Today, most special retail tariffs and DR programs are handled manually using less sophisticated spreadsheet/database tools that will not scale. This creates the need for settlement systems not unlike those used for online digital media, such as for purchasing music, to automate a settlement process for the potential scale and small unit size of transactions and create visibility into the valuation of services and related monetization methods.	COOPs & MUNIS **Y=0%** IOUs (PNM) **Y=0%**
Market Portals - Market portals could provide open channels for market participants to view and visualize information related to distribution operational markets for grid services. Market portals will support access to market data from the front-end (e.g., web-based displays) or from the back-end (e.g., electronic data interchange) for downloading large quantities of data while being safeguarded by strong privacy protections and cybersecurity measures. Several standards-based approaches are in development to support information exchange including: Green Button Connect and Orange Button Connect. Additionally, market portals may include identification of grid services and related locational opportunities, participant registration/enrollment and program/procurement eligibility criteria, pricing information, secure access to participant settlements, and notifications. A market portal may convey different types of information designed for various audiences such as customers, energy service providers and DER aggregators.	COOPs & MUNIS **Y=0%** IOUs **Y=0%**

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[175] From U.S. Department of Energy (2017). *Modern Distribution Grid*, vol 1

[176] All definitions of technologies or tools referenced in the EMNRD Utility Questionnaire come directly from the U.S. Department of Energy's (2017) *Modern Distribution Grid*, vol 2.

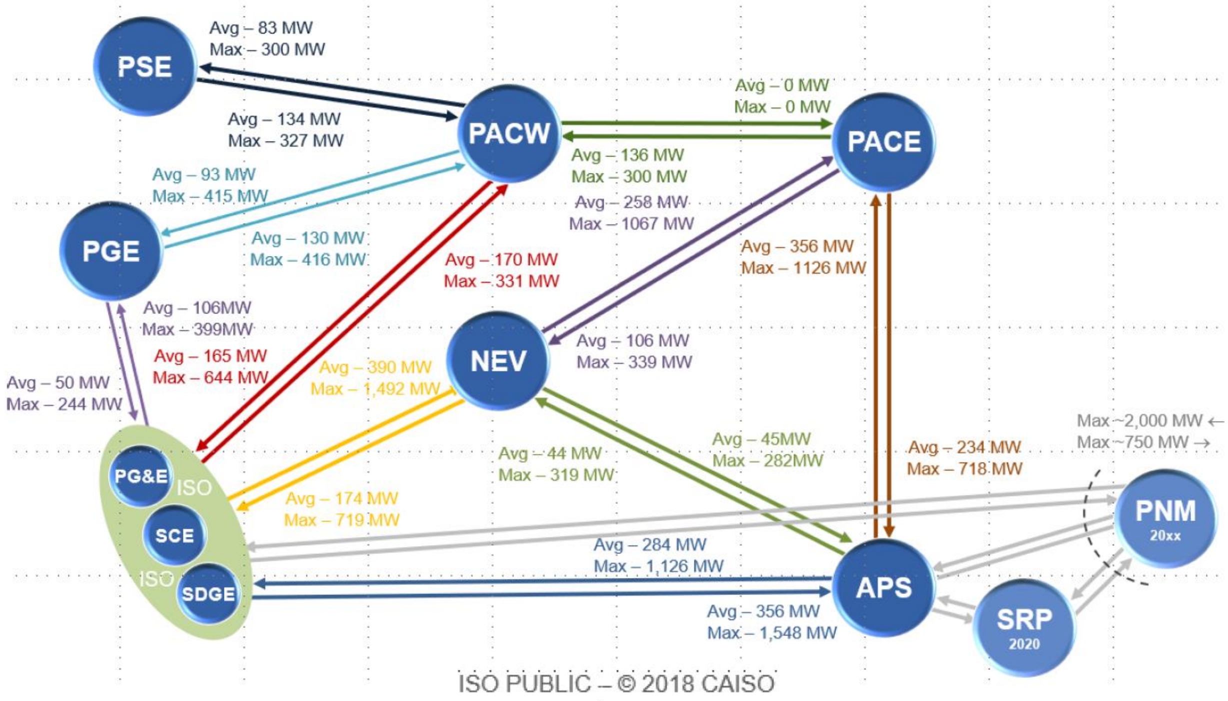
Market Compliance and Surveillance - Distribution operational market participants include both DER providers and directly participating customers. Market participation rules are being defined in terms of the requirements and responsibilities for market participants in order to provide a high quality of service delivery. As such, tools will be needed to oversee and ensure participants' compliance with the new market rules. Expected functionalities will include: • Qualifying (e.g., credit and performance checking) of new participants; • Tracking pre-scheduled or real-time service deliveries; • Managing of participant interactions (e.g., service complaints) and participant non-performance; and • Monitoring market participation (e.g., liquidity). Market surveillance tools can provide continuous surveillance and evaluation of distribution markets, which helps prevent any wrongdoing or anti-competitive behavior, and ensures markets perform as intended. The functionalities of market surveillance tools can be split into two: identifying and addressing wrongdoing in the bidding process, and auditing of posted clearing prices and the evaluation of efficient functioning of the market.	COOPs & MUNIS **Y=0%** IOUs **Y=0%**

The results represent the percent of responding utilities that answered in the affirmative. We are not able to report the degree to which each technology/tool is deployed, and given the broad definitions provided, the actual scope of the tool deployed by each utility may vary. Source: 2020 EMNRD Utility Questionnaire, IOU N=1, Coop and Muni N=7

Wholesale Market Animation

This section describes the state of New Mexico's connection to regional wholesale markets. **Exhibit 27** shows the general flow of energy from New Mexico's biggest IOU (PNM) to points west. As seen in the diagram, a maximum, instantaneous, 2,000 MW can flow out of New Mexico to Arizona and California, while a maximum of 750 MW can be imported. With the closure of two units at the San Juan Generating Station, total generation in the state has fallen from a historic high of 39.7 TWhs in 2009 to 35.2 TWhs in 2019. This along with increases in New Mexico's electricity demand has seen some utilities like PNM experience a fundamental shift in their import/export ratios, while third party generators (many renewable electricity generators) have created export opportunities and are exporting power to regions that once purchased coal-fired electricity and other neighboring states. This influx of new generation has nearly offset the decline in coal generation. Over the last two years (April 2018 to April 2020) New Mexico produced 40% more electricity than it used and remains a net electricity exporter.

Exhibit 27 – New Mexico's connection to regional wholesale markets



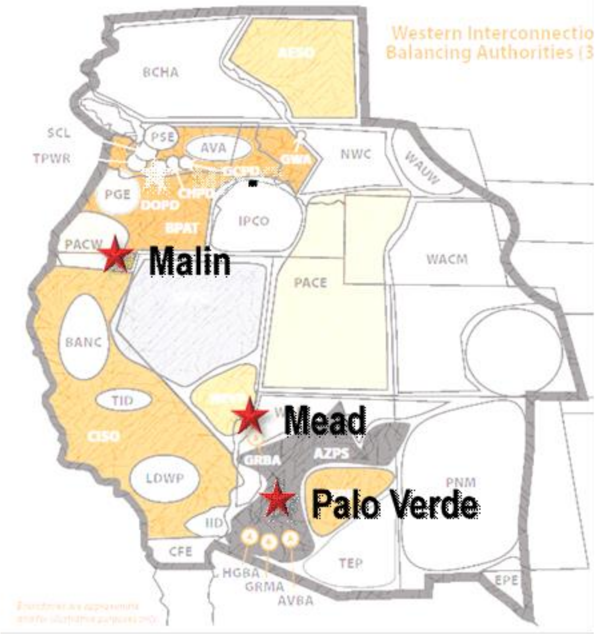
Source: WEIM Regional Issues Forum March 2019, Todd Fridley - PNM

Importing and exporting electricity from other regions requires transmission infrastructure, and in the case of exports, customers are willing to purchase the power at the delivered cost. **Exhibit 27** highlights the physical transmission limitations between PNM's service territory and the rest of the Western Interconnection. Moving electricity eastward through New Mexico's two DC interconnections is very limited and the conversion process is usually cost prohibitive for long-term commercial sales. Currently SPS is the only New Mexico IOU on the eastern grid and thus is the only utility that routinely exports electricity from New Mexico into the eastern grid and into the Southwest Power Pool markets.

In the western grid, exported electricity from New Mexico generally has to reach a trading hub so that it can be traded or sold to other states. **Exhibit 28** shows the trading hubs in the Western Interconnection. A trading hub typically has the following characteristics:

1) A large concentration of generation resources serving multiple control areas;
2) A cluster of buses where the buses could be owned by utilities of different regions;
3) Absence of hurdle rates when power flows within the cluster of buses; when power is exported out of the trading hub; or when neighboring regions export power to the trading hub;
4) Trading hubs are usually located at the boundaries of multiple regions.

