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Review

Policies to Overcome Barriers for Renewable Energy Distributed Generation: A Case Study of Utility Structure and Regulatory Regimes in Michigan

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Abstract: Because of its environmental damage and now often being the most expensive source for electricity production, coal use is declining throughout the United States. Michigan has no active coal mining and seemingly supportive legislation for distributed generation (DG) and renewable energy (RE) technologies. However, Michigan still derives approximately half of its power production from large centralized coal plants, despite the availability of much lower cost RE DG technologies. To understand this conundrum, this study reviews how Michigan investor owned utilities utilize their political power to perpetuate utility structures that work toward the financial interests of the utilities rather than the best interests of the state's electricity consumers, including other firms and residents. Background is provided covering the concept of DG, the cost savings associated with DG, and utility regulatory regimes at the national, regional, state, and local levels. Recent case studies from specific utility strategies are provided in order to illustrate how Michigan utilities manipulate regulatory regimes via policy misinterpretation to deter or hinder the proliferation of DG in favor of maintaining the existing interests in centralized, fossil fuel-based electrical energy production. The results of this study demonstrate how DG proliferation is hindered by Michigan regulated utilities via the exercise of political power within existing legal and regulatory regimes. This highlights the need to think about how utilities may interpret and implement rules when designing energy legislation and policy to maximize the benefits for consumers and society. Policy recommendations and alternate strategies are provided to help enhance the role of energy policy to improve rather than limit the utilization of RE DG.

Keywords: distributed generation; energy policy; renewable energy; electric utilities; utility regulation

1. Introduction

Nearly half of electrical generation in Michigan is provided by coal-fired electrical power plants that are concentrated in the Lower Peninsula [1]. Although there are some coal resources underground in Michigan, the state has no active coal mines [2]. This requires Michigan to import all of its fuel for these coal-fired power plants, moving money out of the state [3]. Yet, Michigan has substantial renewable energy (RE) resource potential in the form of biomass from an abundance of forestland area [4], hydroelectric power along many rivers [5], as well as ample wind [6] and solar energy [7,8]. Modern solar photovoltaic (PV) [9] and wind energy [10] technologies provide a lower levelized cost of electricity [11–13] than coal-fired electricity [14,15]. In addition, they can be inherently distributed (e.g.

each electricity consumer produces some or all of their electricity on site). Distributed generation (DG) has several technical advantages, including improved reliability and reduced transmission losses [16, 17]. RE resources in general and DG RE in particular increase access to more affordable and locally (or even individually) owned energy systems, arguably a more socially just technological application for the provision of electrical energy services [18–22]. Despite these benefits, Michigan's RE profile remains low [1] and some of Michigan's residential electricity consumers are paying approximately 20% more for electricity than the United States (U.S.) averages [9]. To understand why Michigan continues to use more expensive and less environmentally benign electricity generation technologies, this study investigates the utility structures and regulatory regimes in Michigan. It explores how existing utility entities in the state navigate the implementation of existing energy policy, finding that policy interpretation and implementation serve to perpetuate the existing, fossil fuel dependent energy regime.

As with other U.S. states, electrical energy is provided to Michigan's customers by various utility entities organized in three utility structures: (i) municipally owned entities, (ii) cooperative electric associations, and (iii) investor owned utilities (IOUs). Municipal utilities and rural electric cooperatives or rural electric associations are organized as public entities. IOUs, on the other hand, are private and for-profit firms that provide electricity to 67% [23] of U.S. and 84% of Michigan customers [24]. As privately owned utility companies, IOUs must comply with regulatory measures that are set by the state.

However, the implementation of regulatory measures involves interpretation. In the past, Michigan utilities' interpretation and implementation of existing federal and state energy laws functioned to disincentivize DG proliferation, which limited the growth of RE deployment. For example, Michigan maintains a Renewable Energy Standard (RES) that requires regulated utilities to obtain 15% of electrical generation from renewables by 2021 [25]. A net metering program that provides DG customers with credit for excess generation is within the RES; Michigan legislation states that "An electric utility or alternative electric supplier is not required to allow for a distributed generation program that is greater than 1% of its average in-state peak load for the preceding five calendar years" [26]. Some IOUs operating in the state interpret this as a maximum and cap net metering capacity to 1% of the peak generation load [27]. Michigan legislation also provides choice of electric supplier to consumers, yet the legislation limits participation to 10% of the generation load [28]. These are just two examples of how utility interpretation and implementation of energy legislation function to limit DG within the state of Michigan. As a result, the DG capacity of Michigan at the end of 2017 was roughly 30 MW [29], totaling 10% of Michigan total energy usage [30].

