



new energy economy

Addressing the Climate Challenge
With Bold Solutions

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Contents

Executive Summary	1
Introduction.....	4
Understanding the Status Quo	6
New Mexico's Energy Transition: Assessing the Prospects.....	14
A Just Transition: Creating Jobs and Opportunities for Energy Workers	18
The Road Ahead: Realizing the Energy Transition	20
Conclusion	23

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About the Lead Author

David Van Winkle was an executive with Texas Instruments for 30 years, leading large business units and analyzing complex business and technical challenges. For the past eight years, Van Winkle has reviewed and analyzed multiple renewable resource plans of New Mexico utilities and has led the development of strategies for various New Mexican organizations. Van Winkle has considerable experience in analyzing multifaceted cost and financial issues and providing solutions for business problems. He has created operational system models for multiple utilities that utilize multiple years of customer energy usage data (8760 hourly data) and actual resource output, including, among other things, actual solar hourly output. These system models have provided significant insight into utility system generation issues in meeting changing customer loads.

In addition, through extensive discussion and participation in New Mexico electric utility resource issues over the years, Van Winkle has developed technical knowledge about resource options for meeting utility loads. In these discussions, Van Winkle has provided innovative solutions that solved complex problems, such as solving the EPA puzzle in the PNM San Juan retirement challenge. Van Winkle has testified on numerous occasions before the New Mexico Public Regulation Commission as a financial and energy expert. In NM PRC Case No. 16-00105-UT, PNM filed a case before the New Mexico Public Regulation Commission, seeking a \$100 million gas pipeline and plant. No party opposed the case except New Energy Economy; after Van Winkle filed expert testimony claiming that PNM's own load forecasting data proved that the gas plant was unnecessary, PNM withdrew its case.

Van Winkle is the Chair of the Board of Directors for New Energy Economy.

Executive Summary

New Mexicans face a choice: Should we accept a status quo defined by stagnant wages, high unemployment, and rising pollution? Or should we opt to invest in innovation, competitiveness, sustainability, and self-reliance?

Ask New Mexicans, and the answer will be nearly unanimous: People want a high-employment, high-innovation clean energy economy.

With abundant sun and wind resources, hardworking people, and an ever-increasing technical capacity, New Mexico is poised for an extraordinary accomplishment: To become the first state to achieve a 100% renewable electricity sector.

This report lays out a specific and achievable path to such a transition over the next two decades. The report provides a detailed overview of the rationale for a clean energy transition. It concludes with actionable steps for state policymakers to help realize this vision.

The transition to a high-employment clean energy economy starts with the state's largest electricity utility, Public Service Company of New Mexico (PNM). Through the addition of 700 megawatts (MW) of solar power and 1750 MW of wind power by 2035—a development that is both technically and financially feasible—it will be possible for PNM to meet the needs of its 500,000 customers (households and businesses). By setting this needed goal, New Mexicans can drastically reduce the state's air pollution, carbon emissions, and water usage while creating thousands of new jobs and facilitating the emergence of new advanced energy businesses, responsive to the yearnings of people in the state. It's a win-win proposition for our economy and our quality of life.

Across the political spectrum, people want clean air and water and new drivers of job growth and economic development. Eighty-four percent of New Mexicans support renewable energy. The clean energy transition will help manage rising risks of climate change, setting a far-reaching example of how states can exercise leadership and achieve a low-carbon economy. At the same time, the clean energy transition can lessen our dependence on unpredictable energy markets and volatile foreign governments. Crucially, the expansion of energy choice strengthens the forces of market competition in a crucial sector of our state's economy.



New Mexico policymakers can take clear and immediate steps to realize the promise of a high-employment clean energy economy. Specifically, this report recommends:

- **Market-Oriented Decision-Making:** Require competitive market-based assessments that allow investor-owned utilities, regulators, and energy consumers to evaluate and compare all energy options before acquiring new energy supplies to ensure cost-effectiveness and transparency. Additionally, eliminate utility biases toward capital-heavy fossil fuel and nuclear projects.
- **Empower Communities to Make Their Own Energy Choices:** Allow people to pool their energy load and make purchasing decisions collectively to reduce costs, create local jobs, and meet shared energy objectives like sustainability and price stability.
- **Strong Statewide Standards:** Building on the success of New Mexico's existing Renewable Portfolio Standard (RPS) law and those in other high-performing states, strengthen clean energy targets to reflect the preference of 84% of New Mexicans and realize the vision of an all-renewable electricity sector.

The ultimate objective of this report is to demonstrate that a comprehensive clean energy transition is not only feasible—it's necessary and it's already underway. The costs of wind and solar have declined exponentially over the past decade: In 2016, solar and wind became cheaper than any fossil fuel capacity. Concurrent with these falling costs, political support for renewables has risen to unprecedented levels.



New Mexico is poised to become an active driver and beneficiary of this trend. The transition to a 100% renewable electricity sector in New Mexico can happen with a series of clear steps:

- Undertake a responsibly-timed phase-out of existing coal and nuclear power plants:
 - Retire all remaining units of San Juan Generating Station (SJGS) by the end of the coal contract, which currently expires in mid-2022.
 - Terminate interests in 114 MW at Palo Verde Nuclear Generating Station Units 1 and 2, whose current leases expire in 2022 and 2023.
 - Retire 200 MW of coal at Four Corners Power Plant (FCPP) by 2025.
 - Withdraw from the remaining 288 MW of capacity at Palo Verde by 2030.
- Bring 1,200 MW of new solar and wind capacity online over the next 10 years and another 1,200 MW of new solar and wind capacity over the following 10 years.
- Adopt usage of large-scale energy storage systems.

The timing of these steps enables New Mexico to realize the benefits of a considerable economic stimulus through the construction of new clean energy generation facilities, while managing economic adjustments over time. A core principle of this clean energy transition is that it must be fair for all New Mexicans—providing improved livelihoods while lessening dependence on polluting fuels. It must also place those impacted by fossil fuel development and the closure of the state’s coal plants at the center of the transition process in order to ensure a “just” transition.

This energy transition respects our state’s land-based economic traditions while generating new opportunity for our people. Our current path has made our state’s economy vulnerable to the boom and bust of fossil fuel development and has failed to produce adequate employment, affordable energy, or sustainable environmental conditions. Thankfully, we now have a new, vital and viable path that encourages innovation, sustainability, competitiveness, and resilience. It’s up to New Mexican residents and policymakers to take steps today to ensure that we realize this vision.

Introduction

The United States is trailing behind other countries in renewable energy deployment. Leadership at the state level is particularly important given the barriers to national progress. The world's warming, and extreme weather events associated with human suffering, entered "truly uncharted territory" in 2016, according to the World Meteorological Organization (WMO). In its annual State of Global Climate report released in March 2017, the WMO confirmed 2016 was the hottest year on record, documented the new low for Arctic sea ice, and projected that changes in the Arctic and melting sea ice will continue to push extreme temperatures through 2017, even without 2016's strong El Niño influence. Climate disruption is already threatening our food and water supplies and is expected to be a leading cause of forced migration worldwide. In addition, costs incurred by changing climate patterns are estimated as high as \$60 trillion. (NOAA and Nature: 2015). Across the globe we are experiencing record high temperatures, unprecedented famine for tens of millions, and rising sea levels that threaten hundreds of millions worldwide. In the United States, almost 40 percent of the population lives in relatively high-population-density coastal areas. Coral reefs are spawning ground for a quarter of all marine species. They provide food for over 500 million people in 94 countries and territories. Rising sea temperatures could lead to the annual bleaching of 99 per cent of the world's reefs within the century. (Scientific Reports 2017). We've already lost 40% of the photoplankton which is responsible for 50% of our global oxygen.

In New Mexico, we are experiencing reduced snowpack which translates into less water for agriculture and drinking. Scientists say we will have no forest here by 2050 because of forest die-off from bark beetles and drought. (Nature Climate Change 2017). Early false springs, torrential rains, and deep droughts have already seriously impacted agricultural production this year.