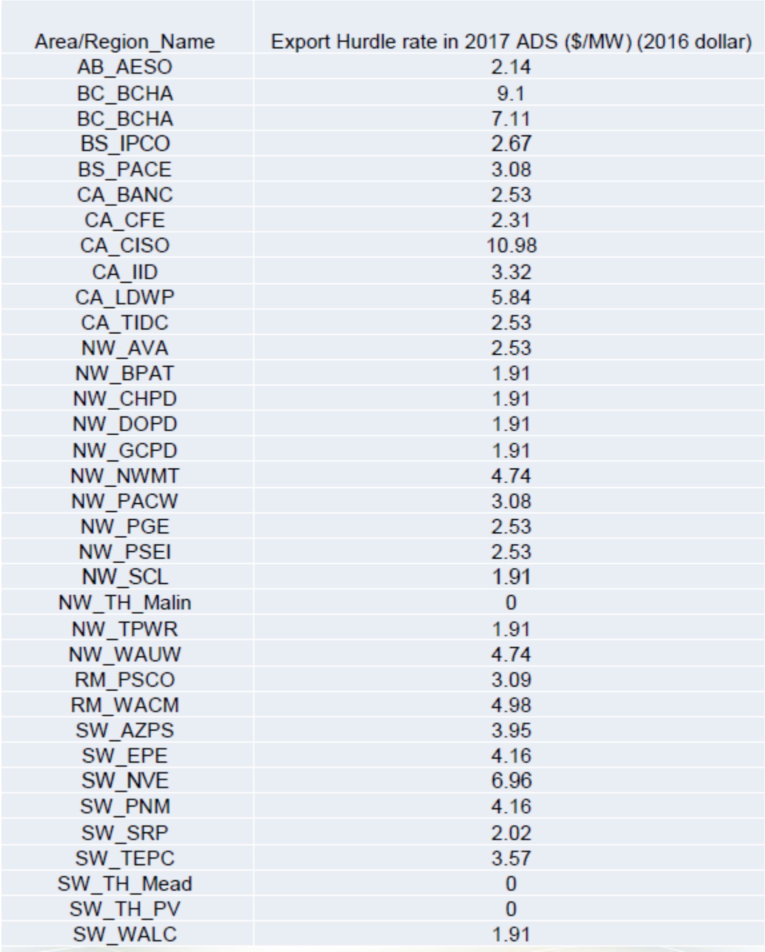
Exhibit 28 – Trading hubs in the Western Interconnection



Source: ADS Data Development and Validation Manual (DDVM), WECC, 2018

Unlike the eastern grid, where large regional ISOs/RTOs like the Southwest Power Pool set and manage transmission costs under one umbrella entity, the western grid is managed by multiple balancing authorities (BAs), each imposing its own transmission hurdle rates and thus setting up a potential for significant pancaking of fees imposed on electricity exports or import from distant regions of the western grid. **Exhibit 29** gives an example of past hurdle rates across the western grid. These hurdle fees (Wheeling or Transmission tariffs) are normally charged to exports out of a BA and not imports into the BA.

Exhibit 29 - WECC Balancing Authority Wheeling Rates, collected in 2013



Area/Region_Name	Export Hurdle rate in 2017 ADS ($/MW) (2016 dollar)
AB_AESO	2.14
BC_BCHA	9.1
BC_BCHA	7.11
BS_IPCO	2.67
BS_PACE	3.08
CA_BANC	2.53
CA_CFE	2.31
CA_CISO	10.98
CA_IID	3.32
CA_LDWP	5.84
CA_TIDC	2.53
NW_AVA	2.53
NW_BPAT	1.91
NW_CHPD	1.91
NW_DOPD	1.91
NW_GCPD	1.91
NW_NWMT	4.74
NW_PACW	3.08
NW_PGE	2.53
NW_PSEI	2.53
NW_SCL	1.91
NW_TH_Malin	0
NW_TPWR	1.91
NW_WAUW	4.74
RM_PSCO	3.09
RM_WACM	4.98
SW_AZPS	3.95
SW_EPE	4.16
SW_NVE	6.96
SW_PNM	4.16
SW_SRP	2.02
SW_TEPC	3.57
SW_TH_Mead	0
SW_TH_PV	0
SW_WALC	1.91

The basic formula for hurdle fees is:

Inter-balancing authority BA hurdles = Wheeling charges + Frictions

where Frictions are market barriers due to lack of timely imformation and price signals from other BAs. The magnitudes of frictions are usually hard to quantify in terms of $/MWh and are generally different from BA to BA, and from hour to hour.

By definition, load pays for transmission infrastructure. In other words, the customer always pays for grid infrastructure and so there are incentives for states and their consumers to limit the volume of imported electricity. California recently enacted a new building code that requires all new residential buildings to be Zero Net Energy (ZNE) starting 2020 and all commercial buildings to be ZNE starting 2030. Transmission hurdle fees, developments like ZNE building codes, and development of wind resources off the California coast are all potential barriers to expansion of electricity export markets for New Mexico producers.

While not a market with buying and selling in the traditional sense, bulk power imbalances are managed regionally through an Energy Imbalance Market (EIM), such as the California Independent System Operator (CAISO) EIM. Each participant of an EIM posts a demand forecast and a unit commitment to meet the demand forecast. Note: any party that does not have sufficient resources to meet its own demand is not allowed to participate on the day they are short of resources. Then participants contribute any “surplus” resources they may have in excess of what they need to meet their own forecast demand to a pool that CAISO will dispatch automatically as efficiently as possible on an as-needed basis. Participants are billed or compensated on the dispatch costs. The savings to all participants are driven by the economic advantage of having a much more diverse pool of reserves to address forecast error than any one participant has in its own fleet. Here El Paso Electric[177] considers this market:

> *It is important to clarify that participation in the EIM does not provide additional resources for the purpose of meeting peak load. Each participant is required to have adequate resources to meet its peak load and regulating requirements. The EIM allows for co-utilization of each entities' regulating reserves and potentially optimize dispatch/operating costs.*

As of its 2018 IRP, El Paso Electric continues to monitor and consider markets such as the EIM, while continuing to plan for adequate resources to meet EPE's load requirements. In contrast, PNM has joined the EIM as of April 2021.

2.6. ASSET OPTIMIZATION

A system that optimizes assets is a system whereby electrical grid planning is made with existing assets in mind and distributed resources are optimized to minimize total system costs. Assets include all wires and associated technologies across transmission and distribution systems. The underlying question is: what assets are utilities currently using and to what level could these asset optimization tools alleviate or defer other costs. In a recent presentation, for example, Kit Carson Electric Cooperative reported that its distribution grid, in general, was built to supply electric power at a volume of 1000 kWh/month/customer. However, the grid in Kit Carson's service territory is currently supplying on average about 450 kWh/month/customer.[178] In other words, the Kit Carson distribution grid is only utilizing 45% of its average design capacity. Many power systems are purposely over-designed or designed to peak loads whether it be the Kit Carson distribution grid or a new home with a 200 amp service panel that rarely if ever pulls more than 50 amps, however, over-design and under-utilization of assets comes at a cost and so maintaining those assets and even deferring the construction of additional assets is vital to a cost effective system. Asset optimization can be tracked by a mix of capital spending on grid infrastructure and rates, understanding that capital expenses will be required for transition.

Optimization analytics is one technology category that can assist in both maintaining existing assets and deferring additional asset cost. The availability of additional grid intelligence can, through analytics, extend the life of assets, predictively maintain equipment, and effectively manage a field workforce to improve overall system performance and efficiencies. Also, as DER services include non-wires alternatives, there is a need to optimally evaluate a complex portfolio or many portfolios of various individual, programmatic and aggregator services to meet specific locational grid needs. The underlying components that support optimization analytics are asset management and DER optimization.

Asset management integrates the grid intelligence acquired in achieving the other milestones with new and existing asset management applications. One important technology is condition-based maintenance (CBM) systems. A CBM system collects data on distribution assets to ensure maintenance is performed only when needed. A CBM integrates with software-based tools that can be deployed to gather grid data, to aggregate and analyze grid data, and to pinpoint locations to add new data collection monitors and sensors. CBM systems leverage asset data to reconcile maintenance schedules with actual asset conditions, organizational priorities, and changes in operating environments.

As DER penetration increases, combining traditional energy assets and DER may require optimization to achieve system reliability, resilience, and/or efficiency goals in a more efficient way. DER optimization

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[177] El Paso Electric (2018) IRP

[178] CEO and General Manager, Kit Carson Electric Cooperative

tools must be capable of analyzing different types of DER in combination with physical grid assets in order to manage distribution operations through dynamic optimizations. This results in the utilization of these resources to achieve desired performance as non-wires alternatives in terms of response time, duration, and load profile impacts.

Reactive and preventative grid maintenance programs that respond to grid events have been widely used by utilities for a long time. However, the integration of CBM programs using software tools is a recent development. Typically, source data is generally available and commercially available analytics are sophisticated. However, integration between the two is often challenging given non-standard data formatting and other data quality issues. For this reason, CBM as described is in early commercial deployment.

DER optimization tools are generally in the R&D stage of adoption maturity. Today, assessment of DER non-wires alternatives portfolios at the distribution level is often performed through spreadsheet-type analysis. Some DER portfolio optimization capability is included in a distributed energy resource management system (DERMS), but these are typically designed for managing the dispatch function, not for constructing portfolios resulting from sourcing evaluations and distribution planning. It may be possible to extend the DERMS functionality for this purpose in planning, as well as to integrate with market operations and grid operations.

In the EMNRD 2020 Utility Questionnaire, 71% of the Rural Electric Coops and Public Utilities that responded reported that they have or plan to (in the next 5 years) implement Asset Management tools, while only 14% reported that they have or plan to implement DER Optimization tools. Meanwhile, PNM, the only IOU to respond, reported using Asset Management but not DER Optimization and that the utility has no plans (in the next 5 years) to implement the tool.

While many of the optimization tools discussed above can provide similar benefits to the transmission system, the transmission system in New Mexico operates somewhat differently from the distribution grid. The transmission system (shown in **Exhibit 30**) not only serves local New Mexico loads but also exports New Mexico generation out of state. While capacity on the current transmission system is adequate to meet the energy needs of New Mexico's consumers, it may be lacking in its ability to export future energy generation to other states and regions. While many of the bottlenecks are more contractual than real, due to the variable energy sources interconnected to some transmission assets, the technology solutions for transmission optimization may be different from those for the distribution system.