The purpose of this study is to investigate how IOUs in Michigan utilize their political power to perpetuate utility structures that work in the financial interests of the utilities rather than the best interests of the state's electricity consumers, including other firms and residents. Background is provided covering the concept of DG, the cost savings associated with DG, and utility regulatory regimes at the national, regional, state, and local levels. Recent case studies of specific utility strategies are provided to illustrate how Michigan utilities use policy interpretation and implementation to deter or hinder the proliferation of DG in favor of the maintenance of existing interests in centralized, fossil fuel-based electrical energy production. Finally, policy recommendations and alternate strategies are provided to help in enhancing the role of energy policy to improve rather than limit RE DG.

2. Background

This section begins with a brief description of DG including the cost savings associated with DG for Michigan utility customers before turning to the Michigan Public Service Commission (MPSC) compliance requirements to the Michigan legislature regarding DG reporting. It then describes the multilevel governance structures within which U.S. utilities operate. The Federal Energy Regulatory Commission (FERC) oversees the wholesale electricity market along with the interstate transmission of electricity. Public Service Commissions (PSC), which are also known as Public Utility Commissions

(PUC), regulate the retail rates of utilities within each state. Different utility types are regulated differently in each state; this section describes utility regulation only as specifically applicable in Michigan.

2.1. What is Distributed Generation?

Distributed generation refers to technology that generates electricity at or near where it will be used [31–33]. DG has different scales and applications, including a residence [34,35], a business [31], or a larger system [36] operating as a microgrid for resilience or security [37]. Utility scale energy generation, by contrast, and regardless of energy source, involves much larger systems, which are often located further away from the site of use, which are owned and operated by or for utility needs first. DG can be powered with RE sources, such as solar [31], wind [32], and hydro [38], as well as other conventional fuels, such as diesel-powered [39] generators and various hybrid arrangements of multiple sources [34,40]. This paper specifically focuses on DG from RE sources for their ability to promote locally owned and operated energy systems as well as the improvement of electrical grid operations by decreasing load and stress on transmission and distribution lines [41–45]. The environmental benefits of RE production as an alternative to conventional fossil fuels are also well established [19–21], such as reduced pollution [46], lower rates of morbidity and mortality from air pollution [47], and lessened environmental degradation [48].

On average, Michigan residential consumers pay \$0.1512/kWh for electricity [9]. In order to show that DG technologies, particularly solar PV, can provide electricity savings to residential customers in almost all Michigan counties, the following analysis was conducted. A state of Michigan county shapefile was obtained from the GIS Open Data database [49]. The electricity rates for each IOU were obtained from the Michigan Public Service Commission bank of electric rate books [50]. Potential savings for each county were calculated using the levelized cost of energy following the method outlined by Branker et al. [11] from the electric rates using the following assumptions: inputting average sun hours/county, an average 5 kW solar residential system capacity, and average \$/W cost of \$2.50/W (The PV \$/W cost was obtained through personal communication with solar development firms in Michigan, including Chart House Energy, LLC, Quality Solar, and Strawberry Solar. The value used is the average of PV suppliers and it does not include any tax credit). In addition, the LCOE is based on average annual sun hours between 3.4 and 4.4 kWh/m²/day in each county, the capacity factor calculated from sun hours, inverter replacement period of 10 years, PV system warranty of 30 years, solar PV system degradation rate of 0.5% per year, and 3.0% annual discount rate for present-value calculations. Subsequently, the savings were calculated by subtracting the solar LCOE from the IOU rates then geolocated onto each Michigan county utilizing ArcMap version 10.6.1. Table 1 breaks down each county by IOU residential rates, LCOE, sun hours [51], and the PV savings per kWh. The average monthly savings of a residential consumer that utilizes 600 kWh/month is shown in Figure 1. It is important to note that most counties contain municipal, electric cooperative, and IOUs. As this paper specifically focuses on IOU strategies to hinder DG proliferation, that is the utility type reflected in both Table 1 and Figure 1. It should also be pointed out that no incentives of any kind were assumed (e.g. current 30% federal investment tax credit), so the PV savings are an extremely conservative estimate.