Climate change will impact nearly every aspect of New Mexico's economy. A recent study done by researchers at the Sandia National Laboratory considered impacts of temperature increases and precipitation declines on the half dozen industries with the greatest water consumption (e.g., agriculture, utilities, mining, chemical manufacturing). The study found that economic damages from increasing water scarcity and costs will be spread widely throughout the rest of the state's economy. There will be higher input costs, lower consumer incomes and spending, population changes and changes in the state's inter-regional competitiveness. Retail trade, food manufacturing and construction will be among the sectors most severely affected by these secondary effects but no sector will emerge unscathed. This study found New Mexico to be among the states with the largest projected percentage losses in income and employment, even though the full range of possible future heat, drought, and precipitation impacts was not considered and optimistic assumptions about adaptation to future water shortages were adopted.

In addition to the Sandia study, the University of Oregon working with economists from the University of New Mexico produced a study, titled "An Overview of Potential Economic Costs to New Mexico of a Business-As-Usual Approach to Climate Change" and undertook an effort to estimate the direct economic costs of climate change to the New Mexico economy. Twenty-one estimation methods were brought to bear: the results must be considered approximations as indirect costs arising from reduced spending and employment were not included. Nonetheless, the results show the cost impact of climate change rising rapidly, doubling between 2020 and 2040 to \$3.3 billion per year.

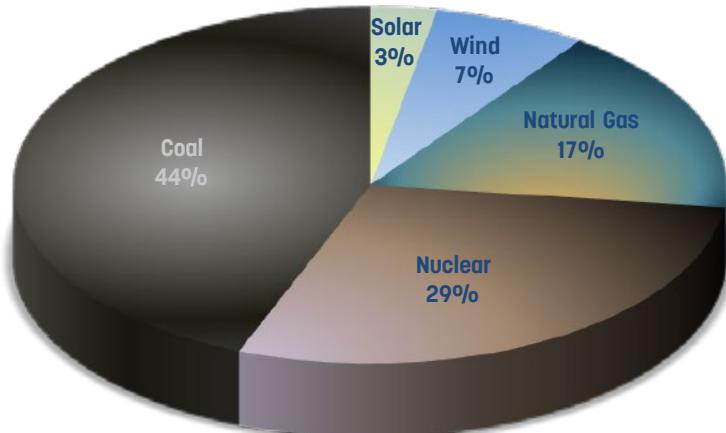
New Mexico has potential to lead the nation's clean energy transition. In doing so, the state can accelerate economic growth and job creation while strengthening free choice in energy markets and making a bold contribution to address climate change.

New Mexico has made considerable progress over the past decade. Over \$1.4 billion in capital investments have already gone into the state's wind farms, and wind producers provide an estimated \$2.4 million annually in lease payments to landowners in the state. As solar prices have fallen dramatically—production is now 100 times cheaper than in 1978—the state's generation capacity has grown accordingly. Solar now powers the equivalent of 150,000 homes in New Mexico and the industry accounts for more than 2,900 solar jobs in 2016, a 54 percent increase from the year prior, when the state had 1,899 jobs.

New Energy Economy's Proposed Transition

But the state remains far from reaching its potential. Despite the strong and rising popularity of residential solar and high-profile development of utility-scale solar and wind, renewables are projected to remain only a relatively small portion of New Mexico's overall energy mix in 2018 unless we implement bold policy changes.

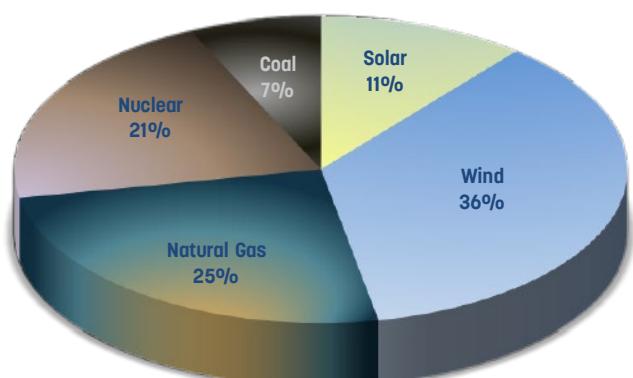
2018 Energy Mix for PNM Ratepayers



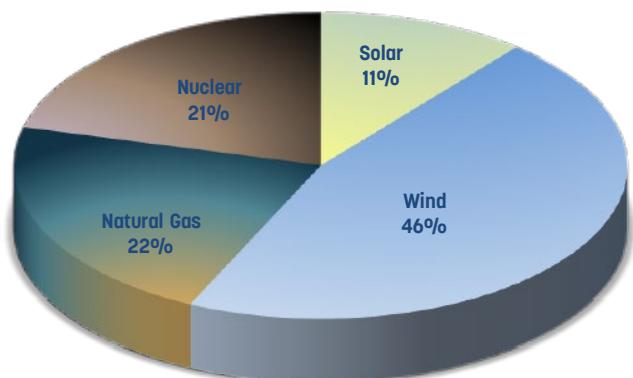
This report lays out a path to rapid and cost-effective growth for the clean energy sector moving forward. The focus of the report is on the specific policy choices that underlie the status quo as well as specific actions that state policymakers can take in the years ahead to realize the promise of clean energy transition. The report is built on an ambitious but achievable vision that is illustrated in the following charts.

Underlying this vision and the accompanying analysis is a focus on a responsible and just process. While climate change is an urgent challenge and the economic opportunities of energy transition are great, the report recognizes that the move to a clean energy sector must happen on a realistic timeframe and must start from an accurate assessment of the economic situation and current energy assets. It must also address the needs of those most directly impacted. The approach described in this report seeks to minimize costs while achieving ambitious environmental goals and maximizing employment and economic growth opportunities.

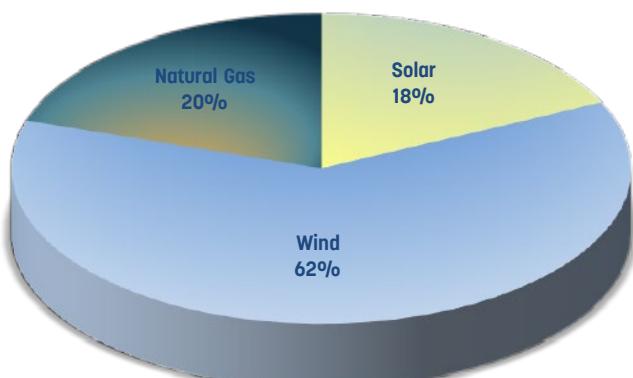
2023 Energy Mix



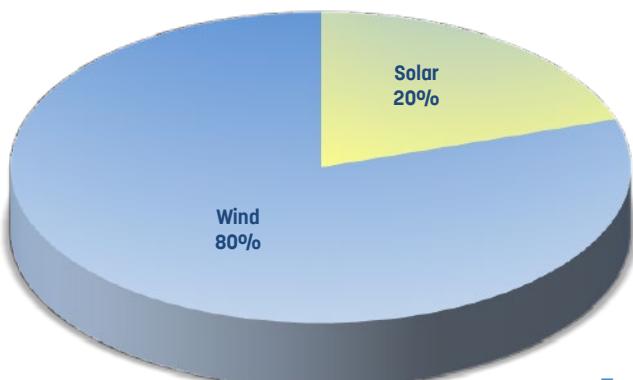
2025 Energy Mix



2030 Energy Mix



2035 Energy Mix



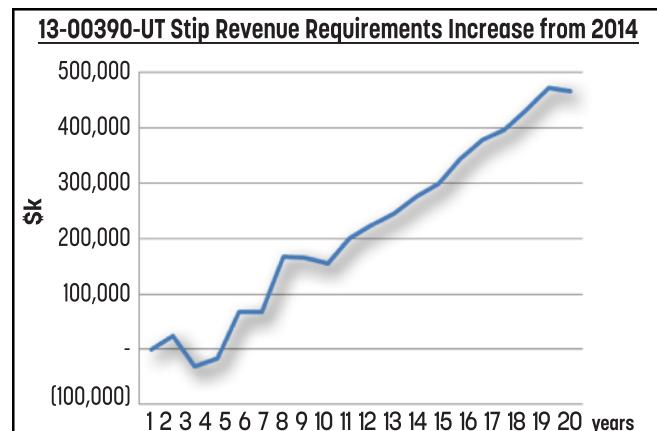
Understanding The Status Quo

Flawed incentives and inadequate competition in New Mexico's utility sector

Currently, 80% of the energy produced by PNM comes from coal and nuclear.