The New Mexico Renewable Energy Transmission Authority's (NM RETA) Transmission and Storage Study (2020) explores asset and resource optimization and trade-offs at the bulk power scale. Transmission is generally seen as a way to "facilitate optimal use of the existing grid resources, lowering the total generation required to serve the electric demand." [179] The report discusses the transmission needs required to optimize development and export (to the West) of wind resources in the eastern part of the state. The report also demonstrates how it would be possible to develop solar resources in optimal locations across New Mexico to take advantage of existing transmission lines and corridors. The authors also note that microgrids can help reduce transmission losses by locating resources closer to load. They can facilitate reduction of overloads in isolated areas of the grid. In high-price areas (particularly due to congestion), the report points out, "microgrids may provide an alternative power source at lower pricing, which does not further overload the transmission system."[180]

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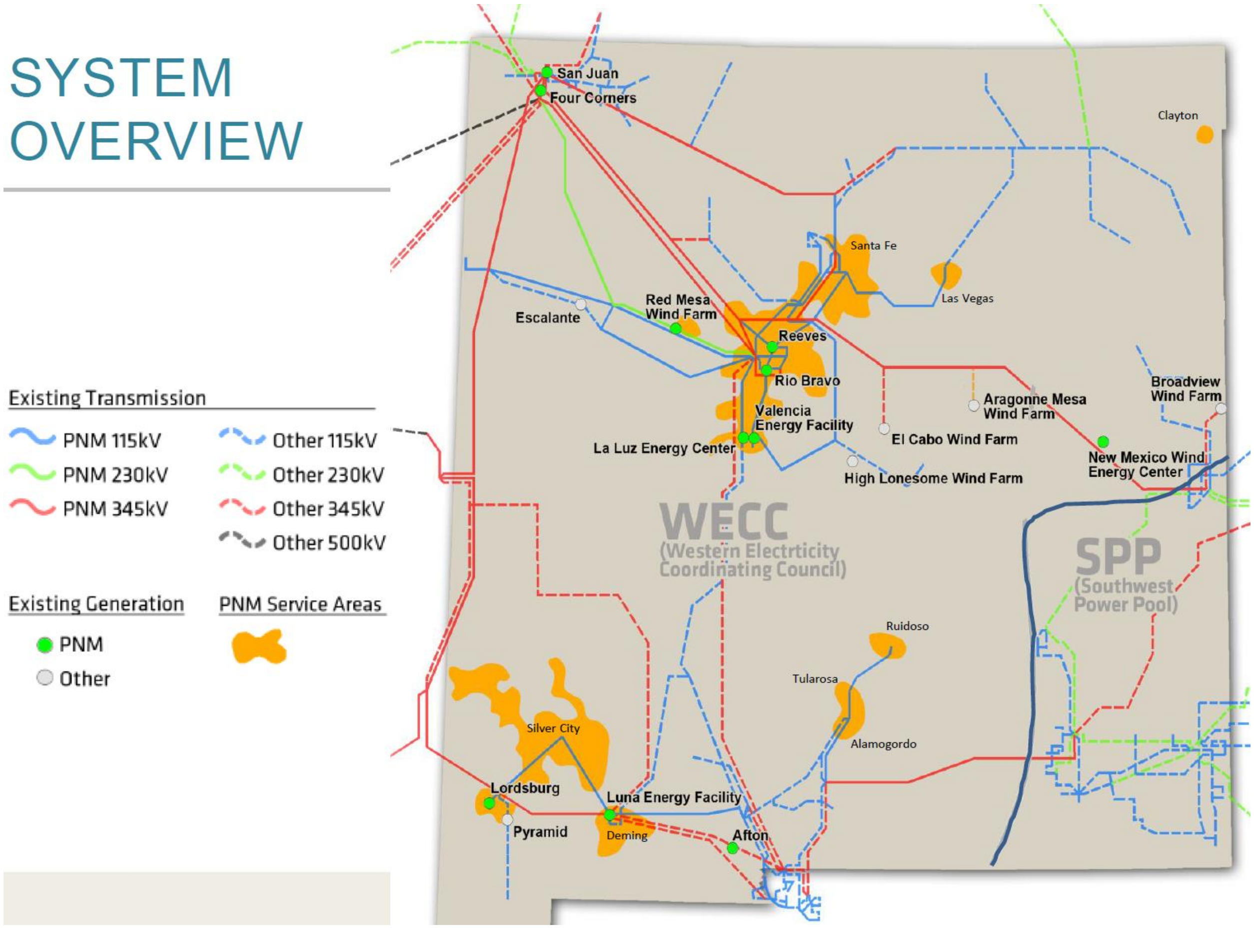
[179] ICF (2020) NM RETA Renewable Energy Transmission and Storage Study, p. 3
[180] Ibid., p. 74

Exhibit 30 – New Mexico transmission system overview



Source: WEIM Regional Issues Forum March 2019, Todd Fridley - PNM

2.7. SYSTEM EFFICIENCY

Similar to asset optimization, this objective of a modern grid means that a system is designed to minimize resource losses through coordination of wires and non-wires solutions. An efficient system is a system designed to enhance the operation of the physically connected generation, transmission, and distribution facilities, which are operated as an integrated unit typically under one central management or operating supervisor. This is tracked by utility reported annual percentage loss trends.

A 2016 study from Pacific Northwest National Laboratory[181] reports that while the U.S. electric transmission and distribution system is among the most efficient in the world, roughly 6% of total generated electricity is lost. The report makes the following observations:

- One of the largest sources of loss is distribution transformers, which contribute roughly a third of total losses, or 2% of all generated electricity in the United States. However new federal efficiency

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[181] PNNL (2016). *Electricity Distribution System Baseline Report*

standards are expected to reduce these losses significantly, saving 3.6 quads of energy over 30 years.

- Further efficiency improvements are possible with both upgrades to more efficient equipment as well as new technologies that allow for the more efficient management of power flows to reduce losses.
- Studies of loss-reduction potential for specific technologies have estimated what losses each technology could reduce; however, these studies predominantly focus on the technical potential of either full deployment of a technology or optimizing operations to minimize losses. These results are likely to overstate the potential for loss reduction when improvements must also be subject to cost-benefit tests or other network-specific operational constraints.
- Replacing existing infrastructure for loss-reduction purposes alone is typically not justifiable on economic grounds. However, there can be positive net benefits for incorporating loss-reduction considerations into the design or planning of new capacity or reliability investments being made for other reasons.
- Efforts to invest in cost-effective efficiency improvements are likely further constrained in part by regulatory policies that do not allow recovery of the cost of the full capture of efficiency benefits by the operators who would incur the costs.

For example, most states (including New Mexico) that historically required utilities to meet energy efficiency resource standards allowed only end-use efficiency to count toward the target. This effectively means there is no incentive for transmission and distribution (T&D) investments, which could have the same impact of reducing the level of generation needed to meet demand. The passage of HB233 in New Mexico might change this by providing an avenue for utilities to recover costs for energy efficiency upgrades as they relate to grid modernization. We will know more once the PRC implements this section of the law.

Exhibit 31 describes losses as reported to EIA in 2018. If we take the average of New Mexico's utilities, total losses are on par with the national average.

Exhibit 31 – System energy losses by reporting utility

	Total Sources of Electricity (MWhs)	Total Losses (MWhs)	Total Losses (% of Total Sources)
Investor-Owned Utility			
Public Service Co of NM	12,207,334	810,349	6.60%
Cooperatives			
Central New Mexico El Coop, Inc	242,235	20,149	8.30%
Central Valley Elec Coop, Inc	893,259	42,553	4.80%
Columbus Electric Coop, Inc	109,975	11,154	10.10%
Continental Divide El Coop Inc	727,220	55,726	7.70%
Farmers Electric Coop, Inc - (NM)	402,637	21,126	5.20%
City of Farmington - (NM)	1,048,812	39,584	3.80%
City of Gallup - (NM)	184,493	-	0.00%
Jemez Mountains Elec Coop, Inc	416,731	27,050	6.50%
Kit Carson Electric Coop, Inc	288,276	23,596	8.20%
Lea County Electric Coop, Inc	1,463,741	78,890	5.40%

Los Alamos County	611,596	17,936	2.90%
Mora-San Miguel Elec Coop	79,968	9,302	11.60%
Otero County Electric Coop Inc	199,586	16,714	8.40%
Socorro Electric Coop, Inc	192,598	14,006	7.30%
Southwestern Electric Coop Inc - (NM)	436,930	6,485	1.50%
Springer Electric Coop, Inc	263,794	3,009	1.10%
Roosevelt County Elec Coop Inc	164,636	11,838	7.20%
Sierra Electric Coop, Inc	69,024	3,585	5.20%
Total	20,002,845	1,213,052	6.20%

Source: EIA 861 Annual Electric Power Industry Report

Efficiency and loss are primarily a function of how dispersed generation assets are from load. Below is a bit of history from PNM's 2017 IRP:

> *PNM's transmission system has undergone dramatic changes in its configuration and uses since its inception in 1920 and is largely unchanged since 1985. The initial system consisted of 46 kV and 115 kV lines used to deliver "locally" generated energy to "local" loads. In the 1950s and 1960s, lines between the cities began to be built so local generators could provide backup support to each other, and an associated increase in reliability of service was attained. PNM's first tie to the "outside world" was by way of a 230 kV line to Four Corners built in 1962, concurrent with APS construction of the original FCPP.*
>
> *The basic 345 kV transmission system that is in place today was developed in the late 1960s and early 1970s as the larger coal-fired generating units at FCPP and SJGS were brought online. This shifted large base-load generation from local to remote resources away from load centers, partly because of environmental, economic, water, and fuel availability considerations, whereas smaller and less efficient intermediate and peaking units were located within the load centers. The availability of remote resources with a mix of low-cost coal and nuclear fuel resulted in the dispatch of generating plants near the load centers was generally only needed during peak hours of the summer or when transmission system import limits would otherwise be exceeded. Economics drive the maximum use of energy brought in from the more efficient and larger remote generators.*

Solar systems take advantage of an abundant in-situ natural resource and require neither additional fuel nor water to operate. There is also the potential for coops and IOUs to develop utility-owned resources on the distribution grid on already disturbed/in-use land. Next door, Arizona Public Service Company has been installing local storage to absorb excess rooftop solar production and also rented rooftops from consumers for solar installations. The multi-national company, Emera, envisions neighborhood microgrids that operate all in front of the meter, owned and operated by the utility. In Colorado, Xcel is building a large solar array for the steel mill in Pueblo.