Table 1. Michigan County solar photovoltaic (PV) savings for residential systems breakdown per kWh.

| County | Utility | Solar Flux (kW/m ² /day) | PV LCOE \$/kWh | Residential Rates \$/kWh | PV Savings \$/kWh |
|----------------|-------------------------------------|--|-------------------|-----------------------------|----------------------|
| Alcona | Consumers Energy | 3.75 | \$0.109 | \$0.162 | \$0.052 |
| Alger | Upper Peninsula Power Co (UPPCo) | 3.57 | \$0.115 | \$0.185 | \$0.070 |
| Allegan | Consumers Energy | 3.80 | \$0.108 | \$0.162 | \$0.054 |
| Alpena | Alpena Power Co. | 3.71 | \$0.110 | \$0.133 | \$0.023 |
| Antrim | Consumers Energy | 3.65 | \$0.112 | \$0.162 | \$0.049 |
| Arenac | Consumers Energy | 3.79 | \$0.108 | \$0.162 | \$0.054 |
| Baraga | UPPCo | 3.62 | \$0.113 | \$0.185 | \$0.072 |
| Barry | Consumers Energy | 3.79 | \$0.108 | \$0.162 | \$0.054 |
| Bay | Consumers Energy | 3.78 | \$0.108 | \$0.162 | \$0.054 |
| Benzie | Consumers Energy | 3.74 | \$0.109 | \$0.162 | \$0.052 |
| Berrien | Indiana Michigan Power (IMP) | 3.79 | \$0.108 | \$0.125 | \$0.017 |
| Branch | Consumers Energy | 3.81 | \$0.107 | \$0.162 | \$0.054 |
| Calhoun | Consumers Energy | 3.81 | \$0.107 | \$0.162 | \$0.054 |
| Cass | IMP | 3.82 | \$0.107 | \$0.125 | \$0.018 |
| Charlevoix | Consumers Energy | 3.68 | \$0.111 | \$0.162 | \$0.051 |
| Cheboygan | Consumers Energy | 3.68 | \$0.111 | \$0.162 | \$0.051 |
| Chippewa | non-IOU | 3.66 | \$0.000 | \$0.000 | \$0.000 |
| Clare | Consumers Energy | 3.73 | \$0.110 | \$0.162 | \$0.052 |
| Clinton | Consumers Energy | 3.79 | \$0.108 | \$0.162 | \$0.054 |
| Crawford | Consumers Energy | 3.70 | \$0.111 | \$0.162 | \$0.051 |
| Delta | UPPCo | 3.70 | \$0.111 | \$0.185 | \$0.074 |
| Dickinson | UMERC | 3.69 | \$0.111 | \$0.138 | \$0.027 |
| Eaton | Consumers Energy | 3.80 | \$0.108 | \$0.162 | \$0.054 |
| Emmet | Consumers Energy | 3.66 | \$0.112 | \$0.162 | \$0.049 |
| Genesee | Consumers Energy | 3.79 | \$0.108 | \$0.162 | \$0.054 |
| Gladwin | Consumers Energy | 3.76 | \$0.109 | \$0.162 | \$0.052 |
| Gogebic | Xcel | 3.65 | \$0.112 | \$0.115 | \$0.003 |
| Grand Traverse | Consumers Energy | 3.69 | \$0.111 | \$0.162 | \$0.051 |
| Gratiot | Consumers Energy | 3.78 | \$0.108 | \$0.162 | \$0.054 |
| Hillsdale | Consumers Energy | 3.82 | \$0.107 | \$0.162 | \$0.054 |
| Houghton | UPPCo | 3.64 | \$0.112 | \$0.185 | \$0.073 |
| Huron | DTE | 3.73 | \$0.110 | \$0.133 | \$0.023 |
| Ingham | Consumers Energy | 3.80 | \$0.108 | \$0.162 | \$0.054 |
| Ionia | Consumers Energy | 3.78 | \$0.108 | \$0.162 | \$0.054 |
| Iosco | Consumers Energy | 3.77 | \$0.109 | \$0.162 | \$0.052 |
| Iron | UMERC | 3.67 | \$0.112 | \$0.138 | \$0.026 |
| Isabella | Consumers Energy | 3.76 | \$0.109 | \$0.162 | \$0.052 |
| Jackson | Consumers Energy | 3.81 | \$0.107 | \$0.162 | \$0.054 |
| Kalamazoo | Consumers Energy | 3.81 | \$0.107 | \$0.162 | \$0.054 |
| Kalkaska | Consumers Energy | 3.67 | \$0.112 | \$0.162 | \$0.049 |
| Kent | Consumers Energy | 3.78 | \$0.108 | \$0.162 | \$0.054 |
| Keweenaw | UPPCo | 3.63 | \$0.113 | \$0.185 | \$0.072 |
| Lake | Consumers Energy | 3.73 | \$0.110 | \$0.162 | \$0.052 |
| Lapeer | DTE | 3.77 | \$0.109 | \$0.133 | \$0.024 |
| Leelanau | Consumers Energy | 3.66 | \$0.112 | \$0.162 | \$0.049 |
| Lenawee | Consumers Energy | 3.84 | \$0.107 | \$0.162 | \$0.054 |
| Livingston | DTE | 3.81 | \$0.107 | \$0.133 | \$0.026 |
| Luce | non-IOU | 3.63 | \$0.000 | \$0.000 | \$0.000 |
| Mackinac | non-IOU | 3.70 | \$0.000 | \$0.000 | \$0.000 |
| Macomb | DTE | 3.81 | \$0.107 | \$0.133 | \$0.026 |
| Manistee | Consumers Energy | 3.73 | \$0.110 | \$0.162 | \$0.052 |
| Marquette | UPPCo | 3.63 | \$0.113 | \$0.185 | \$0.072 |
| Mason | Consumers Energy | 3.76 | \$0.109 | \$0.162 | \$0.052 |
| Mecosta | Consumers Energy | 3.74 | \$0.109 | \$0.162 | \$0.052 |
| Menominee | UMERC | 3.75 | \$0.109 | \$0.138 | \$0.029 |