Utility monopolies like PNM tend to prefer investments in large facilities such as coal and nuclear thermal units in part because significant ongoing capital expenditures are required to keep them operating and in compliance with pollution and safety requirements. These ongoing capital expenditures increase the rate base asset each year, increasing company profits—without adding new capacity. Allowable utility profits are determined by the rate base asset amount and the allowable profit percentage. Put simply: the more assets in rate base, the more profit.

This is an unwelcome situation for ratepayers. While PNM has earned more profit with the growth of the rate base asset, ratepayers must shoulder the costs without any added capacity. There's a clear contrast between these capital-intensive energy sources and renewable power. To illustrate: Palo Verde Nuclear Generating Station has spent \$3 billion on ongoing capital expenditures in the last 20 years. In contrast, renewable energy sources, such as wind and solar, have few ongoing capital expenditure needs—as well has very little maintenance and no fuel costs. The following chart shows the projected increases in customer rates associated with the San Juan Generating Station Abandonment stipulation. It shows about \$500 million per year rate increase, due to heavy dependence upon coal and nuclear generation.



The economic case against the old energy model

Since early 2008, the cost of electricity per kWh provided by PNM to its retail customers has increased by approximately 50%, while New Mexico real median household incomes have declined by 6.4%.

Strikingly, PNM's ongoing earnings increased by 461% from 2008 to 2014.

Cost of Electricity and Economic Environment				
		2008	2014	% Change
PNM				
Residential Electricity Cost	\$/kWh	0.0828	0.1297	56.6%
Overall Retail Electricity Cost	\$/kWh	0.0726	0.1081	48.9%
PNM Ongoing Earnings	\$k	15,684	88,000	461.1%
Real Median Household Income in NM	\$	47,841	44,803	-6.4%

Residential rates have further increased in 2015: YTD 2015 actuals through October were \$0.1361/kWh for a total increase from the base period in 2007-8 of 64%. Residential and overall retail electricity cost for 2008 is the actual for the 12 months prior to the rate increase implemented in April 2008 in case 07-00077-UT. Electricity costs include all costs - base rates, fuel costs, all riders, etc.

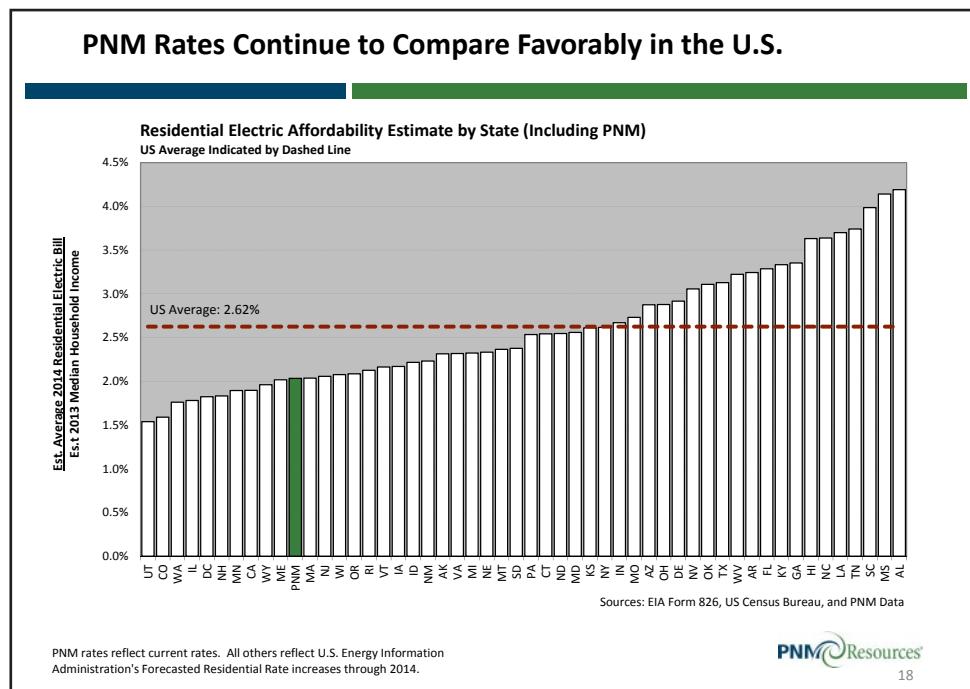
Electricity costs are reported in EIA-826 database. A summary of the data for the time periods indicated is provided in Exhibit DVW-2.

Median income for New Mexicans: www.deptofnumbers.com/income/new-mexico/

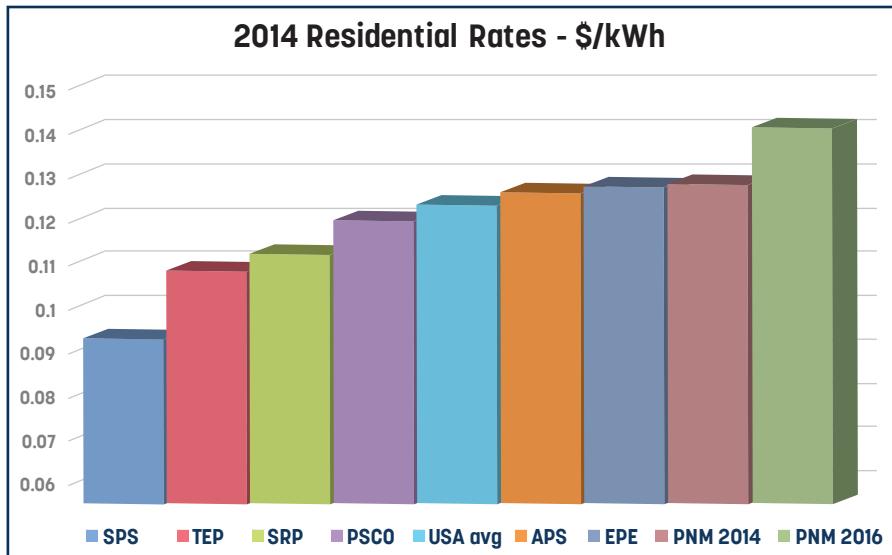
2008 Ongoing Earnings: <http://www.pnmresources.com/~/media/Files/P/PNM-Resources/quarterly-results/2008/2-6-09-updates-to-schedules-1-4.pdf>

2014 Ongoing Earnings: <http://www.pnmresources.com/~/media/Files/P/PNM-Resources/quarterly-results/2014/q4-2014-earnings-release-and-reconciliations.pdf>

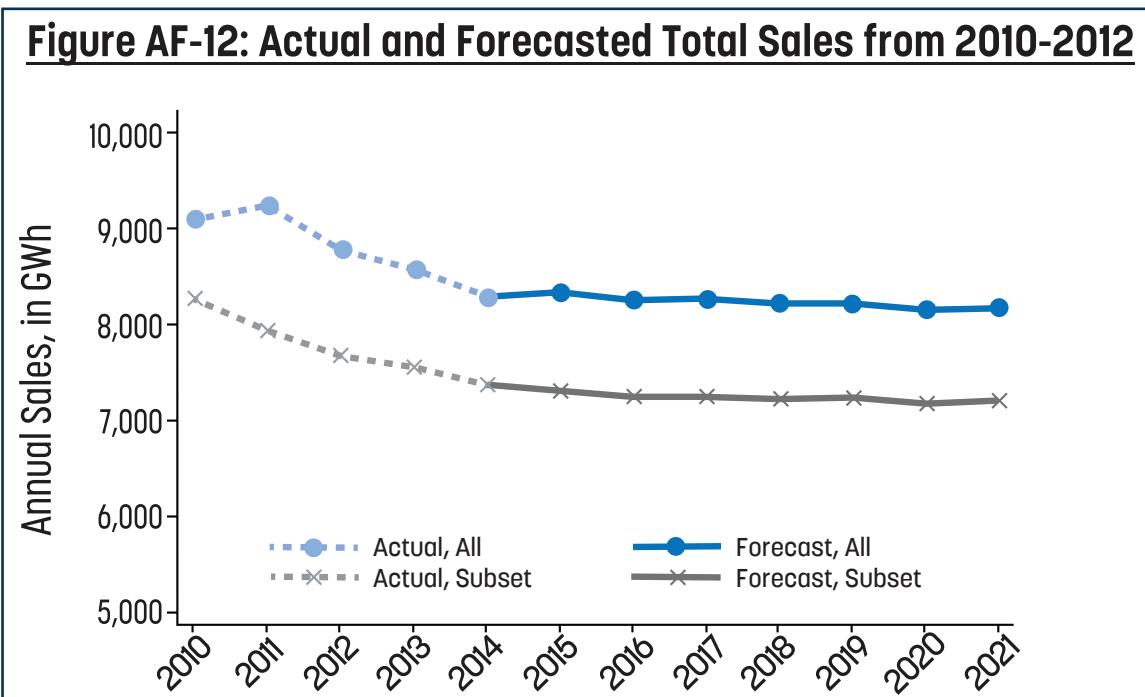
PNM asserts that their residential rates are low compared to other utilities and national averages (as revealed in the investor presentation chart below), yet these arguments are misleading. Consider the following chart from a PNM investor presentation:



