THE CASE FOR AI IN NEW MEXICO: USING ARTIFICIAL INTELLIGENCE TO CUT COSTS AND ACHIEVE AMBITIOUS RENEWABLE ENERGY STANDARDS

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As the federal government moves further from policies that promote sustainability, states have adopted ambitious renewable energy requirements. Faced with the growing threat of climate change, an increasing number of states have committed to carbon neutral energy production in the not-too-distant future. Once science fiction, carbon neutrality in energy production is becoming a reality because of technological advances. While not often associated with the energy industry, artificial intelligence may provide a needed boost to current renewable output while minimizing future investment in transmission capacity.

This Article discusses artificial intelligence and how the technology may be used to assist New Mexico to achieve its recently enacted goal of carbon neutrality by 2045. New Mexico, one of the largest and simultaneously least populated states in the country, introduces many unique issues to carbon neutral energy production. This Article explores the possibility of using artificial intelligence to sync renewable energy production in one corner of the state with consumption in another while potentially reducing investment in new transmission capacity. This Article also analyzes New Mexico's recently enacted renewable energy standard, the Energy Transition Act, and how the statute leaves open the possibility for artificial intelligence to be used in its implementation.

INTRODUCTION

On March 22, 2019, New Mexico Governor, Michelle Lujan-Grisham, signed State Bill 489, the "Energy Transition Act" (ETA), into

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law.[1] The ETA mandates "New Mexico's electricity [to] be 50% renewable by 2030, with a goal of 80% by 2040." [2] As a further effort to combat climate change, it mandates New Mexico's "electricity will be 100% carbon-free by 2045."[3] This is a lofty goal set in the wake of many other states deciding to take charge on climate change and energy security by refusing to wait any longer for the federal government to act.[4] In fact, "[r]oughly half of the growth in U.S. renewable energy generation since 2000 can be attributed to *state* renewable energy requirements."[5] The biggest hurdle to success for New Mexico and other states is likely not political challenges from areas with coal-centric economies, but rather, it is the strained and aging state of the electric transmission grid in America.[6] As the New Mexico Public Utility Commission (NMPUC) begins to consider how to implement the ETA, a key consideration will be how to address transmission of electricity in order to meet customer demands.[7]

New Mexico, the fifth largest and fifty-first most densely populated state or territory, introduces unique challenges to transitioning to renewable energy due to the vast distances between population centers and land well suited for renewable energy generation.[8] One possibility is to invest in costly, new superconducting transmission lines. However, as explained in greater detail below, the current structure of electricity distribution in the United

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1. *See generally* N.M. STAT. ANN. § 62 (2018); *see also 2019 Regular Session - SB 489*, N.M. LEG., (Feb. 9, 2019), https://www.nmlegis.gov/Legislation/Legislation?Chamber=S&LegType=B&LegNo=489&year=19 [https://perma.cc/H4SW-FVBP].
2. *See generally* N.M. STAT. ANN. § 62 (2018); *see also* THE ENERGY TRANSITION ACT (SB 489) (Feb. 9, 2019), https://y00bn3l6sa11vcw1pmj6um14-wpengine.netdna-ssl.com/files/2019/02/190204-ETA-fact-sheet-v1.pdf [https://perma.cc/C6AZ-HLNJ].
3. *Id*.
4. *See State Renewable Portfolio Standards and Goals*, NAT'L CONF. OF ST. LEG. (Dec.31, 2019), http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx [https://perma.cc/8RHU-259D] (California: 100% clean energy by 2045; Hawaii: 100% clean energy by 2045; New Jersey: 50% clean energy by 2030; New York: 50% clean energy by 2030; Vermont: 75% clean energy by 2032; and Washington, D.C.: 100% clean energy by 2032).
5. *Id*. (emphasis added).
6. Joshua D. Rhodes, *The old, dirty, creaky US electric grid would cost $5 trillion to replace. Where should infrastructure spending go?*, THE CONVERSATION (Mar. 16, 2017, 10:49 AM), http://theconversation.com/the-old-dirty-creaky-us-electric-grid-would-cost-5-trillion-to-replace-where-should-infrastructure-spending-go-68290 [https://perma.cc/NA5E-MY2C].
7. *See New Mexico Population, Area, and Density*, STATES101, https://www.states101.com/populations/new-mexico [https://perma.cc/6WU5-XN39] (Mar. 5, 2019).
8. *Id*.

States virtually requires the federal government to mandate such an update and given the United States' current political climate, this may be wishful thinking.

Enter artificial intelligence (AI), the same technology that allows Siri to tell you whether to take an umbrella with you on your morning commute. While it may seem far-fetched, artificial intelligence may hold the key to providing an economically viable alternative to massive infrastructure redevelopment in the short term, by increasing the overall efficiency of the grid through renewable energy management, improved demand side management, and better infrastructure and asset management.[9] This article argues that in order for New Mexico and other similarly situated states to accomplish the ambitious energy goals they have outlined for themselves, it will likely be necessary to make the grid "smarter." While the issue of utility-scale electricity storage still inhibits complete reliance on renewable energy, a smarter grid may provide solutions to many of the problems inherent to an electric transmission grid transitioning to renewable energy. With any luck, the proposals outlined in this article may provide a stopgap that simultaneously buys America more time to develop utility-scale electricity storage while ensuring that consumers' lights stay on as the country transitions to wider dependence on renewable energy.

I. AI BACKGROUND

A. Introduction

Artificial intelligence, or "AI," has long been a dream of humanity. Mechanical men capable of free-thought were recorded in myths from antiquity[10] and it seems that every few years Hollywood reintroduces AI into the mainstream. However, for the first time in history, the disparity between fact and fiction is becoming less and less pronounced. Never before in human kind's existence have we come close to creating something with such wide applicability and transformative power as AI. Some may argue that antibiotics or other achievements of modern medicine rival AI's impact on society; however, rather than medicating or prolonging human existence, AI could, in theory, *supplant* it. Grim doomsday predictions aside, the reality of the situation is more likely that within the next century, AI will be used to

9. *Impact of Artificial Intelligence (AI) on Energy & Utilities (2018)*, FROST & SULLIVAN (Sep. 2018).

10. *See generally* PAMELA MCCORDUCK, MACHINES WHO THINK 523 (A K Peters, Ltd.) (2nd ed. 2004).

radically reimagine virtually every industry on the planet for unprecedented net gains in efficiency.

B. A Definition for AI and Key Terms

Artificial intelligence, in theory, is fairly self-explanatory. It is "artificial" in the sense that it has been created by human beings and "intelligent" insofar as these creations are capable of mimicking human decision making. Andreas Kaplan and Michael Haenlein, professors at ESCP Business School, offer the following definition for AI: "AI [is][] a system's ability to interpret external data correctly, to learn from such data, and to use those learnings to achieve specific goals and tasks through flexible adaptation."[11] While a thesis level exposé of AI is well beyond the scope of both this paper and the author's knowledge, there are a few key definitions one must be aware of in order to better understand AI's potential applications such as: big data, machine learning, deep learning, and cognitive computing.