Table 1. Cont.

| County | Utility | Solar Flux (kW/m ² /day) | PV LCOE \$/kWh | Residential Rates \$/kWh | PV Savings \$/kWh |
|--------------|------------------|--|-------------------|-----------------------------|----------------------|
| Midland | Consumers Energy | 3.77 | \$0.109 | \$0.162 | \$0.052 |
| Missaukee | Consumers Energy | 3.69 | \$0.111 | \$0.162 | \$0.051 |
| Monroe | DTE | 3.85 | \$0.106 | \$0.133 | \$0.027 |
| Montcalm | Consumers Energy | 3.76 | \$0.109 | \$0.162 | \$0.052 |
| Montmorency | Consumers Energy | 3.70 | \$0.111 | \$0.162 | \$0.051 |
| Muskegon | Consumers Energy | 3.78 | \$0.108 | \$0.162 | \$0.054 |
| Newaygo | Consumers Energy | 3.76 | \$0.109 | \$0.162 | \$0.052 |
| Oakland | DTE | 3.80 | \$0.108 | \$0.133 | \$0.025 |
| Oceana | Consumers Energy | 3.77 | \$0.109 | \$0.162 | \$0.052 |
| Ogemaw | Consumers Energy | 3.75 | \$0.109 | \$0.162 | \$0.052 |
| Ontonagon | UPPCo | 3.61 | \$0.113 | \$0.185 | \$0.072 |
| Osceola | Consumers Energy | 3.72 | \$0.110 | \$0.162 | \$0.052 |
| Oscoda | Consumers Energy | 3.72 | \$0.110 | \$0.162 | \$0.052 |
| Otsego | Consumers Energy | 3.68 | \$0.111 | \$0.162 | \$0.051 |
| Ottawa | Consumers Energy | 3.80 | \$0.108 | \$0.162 | \$0.054 |
| Presque Isle | Consumers Energy | 3.68 | \$0.111 | \$0.162 | \$0.051 |
| Roscommon | Consumers Energy | 3.73 | \$0.110 | \$0.162 | \$0.052 |
| Saginaw | Consumers Energy | 3.78 | \$0.108 | \$0.162 | \$0.054 |
| St. Clair | DTE | 3.66 | \$0.112 | \$0.133 | \$0.021 |
| St. Joseph | Consumers Energy | 3.80 | \$0.108 | \$0.162 | \$0.054 |
| Sanilac | DTE | 3.78 | \$0.108 | \$0.133 | \$0.025 |
| Schoolcraft | UPPCo | 3.82 | \$0.107 | \$0.185 | \$0.078 |
| Shiawassee | Consumers Energy | 3.74 | \$0.109 | \$0.162 | \$0.052 |
| Tuscola | DTE | 3.77 | \$0.109 | \$0.133 | \$0.024 |
| Van Buren | Consumers Energy | 3.81 | \$0.107 | \$0.162 | \$0.054 |
| Washtenaw | DTE | 3.83 | \$0.107 | \$0.133 | \$0.026 |
| Wayne | DTE | 3.84 | \$0.107 | \$0.133 | \$0.026 |
| Wexford | Consumers Energy | 3.70 | \$0.111 | \$0.162 | \$0.051 |