The title of this slide states that "PNM rates compare favorably," but the data in the chart refer not to rates but to customer bills. New Mexico's customer bills are below national averages because the state has a moderate climate compared to most other US jurisdictions. Residential usage in PNM's territory in 2014 was 579 kWh/month versus the national average of 902 kWh/month. New Mexico consumers use 36% less electricity than the national average. When actual 2014 residential rates are compared to the PNM's regional peers, it shows that PNM's residential rates were the highest in the region, and above the national average, as shown in the chart below. For example, PNM residential rates are 37% higher than Southwestern Public Service ("SPS") and 41% higher than Farmington municipal utility.



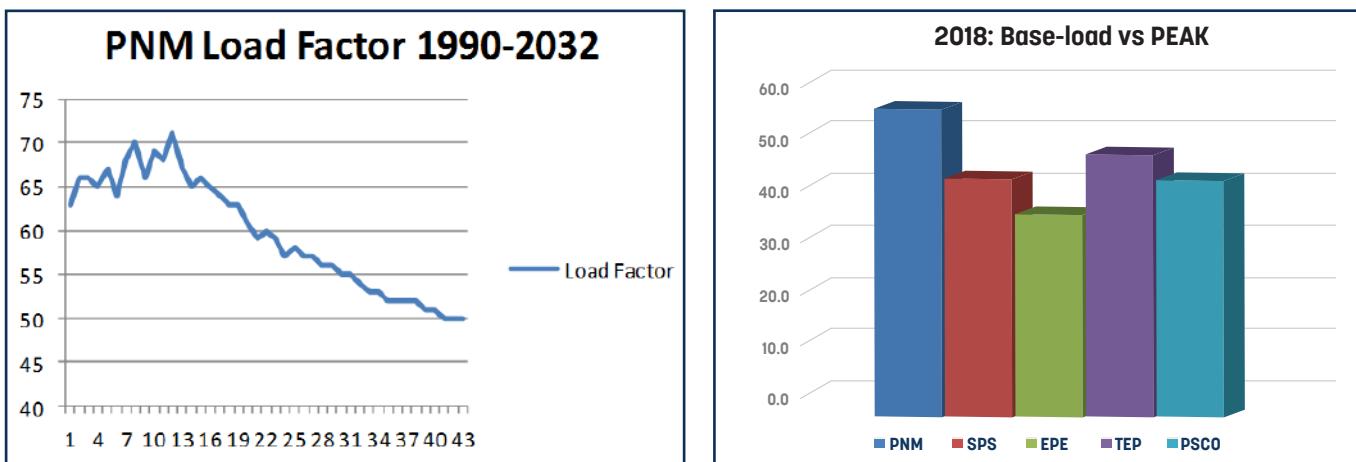
Looking forward, the energy sales outlook is relatively poor. In PNM's testimony in 15-00261-UT, Gerard Ortiz, PNM Vice President of Regulatory Affairs, testified that "declines in PNM's energy sales account for approximately 25% of the identified revenue deficiency, or approximately \$31 million." Further, a PNM witness recently predicted that PNM retail energy sales will continue to be anemic for the next seven years, through 2021, as shown in the figure below (AF-12). This witness, Dr. Ahmad Faruqui, testified that his PNM energy sales forecasts "are in line with what I have seen elsewhere in the industry." He continued, "sales growth has slowed down since the beginning of the Great Recession of 2008-09. It is recovering slowly with weak economic growth, the expansion of utility EE programs, and the introduction of new governmental Codes & Standards that raise the energy efficiency requirements of appliances, light bulbs, and buildings." It should be noted that Dr. Faruqui's energy sales forecasts for 2015-21 are significantly below the actual energy sales in 2010-13 (shown in the figure below):



The current energy sales forecast shows that energy sales for every year from 2016 to 2029 will be lower than those in 2015.

The following chart shows PNM's load factor actuals and forecast for 1990 to 2032. (13-00390-UT, Ortiz 5/22/14 supplemental testimony, PNM Exhibit GTO-1) (This load factor prediction does not include the loss of Navopache or Intel. Both would further reduce the load factor.) A declining load factor means that the customer requirements are characterized by more peak activity and less consistency throughout the day.

Thus, base-load resources such as nuclear and coal, which are intended to run all the time, are not the right type of resources to meet this changing customer demand situation. PNM already has more base-load relative to load or peak than all other regional peers, as shown in the Base-load vs PEAK chart.



Hidden costs: decommissioning and early closures

PNM has significant exposure to decommissioning and mine reclamation costs for both nuclear and coal.

PNM currently assesses its total decommissioning liability at Palo Verde at \$273 million or \$680/kW. However, the average cost of decommissioning of nuclear facilities in the United States is \$1217/kW—meaning that PNM is likely understating its liability by \$216 million. This under-estimation is problematic for two important reasons: First, it is misleading as to the current actual cost of nuclear; and second, because it means actual costs for decommissioning could be multiple times what has been collected and may lead to rate shock. In addition to decommissioning risk, nuclear plants face the risk of early shutdown or large repair costs to allow continued operation. As recent PRC staff testimony explains:

Nuclear power plants such as Palo Verde 3 are very complex facilities and are also subject to substantial regulatory oversight risk. In addition due to their high capital costs and fixed Operation and Maintenance costs, their economics are heavily depending on achieving very high capacity factors by minimizing the number and length of forced and planned outages that are experienced. ...In addition, nuclear power plants also face a risk of early shut down due to unforeseen events such as accidents experienced at other nuclear facilities. Finally, these plants also face the risk that decommissioning and spent fuel disposal costs could exceed current estimates. ... [T]here are significant cost risks associated with Palo Verde 3 that would be transferred from PNM's shareholders to PNM's retail customers that were not modeled in PNM's risk analysis (or market valuation) which would generally not be present with photovoltaic solar generation."

The PRC expert also documents three cases since 2002 of nuclear power plants that either incurred large costs due to down time or were retired early:

The Davis-Besse Power Plant in Ohio had a two-year outage and cost about \$600 million. The Crystal River plant was retired early in 2012 instead of incurring \$1200-3700 million to repair it. San Onofre was retired early instead of incurring \$317 million in repairs and replacement power. Current projections for decommissioning San Onofre, a 2250 MW nuclear facility, exceed 4 billion dollars, and is projected to take 40 years.

El Paso Electric sold its 108 MW of capacity at Four Corners Power Plant (FCPP), becoming coal-free as of July 2016. In the 15-00109-UT filing, coal abandonment case, EPE testified that the estimated decommissioning costs for FCPP units 4 & 5 stand at \$96M. As PNM owns 13% of units 4 and 5, this would mean that PNM will need to pay \$12.5 million for FCPP decommissioning. In the same case, EPE testified that the estimated mine reclamation costs for all of units 4 and 5 at FCPP will be \$388M. As PNM owns 13% of units 4 and 5, this would mean that PNM will need to pay \$50 million for mine reclamation. In both decommissioning and mine reclamation, EPE paid real money to the buyer of this capacity, Arizona Public Service, at the time of closing for these liabilities. Thus, this is not just a hypothetical assessment.

Applying these decommissioning costs and mine reclamation costs on a per MW basis provide a good proxy for San Juan Generating Station (SJGS). Decommissioning cost estimates for PNM's 497 MW of SJGS is \$31 million and the mine reclamation costs stand at \$125 million.