At a bird's eye view, big data simply refers to "the large volume of data – both structured and unstructured – that inundates a business on a day-to-day basis."[12] Kaplan and Haenlein further define big data as "huge amounts (volume) of frequently updated data (velocity) in various formats, such as numeric, textual, or images/videos (variety)."[13]

Machine learning is essentially data mining with the purpose of detecting patterns, then using those patterns to influence future action.[14] While it may seem that machine learning is synonymous with AI, it is important to note that while machine learning is a key component of AI, "AI is broader than machine learning since it also covers a system's ability to perceive data … or to control, move, and manipulate objects based on learned information[.]"[15] Further, machine learning relies on pattern-discovery algorithms to generate "insights" from the information fed to them in order

11. Andreas Kaplan & Michael Haenlein, *Siri, Siri, in My Hand: Who's the Fairest in the Land? On the Interpretations, Illustrations, and Implications of Artificial Intelligence*, 62 BUS. HORIZONS 15 (2019).
12. *Big Data*, SAS GLOB. F. 2020, https://www.sas.com/en_us/insights/big-data/what-is-big-data.html [https://perma.cc/3L3Y-K9SS] (last visited Mar. 5, 2019).
13. *Supra* note 13, at 17.
14. Gavin Mooney, *10 Ways Utility Companies Can Use Artificial Intelligence and Machine Learning*, D!GITIALIST MAG. (May 17, 2018), https://www.digitalistmag.com/digital-economy/2018/05/17/10-ways-utility-companies-can-use-artificial-intelligence-machine-learning-06167501 [https://perma.cc/M8WU-688G].
15. Kaplan & Haenlin, *supra* note 12, at 17.

to apply those "insights" to future data inputs. [16] In other words, this is "a process that sidesteps the need [for an algorithm] to be programmed specifically for every single possible action."[17]

Another necessary term is deep learning, which is essentially machine learning on steroids. Deep learning employs "a complex architecture that mimics a human brain's neural networks in order to make sense of patterns, even with noise, missing details, and other sources of confusion."[18] The defining characteristic of deep learning is that "all the potential future intelligence and reasoning powers are *latent* in the program itself, much like an infant's inchoate but infinitely flexible mind."[19] Unlike machine learning, which relies on a prescribed algorithm, deep learning is a "family of algorithms that implement deep networks with unsupervised learning."[20] Deep learning presents problems that researchers have not *yet* been able to understand, such as *how* programs utilizing deep learning come to certain conclusions.[21] Further research is undoubtedly necessary for humans to glean the full potential of deep learning applications.

Cognitive computing, the final term in understanding AI, is where AI begins to enter into the realm of science fiction. Cognitive computing builds on neural networks and deep learning by "applying knowledge from cognitive science to build systems that simulate human thought processes."[22] Cognitive computing's importance to the future of AI cannot be understated as the technology may bring to life many of Joseph Schumpeter's fears of "creative destruction," or the idea that current jobs and industries will be eliminated by future technological innovations.[23] This is because cognitive

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16. Cecille De Jesus, *Artificial Intelligence: What It Is and How It Really Works*, FUTURISM (Jan. 1, 2017), https://futurism.com/1-evergreen-making-sense-of-terms-deep-learning-machine-learning-and-ai [https://perma.cc/WR9H-FYEK].
17. *Id*.
18. *Id*.
19. *Id*. (Emphasis added).
20. M. Tim Jones, *A beginner's guide to artificial intelligence, machine learning, and cognitive computing*, IBM (June 1, 2017), https://developer.ibm.com/technologies/artificial-intelligence/articles/cc-beginner-guide-machine-learning-ai-cognitive/ [https://perma.cc/Q672-9D2L].
21. *Id*. ("A recent application of deep learning to skin cancer detection found that the algorithm was more accurate than a board-certified dermatologist. But, where dermatologists could enumerate the factors that led to their diagnosis, there's no way to identify which factors a deep learning program used in its classification. This is called deep learning's black box problem.").
22. *Id*.
23. *See generally* JOSEPH A. SCHUMPETER, CAPITALISM, SOCIALISM, & DEMOCRACY 81-86 (George Allen & Unwin Ltd ed. 1976) (1942).

computing introduces the very real possibility that many jobs currently performed by human beings will be replaced by machines.

ELECTRIC UTILITIES INDUSTRY REGULATION

A. Overview of the Electricity Industry

The United States electric industry operates through three different sectors: generation, transmission, and distribution.[24] Generation is characterized by the physical generation of electrons sent through lines and used by consumers of all sizes (commercial, residential, etc.).[25] Electricity is generated when magnets are spun inside of coils of wire, an action often powered by steam.[26] There are a variety of methods for producing the requisite steam; however, the United States has primarily relied on fossil fuel combustion, specifically coal, as the fuel source for electricity generation.[27]

Electric transmission involves channeling the flow of the electrons produced in generation to the markets where those electrons are put to use.[28] Due to the high costs of building transmission lines and the decreasing cost of electricity as transmission systems increase in size, electric transmission has long been viewed as a "natural monopoly."[29] Thus, federal and state governments grant some entities the right to own and operate transmission lines in return for charging fair rates to all who seek to transmit electricity.[30] Electricity transmission relies on extremely high voltages to accommodate for the natural loss of some electricity, due to resistance encountered over long distances.[31]

Finally, distribution is the sector of the power industry where electricity is taken from transmission lines, reduced in voltage, and delivered

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24. *United States Electricity Industry Primer*, DEP'T OF ENERGY 6 (July 2015), https://www.energy.gov/sites/prod/files/2015/12/f28/united-states-electricity-industry-primer.pdf [https://perma.cc/LQM6-WT2U].
25. *Id*.
26. *Id*. at 8.
27. *Id*.
28. *Id*. at 13-20.
29. David Roberts, *Power utilities are built for the 20th century. That's why they're flailing in the 21st.*, VOX (Sep. 9, 2015), https://www.vox.com/2015/9/9/9287719/utilities-monopoly.
30. *Frequently Asked Questions (FAQs)*, FEDERAL ENERGY REGULATORY COMMISSION, https://www.ferc.gov/resources/faqs/about.asp [https://perma.cc/BA87-TJH8] (last visited Apr. 8, 2020).
31. *Supra* note 25, at 13.

to end users. Distribution has also historically been seen as a "natural monopoly" due to the impracticality of numerous wires from different providers being strung to homes or factories.

B. Key Federal and State Actions on Electricity Industry Regulation and Deregulation

The United States' electric industry operates within the confines of a highly complex regulatory framework. Federal regulation of the electric industry began in 1935 with the passage of the Public Utilities Holding Company Act (PUHCA).[32] Through PUHCA, Congress granted regional monopolies to specific utilities in return for regulated rates of return determined by federal and state regulators.[33] PUHCA also "required utility parent companies to incorporate in the same state where the utility operates, so that the state could regulate them, or to be regulated by the Securities and Exchange Commission (SEC) if they operated in several states."[34] Part of the reasoning behind enacting PUHCA was to prevent utilities from engaging in the speculative behavior that led to Enron's demise.[35] The next 35 years of American history saw relatively little change in energy policy until deregulation of the electricity industry began to gain traction during the energy crisis in the 1970s.[36]

Passage of the Public Utilities Regulatory Policy Act (PURPA) in 1978 was the first step toward deregulating the electric industry.[37] PURPA created a market for "power from non-utility power producers" as well as legal entities known as Independent Power Producers (IPPs).[38] IPPs are non-utility owned producers of electricity and their legal recognition laid the groundwork for greater utilization of renewable energy within the United States.[39] This was accomplished by requiring utilities to buy non-utility

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32. 15 U.S.C.A. § 79; *See also The Public Utility Holding Company Act*, PUBLIC CITIZEN (2019), https://www.citizen.org/our-work/climate-and-energy/public-utility-holding-company-act [https://perma.cc/NK9P-HL6M].
33. *Id*.
34. *Id*.
35. *Id*.
36. *Timeline and History of Energy Deregulation in the United States*, ELECTRIC CHOICE, https://www.electricchoice.com/blog/timeline-history-energy-deregulation/ [https://perma.cc/Q9EM-K4YV] (last visited Apr. 4, 2019).
37. *Public Utility Regulatory Policy Act (PURPA)*, UNION OF CONCERNED SCIENTISTS (July 15, 2019), https://www.ucsusa.org/clean_energy/smart-energy-solutions/strengthen-policy/public-utility-regulatory.html [https://perma.cc/FH8M-9SSM].
38. *Id*.
39. *Id*.

power if the cost was below the utilities' marginal cost of production.[40] The passage of PURPA marked the United States' first foray into creating "energy markets" and set the stage for further deregulation of the industry.