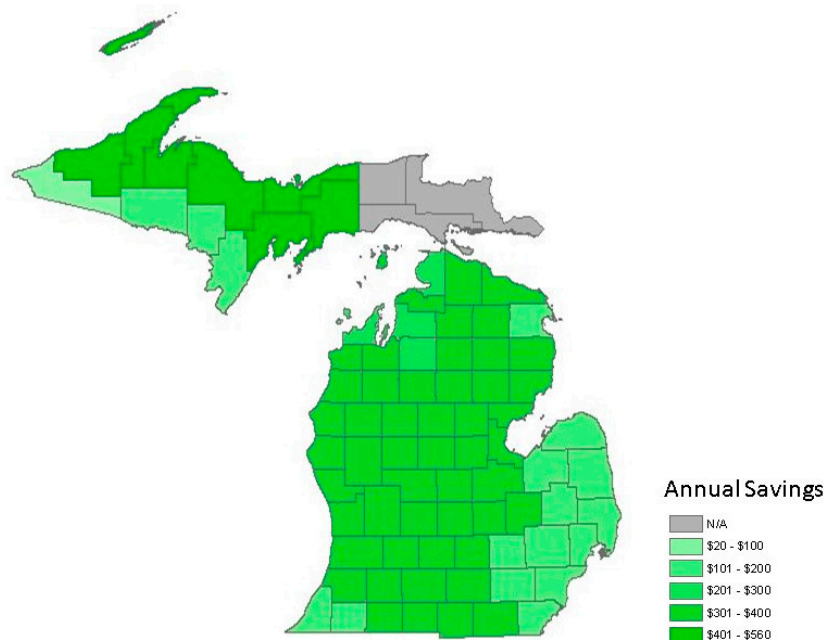


Figure 1. Savings (\$/kWh) provided to each Michigan county from residential solar PV.

2.2. Utility Regulatory Regimes: National, Regional, State, and Local

The current U.S. electrical system is largely comprised of a complex network of centralized power plants, transmission and distribution infrastructure. Regulatory bodies at the national, regional, and state levels govern this network. At the national level, the Federal Energy Regulatory Commission (FERC) regulates electricity markets. Broadly, FERC regulates interstate transmission of electricity, natural gas, and oil [52]. Specifically related to electricity, FERC regulates the rates and services for interstate electric transmission and electric wholesale power sales by public utilities, transmission companies, and independent power producers. FERC maintains its legal authority from the Federal Power Act, which allows the commission to “prescribe, issue, make, amend, and rescind orders, rules, and regulations” regarding public utility activity [53]. FERC does not have authority over the local distribution of electric energy, sales of energy to customers, or determining what generation and transmission is built.

In efforts to increase competition in the wholesale electric marketplace and to provide better management of multiple independent power supply companies, FERC issued two Orders in 1998 [54], to introduce Regional Transmission Authorities (RTOs) and Independent System Operators (ISOs). These regional authorities are responsible for controlling, coordinating, and monitoring operations across multiple states or within a single state. A key task of RTOs and ISOs is to operate wholesale electricity markets, allowing for participant utilities to buy and sell electrical power. Ideally, this system allows for reliable long- and short-term electricity supply for participants and their consumers at the lowest possible cost. However, electricity in remote communities becomes costly for consumers based on a centralized model of distribution, as long transmission and distribution lines are necessary to provide access to these areas. A majority of Michigan’s electricity market is currently under the purview of the Midwest Independent System Operator (MISO), with a small portion participating in the Pennsylvania, Jersey, Maryland Power Pool (PJM) [55].

State legislatures consider energy matters that are brought forth by the governor or other state congressional and committee members. They create energy legislation and subsequent laws that PSCs must comply with and enforce. For example, the Michigan Public Service Commission (MPSC) is required to produce a report [27] to summarize the previous year’s electric utility RE growth. The report serves two purposes: to ensure that electric utilities comply with RE standards in existing Michigan energy laws as well as ensure that the MPSC is properly monitoring electric utilities’ utilization of RE resources. The MPSC compiles data from each electric utility’s reports and presents it to the senate and house committees on an annual basis.

The MPSC regulates electric utility interconnection, reviews rate cases, and regulates the state’s renewable energy mandates. Currently, Michigan electric cooperatives [56] and municipal utilities are allowed to regulate their own electric rates. The 2008 energy law package allowed a pathway for Michigan’s electric cooperatives to become member regulated [56]. While electric cooperatives can still choose to be rate regulated by the MPSC, all of them remain unregulated in terms of electric rates. This allows electric cooperatives to be accountable to their members rather than a governmental agency [57,58]. The MPSC still regulates electric cooperative interconnection as well as cooperative and municipal adherence to renewable portfolio standard and energy waste reduction standards.

3. Policy Review

This paper reviews the existing regulations and laws that address DG proliferation at both the national and state levels. First, Public Utility Regulatory Policy Act (PURPA), the Clean Renewable and Efficient Energy Act and its amendments, and the Customer Choice and Reliability Act of 2000, are discussed [25,26,28]. Examples from utility legal and rate cases, in addition to direct firsthand experiences working with utilities, are provided to illustrate how IOUs in Michigan manipulate regulation through practices of interpretation and implementation and how these practices limit the growth of DG.