Poor reliability at New Mexico coal plants

The reliability of the 51-year-old Four Corners Power Plant (FCPP) is significantly worse than national averages. FCPP Equivalent Forced Outage Rate (EFOR), the portion of time a unit is in demand, but is unavailable due to meet customer needs due to forced outages, for 2013-16 was 23.8%, 3.5 times as much as the national average for EFOR as reported in North American Electric Reliability Corporation (NERC) for similar size coal facilities at 6.8% for 2007-11.

The reliability of SJGS is also significantly worse than national averages. SJGS Equivalent Forced Outage Rate (EFOR) for 2005-14 was 12.4%. The national average for EFOR as reported in NERC for similar size coal facilities was 7.6% for 2007-11. Recently, the EFOR at San Juan has been particularly troublesome: in 2013 at 15.6% and in 2014 at 19.5%.

Due to poor reliability at both FCPP and SJGS, PNM must have back-up sources of energy—including gas generation capacity and purchases on the open market—that cost more than coal fuel and represent additional cost burdens to ratepayers.

Stranded assets

Utilities depreciate book values over the theoretical useful life of an energy-producing asset. If a resource is abandoned prior to its end of its useful life, there will be undepreciated assets on the utility's books. These are known as stranded assets. This situation has been illustrated in New Mexico in case 13-00390-UT, when PNM abandoned units 2 and 3 of SJGS as part of its compliance with the Clean Act requirements. In this case, the stranded assets were valued at \$257 million. The final order stated that PNM shareholders would be responsible for 50% and ratepayers would be responsible for the other 50%. We can expect a similar situation when SJGS, FCPP, and Palo Verde are retired prior to the end of their "useful" life. Utilities often define "useful" life as the end of a plant's depreciation schedule. The current undepreciated book value for PNM's share of these resources is:

SJGS	\$320M	2022
FCPP	\$100M	2031
Palo Verde	\$500M	2047

As each of these aging facilities will require significant ongoing capital expenditures, the amounts will increase as time goes on.

An irresponsible economic model

To summarize, PNM has declining energy sales combined with limited growth in peak demand. This situation contra-indicates use of base-load resources, as those resources produce a great deal of energy but are not flexible resources capable of supporting growing peak demands on PNM's system. PNM needs more resources that can meet the peak demands, not more base-load resources. Both aging coal and nuclear facilities require substantial on-going capital expenditures just to keep them running. The PRC should be very concerned that adding costs for base-load resources combined with fewer energy sales will cause substantial increases to customers, who cannot afford it, over the coming years.

Consistent with the New Mexico statutory purpose of preventing “unnecessary duplication and economic waste,” Section 62-9-1 NMSA, the New Mexico Supreme Court held: “[C]ompetition within the industry, ... prevent[s] overinvestment in high fixed costs and encourage[es] the achievement of economies of scale.” The Court recognized that as a monopoly the utility will take advantage of its position and its customers unless there is adequate PRC oversight and regulation. *Morningstar Water Users Ass’n v. New Mexico Pub. Util. Comm’n*, 1995-NMSC-062, 120 N.M. 579, 583, 904 P.2d 28, 39-40.

Understanding the broader risks of coal and nuclear

Investments in solar and wind are a hedge against rising utility rates. They do not incur cost risks due to pollution controls, the need for constant infusion of capital to fix parts that break or to meet safety standards, decommission risk, reclamation risk, stranded asset risk, and litigation risk. Additionally, they are clean energy sources and thus avoid other cost challenges related to health and the environment.

Globally, climate change poses tremendous risks to global food systems, water supplies, and settlement and migration patterns. It threatens to displace large groups of people through flooding, fire and drought as well as foster political conflict over increasingly scarce natural resources.

New Mexico faces acute risks from climate change—including water shortage, threats to agriculture, and fires. New Mexico also faces localized environmental and public health dangers from coal and nuclear plants, including air and water pollution and contamination from nuclear waste. Pollution emitted from coal-fired power plants has been linked to asthma, lung disease, neurological damage, heart disease, and other serious and debilitating illnesses.

Taking coal plants off line reduces carbon dioxide, nitrogen oxide, sulfur dioxide and a variety of particulate emissions. The pollution from the San Juan coal plant is known to cause increased rates of asthma, heart attacks, strokes, cancer, birth defects and infant mortality. A “conservative estimate” of “the total public health-based [costs is]... between \$24.7 to \$60.8 million per year.” These are externalized costs, meaning that PNM does not incur these costs but the public pays for them in emergency room visits, hospitalizations, loss of work days, etc.

Mining coal, especially underground, exposes workers to known carcinogens as well as other health risks (black lung disease) and risk of underground fires. The San Juan mine was closed for eight months in 2011-2012 due to a fire, a significant public safety issue as well as a supply risk for the SJGS power plant.

Both coal and nuclear power plants require huge amounts of water. For example, coal-plants SJGS and FCPP consume 647 gallons/MWh and 496 gallons/MWh, respectively. The Palo Verde nuclear plant consumes 768 gallons/MWh. Cumulatively, a typical coal plant can consume up to four billion gallons of water in a year while contaminating larger bodies of water. Solar, in contrast, uses an insignificant amount of water: about 20 gallons per megawatt hour of electricity generation on average (mostly for cleaning surfaces).

Conventional energy's extreme water demands present a risk not only to New Mexico's water resources but also to the availability of energy: major plants are at risk of shut-down or operational curtailment due to water shortages in periods of drought.

After 50 years in a mature industry, there is still no solution as to how to safely dispose of nuclear waste (which is radioactive for thousands of years). Such waste poses serious potential threats to workers and entire communities.

Disproportionate risks to the Navajo Nation

As of 2011, 23 coal-fired power plants were spewing millions of tons of pollutants into the air around the Navajo Nation, as shown in this chart. Since this report, only three small units at FCPP have been retired. SO₂ and NOx are known contributors to respiratory health problems and CO₂ is the major cause of climate change.

Coal-fired Power Plants Surround the Navajo Nation								
2011	<u>Cholla</u>	<u>Coronado</u>	<u>Springerville</u>	<u>NGS</u>	<u>Escalante</u>	<u>FCPP</u>	<u>San Juan</u>	TOTAL
Units	4	2	4	3	1	5	4	23
MW	995	773	1560	2250	250	2060	1800	9688
SO ₂ (tons)	6,738	7,351	7,534	4,643	1,257	11,822	4,720	44,065
NOx (tons)	10,995	10,185	6,724	19,840	3,385	38,712	17,101	106,942
CO ₂ (tons)	8,605,503	6,594,556	11,459,152	18,500,000	2,100,000	14,500,000	12,900,000	74,659,211



New Mexico's Energy Transition: Assessing the Prospects

New Mexico's renewable potential

There's a reason the Zia Pueblo sun symbol rests at the center of New Mexico's flag: the state has extraordinary amounts of sunlight. Albuquerque ranks in the top 4 percent of American municipalities in average daily sunlight. Similarly, New Mexico—particularly the eastern part of the state—has extraordinary wind resources.

The potential for wind energy development can be assessed by comparing the states in the Plains areas, close to New Mexico. This table provides actual wind power generation by state:

Wind Power Generation by State	
	<u>MW</u>
Texas	18,500
Oklahoma	5,500
Kansas	3,800
Colorado	3,000
New Mexico	1,100

<http://www.awea.org/resources/statefactsheets.aspx?itemnumber=890>

As described in the roadmap below, PNM needs 1750 MW of new wind to achieve the 100% renewable energy target in the coming decades. Just a cursory assessment of capacity in neighboring states demonstrates that this goal is attainable.

A key objective of the energy transition is the development of additional energy capacity that can be exported to other states. There are two major wind projects nearing completion in eastern New Mexico with 800 MW that will all be exported beyond state borders.

New Mexico is second only to Arizona in highest potential for solar energy of any state in America. While there's now 365 megawatts of solar capacity available in New Mexico, the potential is exponentially greater. We are harnessing a minuscule portion of the state's abundant sunlight.

700 MW of solar and 1750 MW of wind will enable New Mexicans to power homes, businesses, and community institutions while drastically cutting our state's emissions, protecting and preserving our water supplies, and reducing air, water, and soil pollution. The transition will require steady investment in new infrastructure, which will create an economic surge in a state that needs the investment.