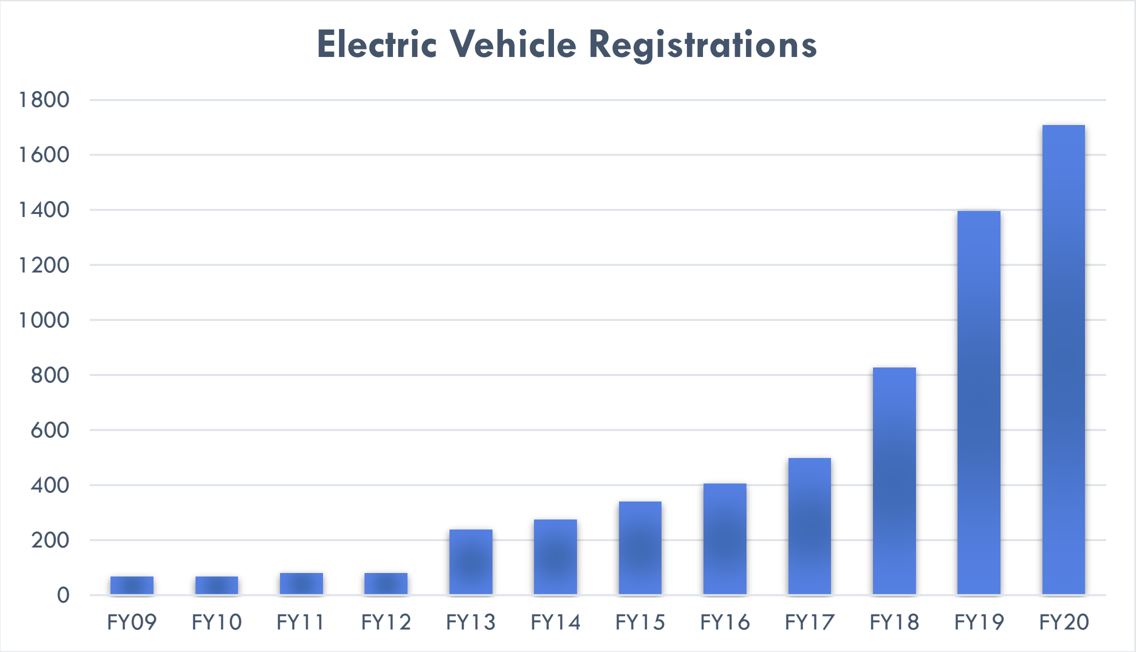
In addition to generation, demand management can also help with system efficiency. Many opportunities exist for variable production industries that can match supply (e.g. frozen foods storage industry).

2.8. ELECTRIFICATION/DECARBONIZATION

This objective refers to the electric grid's ability to absorb load (as discussed in **Section 2.1**) from the electrification of other carbon contributing sectors of the economy.

Questions regarding adoption of electric vehicles include: 1) How will EVs increase overall electricity demand? and 2) How will charging behavior and/or the ability to influence charging behavior impact peak demand? **Exhibit 32** In considering the additional load of EVs, a study by the Brattle Group[182] estimates growth of about 20 million EVs by 2030 in the U.S., adding up to 95 TWhs of annual demand. If we assume NM is 1% of the U.S. EV market, adding approximately 200,000 EVs, the load increase would be 1 TWh of annual demand (approx. 2 weeks of new load). Based on the report's rationale, we may predict EVs will add 100 to 200 MW of peak load growth (less than 5–10% of current peak load). However, these estimates are uncertain, and the lack of charging behavior data makes it hard to predict in the future.

Exhibit 32 – New and renewing registrations of EVs in NM



Source: New Mexico Motor Vehicle Division, Tax and Revenue Department

Exhibit 32 describes the electric vehicle adoption rate in terms of numbers of electric vehicles registered with the Motor Vehicle Division of New Mexico's Tax and Revenue Department. The adoption of vehicles will likely co-evolve with the build-out of charging infrastructure. **Exhibit 33** shows geographic locations of non-residential EV charging stations throughout the state. At this time, public charging infrastructure is concentrated in urban areas and mainly along interstates and major road corridors.

PNM predicts that there will be 7,800 electric vehicles in its service territory by 2022.[183] To serve this expected market at the International Energy Association's recommended ratio, PNM expects there should be approximately 70 Direct Current Fast Chargers (~25%) and 200 Level 2 Chargers (~75%) located at

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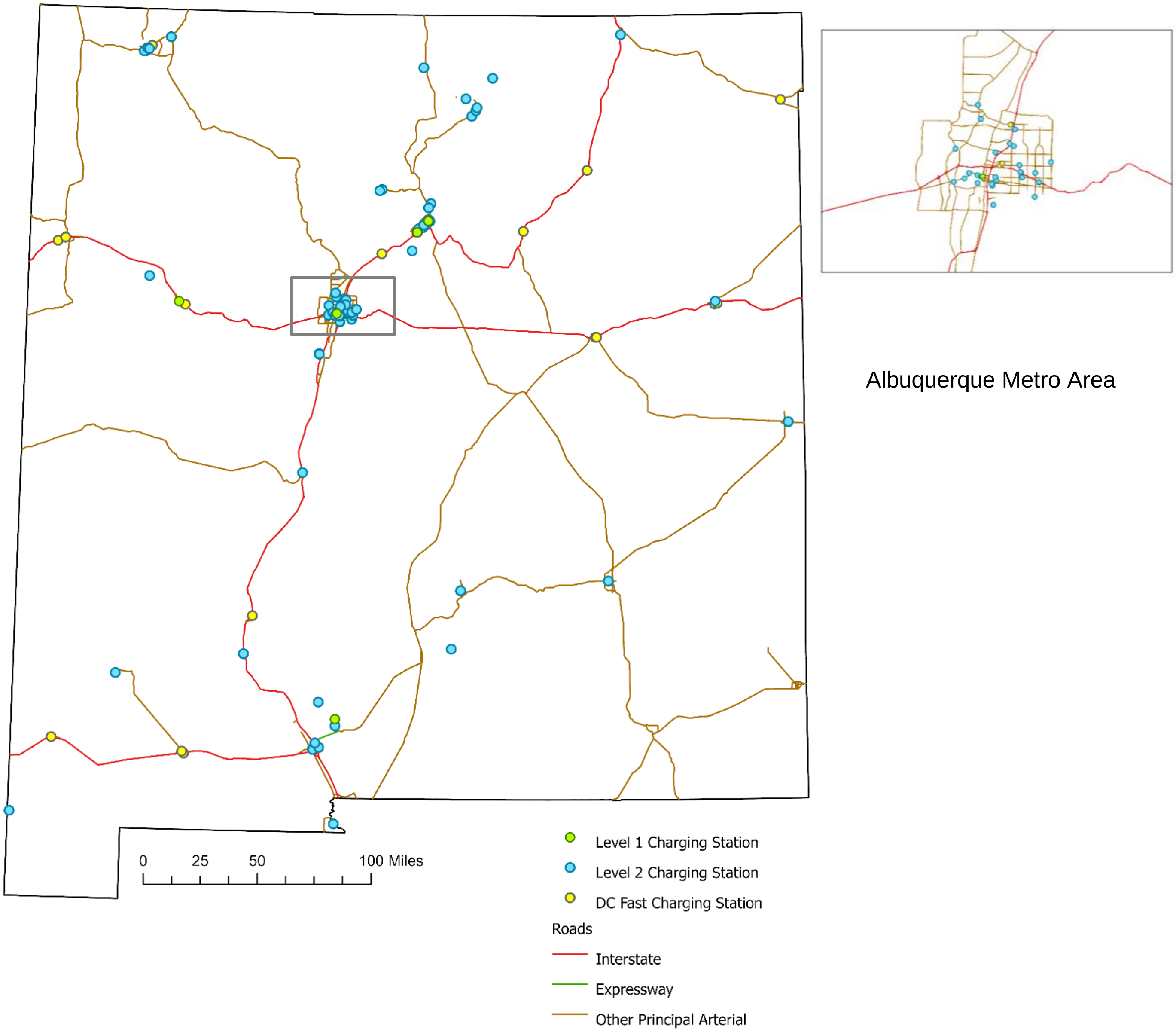
[182] The Brattle Group (2020) Getting to 20 Million EVs by 2030: Opportunities for the Electricity Industry in Preparing for an EV Future (presentation).

[183] PNM Transportation Electrification Plan, Presentation of Planned Filing, March 2020

public places, workplaces, and multi-family residences. To incentivize off-peak charging, PNM has proposed time-of-day rate charges for both residential and commercial transportation charging load.

Exhibit 33 Electric Vehicle Public Charging Infrastructure



Data Sources: US DOE, EERE, Alternative Fuels Data Center, accessed April 13, 2021; US DOT
Note: Multiple chargers may be sited at each station.

Heavy duty and fleet vehicles will likely have an even greater impact on the grid. These vehicles may require more energy overall and/or may need to be charged simultaneously. The city of Albuquerque Transit Department is applying for five electric busses and the Santa Fe Public School District is applying for one electric school bus.[184] A bill introduced during the 2021 New Mexico Legislative regular session would have required the state fleet to transition to electric vehicles. One company in Santa Fe (Dashing Delivery) uses only electric vehicles for food delivery service.

Data for the building sector, at least for New Mexico specifically, is sparser. A 2015 EIA summary[185] reports that approximately 25% of homes in the Mountain South region of the West heat water with electricity.

While important to consider, we are not able to provide data to describe the extent to which New Mexicans have replaced traditional cooling methods (i.e., swamp coolers) with electricity-intensive AC systems.