Michigan is currently undergoing deliberations regarding net metering, electricity provider choice, integrated resource planning (IRP) rulemaking, along with annual rate cases [59]. Therefore, this section provides a timely review of Michigan IOUs' interpretation and implementation of existing legislation. Federal and Michigan energy laws are reviewed to provide a foundational understanding of the environment within which Michigan utilities must operate. The PURPA review provides the federal legal context through which regulated utilities must buy power from independent power producers. P.A. 295 [26] describes Michigan's 2008 energy law that implemented the renewable energy standard and subsequent net metering program. P.A. 341 [25] and 342 [60] are the recent 2016 amendments to P.A. 295. P.A. 141, 142, and 286 [28] are the energy laws regarding customer choice in Michigan. This section only reviews the portions of the above laws that are related to DG.

3.1. Public Utilities Regulatory Policies Act (PURPA), 1978

The Public Utility Regulatory Policy Act (PURPA) was passed in 1978 in response to the 1973 oil shocks. Legislatures hoped to promote generation from alternative energy sources and energy efficiency, and to diversify the electric industry [61–63]. PURPA requires utilities to buy power from independent companies or qualified facilities (QF) that can produce power for less than what it would have cost for the utility to generate the power, called “the avoided cost”. While FERC and state Public Utility Commissions (PUC) share the enforcement of PURPA, FERC designates the QF, as well as setting the general regulatory framework. PUCs calculate and set the avoided cost and determine PURPA contract terms. In order to compromise with contestations against PURPA's mandatory purchase obligation, Congress amended PURPA through EPAct 2005. Legislatures found that, as QF have nondiscriminatory access to wholesale power markets, utilities are no longer obligated to purchase power from QF with 20+ MW. FERC's final order keeps the purchase obligation in place, but allows for utilities to apply for relief from the obligation; QF's can rebut the application if they are not receiving nondiscriminatory access. The purchase obligation remains wholly in place with QFs of less than 20MW. FERC can respond to petitions for action by choosing to intervene in state utility operations during interstate electricity commerce issues or if a ruling is needed during PURPA contestations [64].

PURPA has been instrumental in creating a market for power from non-utility power producers. This is especially true with DG, as current PURPA avoided cost rates are based on natural gas generation and the RE costs continue to drop below this [14]. This is due to the interpretation of FERC orders that utility avoided cost should be based on the cheapest available marginal power (natural gas combined cycle) [65], whereby DG is competing against a lower avoided cost than the relatively high cost of coal-fired electricity in antiquated power plants that make up the majority of Michigan's power plants [13]. Before PURPA, only utilities could own and operate electric generating plants. However, recent contestations to PURPA include cuts to contract terms [66], reductions in avoided cost rates [67], and issues with providing open access to interconnection [68].

The MPSC recently issued a new framework for PURPA contracts in the state. Despite PURPA's significance in driving RE development, Michigan utilities met the new framework with strong resistance. The MPSC recently ordered 20-year contracts at a standard rate for projects that are up to 2MW and a PURPA avoided the cost rate of ~\$0.10/kWh [62]; PURPA avoided cost rates had not been updated in 30 years, which are not reflected in the cost of electricity to consumers, which has increased by over 50% in 30 years in Michigan [69]. As the new avoided cost rate is favorable (\$0.10/kWh), independent power producers can now secure financing more easily with a 20-year contract term [70]. Michigan utilities simply object to being forced to buy power from PURPA projects, despite the fact that RE systems provide power at lower costs than the utilities can produce from their less-efficient power plants [71].

3.2. Clean Renewable and Efficient Energy Act Public Act (P.A.) 295, 2008

In 2008, Michigan enacted Public Act 295, which is also known as Michigan's Renewable Energy Standard. P.A. 295 is a renewable portfolio standard (RPS) that required utilities to obtain 10% of

energy generation from renewables by 2015 (recently increased to 15% by 2021) [26]. Under P.A. 295, Michigan's municipal utilities must file a renewable energy plan with the MPSC. Every year following P.A. 295 enactment, the MPSC is required to submit a report to the Michigan Senate and the House of Representatives detailing the implementation of P.A. 295.

Under P.A. 295, Michigan regulated utilities are required to provide a net metering program to DG prosumers [72,73]. This is different from the required interconnection service that was established under the Energy Policy Act of 2005, as EPAct 2005 amended net metering and interconnection standards with regards to PURPA [74]. Although this is the law, a recent study has found widespread inconsistencies in the net metering policies throughout the U.S., within states, and even within individual companies, with a tiny percentage offering retail rate compensation [75]. P.A. 295 language states that a minimum of 1% of the utility's peak generation load could apply and participate in the net metering program.