A Roadmap for the Renewable Energy Transition

Our projections are clear: In one decade, we can reach the 50% renewable threshold and drive coal-produced electricity from 50% to zero. Most forecasts show that economical energy storage will be available within 5 years, enabling a transition to 80% renewable energy. With sustained investment and policy commitment, we can establish our state as a recognized national and global leader by 2035: generating 100% renewable energy.

Energy - % MWh	PNM Model				Roadmap to 100% Renewable Energy for PNM customers					
	2015	2018	2020FB	2025FB	2023	2023	2025	2030	2030S	2035S
Coal	50	44	37	35	9	7	0	0	0	0
Nuclear	31	29	29	29	29	21	21	0	0	0
Natural Gas	12	17	16	12	23	25	22	31	20	0
Wind	5	7	12	15	29	36	46	54	62	80
Solar	2	3	6	9	10	11	11	15	18	20
Total	100	100	100	100	100	100	100	100	100	100
Major assumptions - MW										
FCPP capacity	200	200	200	200	200	200	0	0	0	0
SJGS capacity	497	497	497	497	0	0	0	0	0	0
PV capacity	402	402	402	402	402	288	288	0	0	0
Major additions from 2016 - MW										
Added solar capacity		0	105	200	250	260	260	410	500	700
Added wind capacity		0	100	180	550	720	970	1180	1400	1750
% Renewable energy	7	10	18	24	39	47	57	69	80	100
% Fossil	62	61	53	47	32	32	22	31	20	0
2015 & 2018 energy % from PNM Investor presentation of 10/6/16, page 37 2020FB & 2025FB include planned solar and wind capacity for FB per Exhibit 1 of PNM Motion to Vacate of 10/28/16 2023 thru 2035 are based on System Model for PNM system developed by David Van Winkle This model was provided to PNM in 13-00390-UT and PNM did not challenge it in any way in 20 hours of cross examination and deposition This model includes: Seven years of hourly customer usage data - 8760 hours per year; Actual solar and wind output 8760 data; Actual nuclear output, including planned outages, 8760 hours; Actual coal reliability at FCPP and SJGS										

In May 2017, Tucson Electric Power, an investor-owned-utility in Arizona, signed a power purchase agreement for a solar-plus-storage system at “an all-in cost significantly less than \$0.045/kWh over 20 years.” The project calls for a 100 MW solar array and a 30 MW, 120 MWh energy storage system. Solar-plus-storage facilities compete with gas peakers on price, is low risk for consumers and is a hedge against volatile and rising electric rates.

Cost Considerations

The transition to clean renewable energy will yield considerable advantages for New Mexico rate-payers. Already, wind and solar costs per kilowatt-hour (kWh) are significantly less than the costs/kWh for coal and nuclear energy. PNM received quotes for wind and solar energy in early 2016 that clearly demonstrate this fact.

Cost of Electricity Generation

\$/kWh

Wind	3.3
Solar	4.2
Gas fuel	3.8
Coal	7.4
Nuclear	8.5

Wind: Levelized cost from PNM Compliance filing in 13-00390-UT, PNM Appendix 2, Table 3, Line 1 (Includes wheeling cost) (June, 2016)

Solar: Levelized cost from PNM Compliance filing in 13-00390-UT, PNM Appendix 2, Table 2, Line 1 (Includes wheeling cost) (June, 2016)

Gas fuel: Levelized cost: Fuel cost from PNM 9/22/16 2017 IRP presentation, Pace documents, page 16; Heatrate from PNM 2017 IRP, Working document dated 11/10/2016, page 2 of 10, Line 8, 85MW Aeroderivative

Coal: Levelized cost from: 13-00390-UT, Van Winkle Direct Testimony 9/25/15, Exhibit DVW-58 (Sept 2015)

Nuclear: Levelized cost from: 15-00261-UT, Van Winkle Direct Testimony 1/29/16, page 20, adjusted to valuation of \$1306/kW instead of \$2500/kW and for 43% escalation of nuclear costs per PNM Exhibit BR October 21-1 in 13-00390-UT, pages 1 & 2, line 8

The costs of renewables are declining precipitously, just as the societal costs of coal and nuclear, including extreme water usage and unsustainable pollution, are rising. A high-profile news story from New Mexico—Facebook’s decision to locate a \$250 million data center in the state—demonstrates that PNM already has the capacity to provide clean energy at rates below those of the standard coal and nuclear generated power. When Facebook executives required competitive rates for 100% renewable energy as a condition of the deal, the utility obliged.

The energy transition also has positive implications for state budgets and the macro-economy. Energy price fluctuations have damaged New Mexico’s economy. Oil production has fallen in recent years as firms face break-even costs that start at \$40 to \$52 per barrel, with oil prices stubbornly remaining at the mid- to low \$30s per barrel as of 2016. The growth of renewable energy provides an important opportunity for budget stability and economy diversification. It gives the state an opportunity to export energy, provides firms an incentive for new high-value construction, and affords farmers and land owners an opportunity to benefit from a new revenue stream. Renewable energy development also provides important opportunities in workforce development and workforce retraining for communities previously dependent on the extractive industry. Innovative green jobs that feel relevant and meaningful and pay well will help us retain our state’s talent and provide an inspiring educational path for our state’s young people.

New Mexico also has an enormous opportunity to model the “just transition” in the West by making sure that workers are protected and supported with retraining, health benefits, and financial security, and that environmental remediation is done thoroughly and responsibly to protect public health and the viability of the land and water and surrounding communities.



A Just Transition: Creating Jobs and Opportunities for Energy Workers

Clean energy jobs are the jobs of TODAY, as well as the future. Solar and wind jobs are growing at a rate 12 times faster than the rest of the U.S. economy. According to a 2015 report from the Environmental Defense Fund, renewable energy jobs in the United States enjoyed a 6 percent compound annual growth rate between 2012 and 2015. Fossil fuel jobs, by contrast, had a negative 4.5 percent compound annual growth rate over the same time period. And, according to the Bureau of Labor Statistics, the nation's fastest growing profession over the next decade is likely to be a wind turbine technician.

The clean energy industry employs more people than the fossil fuel industry in nearly every state throughout America where clean energy jobs outnumber fossil fuel jobs by more than 2.5 to 1, according to Department of Energy jobs data. New Mexico too is seeing remarkable job growth in the renewable energy sector. In 2016, according to The Solar Foundation, there were 2,929 family-supporting solar jobs in New Mexico. There was a 54% growth in solar jobs in 2016. Albuquerque had one of the highest increases in solar jobs in the country. Across the country, solar jobs increased by 25 percent from 2015 to 2016, for a total of 260,077 solar workers. Solar powers 144,851 homes

in New Mexico. 83% of the solar installations have been on residences, 13% on commercial facilities, and only 1% utility-scale solar. **Solar jobs grew 179 times faster than the overall state economy in 2016.**

**Watch the meter go backwards!
Solar is an affordable option for
homes and businesses today.
Solar energy reduces cost, and
in some cases eliminates utility
bills. Savings can be redirected
back into the community or
used for other purposes.**

Solar is a hedge against rising electricity rates. As PNM has pushed rates more than 50% higher on its residential customers from 2008-2014, PNM's ongoing after tax profits rose 461% from 2008 to 2014 - and its stock price rose 194%. Over the same time period median income for New Mexicans decreased by 6%. Simultaneously, PNM disconnected the electricity of 22,485 New Mexicans in 2014. In 2016, PNM secured an additional 9.5% non-fuel rate increase and less than a year later PNM and the other parties have agreed to squeeze another 9% rate hike from ratepayers. New Energy Economy is the only organization opposing this latest rate increase.

There are now more solar and wind jobs in New Mexico today than fossil fuel jobs.

Market forces and the realities of environmental change are making large-scale energy transition inevitable. Yet it's up to us to ensure that the transition is responsible and just—that it creates good jobs and livelihoods for people, and that it is paced and sequenced in a manner that minimizes economic disruptions. The analysis in this report is unique insofar as it specifies the timing for each step of New Mexico's transition.

The first step, as outlined is to close the San Juan Coal plant by 2022. At the time of this report's writing, three cases are currently pending before the New Mexico Supreme Court that lay out the reasons why further investment in San Juan is imprudent and economically infeasible. Though PNM argued otherwise before the Supreme Court earlier this year, the company has since admitted that the plant will be retired in 2022 because it is not "cost effective for customers" and will save ratepayers money.