The next step towards deregulation was the Energy Policy Act of 1992, which repealed PUHCA, while eliminating price controls in the sale of electricity between power producers.[41] While the Energy Policy Act was intended to create a more competitive wholesale market for electricity, an unforeseen consequence was the rapid growth of the wholesale market to a level that the transmission grid was never designed to accommodate.[42] In 1996, the Federal Energy Regulatory Commission (FERC) mandated "open and equal access" to utilities' transmission grids for all energy producers, adding further strain to existing infrastructure.[43] As the FERC began to see some of the less desirable side effects of deregulation, it introduced Independent System Operators (ISOs) which were to be tasked with coordinating regional transmission in a nondiscriminatory manner.[44] Joining an ISO was voluntary but emergence of ISOs was slowed by the failure of the FERC and state regulators to define ISO responsibilities.[45] The FERC's next proposed Regional Transmission Organizations (RTOs) in an effort to expand the ISO concept; however, many of the same problems beleaguered RTOs as did ISOs.[46]

Any history of electricity deregulation in the United States would be incomplete without mention of the mixed results of state electricity deregulation. The 1990s saw a wave of state legislatures attempting to create markets for electricity choice, the most notable being California.[47] The spectacular failure that was the Golden State's attempt at deregulating

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40. *PURPA-qualifying capacity increases, but it's still a small portion of added renewables*, U.S. ENERGY INFO. ADMIN. (Aug. 16, 2018), https://www.eia.gov/todayinenergy/detail.php?id=36912.
41. Energy Policy Act of 1992, Pub. L. No. 102-486, H.R. 776, 102nd Cong.
42. Kenneth W. Costello, *Overview of Issues Relating to the Retail Wheeling of Electricity*, NAT. REG. RES. INST. (May 1994), http://ipu.msu.edu/wp-content/uploads/2016/12/Costello-Overview-of-Issues-Relating-94-09-May-94-1.pdf [https://perma.cc/R4HQ-MAZZ].
43. *Order No. 888*, 75 F.E.R.C. ¶ 61,080 (1996).
44. NATIONAL RESEARCH COUNCIL, COMPETITION IN THE ELECTRIC INDUSTRY: EMERGING ISSUES, OPPORTUNITIES, AND RISKS FOR FACILITY OPERATORS 6-10 (1996).
45. *Regional Transmission Organizations*, 89 F.E.R.C. ¶ 61,285 (1999).
46. *Id*.
47. *Map of Deregulated Energy States & Markets*, ELECTRICCHOICE, https://www.electricchoice.com/map-deregulated-energy-markets/ [https://perma.cc/F4A2-T85C] (last updated 2018).

electricity markets[48] left many other states with a healthy skepticism of the perceived merits of deregulation. New Mexico, along with a number of other states, ultimately suspended deregulation attempts in 1998.[49] As of April 2020, only seventeen states have "deregulated electricity markets."[50] For all of the pitfalls of electricity deregulation, there are those that advocate for greater interstate connectivity to exploit different energy generation techniques across the United States, likely resulting in individual energy producers choosing the most economic fuel source.[51] The Public Service Company of New Mexico is hoping to join a newly created interstate energy market, the Western Energy Imbalance, by 2021.[52] It remains to be seen whether this new energy market will realize its potential, however with the enactment of the ETA, it may behoove New Mexico to return to the drawing board regarding energy deregulation. If properly implemented, deregulated energy markets can yield massive benefits for utilities and consumers alike.

C. The Grid and Grid Management

"The grid" is the term used for the interlinkage of the generation, transmission, and distribution industries.[53] Pundits have likened the grid to a

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48. *See generally* CHRISTOHPER WEARE, THE CALIFORNIA ENERGY CRISIS: CAUSES AND POLICY OPTIONS, PUB. POLICY INST. OF CAL. (2003), https://www.ppic.org/content/pubs/report/R_103CWR.pdf [https://perma.cc/HSM8-BLP8] (in short, Enron was able to exploit numerous loopholes in California's deregulation law that resulted in exponential price increases of retail electricity and failures of the California grid).
49. Kathleen Davis, *State of Deregulation: N.M., Nev. looking to return their deregulation packages*, POWERGRID INT'L (July 1, 2001), https://www.elp.com/articles/print/volume-79/issue-7/departments/state-of-deregulation-nm-nev-looking-to-return-their-deregulation-packages.html [https://perma.cc/QX3C-TYHF].
50. *State-by-State Look at Energy Regulation in the U.S.*, SPARK ENERGY, https://www.sparkenergy.com/en/energy-regulation-by-state/ [https://perma.cc/2HJK-5U7M] (last visited Apr. 9, 2020) (These States are: California, Connecticut, Maine, Maryland, New Hampshire, Illinois, Massachusetts, Michigan, New Jersey, New York, Ohio Pennsylvania, Rhode Island, Washington, D.C., Delaware, Oregon, and Texas).
51. Robert W. Crandall, *Extending Deregulation*, THE BROOKINGS INST. (2008), https://www.brookings.edu/wp-content/uploads/2016/06/PB_Deregulation_Crandall.pdf [https://perma.cc/W2T3-6DBE].
52. Susan Montoya Bryan, *New Mexico utility seeks to join western energy market*, AP (Aug. 22, 2018), https://apnews.com/962a128eaec24b2e8903b84935476146 [https://perma.cc/XU24-8V52]; *see also 60.72m Savings in Q4 2019*, WESTERN ENERGY IMBALANCE MKT., https://www.westerneim.com/pages/default.aspx [https://perma.cc/Z2HT-SLU5].
53. Ehineni Kehinde, *Electrical Grid*, STUDENT ENERGY, https://www.studentenergy.org/topics/electrical-grid [https://perma.cc/5PP5-E53S] (last visited Apr. 2, 2019).

"network of large water ponds arrayed across a vast landscape."[54] In this analogy, generators are akin to waterfalls that maintain a constant water level in all of the interconnected ponds while distribution of electricity to end users is represented by small channels leading off of and withdrawing from each pond.[55] Grid management is the practice of determining the rate of water that needs to be going into the ponds at any given time to maintain a constant level of water in the ponds while withdrawals from the ponds occur simultaneously at an ever changing rate.[56] Grid management is essentially the task of the balancing authority, or body that is charged with maintaining constant flow of electricity on the grid.[57] A very small degree of electricity transmission fluctuation is permissible due to inherent limitations of the physical line structure, therefore, the most important aspect of an electric power system is the constantly maintained balance between generation and distribution.[58]

Due to the unpredictability of when wind will blow or sun will shine, renewable energy introduces additional complications to grid management because of the uncertain nature of how much electricity will be produced at any given time. New Mexico's ETA seeks to accomplish powering the entire state with solely renewable electricity, however, the complications with such a goal can become insurmountable logistical hurdles. Traditional power plants reliant on fossil fuels, such as coal and natural gas, provide a *constant* source of power that is *predictable* in its output. Conversely, renewable energy sources are anything *but* constant and are difficult to predict with precision, rendering grid management of a completely renewable supply incredibly difficult.