2.9. RELIABILITY AND RESILIENCE

This grid objective refers to the ability to maintain and enhance the safety, security, reliability, and resilience of the electrical grid at fair and reasonable costs, within accepted standards and consistent with the state's energy policies. With respect to the customer, reliability is seen as the number and duration of power outages per year. Reliability can be tracked by traditional reliability ratings (NOTE: work is required to agree on a reporting system that works for all electricity providers, i.e., IOUs, co-ops and municipally-owned utilities) and may require new metrics for distribution-level security. EMNRD can also track utility use of the distribution planning and system operation tools described below by periodically readministering the Utility Questionnaire.

The main causes of customer power outages are disruptions on the distribution grid, such as a tree limb falling on a power line, icing of power lines in the winter, or squirrels shorting out transformers. Utilities must quickly detect outages, dispatch repair crews, and restore service to customers.

A second, less common type of outage is caused by problems in the bulk power system. These can be due to inadequacy of generation facilities or failures in the transmission system. There are three main components to bulk power system reliability:[186]

1) Long-term reliability is a function of resource adequacy. Resource adequacy (RA) is a condition when the utilities and load serving entities (LSEs) of a certain region have acquired sufficient resources to meet their load reliably in a given period. It can also be defined as "the ability of an electric power system to meet demands for electricity using its supply-side and demand-side resources (NERC, 2011)."[187] The benchmark for adequacy is 1 day in 10 years of not meeting resource needs.
2) Medium-term reliability (seconds to 1 day ahead) is achieved through system balancing. The more flexible a system is to respond to short-term fluctuations in resource supply (especially wind and solar) the better. Ways to balance a system include the inputs cited above in addition to price mechanisms that influence demand.

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[184] https://www.env.nm.gov/air-quality/wp-content/uploads/sites/2/2020/04/VW-Project-Selection_22Apr20_AltFuel.pdf

[185] Table CE4.5 Annual household site end-use consumption by fuel in the West—totals, 2015, from 2015 Residential Energy Consumption Survey: Energy Consumption and Expenditures Tables

[186] For fuller explanations, see Debra Lew and Nick Miller, WIEB/WIRAB Webinars (2020), *Grid Reliability and the Changing Resource Mix*, https://westernenergyboard.org/2020/04/wirab-webinar-series-grid-reliability-and-the-changing-resource-mix/

[187] NERC definition used and cited in Carvallo et al. (2020*) Implications of a regional resource adequacy program on utility integrated resource planning: Study for the Western States*, p. v.

3) Short-term reliability (nanoseconds) is a function of system stability. System stability, in turn, includes three elements: frequency control; small signal stability; and transient stability.

Reliability can be considered a relatively fixed objective in that there are federal standards and layers of oversight. At the same time, we know that transitioning to clean energy resources is a challenge to the boundary of existing technologies, especially as we approach 100% inverter-based resources.

The following section describes the reliability of New Mexico’s electric systems as reported in 2018 to the EIA.

Exhibit 34 - 2018 New Mexico reported reliability data

2018 Reliability Data Reported on EIA- 861

	SAIDI Reported	SAIDI w/out MED Reported	SAIFI Reported	SAIFI w/out MED Reported	CAIDI Reported	CAIDI w/out MED Reported	IEEE Standard	Other Standard
IOUs								
El Paso Electric Co	✓	✓	✓	✓	✓	✓	✓	
Public Service Co of NM	✓	✓	✓	✓	✓	✓	✓	
Southwestern Public Service Co	✓	✓	✓	✓	✓	✓	✓	
Cooperatives								
Central New Mexico El Coop, Inc	✓	✓	✓	✓	✓	✓		✓
Central Valley Elec Coop, Inc	✓	✓	✓	✓	✓	✓	✓	
Columbus Electric Coop, Inc	-	-	-	-	-	-		
Continental Divide El Coop Inc	✓	-	-	✓	-	-		✓
Farmers Electric Coop, Inc - (NM)	✓	-	✓	✓	✓	-		✓
Jemez Mountains Elec Coop, Inc	✓	✓	✓	✓	✓	✓	✓	
Kit Carson Electric Coop, Inc	-	-	-	-	-	-		
Lea County Electric Coop, Inc	✓	✓	✓	✓	✓	✓		✓
Mora-San Miguel Elec Coop	✓	✓	-	-	-	-	✓	
Navopache Electric Coop, Inc	-	-	-	-	-	-		
Otero County Electric Coop Inc	-	-	-	-	-	-		
Rio Grande Electric Coop, Inc	-	-	-	-	-	-		
Roosevelt CountyElec Coop Inc	-	-	-	-	-	-		
Sierra Electric Coop, Inc	✓	✓	-	-	-	-		✓
Socorro Electric Coop, Inc	-	-	-	-	-	-		
Southwestern Electric Coop Inc - (NM)	-	-	-	-	-	-		
Springer Electric Coop, Inc	-	-	-	-	-	-		
Tri-CountyElectric Coop, Inc	-	-	-	-	-	-		
Public Utilities								
City of Farmington - (NM)	✓	✓	✓	✓	✓	✓	✓	
City of Gallup - (NM)	-	-	-	-	-	-		
Los Alamos County	✓	-	✓	-	✓	-	✓	
Navajo Tribal Utility Authority	✓	✓	✓	✓	✓	✓		✓

Source: EIA 861 Annual Electric Power Industry Report

The System Average Interruption Frequency Index (SAIFI) is a measure of the probability that a customer will experience an outage. The System Average Interruption Duration Index (SAIDI) is a measure of the average outage duration per customer, in minutes. There are different standard(s) used to calculate reliability metrics. There is an IEEE standard, but several co-ops and the Navajo Tribal Utility Authority (NTUA) use other (unspecified) standards. Thus, the data are not comparable.

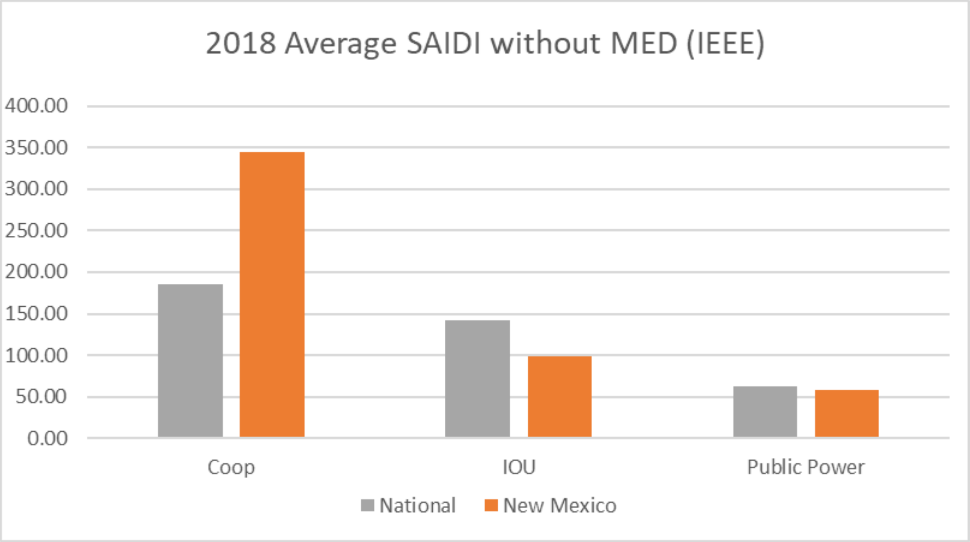
Another complicating factor is the ability to see day-to-day reliability versus the ability to bounce back from major outage events. Some utilities include Major Event Days (MEDs) in reliability calculations. IEEE suggests that removing MEDs allows for a clearer picture of normal day-to-day reliability. By removing MEDs, data become effectively normalized, but even this is problematic given that there is not standardized threshold for an MED. An MED is defined as:

> *A day in which the daily system SAIDI exceeds a threshold value, T_{MED}. For the purposes of calculating daily system SAIDI, any interruption that spans multiple calendar days is accrued to the day on which the interruption began. Statistically, days having a daily system SAIDI greater than T_{MED} are days on which the energy delivery system experienced stresses beyond that normally expected (such as severe weather). Activities that occur on major event days should be separately analyzed and reported.*[188]

Again, there is variability across the utilities when it comes to reporting interruptions with and without MEDs.

Exhibits 35 and 36 show a subset of the SAIFI and SAIDI indicators calculated without MEDs and that use the IEEE standard. Based on these data, New Mexico IOUs and Public Power systems fared slightly better than the national averages for reliability, while the average reliability indicators for cooperatives in New Mexico were higher than the national averages for 2018. It should be emphasized that these data represent a snapshot in time and do not give us an indication of trends.

Exhibit 35 - National versus New Mexico SAIDI



Source: EIA 861 Annual Electric Power Industry Report. Note: New Mexico cooperatives N=3; IOUs N=3, Public Power N=2

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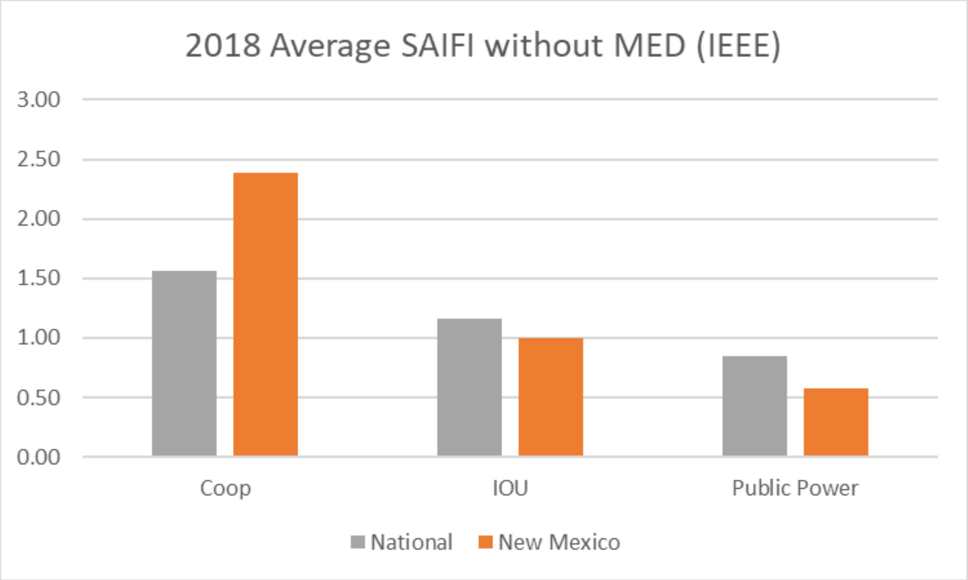
[188] IEEE Guide for Electric Power Distribution Reliability Indices