The 250 acre site of the San Juan plant has been heavily polluted. In addition to serious air pollution in San Juan County (including an F-rating from the American Lung Association), both the soils and groundwater have been compromised with toxic pollutants. Enormous mine pits have been filled with toxic ash. Both the lands and the people living in the vicinity have, tragically, been treated as "disposable."

This 250 acre site does, however, have the opportunity to serve as an important engine for the growth of a new clean energy economy. Clean-up will require a workforce and once remediated, an appropriate beneficial use would be the installation of new solar arrays, and the existence of extensive electricity transmission infrastructure on the land means that the redevelopment for utility-scale renewables can happen quickly and cheaply. The development of these new assets can create good livelihoods for people living in nearby communities. Moreover, decentralized generation creates opportunities for Native people who currently lack adequate access to electricity to obtain it.

Transition IS possible: The San Juan Coal Plant and Mine complex can be transformed into a solar farm. Clean-up and construction will employ hundreds in the Four Corners area. A Kentucky coal company announced in April 2017 that it is planning to build a solar farm on a reclaimed mountaintop removal coal mine and that the project would bring both jobs and energy to the area. Berkeley Energy Group, the coal company behind the project, billed it as the first large-scale solar farm in the Appalachian region, which has been hit hard by the decades-long decline in the U.S. coal industry. The company, in partnership with EDF Renewable Energy, is currently conducting feasibility studies for the project on two reclaimed strip mines, both located in the eastern part of the state. Berkeley Energy Group estimates that the solar farm could produce as much as 50 or 100 megawatts of electricity, which would be five to ten times the size of Kentucky's largest solar farm.



The Road Ahead: Realizing the Energy Transition

Next Steps for Citizens and Policymakers

New Mexico policymakers can take clear and immediate steps to realize the promise of a high-employment clean energy economy. Crucially, this energy transition does not require major new taxpayer spending. Rather, it requires simple and straightforward application of regulatory principles and policy changes to put renewable energy on a level playing field with older, polluting energy sources.

Policy solutions fit into three general categories:

- Free and Competitive Markets: Require competitive market-based assessments for all new resource acquisitions to allow investor-owned utilities, regulators, and energy consumers.
- Strengthen Community Choice: Allow people to pool their energy load and make purchasing decisions collectively in order to reduce costs, create local jobs, and meet shared energy objectives like sustainably and reliability.
- Strong Statewide Standards: Building on the success of New Mexico's existing Renewable Portfolio Standard (RPS) law and those in other high-performing states, lawmakers should strengthen clean energy targets to realize the vision of an all-renewable electricity sector.

Advocates of energy transition should focus on a series of clear, attainable, fiscally-responsible policy choices.

Free and Competitive Markets

Transparency is essential for energy markets. Yet, currently, determinations around public utility energy investments are not based on clear, objective, transparent processes. We need sensible requirements for Requests for Proposals (RFPs) and independent evaluators.

Across the country, it's a standard practice to require RFPs from public utilities for procurement of new supply-side power generation resources to meet projected service needs. A 2008 study commissioned by the National Association of Regulatory Utility Commissioners (NARUC) and the Federal Energy Regulatory Commission (FERC) stated: "Competitive procurements can provide utilities with a way of obtaining electricity supply that has the 'best' fit to customers' needs at the 'best' possible terms. In principle, competitive procurements accomplish this goal by requiring market participants to compete for the opportunity to provide these services."

Unfortunately, current laws and regulations in New Mexico do not require that an investor-owned public utility provide the PRC with the results of a reasonable RFP process to support a request for approval of a proposed new supply-side resource. In other words, there is no requirement to show the PRC that the utility reasonably identified all feasible resource alternatives and reasonably evaluated and compared the costs, risks and benefits of those feasible alternatives to those associated with the utility's proposal.

These sensible requirements would, we believe, create a more level playing field for a diversity of energy resources—including renewables. All of our neighboring states and more than 40% of states in the U.S. have also directed their regulatory agencies to implement “independent evaluator” or “independent monitoring” procedures to advise their regulatory agency as to the reasonableness of the scope of utilities’ RFPs to further increase transparency in the process. Legislation in New Mexico could create a clear and cost-effective option for implementing these reforms.

When another energy utility in New Mexico, Southwest Public Services (SPS), voluntarily issued a solicitation for competitive resource procurement, the bids SPS selected saved customers many millions of dollars and have proved to be reliably integrated renewable resources. SPS has installed two new solar facilities: 70 MW in Roswell and another 70 MW in Chavez County that went into production in 2016. Both are 25-year power purchase agreements. The leveled cost for both is 4.2¢/kWh. Solar will save customers approximately \$80M over the life of the project in avoided fuel expenditures. SPS has also obtained low cost wind energy: in 13-00233-UT SPS received approval for the purchase of 700 MW of wind at 2.3¢/kWh and will save customers \$590M.

Strengthen Community Choice

Cities, town, and other communities need a say in energy markets. Community Choice Aggregation (CCA) allows local governments to pool their electricity load, so that they can purchase or generate power on behalf of their residents, businesses, and municipal institutions. The idea of CCA is to work in partnership with a region’s existing utility, which can continue to delivery power, maintain and manage the grid, manage billing and other customer services, while allowing communities to select their energy supplies. CCA has been established by law in seven states so far. It’s an important model for how New Mexico can drive the energy transition. The objectives of transitioning to a CCA include:

- Reduced electricity rates
- Opportunities to transition to a cleaner, more efficient energy supply
- Consumer choice and local control
- Local job creation and economic development

Illinois has CCA, which has resulted in 91 cities and towns producing 100% renewable energy.



Energy aggregation can be done on an opt-in or opt-out basis (depending on state statute), but the most successful CCA programs operate on an opt-out basis, meaning that customers are automatically enrolled after a successful local referendum (as in Illinois and Ohio) or when local elected officials vote to form or join a CCA program (as in California). Non-profit municipal utilities have demonstrated the ability to provide highly reliable electricity at rates that average 15 to 20 percent below those of investor-owned utilities like PNM. Similarly, CCAs provide flexibility, cost efficiencies, and local control-making it possible for people to realize their objectives on matters like environmental targets. The CCA model brings the benefits of locally-controlled power supply and generation that many communities have pursued through municipalization, without the considerable financial costs of purchasing and maintaining antiquated utility infrastructure.

New Mexico legislators should follow the examples of states that have transitioned effectively to the CCA model. There's no shortage of policy options for authorizing communities to transition to the CCA model.

Strong Statewide Standards

The most direct way that officials can catalyze a clean energy transition is by expanding our state's Renewable Portfolio Standard (RPS). Recent polling has found that upwards of 80 percent of Americans, including clear majorities of conservative Republicans, support requiring utilities like PNM to produce more clean power. New Mexico's RPS – which requires that 15.7 percent of our electricity come from renewable sources by 2021 – is already improving environmental quality and driving energy sector innovation. Yet our current RPS does not comport with the climate and economic demands of today.

Other states are far more ambitious: Hawaii is aiming for 100% renewables by 2045, Colorado must generate 30% of their electricity from renewable energy by 2020, and California is considering a proposal to reach 100% by 2045. These standards work. According to new research from the Lawrence Berkeley National Laboratory and National Renewable Energy Laboratory, renewable portfolio standards across US states have created \$7.5 billion in annual environmental benefits due to reduced air pollution, 27 billion gallons in reduced annual water consumption, and between \$1.3 billion and \$4.9 billion in reduced consumer energy prices. They have additionally supported the creation of 200,000 American jobs and up to \$20 billion in annual GDP.

New Mexico lawmakers can take an important step toward realizing the clean energy transition by establishing a stronger long-term RPS law in line with the recommendations in this report.

About 27 cities and counties have set targets of 100% renewables.