ARTIFICIAL INTELLIGENCE AND UTILITIES

A. Introduction

As alluded to earlier, AI's ubiquity quickly became the zeitgeist of the late 2010's tech industry. The excitement surrounding the technology, seems to give the impression that AI is capable of solving any of the world's problems. A quick google search for "artificial intelligence and the utilities industry" demonstrates the electricity industry is no exception.[59] From supply

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54. PETER FOX-PENNER, SMART POWER: CLIMATE CHANGE, THE SMART GRID, & THE FUTURE OF ELECTRIC UTILITIES 25 (Island Press 2nd ed. 2014) (2010).
55. *Id*. at 25-27.
56. *Id*.
57. *Id*.
58. *Id*. at 26.
59. A Google search of "artificial intelligence and the utilities industry" resulted in about 20,500,000 results.

side considerations like grid reliability maintenance to demand side applications like smart devices (that can learn a user's preferences to determine how much electricity should be designated to a given user at a given time), AI is well suited to address many areas in the utilities industry.[60] However, the prospect of handing the reins of the U.S. utilities industry to AI is probably not as near on the horizon as some may hope. As with any new technology, significant testing and development must take place prior to industrial applications, as consumers will be loath to any hiccups in electricity service.

This section will specifically explore AI's application to renewable energy management, demand management, and infrastructure management. This section will also identify potential pitfalls of applying AI to these areas. Finally, special consideration will be given to how the AI applications might be utilized by New Mexico to reach the goals set out in the ETA.

The remainder of this section utilizes much of the information provided by the firm in its report as support for the proposal that AI is a viable technological solution in the energy industry. In 2018, market research firm Frost & Sullivan compiled one of the most in-depth analyses of AI's potential impact on energy yet completed, "Impact of Artificial Intelligence on Energy and Utilities, 2018" (Frost & Sullivan Report).[61] In the Frost & Sullivan Report, the firm sought to analyze the prospective future impact that AI would have on the energy industry between 2018 and 2025 and the three main areas in which AI can be leveraged.[62] The firm also identified the leading companies that leverage AI technology in the energy and utilities sector.[63]

B. Renewable Energy Management

As previously mentioned, electricity generated from renewable sources is dependent on weather and is highly unpredictable.[64] This complicates grid management due to uncertainty over how much electricity will be available at any given time. In March 2018 for example, the country

60. Robert Walton, *With artificial intelligence it's a brave new world for utilities*, UTILITY DIVE (Nov. 24, 2017), https://www.utilitydive.com/news/with-artificial-intelligence-its-a-brave-new-world-for-utilities/511008/ [https://perma.cc/T9KZ-6X8A].
61. Frost & Sullivan, *supra* note 10.
62. *Id*.
63. *Id*.
64. *See supra*, Section III.C.

of Portugal produced more renewable electricity than it consumed,[65] however there were still "some hours when thermal fossil power plants and/or imports were required to complement the electricity supply of Portugal."[66] More sophisticated grid management may provide a potential workaround for irregular supply and AI is well suited to address this need. The idea is that "Al could help enhance the forecasting of short-term electricity generated from [renewable energy sources], improve equipment maintenance, and predict downtime in advance using sophisticated [machine learning] algorithms."[67] AI's value comes from forecasting electricity demand, generation capacity, and weather patterns to better direct available electricity to where it is needed. While humans can already do this, AI research is beginning to reach a point that outpaces and exceeds human performance.[68] At present, "Al is being deployed in various pilot studies to obtain wind turbine operation data and solar panel sensor data that gauges sunlight intensity and other renewables."[69] AI then combines this information with atmospheric data obtained from numerous sources with the ultimate goal of being able to precisely predict electricity generation given certain atmospheric indicators.[70]

C. Demand Management

Demand management is "changing [. . .] electricity usage based on change in the price of power."[71] Demand management is a fundamental principle in deregulated energy markets, where the goal is reducing energy consumption. Theoretically, if consumers are provided with precise information of the actual costs of their electric use, they may be inclined to reduce their overall consumption to save money. Demand management, also known as "demand-side management" (DSM), is not limited to consumer behavior. Large-scale DSM projects "consist of planning, implementing, and

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65. Olivia Gagan, *Here's how AI fits into the future of energy*, WORLD ECONOMIC FORUM (May 25, 2018), https://www.weforum.org/agenda/2018/05/how-ai-can-help-meet-global-energy-demand [https://perma.cc/JM26-FFB2].
66. Camila Domonoske, *In March, Portugal Made More Than Enough Renewable Energy To Power The Whole Country*, NPR (Apr. 5, 2018, 6:24 PM), https://www.npr.org/sections/thetwo-way/2018/04/05/599886059/in-march-portugal-made-more-than-enough-renewable-energy-to-power-the-whole-coun [https://perma.cc/J5U4-KAJC].
67. Frost & Sullivan, *supra* note 10.
68. *Supra* note 52.
69. Frost & Sullivan, *supra* note 10.
70. *Id*.
71. *Demand Management*, ENERGYWATCH, https://energywatch-inc.com/demand-management/ [https://perma.cc/8W25-KSVT] (last visited Apr. 4, 2019).

monitoring activities of electric utilities."[72] Historically, "the primary objective of most DSM programs was to provide cost-effective energy and capacity resources to help defer the need for new sources of power, including generating facilities, power purchases, and transmission and distribution capacity additions."[73] Recent trends in the industry have seen a greater focus on improving customer service.[74] Due to this increased focus on customer service, DSM is one area of the energy industry that has already experienced significant AI implementation. As Frost & Sullivan point out, "[l]arge commercial and industrial (C&I) consumers like retail markets, office buildings, industries, railways, and grid operators currently use AI to make real-time decisions to maximize demand side flexibility."[75]

Demand management has the dual effect of reducing costs for consumers while simultaneously helping the grid remain stable[76] due to a reduction in the need for development of new generating capacity.[77] Further, "AI will [be able to] leverage blockchain or other distributed ledger technologies to protect data"[78] and increase the reliability of the energy grid. Finally, an untapped advantage of AI application in demand management is that "AI can help facilitate [demand management] programs through game theory algorithms to attract more customer participation in [demand management]."[79] Game theory is essentially an analysis of competitive situations where "the outcome of a participant's choice of action depends critically on the actions of other participants."[80] A recent study has demonstrated that through a specific game theory application, net utility profits can increase simultaneously with reduced demand fluctuation and savings on energy bills for end users.[81] In other words, utility scale game theory applications can result in net efficiency increases for the grid.

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72. *Electric Utility Demand Side Management – Archive*, U.S. ENERGY INFO. ADMIN., https://www.eia.gov/electricity/data/eia861/dsm/ [https://perma.cc/TK9S-4TF4] (last visited Apr. 4, 2019).
73. *Id*.
74. *Id*.
75. Frost & Sullivan, *supra* note 10.
76. *Demand Management*, *supra* note 58.
77. *Electric Utility Demand Side Management – Archive*, *supra* note 59.
78. Frost & Sullivan, *supra* note 10.
79. Frost & Sullivan, *supra* note 10.
80. *Game Theory*, LEXICO, https://www.lexico.com/definition/game_theory [https://perma.cc/ZK8K-R439] (last visited Apr. 12, 2020).
81. Rui Tang, Shengwei Wang, and Hangxin Li, *Game theory based interactive demand side management responding to dynamic pricing in price-based demand response of smart grids*, 250 APPLIED ENERGY 118-130 (Sep. 15, 2019), https://www.sciencedirect.com/science/article/abs/pii/S0306261919308396?via%3Dihub [https://perma.cc/7NX2-VPC4].

D. Infrastructure Management

Infrastructure management (IM) refers to "the management of essential operation components, such as policies, processes, equipment, data, human resources, and external contacts, for overall effectiveness."[82] This definition, which essentially characterizes IM as the managerial wheelhouse of a company's tech, is emblematic of just how embedded technology has become in today's business environment. The utility industry is no exception, with significant expenditures in a variety of areas including "advanced metering infrastructure," "meter data management," and analytics.[83] Metering being collecting data on a building or residence's energy usage over time.[84] However, "[i]nnovation within the utility industry has been slow and limited," resulting in underutilization of available information.[85] Utilities can leverage AI to better direct how the information coming in from their vast networks of devices can be used to manage their resources more efficiently. Frost and Sullivan notes that, "[machine learning] algorithms can be used to analyze and highlight potential challenges and risks across electric grids and utility infrastructure" with the ultimate goal that ML can model and recommend changes based on perceived weaknesses.[86] AI can also assist with energy transmission system upkeep.[87] For example, "AI is currently deployed for fault diagnostics and maintenance of generation assets in thermal and biogas plants and in the detection of leakage of hazardous gases from these plants." Further, "AI can also help the energy and utilities market improve safety, reliability, and efficiency…[while providing]…visibility into energy leakage, consumption patterns, and equipment health."[88] Accordingly, utilities in New Mexico and across the United States can get more out of their existing infrastructure through AI deployment, which will improve efficiency of the grid, while maintaining or reducing costs for consumers.