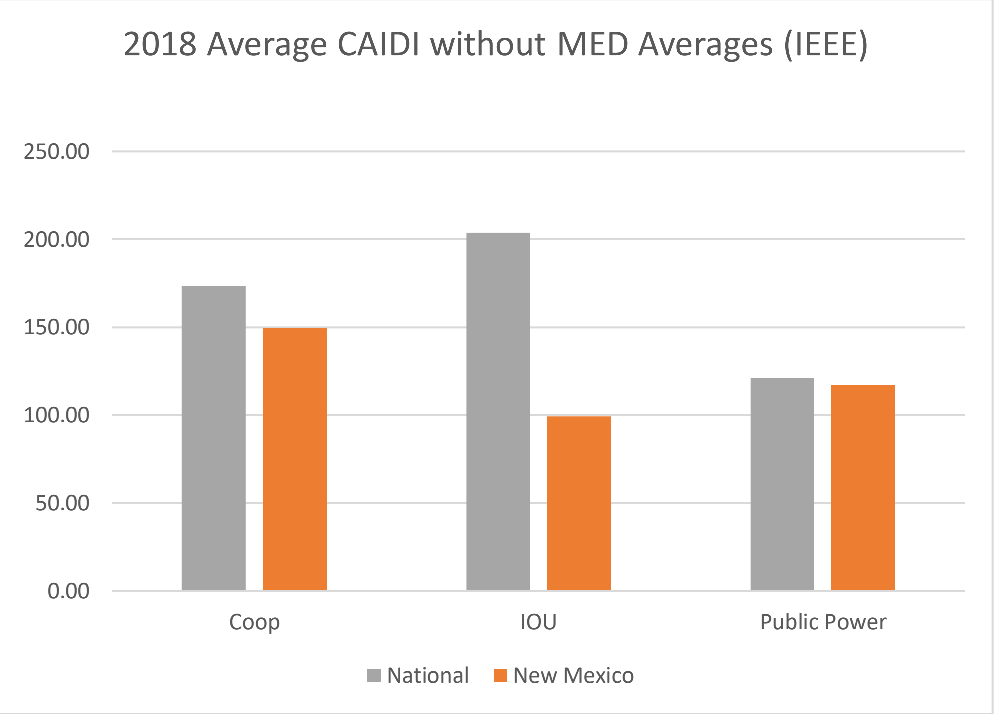
Exhibit 36 - National versus New Mexico SAIFI



Source: EIA 861 Annual Electric Power Industry Report. Note: New Mexico Cooperatives N=2; IOUs N=3; Public Power N=2

A measure that tells us about the ability to respond to interruptions is the Customer Average Duration Index (CAIDI) which tells us the average time it took to restore services, in minutes, for all system-wide interruption events. **Exhibit 37** shows that, on average, New Mexico’s systems fare better than the average of all systems nationally, for systems reporting CAIDI using the IEEE standard and not including MEDs. That is, it took fewer minutes, on average, to restore outages in New Mexico across all three utility system types.

Exhibit 37 - National versus New Mexico CAIDI



Source: EIA 861 Annual Electric Power Industry Report. Note: New Mexico Cooperatives N=2; IOUs N=3; Public Power N=1

Resilience is defined by the National Association of Regulatory Utility Commissioners (NARUC) as “robustness and recovery characteristics of utility infrastructure and operations, which avoid or minimize interruptions of service during an extraordinary and hazardous event.”[189] Essentially this is the ability to prepare for and adapt to changing conditions and withstand and recover rapidly from major disruptions. Resilience includes the ability to withstand and recover from deliberate attacks, accidents, cascading failures, or naturally occurring threats or incidents. While national standards have not yet been developed for resilience, as has been done for reliability, it is important for New Mexico to consider the overall resilience of its energy system.

Various technology tools are or are becoming available for utilities to better plan for and manage grid upsets. **Exhibit 38** provides information on each tool and implementation of each tool by the New Mexico utilities that responded to the survey.

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[189] NARUC (2013). *Resilience in Regulated Utilities, p. 3*

Exhibit 38 – New Mexico utility use of tools for distribution planning and system operation

Distribution System Planning Tools (see 2017 DOE Modern Distribution Grid: Vol. II, pages 10 and 18-31 for more information)	Used Technology or conducted task in last 5 years or plan to use in next 5 years for distribution system? (Y/N)
Power Flow Analysis	
Peak Capacity Planning Study - Peak capacity planning study tools examine load growth over a planning horizon. This is done to determine whether there is a need to upgrade transformers or other grid equipment to meet load growth and keep the system operating reliably and safely. Multiple snap-shot power flow analyses (often one for each year) are run to see how the system performs and what needs to be upgraded or changed. The analysis can also consider commissioning and decommissioning dates for network components. Absolute or relative load changes can be assigned to individual loads, groups/types of loads, or loads in graphically selected areas. Commissioning and decommissioning data for grid assets can be entered, which allows for taking new elements, including loads, transformers, and lines, into service and existing ones out of service at future points in time. The analytical result is an entire load flow calculation with an evaluation of minimum and maximum values (e.g., voltages or loading levels). Finally, the analysis can provide diagrams with information on power requirements and overloaded lines, as well as additional information if limits have been violated during the calculation.	COOPs & MUNIS **Y=100%** IOUs (PNM) **Y=100%**
Voltage Drop Study - A voltage drop calculation tool helps investigate the possibilities of voltage limit violation and plan the operations of regulators and capacitors. A voltage drop calculation is one of the basic power flow functions in distribution grid software tools. Industry standards such as ANSI C84.1 provide guidelines for acceptable voltage ranges. To the extent that voltage violations are identified during the study, these can be mitigated by leveraging the ability of tap changers, regulators, and capacitors to regulate feeder voltages within the defined ranges. A voltage drop study may be performed as part of an integrated power flow study.	COOPs & MUNIS **Y=100%** IOUs **Y=100%**
Ampacity Study - Ampacity studies are used to calculate the minimum conductor size and cable configuration required based on the design requirements and expected load. Because the ampacity of a conductor is affected by ambient temperature, ampacity ratings under different temperatures are usually calculated. Key inputs to a calculation include conductor temperature, ambient temperature, conductor resistance, and thermal resistance and related loss factors.	COOPs & MUNIS **Y=100%** IOUs **Y=100%**
Contingency and Restoration Study - The contingency and restoration module of a distribution grid software tool allows the simulation of multiple “what-if” scenarios in a batch Monte-Carlo type analysis. These “what-if” cases represent the loss and/or disconnection of a device. Several contingencies can be concurrently defined to represent network operation under a variety of scenarios, such as the	COOPs & MUNIS **Y=86%** IOUs **Y=100%**

modification of loads and DER generation, the connection and disconnection of line sections, and the addition and removal of induction and synchronous motors.	
Reliability Study - This software tool is designed to assess the reliability of electric distribution networks. The tool computes a set of predictive reliability indices for the overall system and their corresponding protection zones such as SAIFI, SAIDI, and CAIDI. It also computes customer point indices, such as the frequency of interruption and duration for each customer. The tool can also calibrate a predictive model based on historical data. This functionality can be useful in adjusting the failure rates and repair time for the overhead lines and cables, in order to match the simulated model with historical indices. A future-focused reliability study tool should include modules to plan and optimize the placement of new distribution automation (DA) devices to maximize their reliability benefit. Additionally, it should support a risk-based reliability planning module that compares the benefits of different reliability improvement programs (tree trimming, cable replacement, DA, inspection/maintenance, etc.) on an individual feeder basis and produces a plan on how to spend reliability improvement budgets to maximize impact.	COOPs & MUNIS **Y=100%** IOUs **Y=100%**
Time Series Power Flow Analysis - A time series power flow analysis tool is used for multiple steady-state load flow calculations with user-defined time step sizes between each power flow, with simulation periods ranging from seconds to hours or years. It analyzes the impacts of variations in solar irradiance or wind on power system controls, such as regulators, load tap changers, and switched capacitors. A time series power flow tool can help verify the sequence and performance of automatic switching, voltage control, and protection system operations. It may include the effects of end-use load components turning on or off, which can create short-term overloads or voltage disturbances. In conjunction with other tools, the time series power flow analysis may enable the study of grid interactions with markets (e.g., DR and transactive energy) and communication systems in the future. In addition, a time series power flow analysis can be used in power quality studies.	COOPs & MUNIS **Y=71%** IOUs **Y=100%**
Load Profile Study - Load profile software modules evaluate actual customer consumption curves from interval metering or typical customer load curves developed from historical data. A load profile study tool allows the user to define the time period for which loading patterns are to be analyzed. This tool allows the user to determine peak and off-peak load days, feeder loading patterns, transformer loading and line losses. The tool can also be used to estimate future electricity generation requirements.	COOPs & MUNIS **Y=86%** IOUs **Y=100%**
Stochastic Analysis - Stochastic analysis tools are distribution grid software tools that model the impact of random variations of load, DER changes, and changes to the distribution system on system operation. The model operates on a defined set of input variables (e.g., the number, size ranges and locations of solar photovoltaic (PV) systems) and then performs a large number of simulations. Each Monte-Carlo simulation uses a random selection of different variable choices in accordance with statistical rules for these choices.	COOPs & MUNIS **Y=29%** IOUs **Y=0%**