The net metering program separated and defined credits for excess energy from DG systems into three different levels. The first level represented systems up to 20 kW. These systems received "dollar for dollar" compensation, which is otherwise known as retail credit. The second level included consumers considering installations between 20 KW and 150 KW. These customers receive less than retail credit. Finally, the third level comprises DG systems with grid-tied generation of 150 KW or more [76]. These generators receive zero credit for excess generation under current legislation. The 2016 amendment, however, allows for 150+ kW methane digesters to receive partial credit (amount subject to each utility's discretion) in a modified net metering program. The act also included capacity requirements for utilities in Michigan that served between 1–2 million retail customers and two million customers or more. The first designation required these utilities to install 500 MW of renewable energy capacity by 2015; 600 MW for the second designation. Only two utilities, Consumers Energy (1.9 million customers) and DTE (1.2 million customers), qualify under these designations.

3.3. P.A. 341

P.A. 341 updated legislation regarding utility rate cases, electric choice, and capacity, and established an integrated resource planning process. For utility rate cases, P.A. 341 no longer allows for utilities to institute rate increases if the MPSC has not issued a final order six months after receiving the rate case. P.A. 341 updates provisions to electric choice, specifically with regards to the reliability and capacity of alternative suppliers. The alternative suppliers must show that they can meet the energy needs of their customers. The MPSC is now required to determine the rate that the utility must pay qualifying facilities for energy generation under PURPA. P.A. 341 creates a process to review avoided cost rates, which had not been conducted in Michigan since August 27, 1982 [77].

P.A. 341 also requires utilities to create and submit an integrated resource plan (IRP) to the MPSC, which is a utility roadmap to the provision of least cost service. The roadmap is supposed to assess the full range of options regarding energy generation and savings to a utility. The IRP must include 5-, 10-, and 15-year projections regarding utility load obligations as well as plans to meet each obligation. Projections also include utility sales, generation type to satisfy proposed capacity needs, RE purchases, and eliminated energy waste, among other considerations. Utilities must provide projected rate impacts that are based on the proposed plan. Once a utility submits an IRP, the MPSC reviews and can approve, deny, or request revisions from the utility. At the close of 2018, Consumers Energy Company was the only regulated Michigan utility to have filed an IRP, which has not been approved. The MPSC and Consumers Energy are currently in settlement negotiations regarding the IRP. Utilities have varying filing dates and requirements as determined by the MPSC [78].

3.4. Clean and Renewable Energy and Energy Waste Reduction Act, P.A. 342

P.A. 342, passed in 2016, updated RE, energy waste reduction, DG, and on-bill financing laws. This section focuses on the amendments that are related to RE and DG. First, P.A. 342 increased the RE requirement for Michigan utilities from 10% by 2015 to 15% by 2025. Utilities are now required to offer

green pricing programs to retail customers. Language remained from P.A. 295, whereby utilities must allow a minimum of 1% of peak generation load to participate in the net metering program, yet the wording allows for an interpretation whereby they can continue to treat this as a limit.

P.A. 342 required the MPSC to create a new DG program; part of this legislation required the MPSC to conduct a cost of service study to determine an appropriate tariff for DG customers. The DG program calculates credit for excess energy based on an inflow/outflow methodology. DG customers will pay for all inflow of electricity delivered by the utility that is based on their regular cost of service (or retail rate), while the outflow from the solar PV system back to the electrical grid will receive a credit that is yet to be determined. Two utilities (UPPCCo and Detroit Edison) have already submitted the proposed DG tariffs for MPSC review. Both utilities that have submitted their rate case proposals to value DG at a wholesale cost [79,80].

3.5. Customer Choice and Reliability Act of 2000; P.A. 141, 142, 286

Until the 1990's, most U.S. utilities were vertically integrated monopolies that maintained control over generation, transmission, and distribution of energy. However, states with high electricity rates reconsidered this structure and then sought ways to lower prices and provide more efficient utility operations [81]. Broadly, restructuring essentially establishes new legal ground rules for electricity, generation, and transmission; the exact definition is specific to each aspect of the electricity industry. In Michigan, restructuring introduced provisions to allow customers to purchase energy from alternative suppliers, to require regulated utilities to either join a RTO or divest transmission facilities, to lower residential rates, and to freeze rate increases.

High energy costs and aging electricity infrastructure in the late 1990's catalyzed the Michigan legislature to act. The Customer Choice and Reliability Act of 2000 (P.A. 141) amended Public Act 3, 1939, the legislation that directed the regulation of public utilities by the MPSC. The amendment served to shift Michigan's electricity industry towards deregulation or restructuring. The legislature intended to bring competition into electric supply as well as to encourage investment in more efficient generating capacity. The main component of Michigan's restructuring involves functional unbundling. Rather than having generation, transmission, and distribution as one package deal, the services have been separated into discrete, separately priced components. The Michigan power supply is available to competitive suppliers, while the transmission and distribution remain under the regulated utilities. Public Act 142 allowed for incumbent utilities to secure compensation for their costs that are incurred pre-restructuring that are higher than the costs during competition and in the overall transition to the competitive market.