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82. Margaret Rouse, *What is infrastructure management (IM)?*, TECHTARGET, https://searchcio.techtarget.com/definition/infrastructure-management [https://perma.cc/Y9QK-6GJX] (last updated June 2007).
83. Greg Zimmerman, *Top 10 Utility Technology Investments*, ENERGYACUITY (Jan. 9, 2019), https://energyacuity.com/blog/top-10-utility-technology-investments/ [https://perma.cc/77FH-X5FE].
84. *What is an Electric Meter?*, ENERTIV (2019), https://www.enertiv.com/resources/faq/what-is-electric-meter [https://perma.cc/P3FN-PQK7].
85. Marilyn Waite, *Why US utilities should invest in innovation*, UTILITY DIVE (Apr. 24, 2017), https://www.utilitydive.com/news/why-us-utilities-should-invest-in-innovation/441114/ [https://perma.cc/AR86-9D7A].
86. Frost & Sullivan, *supra* note 10.
87. *Id*.
88. *Id*.

NEW MEXICO UTILITIES: BACKGROUND AND REGULATION

A. Introduction

The utilities industry in New Mexico is currently dominated by coal and natural gas.[89] In December 2018, coal-fired power plants accounted for 44% of the state's electricity generation and natural gas-fired power plants accounted for another 29.8%.[90] New Mexico is currently above the national averages for the total percentage of electricity generated from coal and natural gas. However, it is also above the national average for energy generated by renewables.[91] Additionally, New Mexico contains a wealth of natural resources, with roughly 8.3% of the nation's crude oil reserves and a projection of 6.5% of the nation's future production of natural gas plant liquids.[92] This makes the passage of the ETA all the more remarkable as the cost of future reliance on natural gas as a fuel source is likely the more economically sound policy, at least in the short term.

Regulation of electric, gas, and water utilities in New Mexico is outlined in Chapter 62 of the New Mexico Statutes (Chapter 62).[93] The New Mexico Public Regulation Commission (NMPRC) is the governmental body tasked with overseeing Chapter 62 regulations.[94] Chapter 62 requires that public utilities provide "reasonable and proper services" at "fair, just, and reasonable rates."[95] This is to be executed in such a manner that capital and investment are encouraged and attracted to provide for the construction, development, and extension of power plants and facilities as well as demand-side resources for service delivery to the general public and to industry.[96] Unsurprisingly, the mission statement of the NMPRC states that the

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89. *New Mexico State Energy Profile,* U.S. ENERGY INFO. ADMIN., https://www.eia.gov/state/print.php?sid=NM [https://perma.cc/W8JP-TAP9] (last updated Feb. 20, 2020).
90. *Id*.
91. *Id*. (The national averages for coal and natural gas electricity production are 28.7% and 31.7%, respectively. Further, the national average for renewable energy generation is 17.3%, whereas renewables account for 19% of New Mexico's electricity production. The reason New Mexico is above all national averages is that nuclear energy does not account for any electricity production in New Mexico, whereas, nationally it accounts for 21.2%).
92. *Id*., under *Data Reserves* and *Supply and Distribution*.
93. *See generally* N.M. STAT. ANN. § 62 (2018).
94. *See* § 62-6-4.
95. § 62-3-1.
96. *Id*.

organization seeks to "ensure fair and reasonable rates, and to assure reasonable and adequate services to the public as provided by law."[97]

B. Energy Transition Act

The ETA was signed into law on March 22, 2019.[98] The ETA sets out the new Renewable Portfolio Standard (RPS) for New Mexico in § 62-16-4.[99] In relevant part, the ETA sets the following requirements for the RPS in New Mexico: a 20% renewable energy requirement by January 1, 2020; a 40% renewable energy requirement by January 1, 2025; a 50% renewable energy requirement by January 1, 2030; an 80% renewable energy requirement by January 1, 2040; and a 100% energy requirement by January 1, 2045.[100]The ETA also contains extensive provisions on financing new renewable energy projects in order for public utilities in New Mexico to comply with these ambitious goals.[101] These ETA sections provide guidance for many of the potential problems in adopting the new RPS, such as abandonment of fossil fuel power plants and plans to re educate displaced workers.

Renewable energy creates glaring issues for demand management. The inconsistent supply of electricity from renewable sources creates headaches for grid managers and, even when a country like Portugal who produced more than 100% of its energy requirements from renewables, fossil fuel power plants were still needed to supplement occasional dips in renewable production.[102] The ETA, in an attempt to circumvent issues of renewable electricity supply, contains several provisions related to energy storage systems (methods and technologies used to store electricity)[103] A general lack of economically viable utility scale energy storage has long been an impediment to widespread reliance on renewable energy.[104] However, recent developments such as "solar-plus-storage"[105] are becoming

97. *NMPRC Mission Statement & What We Do*, N.M. PUB. REGULATION COMM'N, HTTP://NMPRC.STATE.NM.US/INDEX.HTML [https://perma.cc/R8QE-U62K] (last visited Mar. 28, 2019).
98. *2019 Regular Session - SB 489*, *supra* note 2.
99. N.M. STAT. ANN. § 62-16-4.
100. *Id*.
101. N.M. STAT. ANN., Chapter 62, Sections 1 – 24.
102. Domonoske, *supra* note 53.
103. *See generally* N.M. STAT. ANN., Chapter 62, Sections 1 – 24.
104. Rachel Carnegie, et. al., *Utility Scale Energy Storage Systems*, STATE UTILITY FORECASTING GROUP (June 2013), https://www.purdue.edu/discoverypark/energy/assets/pdfs/SUFG/publications/SUFG%20Energy%20Storage%20Report.pdf [https://perma.cc/9CRF-JJ2C].
105. *Solar-Plus-Storage 101*, OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY (Mar. 11, 2019), https://www.energy.gov/eere/solar/articles/solar-plus-storage-101

increasingly cost competitive.[106] Further, the Energy Storage Tax Incentive and Deployment Act, introduced by the House of Representatives in April 2019, seeks to "add stand-alone energy storage to the list of technologies eligible for the federal Investment Tax Credit (TIC)."[107] As of April 2020, the bill has not been passed. A renewed federal emphasis on long-term energy storage will only benefit New Mexico and other states, as states seek to implement their ambitious RPSs.

The ETA appears purposefully vague as to the "methods and technologies" of energy storage. However, the New Mexico legislature likely intended it to mean any conceivable technology that can result in energy savings to help the state achieve its new RPS. First, the ETA specifies that the NMPRC *shall* approve a certificate of public convenience and necessity for an energy storage system that "reduce[s] costs to ratepayers by avoiding or deferring the need for investment in new generation and for upgrades to systems for the transmission and distribution of energy."[108] This provision can be satisfied by a variety of technological advancements, not just utility scale batteries. This opens the door for a utility incorporating AI into its grid management portfolio. Second, the ETA provides for the approval of "energy storage" systems that "assist with ensuring grid reliability, including transmission and distribution system stability, while integrating sources of renewable energy into the grid."[109] The ETA's lack of rigidity will facilitate New Mexico's utilization of technology ancillary to the grid, such as AI, to achieve its carbon reduction goals.