Volt-var Study - Volt-var optimization analysis focuses on system design considering voltage and reactive power compensation controls in order to optimize system losses and demand reduction. The analysis takes into account system criteria such as power factor, reactive power, and voltage limits, as well as varying loading conditions and the operation of system assets such as voltage regulators and load tap changers (LTC).	COOPs & MUNIS **Y=71%** IOUs **Y=100%**
Balanced and Unbalanced Power Flow Analysis - The load flow or power flow calculation analysis tool is the software module for the analysis and optimization of existing networks for network planning. Various solution algorithms (e.g., Newton-Raphson, Gauss-Seidel, and current iteration) are available for calculating the distribution of currents, voltages, and loads in the network, even under difficult circumstances (such as when several in-feeds, transformer taps and poor supply voltages are involved). Balanced network models can be easily transformed into unbalanced network models by changing model parameters.	COOPs & MUNIS **Y=86%** IOUs **Y=100%**
Power Quality Analysis	
Voltage Sag/Swell Study - Software tools used for this purpose assess the voltage stability of a network using the Power-Voltage (P-V) study9 technique. This is achieved by scaling up all the loads by bus, areas, zones or globally in user-defined steps for a given network, base case, and all defined contingencies. The steady-state P-V approach dictates that for each load increase, pertinent generators within the system should be re-dispatched to match this load increase. Voltage calculations result from several studies, such as power flow and fault analyses. In most cases, post-processing of voltage data is needed for accurate voltage sag and swell studies, based on the duration of over-voltage and under-voltage conditions.	COOPs & MUNIS **Y=71%** IOUs (PNM) **Y=100% Transmission only**
Harmonics Study - A harmonics study analyzes the disruptions to a current or voltage waveform. This software tool features analyses such as frequency scan, voltage and current distortion calculations, capacitor rating and filter sizing analysis, and K-Factor calculations. The module allows the user to model non-linear loads and other sources of harmonic currents such as converters and arc furnaces, and to detect resonant frequencies due to capacitor banks.	COOPs & MUNIS **Y=57%** IOUs **Y=100%**
Fault Analysis	
Arc Flash Hazard Analysis - The arc flash hazard analysis tool allows users to evaluate the risk of arc flash hazards on any part of a network. It calculates the short-circuit fault current using a short-circuit calculation algorithm, finds the clearing time from a library of device specific time-current curves, and calculates the resulting incident energy and risk level. These tools can also be run to allow the analysis for every bus in the network in one single simulation.	COOPs & MUNIS **Y=100%** IOUs (PNM) **Y=100%**
Protection Coordination Study - A protection coordination study determines the optimum characteristics, ratings, and locations of power system protective devices. The associated software tool draws on a library of protective decisions, which stores several thousand device characteristics, time-current curve plots and device settings reports. The tool may offer a screen editor that allows the user to build a line diagram with the desired circuit devices, by choosing them from the	COOPs & MUNIS **Y=100%** IOUs **Y=100%**

device library. The program is capable of generating all the necessary study benchmarks, such as cable and conductor damage curves, motor starting curves, transformer withstand curves, inrush, and thermal points. It also offers comprehensive graphical and tabular means for verifying the curve clearances at any fault current or system voltage level.	
Fault Probability Analysis - Fault analysis in the context of the planning process involves determining the probable location of future fault events and momentary outages in the distribution grid. The associated software tool takes into account the actual switching configuration of the network, as well as the load flow. The grid planner can place possible line faults and vary their location on a line in order to ascertain their impact to the grid. A number of fault and conductor interruption types (single and three phase) can be simulated on lines.	COOPs & MUNIS **Y=71%** IOUs **Y=100%**

Distribution Grid Operations Tools (see 2017 DOE Modern Distribution Grid: Vol. II, pages 13-14 and 33-63 for more information)	**Used Technology or conducted task in last 5 years or plan to use in next 5 years for distribution system? (Y/N)**
Substation Automation	
Substation SCADA - Several manufacturers supply substation SCADA for use in electrical substations that are compliant with well-established standards. These SCADA measurement, controls and computing platforms are available in a wide range of processing power and capacity. The distributed computing capability in a substation provides support for several functions, such as analytics, control functions, physical security and cybersecurity, and sensor and data management.	COOPs & MUNIS **Y=71%** IOUs (PNM) **Y=100%**
Advanced Protection - Advanced protection relays are digital and software-driven with standards-based communication interfaces. This contrasts with traditional electro-mechanical relays that are still prevalent in distribution substations. Advanced protection has the capability to remotely change settings (e.g., current, voltage, feeders, and equipment) both periodically and in the future, as needs may dictate, in real time based on signals from local sensors or a central control system. For example, a change in settings preserves the protective function of the relay while preventing false trips (i.e., disconnects or activations) despite changing conditions that result from the varying output of DER.	COOPs & MUNIS **Y=71%** IOUs **Y=100%**
Operational Analytics	
Field Data Management – includes Sensor and Meter data management. Meter data management consists of processes and tools for securely storing, organizing, and normalizing data from advanced meters, integrating data from other meters, and making the data available for multiple applications including customer billing, analysis for grid control, and outage management. Advanced meter data management systems include integrated applications for analytics and interfaces for integration with other operational systems such as GIS	COOPs & MUNIS **Y=86%** IOUs (PNM) **Y=100%**

and OMS. Meter data management systems have specific provisions for both data security and data privacy. Sensor Data Management use advanced "Big Data" analytics and multiple protocols and information silos to integrate disparate data sources and create a single, comprehensible source of data. In order for sensor-based data management to support Big Data analytics, a system or process model must not only define the context of a sensor within a process and operation, but also provide context management that allows data to be reliably rolled-up and compared to other data streams across operations.	
Electrical Network Connectivity model - An electrical network connectivity model is a data set, in spatial context that contains geospatial grid asset details (physical data), configuration information, customer and DER connectivity details, and electrical network information (connectivity data) to accurately depict the current state of the distribution system. This model is often visually represented in a GIS and used in power flow studies. Distribution operations employs two versions of the model: as-built and as-operated. The as-built model reflects original design and implementation, while the as-operated model reflects the actual real-time model for daily operations. This data is also used in the planning activities. Connectivity model data can be volatile on both short and long-time scales through outage remediation (short) and maintenance and construction (long).	COOPs & MUNIS **Y=100%** IOUs **Y=0%**
Distribution State Estimation - State estimation is the prediction of all voltages and currents in the system, from a limited set of actual measurements. It must account for missing or bad data, load variations, and local control operations such as capacitor switching, voltage regulator operation, and automatic switch operation. State estimation is a key enabler for a number of applications on the distribution system; these include reactive power management, outage management, loss reduction, DR, adaptable over-current protection, condition-based maintenance, integration with transmission system operations, and more.	COOPs & MUNIS **Y=57%** IOUs **Y=100%**
Outage Management (OMS) - An OMS integrates meter-level outage information and real-time information (such as interactive voice response) on customer outages. Analysis of that data identifies interrupted equipment and circuits, enabling work crews to be dispatched to the location of the fault and decreasing the time to repair and the duration of the outage. It also provides suggested switching plans to accelerate outage restoration. OMS can monitor and observe equipment status to optimize outage prediction and enhance situational awareness by integrating real-time data from customers with telemetered analog data from the distribution system.	COOPs & MUNIS **Y=100%** IOUs **Y=100%**
Geographic Information System - A GIS is used to capture, store, manipulate, analyze, and manage all types of geospatially referenced data. GIS tools enable users to create queries, analyze spatial information, edit data and maps, and present the results. Relevant geodata types might include land-based data, streets, ownership/real estate, vegetation, network topology, GPS location data for grid devices and components, and census data.	COOPs & MUNIS **Y=100%** IOUs **Y=0%**

The results represent the percent of responding utilities that answered in the affirmative. We are not able to report the degree to which each technology/tool is deployed, and given the broad definitions provided, the actual scope of the tool deployed by each utility may vary. Source: 2020 EMNRD Utility Questionnaire, IOU N=1, Coop and Muni N=7

2.10. ADOPT CLEAN ENERGY TECHNOLOGIES

The adoption of clean energy technologies—at the bulk power and distributed scale—is another underlying objective for grid modernization. As discussed in Part 1 above, New Mexico has established an ambitious zero-carbon goal for its utilities –100% of sales from zero carbon sources by mid-century—. This section looks at where we are currently in terms of electricity generation mix, including estimates of new firm generation.

As discussed in **Section 2.1**, New Mexico currently has a wealth of generation capacity due in part to the expansion of renewable energy generators, both utility-scale and behind-the-meter or customer-based generation. **Exhibit 39** details both electric generation and demand (sales) in the state over the past two plus years, while **Exhibit 40** compares sales to in-state renewable generation. The percentages are compared to the current 20% RPS level for 2020. Since January 2017, New Mexico's statewide renewable generation has met the 20% RPS level for 2020 on an annual basis and has only failed to meet it once on a monthly timeframe. **Exhibits 41 and 42** show generation capacity, annual generation, power purchase agreements (PPAs), and other wholesale power purchases by responding utilities to the 2020 EMNRD Utility Questionnaire.

As described previously, load growth in New Mexico has in recent years been climbing at historically high rates. This along with the potential electrification of transportation will mean, in order to meet the future renewable portfolio stipulated in the ETA, more renewable energy generation will be required. The recently released New Mexico Renewable Energy Transmission and Storage Study[190] highlights almost 3,000 MW of firm renewable generation and 500 MW of firm natural gas fired generation coming online by 2023.