Resources for CCA:

- www.citizensforlocalpower.org/cca
- www.leanenergyus.org
- www.cpuc.ca.gov/general.aspx?id=2567
- www.eenews.net/stories/1060038517
- theeastcoastnews.com/2017/03/17/hundreds-gather-to-learn-about-community-choice-energy/
- growssolar.org/wp-content/uploads/2014/10/Leading_from_the_Middle_IL_Report_FINAL.pdf
- www.localcleanenergy.org/files/CommunityPowerPublication_12-3-10.pdf

Resources for RFP Requirement:

- www.abqjournal.com/957752/pnm-should-come-clean-on-renewable-energy-costs.html
- santafenewmexican.com/news/legislature/proposal-would-require-utilities-to-shop-for-cheaper-energy-options/article_2ac38160-581a-5e8b-a435-4b4e564b385d.html
- www.utilitydive.com/news/new-mexico-bill-would-require-competitive-resource-procurement-at-utilities/436248
- www.abqjournal.com/984209/nm-misses-another-chance-at-progress.html

Resources for 100% Renewables:

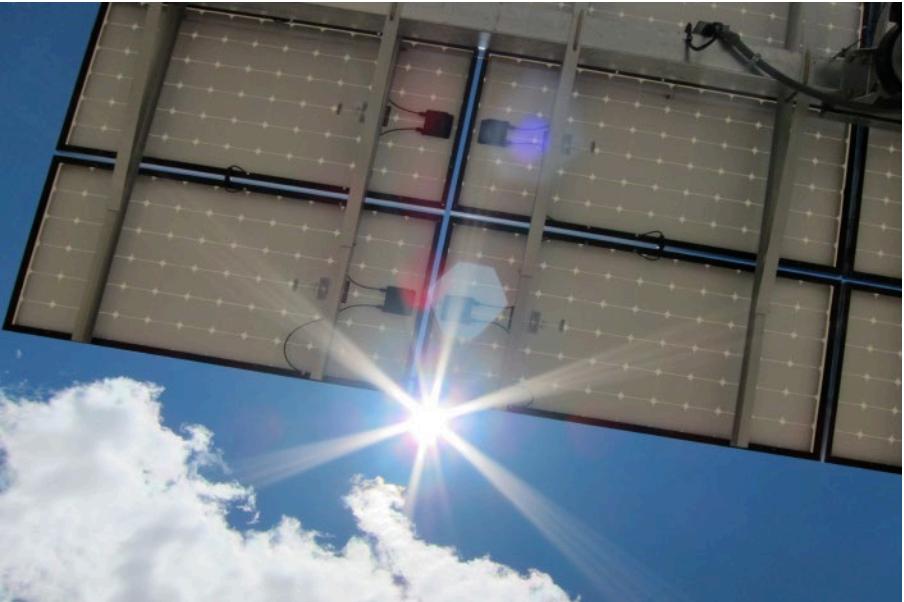
- www.thesolutionsproject.org
- www.go100re.net
- www.sierraclub.org/ready-for-100
- 350newmexico.org/videos (A Plan to Build 100% Clean Renewable Energy)
- www.ilsr.org/how-states-and-cities-can-unlock-local-clean-energy

Conclusion: Seizing the Opportunity

According to recent polling, 91 percent of voters—including strong majorities of both Republicans and Democrats—believe that the United States should accelerate its transition to renewable energy. Further, the study found that people from both major parties believe that utility companies should exercise more leadership in the development of clean renewable power. The clean energy transition will help manage rising risks of climate change, setting a far-reaching example of how states can exercise leadership and achieve a low-carbon economy. At the same time, the clean energy transition can lessen our dependence on volatile global energy markets. Crucially, the expansion of energy choice strengthens the forces of market competition in a crucial sector of our state’s economy.

The choice is clear. New Mexicans want to move beyond the status quo of stagnant wages and rising pollution. Our citizens want a high-employment clean energy economy. It’s up to policymakers to take the steps necessary to help create it.

PLEASE JOIN US!



New Energy Economy

New Energy Economy is an IRS approved 501(c)3 non-profit organization founded in 2004 to build a carbon-free energy future for our health and the environment. New Energy Economy employs public education, community organizing, targeted litigation, and model solar energy projects to shift our energy economy from fossil fuel and nuclear extraction to clean alternatives in pursuit of environmental justice and human and environmental health. New Energy Economy received the 2012 Sustainable Santa Fe Award in Renewable Energy for our Sol Not Coal Project, the Santa Fe Community Foundation's prestigious VISIONARY LEADER award in 2013, and the 2015 ENVIRONMENTAL ADVOCATE award from the City of Santa Fe. In 2014, EPA Administrator Gina McCarthy congratulated New Energy Economy on its Sol Not Coal campaign, for the deployment of solar in under-represented communities. In 2016, the Mayor of Santa Fe and the Sustainability Commission recognized the leadership of New Energy Economy's Executive Director Mariel Nanasi and presented her with the "Excellence in Sustainability" award. New Energy Economy is known for its collaborative campaigns that mobilize diverse constituencies and formidable partners to make positive change happen in New Mexico.

**To learn more about New Energy Economy and
join our 100% Renewable Energy Campaign please visit:**

www.NewEnergyEconomy.org.

New Energy Economy
343 East Alameda St.
Santa Fe, New Mexico 87501-2229
505.989.7262



new energy economy

Addressing the Climate Challenge
With Bold Solutions

Footnotes and other references:

¹ 13-00390-UT, PNM Exhibit NEE 1-20

² 13-00390-UT, Direct Testimony in Opposition to Supplemental Stipulation, David Van Winkle, 9/25/15, page 34

³ PNM chose to replace the lost energy from the abandonment of SJGS units 2 and 3 with more of its own money-losing coal and nuclear. PNM's further investment in coal and nuclear was accepted by the New Mexico Public Regulation Commission and that case (13-00390-UT) has been appealed to the New Mexico Supreme Court (Case No. 35,697, decision expected Q1 2017). PNM Senior Vice President, Ron Darnell, admitted that despite the fact PNM would spend hundreds of millions of dollars for the purchase of more coal and more nuclear (and receive reimbursement plus a return on equity from ratepayers) there would be NO jobs created by PNM's purchase of more coal and nuclear. 13-00390-UT, Transcript, 1/7/15 TR (Darnell), p. 362.

⁴ EIA-826 database

⁵ PNM regional peers: PNM, El Paso Electric (NM), Southwestern Public Service (NM), Public Service Company of Colorado, Tucson Electric, Arizona Public Service, Rocky Mountain Power (Utah)

⁶ Exhibit DVW-3

⁷ 15-00261-UT, Ortiz direct testimony, page 4-5

⁸ 15-00261-UT, Faruqui direct testimony, page 44

⁹ 15-00261-UT, Faruqui direct testimony, page 45

¹⁰ 13-00390-UT, Exhibit DVW-5: PNM Exhibit NEE 21-2b(3rd Supplemental), 2015 Rate Case (No NEC) System Energy and Peak Demand Summary

¹¹ 13-00390-UT, James Dauphinais testimony for NM Industrial Energy Consumers, 8/29/14, page 33-38.

¹² 13-00390-UT, PRC Staff Testimony, Rode, pages 40-41

¹³ 15-00109-UT, Exhibit NLP-1, see page 89

¹⁴ Exhibit DVW-29: 15-00109-UT, Exhibit NLP-1, see page 92

¹⁵ 15-00261-UT, David Van Winkle testimony for NEE, 1/29/16, Exhibit DVW-27

¹⁶ Exhibit DVW-59 (Sept 2015)

¹⁷ See, Ojo Line Extension, Case No. 2382, Final Order Approving Recommended Decision, November 20, 1995, p.88: "New Mexico still suffers from the burden of costly utility plant built in the basis of load projections which never materialized, where the benefits vanished while the costs remained. ... [D]ifficulties arise[e] from [...] plant overcommitment and overoptimistic load projections [including the impact of Palo Verde on PNM and EPE] to support [the] recommendation that the Commission 'should always be conservative in its estimates of need.'"

¹⁸ San Juan coal plant is 40 years old, Four Corners coal plant is 50 years old.

¹⁹ Palo Verde nuclear plant is 28 years old.

²⁰ PNM 2017 IRP handout, 11/10/16, Resource Performance Data, pages 6-7

²¹ PNM 2014 IRP, page 23

²² Declaration of Dr. George Thurston, Professor of Environmental Medicine at New York University, filed in the United States Court of Appeals for the 10th Circuit, Public Service Company of New Mexico v. United States Environmental Protection Agency, Case No. 11-9557, January 12, 2012.

²³ Though this paper is specifically analyzed relative to PNM retail customers the conclusions can be applied to the remainder of the State.