C. Rate Making in New Mexico

A central part of the NMPRC's responsibilities is setting and monitoring rates that public utilities charge their customers. The financial structure of most public utilities and investor owned utilities relies on

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[https://perma.cc/H2CP-2RRM] (Solar-plus-storage routes electricity produced by photovoltaics to lithium-ion batteries for later use).

106. Jeff St. John, *5 Predictions for the Global Energy Storage Market in 2019*, GREENTECH MEDIA (Dec. 11, 2018), https://www.greentechmedia.com/articles/read/five-predictions-for-the-global-energy-storage-market-in-2019#gs.3ziad1 [https://perma.cc/H5WN-9VAR].

107. Jeff St. John, *US House Introduces Energy Storage Tax Credit Bill*, GREENTECH MEDIA (Apr. 4, 2019), https://www.greentechmedia.com/articles/read/congress-introduces-energy-storage-tax-credit-bill#gs.3zi9xp [https://perma.cc/CAC6-6RNV] (noting that the first version of this bill in 2016 was proposed by Senator Martin Heinrich, a Democrat from New Mexico).

108. N.M. STAT. ANN., *supra* note 85, at § 25(D)(1).

109. § 25(D)(3).

sufficient economic returns to pay for infrastructure and create a reasonable return on investment for investors. In New Mexico, and a majority of the country, rates are determined through a process known as "rate making." Utilities increase rates for many different reasons. They increase rates because of increased cost of fuel sources and also to recoup costs for infrastructure updates. In any case, the first step a utility must take to adjust or set rates, is to show the NMPRC that the utility has a need.[110] Once the utility identifies a need, they may file an application to increase rates with the NMPRC.[111] In its application, the utility must demonstrate the "public convenience and necessity" of the proposed project. Thereafter, the NMPRC notifies the public of the rate case filing and the NMPRC Commissioners and staff review the utility's application and calculate the legitimacy of the proposed increase.[112] Once the NMPRC determines that a public hearing is necessary,[113] it issues a notice for a public hearing. Up until the public hearing, affected parties have the opportunity to file discovery, responses, and rebuttal testimony.[114] Once all affected parties have the opportunity to respond to one another, the NMPRC holds a public hearing. During the public hearing witnesses are cross-examined about the justification for and possible effect of the utility's proposed rate change.[115] Thereafter, NMPRC Commissioners review the evidentiary record and deliberate before issuing a final order.[116] After NMPRC Commissioners issue a final order, the utility adjusts its rates to reflect the ruling.[117]

While the NMPRC makes decisions under the auspices of "fair and reasonable rates," new legislation allows utilities to request rate changes for compensation of costs incurred under special circumstances that fall outside the parameters of normal rate change requests.[118] Recoupment of cost for "development and ongoing construction of a clean energy project" qualifies

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110. *See "How The PRC Sets Rates"*, N.M. PUB. REGULATION COMM'N, http://www.nmprc.state.nm.us/administrative-services/docs/how-prc-sets-rates.pdf [https://perma.cc/AR9L-WKZ7].

111. *Id.*; *see also* N.M. STAT. ANN. § 62-8-7(A); § 62-6-20 (the NMPRC is permitted to consider a number of factors when setting rates such as "prescrib[ing] reasonable rules, regulations and standards to secure the substantial accuracy of all meters and other devices for measurement of utility service or products which shall be complied with by the utility and consumer").

112. N.M. PUB. REGULATION COMM'N, *supra* note 108.

113. § 62-8-7(C)-(D).

114. N.M. PUB. REGULATION COMM'N, *supra* note 108; *see also* N.M. STAT. ANN. § 62-8-7(E).

115. N.M. PUB. REGULATION COMM'N, *supra* note 108.

116. *Id*.

117. *Id*.

118. *See generally* N.M. STAT. ANN. § 62-6-28.

as a special circumstance.[119] Clean energy projects are defined as the "construction or modification of a new or existing electric generation facility in a manner that employs a technology that has additional financial risk because it is not commercially established..."[120] Further, cost recoupment is limited to "costs *reasonably* incurred up to the time [the utility] files a general rate case whether or not the project is in service."[121]

Public utilities in New Mexico "that incur[] costs to reduce harmful air emissions at new or existing power plants may seek recovery of those costs in a general rate case, regardless of whether the technology or method used qualifies as a clean energy project."[122] To that end, the statute permits the NMPRC to find expenditures reasonable that "reduce harmful air emissions beyond levels required by law or rule."[123] Finally, in an effort to establish how costs might be recouped in non-traditional ways, NMPRC is compelled to, "upon petition or its own motion, open a docket to consider appropriate performance-based financial or other incentives to encourage public utilities to develop and construct clean energy projects."[124]

COMING FULL CIRCLE: HOW TO USE AI IN IMPLEMENTING NEW MEXICO'S ETA

A. Introduction

Utility management is highly complex with countless variables affecting decisions at every level. The current framework for America's electric utility industry was built on the assumption that fossil fuels would provide the lion's share of electricity generation and, until recently, this paradigm seemed etched in stone due to economic and logistical complications. However, market forces have recently yielded price reductions and efficiency gains for renewable energy generation.[125] The

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119. N.M. STAT. ANN. § 62-6-28(A) ("'[D]evelopment means the study, plan, design, site, permit, engineering, assessment and determination of the economic and operational feasibility at one or more locations and may include small-scale demonstration projects, if approved by the commission, as a reasonable expenditure").
120. § 62-6-28(D)(2).
121. § 62-6-28(A).
122. § 62-6-28(B).
123. *Id*.
124. § 62-6-28(C).
125. Aleksandra Wisniewska, *Prices are down and capacity is up as solar and wind take hold*, FINANCIAL TIMES (Nov. 6, 2019), https://www.ft.com/content/6a0f89a4-e37a-11e9-b8e0-026e07cbe5b4 [https://perma.cc/B55Z-UUK8].

question these days seems to be not so much "if", but rather "when" will renewable energy completely supplant fossil fuel reliant industries.

The recent, bold choice by the State of New Mexico to transition entirely to renewable energy by 2050 is likely going to become the new norm for state legislatures. These "early" attempts at completely pulling the plug on fossil fuel generated electricity will no doubt create complications and roadblocks along the way.[126] It is the position of this article that through widespread implementation of AI, these complications and roadblocks may be ameliorated or made surmountable. The following section explores other states' plans to meet their ambitious RPSs, compares how those plans could fare in New Mexico, and zealously advocates for the use of AI in solving problems inherent to any 100% renewable energy initiative.

B. Similar State Renewable Portfolio Standards

As of April 2020, there are eight states or territories aside from New Mexico that are currently seeking to go fully renewable by 2050: Hawaii, by 2045; California, by 2045; Maine, by 2050; Nevada, by 2050; New York, by 2040; Puerto Rico, by 2050; Washington, by 2040; and Washington, D.C., by 2032.[127] As deadlines are met or reneged, other states will be watching closely to learn from any missteps in the implementation of these ambitious plans.[128] While reliance on renewable energy has positive benefits for global warming and climate change, this increase in reliance will undoubtedly add more strain to the grid. This strain justifies greater expenditures in infrastructure and more sophisticated grid management tools such as AI, to maintain the reliability Americans are accustomed to.