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[190] ICF 2020

Exhibit 39 – New Mexico net electricity generation by fuel type and total electricity sales

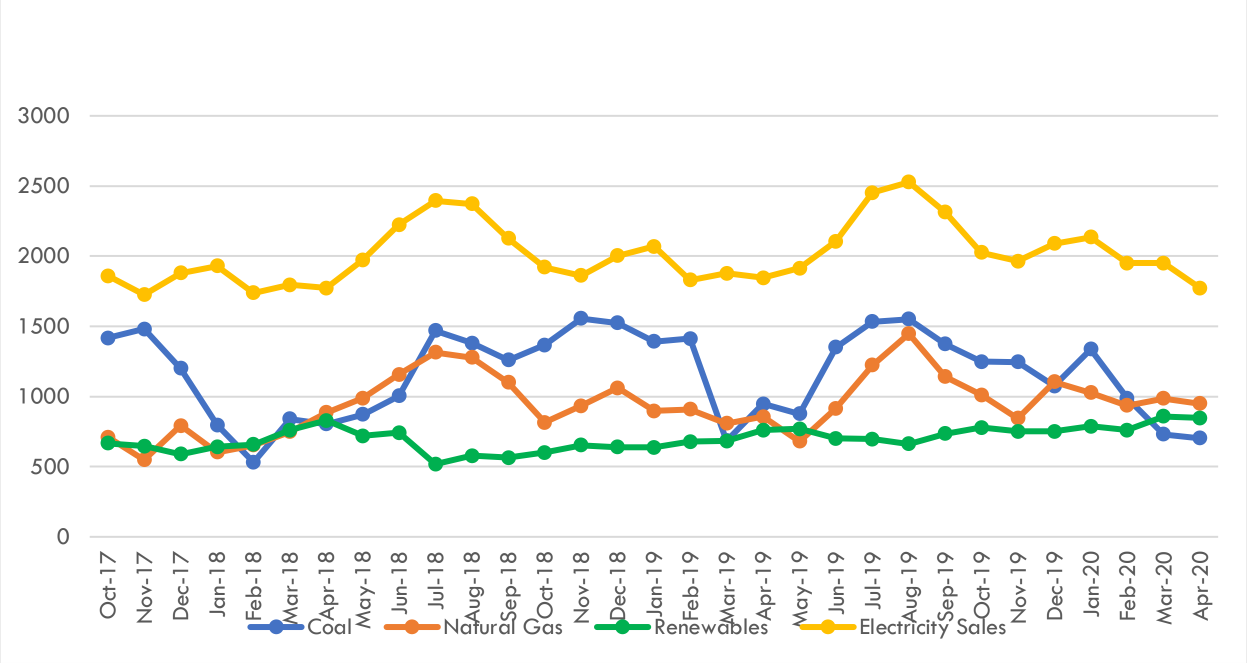

Exhibit 40 – Retail sales of electricity and renewable energy electricity generation as a percent of retail sales in New Mexico (2020)

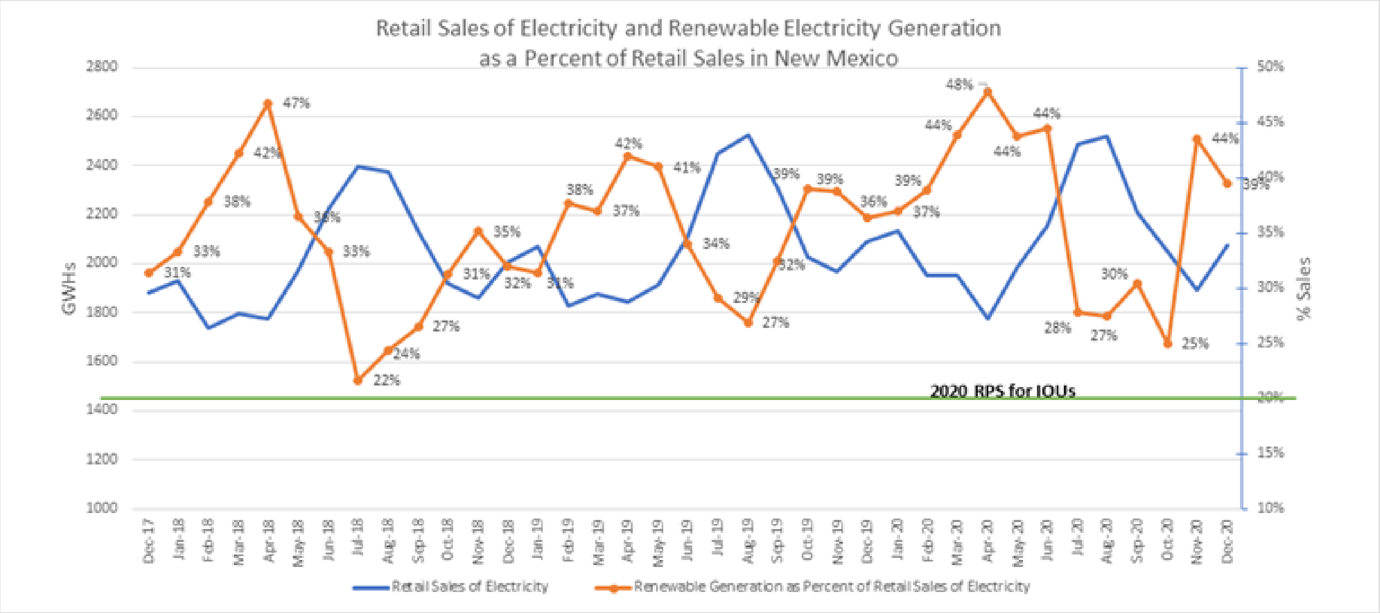

Exhibit 41 – New Mexico rural electric coop/municipal utility generation mix and power purchase from wholesale market

Generation Mix - Utility owned or PPA (as of 12/31/2019)	Source Type (percent is the total percent for each source type from all responding utilities)
Total Capacity: 312.8 MW 2019 Generation: 1432.8 GWhs Generation Mix Interconnected Directly to Distribution System: 45 MW	Coal 31% Capacity 55% Generation
	Natural Gas Steam Cycle
	Natural Gas Turbine – Simple Cycle 14% Capacity 4% Generation
	Natural Gas Turbine – Combined Cycle
	Hydro – Conventional 31% Capacity 34% Generation
	Geothermal
	Wind
	Solar (PV) 24% Capacity 7% Generation
	Solar (Thermal)
	Nuclear

Power Purchases from Wholesale Markets (not covered in PPAs above)	**Name of Wholesale Electricity Provider/Market**
Total 2019 Annual Power Purchased: 1274.3 GWHs Percent Renewables: 22	Tri-State Generation and Transmission Association, Inc.
	Western Farmers Electric Cooperative, Inc./SPP
	Western Area Power Administration
	WSPP
	CDEC
	TEP
	APS
	SPPA
	PacifiCorp
	Guzman Energy

Exhibit 42 – New Mexico IOU generation mix and power purchase from wholesale markets

IOUs (PNM and SPS)

Generation Mix - Utility owned or PPA (as of 12/31/2019)	**Source Type**	**Capacity (MW)**	**% of capacity located in New Mexico**	**2019 Annual Generation (GWhs)**	**% of Annual Generation serving New Mexico retail customers**
	Coal	762 PNM 2115 SPS	100 0	3338 6477	100 28
	Natural Gas Steam Cycle	145 PNM 1739 SPS	100 21	- 5443	100 28
	Natural Gas Turbine – Simple Cycle	425 PNM 847 SPS	100 33.9	563 3303	100 28
	Natural Gas Turbine – Combined Cycle	419 PNM 557 SPS	100 100	413 3375	100 28
	Hydro – Conventional	PNM N/A SPS	- N/A	0 N/A	- N/A
	Geothermal	15 PNM N/A SPS	100 N/A	51 N/A	100 N/A
	Wind	300 PNM 1930 SPS	100 37.5	952 7444	100 28
	Solar (PV)	237 PNM 190 SPS	100 100	397 427	100 28
	Solar (Thermal)	PNM N/A SPS	0 N/A	- N/A	- N/A
	Nuclear	402 PNM N/A SPS	0 N/A	3167 N/A	100 N/A

Power Purchases from Wholesale Markets (not covered in PPAs above)	Name of Wholesale Electricity Provider/ Market	2019 Annual Power Purchase (GWhs)	If known, % of purchased power generated in New Mexico	% of purchased power that is either renewable or "Zero Carbon"	% serving New Mexico retail customers
PNM	n/a	n/a	n/a	n/a	n/a
SPS	Southwest Power Pool	1250 GWh (net)	N/A	N/A	N/A

Along with an increase of variable renewable generation sources comes the need to manage the variability and to store the excess generation for use when it is needed. Currently, according to EIA data, only one wind farm (Casa Mesa Wind Energy Center) and no utility scale solar arrays in the state have an energy storage system. Recently, as part of the San Juan Generating Station replacement plan, PNM announced the planned installation of a 130 MW battery energy storage system. Battery storage is just one of many options utilities have for managing the grid in the face of growing variable generation resources.

In 2003, when the first utility-scale wind energy center went online, renewable generation (including existing hydroelectric) was 354 GWhs. In 2019 customer installed small-scale solar installation alone produced 300 GWhs of electric power. All told, 2019 saw a record 8,740 GWhs of total renewable generation, or almost 25 times the level generated in 2003. Given New Mexico's 2019 electricity sales were just over 25,000 GWhs, the state could theoretically meet annual consumption with only another 3-fold increase in generation. While some of that generation is slated for interstate markets, the work of the past 16 years has paved the way the state's energy generation transition. The Grid Modernization Roadmap will lay out a path for delivering clean energy to New Mexico consumers.

CONCLUSION

This Baseline captures what are considered to be essential elements of grid modernization. The data presented herein is intended to provide a realistic picture of the current electric grid, with an understanding that EMNRD does not have access to all of the data, tools and analysis available to individual utilities.

We note a few positive trends that New Mexico may build on, such as the relatively low cost of renewable electricity generation; the ability, up to now, of the electricity sector to meet demand; the abundance of clean energy generation resources and potential for more; the leadership of New Mexico's rural cooperatives in adopting distribution technologies and planning tools; the tools available and commitment of New Mexico's utilities to providing reliable service; and the timing of the Energy Grid Modernization Roadmap Act and the Roadmap initiative, which encourages coordinated grid modernization planning well ahead of clean energy transition deadlines.