1. Hawaii

Hawaii provides a particularly interesting "case study" for the roadmap to 100% renewables because Hawaii is completely removed from the mainland electric grid. This unique position creates a closed system where small-scale implementation of potential solutions to large-scale problems can

126. *Overcapacity and the challenges of going 100% renewable*, POWER TECHNOLOGY (July 17, 2017), https://www.power-technology.com/features/featureovercapacity-and-the-challenges-of-going-100-renewable-5872868/[https://perma.cc/QFD5-NE3U].
127. *State Renewable Portfolio Standards and Goals*, *supra* note 5.
128. John Fialka, *As Hawaii Aims for 100% Renewable Energy, Other States Watching Closely*, SCIENTIFIC AMERICAN (Apr. 27, 2018), https://www.scientificamerican.com/article/as-hawaii-aims-for-100-renewable-energy-other-states-watching-closely/ [https://perma.cc/7LHA-LH4E].

be tested. Between 2011 and 2017, the overall percentage of renewable energy generation throughout Hawaii increased dramatically, from about 10% to nearly 30%.[129] Additionally, Hawaiian Electric, Maui Electric, and Hawaii Electric Light plan to have a 60% reduction in fossil fuel use by 2022 as more than a dozen wind, solar and battery storage projects now planned or under construction come online.[130] A key component of Hawaii's plan to achieve their RPS is mandating a "4,300-gigagwatt-hour reduction in electricity use by 2030 through efficiency and conservation measures."[131] This is an interesting approach to transitioning to renewables because reducing overall electricity demand negates the need to build additional generating capacity. AI could be used to assist statewide energy conservation considering that net efficiency gains as a result of AI implementation have already seen private sector energy use reductions.[132] The Hawaii State Building Code Council, in an effort to assist energy efficiency gains, adopted the International Energy Conservation Code (IECC) in 2015.[133] As reported by the Hawaii State Energy Office, "[t]he estimated net savings from the 2015 IECC with Hawaii amendments is . . . 1,083,590 MWh in 2019 (year 10), and 1,991,059 MWh in 2032 and 4,702,738 MWh in 2038 (year 20)…[which] could power 732,514 homes in 2038, assuming the code is adopted by all counties."[134]

Another way in which Hawaii hopes to meet its RPS is through effectively crowd-sourcing energy production from consumers.[135] As detailed by the Hawaii State Energy Office, the Customer Grid-Supply Plus (CGS+) program "allows customers to install private rooftop solar or other renewables that export energy to the electric grid throughout the day."[136] This

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129. *SECURING THE RENEWABLE FUTURE*, HAW. STATE ENERGY OFFICE, http://energy.hawaii.gov/renewable-energy [https://perma.cc/H9F5-FULM].
130. Betsy Lillian, *In 2018, Hawaii Made Big Progress On Path To 100% Renewable Energy*, SOLAR INDUSTRY (Jan. 3, 2019), https://solrenen.com/blog/2019/01/03/in-2018-hawaii-made-big-progress-on-path-to-100-renewable-energy/ [https://perma.cc/EGA9-QXMG].
131. *Hawaii Energy Facts & Figures*, HAW. STATE ENERGY OFFICE 1 (Jun. 2018), https://energy.hawaii.gov/wp-content/uploads/2018/06/HSEO_2018_EnergyFactsFigures.pdf [https://perma.cc/6PQK-GEJX].
132. Adam Vaughan, *Google uses AI to cut data centre energy use by 15%*, THE GUARDIAN (Wed., Feb. 14, 2018), https://www.theguardian.com/environment/2016/jul/20/google-ai-cut-data-centre-energy-use-15-per-cent [https://perma.cc/R4DW-XY3Z].
133. HAW. STATE ENERGY OFFICE, *supra* note 113 at 16.
134. *Id.*
135. *Id*.
136. *Id*.

innovation could yield massive cost savings for Hawaiian utilities as it will potentially mean they can forego developing more renewable energy generation of their own. However, opening up the grid to more energy producers makes the job of grid management all the more complicated, reinforcing the need for more sophisticated grid management.

2. California

California State Bill 100 (SB 100) may currently be the most ambitious RPS in the country due to the size of the state's population and economy. SB 100 "raises California's renewable energy target to 60 percent by 2030 with interim targets, and gives the state until 2045 to generate the rest of its electricity from carbon-free sources."[137] In order to achieve its ambitious targets, the California senate has identified a number of technical advances that should prove beneficial, such as projected cost decreases for renewable technology and utility scale storage.[138] The California senate has also identified better weather forecasting, western grid operators working in unison (specifically targeting efficiency when renewables are less readily available), and "[n]ew advancements in the ability of large and small electricity users to shift usage towards times when electricity is cheaper and when the supply of renewables is most abundant."[139]

Utilities in California have already begun to adopt AI to carry out some of their operations. Southern California Edison (SCE), one of the United States' largest electric utilities, is a prime example.[140] First, SCE uses AI to perform "mundane, and routine" tasks, which allows employees to focus on customers, therefore improving customer service.[141] Second, SCE uses AI to aid in hiring employees.[142] While neither improved customer service nor employee hiring is quite as dramatic as a utility ceding decision-

137. Julian Spector, *California Assembly Passes Historic 100% Carbon-Free Electricity Bill*, GREENTECH MEDIA (Aug. 28, 2018), https://www.greentechmedia.com/articles/read/california-100-percent-clean-energy-grid-de-leon#gs.406zhu [https://perma.cc/FWR9-VBSU].
138. *FAQs*, 100% Clean Energy (SB100), https://focus.senate.ca.gov/sb100/faqs [https://perma.cc/7QY2-NBLN] (last visited March 24, 2019).
139. *Id*.
140. *Who We Are*, S. CALI. EDISON, https://www.sce.com/about-us/who-we-are (last visited April 2, 2019).
141. James McClelland, *Renewing the utility workforce for renewable energy realities*, ENERG MAGAZINE (2019), https://www.altenerg.com/back_issues/story.php?sid=1704 [https://perma.cc/3MK5-JYYH].
142. Hot Topics, *What are Southern California Edison's wide-reaching artificial intelligence strategies?*, YOUTUBE (July 24, 2018), https://www.youtube.com/watch?time_continue=81&v=SlODCBaIIWE.

making capabilities to a machine, these applications show that electric utility companies in California and elsewhere are actively considering the benefits of implementing the technology.

C. Implementing AI in New Mexico

The bulk of this paper has been devoted to discussions of how AI and the utilities industry work. However, aspirational discussion is useless if it cannot be applied in a tangible way. The next section of this paper explores ways that AI might be used in New Mexico. The section begins by noting the New Mexico Statutes' broad language and possibility that using AI for utilities within the state may already be permissible. Then this section will identify specific components of the California and Hawaii plans that New Mexico can learn from and how companies have already developed technology necessary to their implementation.

1. Statutory Permissiveness of AI Implementation

The State of New Mexico has given the NMPRC "general and exclusive power and jurisdiction to regulate and supervise every public utility in respect to its rates and service regulations."[143] The main limitation on exercising this power is that public utilities in New Mexico are required to prevent economic waste and preserve public health, safety, and welfare.[144] Considering that AI can be used to increase efficiency and prevent economic waste, there is likely statutory authority for the NMPRC to compel electric utilities to utilize AI in New Mexico.

Additionally, corporations can be formed and organized for the broad purpose of electricity generation, transmission, and distribution under the general incorporation laws of New Mexico.[145] This creates the possibility that a corporation may be organized in New Mexico for the purpose of applying AI to grid management, as grid management impacts every aspect of electricity generation, transmission, and distribution. Corporations created with these purposes would have the power to merge with one another and connect their transmission lines, allowing greater long-term efficiency of the grid, and the ability to remedy problems many areas face with geographical isolation.[146]

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143. N.M. STAT. ANN. § 62-6-4.
144. § 62-3-2.
145. § 62-1-1.
146. § 62-1-5.

2. AI Uses in New Mexico: Learning from Hawaii, California, and private companies

After clearing the statutory hurdle, the next step is determining areas of the utilities industry best suited for AI implementation. A key component of the Hawaiian plan to meet its RPS is through increased efficiency and conservation. Hawaii also plans to rely heavily on renewable energy generated by property owners via "distributed generation" or the ability of private property owners to sell power back to the grid through various generation techniques. Aggregating various distributed energy resources allows utilities to visualize these dispersed entities as a single conglomerate, which allows those in charge of demand management to more effectively route electricity to where it is needed as opposed to where it is being produced. Two private sector entities have begun to use AI to assist the seamless utilization of distributed generation through management. Upside Energy, a company in the United Kingdom, developed "a cloud platform (virtual energy storage) that aggregates various [distributed energy resources] connected to the system and offers customized [demand response] solutions to its customers."[147] Hazama Ando Corporation is another company attempting to use AI for energy conservation and demand management.[148] It has developed an AI-based smart energy management system that can forecast electricity demand and optimally control the flow of energy through distributed energy resources and energy storage systems.[149]

Either or both of these companies' innovative solutions could be applied in New Mexico in order to both conserve energy and create a more efficient grid, which have been heavily encouraged by the New Mexico Legislature through the Efficient Use of Energy Act (EUEA). The EUEA was enacted by the New Mexico State Legislature in 2008 to encourage public utilities to institute energy efficient measures for "load management."[150] The New Mexico legislature cited energy security, economic benefits, and current underutilization of energy resources within

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147. *Id*.; *see also Homepage*, UPSIDE ENERGY, https://upsideenergy.co.uk/ [https://perma.cc/GZ3V-9ANF] (last visited Apr. 7, 2019).
148. Frost & Sullivan, *supra* note 10.
149. *Id*.; *see also* Shinichi Kato, *AI-based smart energy system developed*, JAPAN TODAY (Dec. 4, 2016: 6:33 AM), https://japantoday.com/category/tech/ai-based-smart-energy-system-developed.
150. § 62-17-3; *see also The basics of utility load management and its main benefits*, BORDER STATES (Dec. 5, 2017), https://solutions.borderstates.com/the-basics-of-utility-load-management-and-its-benefits/ [https://perma.cc/ZM8L-KC3F] (Load management "is the process of balancing the supply of electricity on the power grid with the electrical load by adjusting or controlling the load rather than the power station output.").

New Mexico as reasons for enacting EUEA.[151] The Southwest Energy Efficiency Project, a non-profit organization focussed on promoting energy efficiency in the American Southwest, noted that "[i]mproving energy efficiency [in New Mexico] is a 'win-win' strategy – it saves money for consumers and businesses, reduces the need for costly and controversial new power plants, increases the reliability of energy supply, cuts pollution and greenhouse gas emissions, and lowers energy imports."[152] To accomplish greater energy conservation, EUEA "established energy savings requirements for investor-owned electric utilities of 5 percent of 2005 total retail kWh sales by 2014, and 8 percent of 2005 total retail kWh sales by 2020."[153]

New Mexico can also learn from California's Senate Bill 100 (SB 100). SB 100 advocates for both "specifically targeting efficiency when renewables are less readily available" and "new advancements in the ability of large and small electricity users to shift usage towards times when electricity is cheaper and when the supply of renewables is most abundant" as possible technological advancements that will aid in meeting its RPS.[154] AI can be used to facilitate both of these concepts.[155] As a proof of concept, GE has already started using AI for renewable energy grid management in Japan.[156] GE utilizes an algorithm to collate "wind turbine operation data together with real-time satellite, radar, and weather data to predict the power generation" of the turbines.[157] Xcel Energy, another major American electricity company, is also using "AI-based software and sophisticated weather modeling techniques to analyze turbine wind speed and power generation measurements [to] produce a wind power generation forecast."[158] In order for New Mexico to comply with the ETA, the state could adopt these AI applications to assist grid managers who will be entirely dependent on renewable electricity sources.

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151. *Id*.
152. *New Mexico Energy Fact Sheet*, SW. ENERGY EFFICIENCY PROJECT 1(July 2017), https://www.swenergy.org/Data/Sites/1/media/nm-sweep-factsheet-2017-.pdf [https://perma.cc/Q4HQ-HNQK].
153. *Id*. at 3.
154. Cal. S.B. 100.
155. Frost & Sullivan, *supra* note 10 (Renewable energy management is how utilities address the "imbalance in demand and supply caused by" the unpredictable nature of renewable energy sources).
156. *Id*.; *see also AI to propel wind farm efficiency in Japan*, NIKKEI ASIAN REVIEW (Mar. 11, 2017, 4:40 PM), https://asia.nikkei.com/Business/AI-to-propel-wind-farm-efficiency-in-Japan [https://perma.cc/6SXR-R9HV].
157. *Id*.
158. *Id*.

SB 100 also depends in part on western grid operators working in unison.[159] AI is particularly well suited to assist in managing vast transmission networks and generation assets across the western grid because the technology necessary to implement this interconnection already exists. GE and IBM, both major American technology companies, "have already developed AI systems for automatically monitoring their generation assets."[160] Further, existing technology has been used to "reduce the energy consumption of Google acquired United Kingdom-based DeepMind in 2014 and has used the company's algorithms to "reduce the energy consumption of its enormous data centers by 40%, ultimately cutting the overall electricity consumption by 15%."[161] Verdigris Technologies, a United States-based AI company, has developed AI-based building monitoring systems that monitor "every electrical device in a building by assessing the electrical feeds from the building's circuit panel."[162] The software then "provides data, actionable insights, and automation to help commercial facility managers increase the energy efficiency of buildings."[163]

Thus, infrastructure management is already used to conduct quality control analysis of a utility's entire network at a significantly lower cost than simply replacing all of the older infrastructure. It is this author's opinion that if "old" transmission lines are still capable of transmitting electricity and if software can be deployed to increase the overall efficiency of the use of those transmission lines, it is a complete waste of valuable resources to retrofit the entire system. AI provides utilities with a less wasteful alternative to spending scare funds on a new transmission system, especially in a state like New Mexico, which routinely ranks in the bottom ten states for GDP,[164] where spending money the most effectively is key.

There are countless places that AI could be deployed throughout New Mexico's electric utility industry to aid it in achieving its RPS. New Mexico's overall statutory framework provides many opportunities for allowing and, potentially requiring, AI implementation.

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159. *FAQs*, 100% Clean Energy (SB100), https://focus.senate.ca.gov/sb100/faqs [https://perma.cc/RFK5-LJUQ] (last visited March 24, 2019).
160. Frost & Sullivan, *supra* note 10.
161. *Id.*; *see also* Vaughan, *supra* note 114.
162. Frost & Sullivan, *supra* note 10; *see also Homepage*, VERDIGRIS, https://verdigris.co/ [https://perma.cc/USG2-JVPP] (last visited March 29, 2019).
163. Frost & Sullivan, *supra* note 10.
164. *Gross Domestic Product by State: Third Quarter 2018*, U.S. DEPT. OF COMM. BUREAU OF ECON. ANALYSIS (Feb. 26, 2019, 8:30 AM), https://www.bea.gov/system/files/2019-02/qgdpstate0219.pdf [https://perma.cc/5982-X4UJ].

CONCLUSION

While the Federal Government seems dead-set on reanimating the corpse of the coal industry, states across the country have taken up the fight against climate change in practical and creative ways. New Mexico's ETA is an example of the ambitious mandates these states are adopting. Transitioning entirely to renewable energy is, perhaps, the most significant and impactful step towards reducing America's carbon footprint. It is with powerful technologies such as AI that we will be able to fully implement plans of going completely renewable. AI is a highly disruptive technology that will impact every sector of daily life, including the energy sector. Utilities have already begun transitioning to smart meters to increase existing grid efficiency, without undergoing costly infrastructure updates. Until utility companies invest greater capital for grid upkeep the best available "bridge" to the next version of the grid may be technological software solutions. AI is the way of the future for grid management and New Mexico should fully embrace this transformational technology in its pursuit of going completely renewable.