Michigan is considered to be a restructured state in that it allows for 100% electric choice in energy supply. This is misleading, though, as, in 2008, an amendment stipulated that only 10% of a regulated utility's retail sales can engage in electric choice (P.A. 286, amendment to P.A. 141). While Michigan's choice model states that it allows all consumers the option for electric and gas choice of suppliers, utilities cap the number of customers that can participate in retail choice opportunities. Even though the legislative language sets choice at 100%, the reality is that some services are mandatory (transmission and distribution), while some are subject to choice (supply). Additionally, alternative suppliers cannot directly provide electricity to each customer contract. This may be due to the regulatory compact guiding utility and regulator engagement; the MPSC regulates utility rates, while the utility is guaranteed a service territory [82]. This means that customers do not directly receive power from an alternative supplier. Some areas where other non-incumbent utilities do not provide service, the incumbent serves as the default service provider. For example, the Village of L'Anse in the Upper Peninsula of Michigan is a municipal utility that is located adjacent to territory served by UPPCCo, an IOU. The Village utility electric rates are roughly \$0.07–\$0.14 lower when compared to UPPCCo, motivating consumers in UPPCCo territory to seek out lower rates. For example, an industrial park that is entirely located within the Village limits contracted services from UPPCCo for a limited timeframe; after this contract closed, the industrial park sought power directly from the Village because of the cost savings [83]. UPPCCo is now currently pursuing litigation against the Village of L'Anse.

4. Policy Interpretation and Implementation as Utility Driven Manipulation

The history of the electricity industry credits Samuel Insull with the consolidation of utilities into larger, investor owned, centralized electrical generation stations [84]. Since this time, utilities have increasingly operated according to the main goal of maximizing profits. Decisions surrounding how to maximize profits do not usually occur without a precedent or prior experience of the firm or regulators [85]. Profits and previous experience shaped and explained utility companies' behaviors during the first half of the 20th century [86]. However, contemporary IOUs, as examined here in the case study of Michigan utilities, continue to rely on these considerations to manipulate the interpretation and implementation of laws in ways that align with business as usual utility operations and cost recovery goals.

4.1. Rate Cases and the New Inflow/Outflow Methodology

The first way that a public utility can manipulate the law is through proposed rate cases. IOUs are subject to state regulation by PSCs [82], and the PSCs set prices for different customer types as well as determining the rate of return on investment for a utility. This is a measure of profitability for the utility and therefore it is constantly updated with each rate case that a utility proposes. Prior to Michigan's 2016 legislation, regulated utilities could self-implement rate increases if the MPSC had not issued a final order within six months of receiving the rate case.

As stated above, the MPSC recently accepted an inflow/outflow methodology of crediting DG customers for their excess generation. This means that utilities will use instantaneous metering to read any electricity that flows into the customer's home, business, or building as well as excess generation from the DG system. As per the 2016 energy legislation (section 460.1177), "the credit per kilowatt hour for kilowatt hours delivered into the utility's distribution system shall be either of the following:

(a) The monthly average real-time locational marginal price for energy at the commercial pricing node within the electric utility's distribution service territory, or for the distributed generation customers on a time-based rate schedule, the monthly average real-time locational marginal price for energy at the commercial pricing node within the electric utility's distribution service territory during the time-of-use pricing period.

(b) The electric utility's or alternative electric supplier's power supply component, excluding transmission charges, of the full retail rate during the billing period or the time-of-use pricing period."

Utilities can choose to select one of these two options to credit DG customers. Option (a) utilizes locational marginal pricing from the MISO Michigan Hub. Utilities that select this option would essentially credit DG customer outflow at a wholesale rate, or \$0.03/kWh (2017 average MISO Michigan Hub price) [87]. MPSC staff was not aware of any utility selecting this option to credit DG customers under the current net metering program (Personal communication with MPSC staff on October 31st, 2018.). However, DTE recently submitted their proposed DG tariff [79], in which they propose to credit customers with the locational marginal pricing, in which power from DG sources is less valued and it does not reflect DG's contribution to reducing overall DTE operations costs, capacity, and other factors that would be considered in a Cost of Service Study, such as avoided transmission, distribution and voltage control costs [88]. Several studies have shown that DG actually lowers the electric grid operational costs that are incurred by the utility and they should be valued higher than the proposed LMP [88]. Accepting an outflow credit at this rate would create a great deterrent in the development of grid-connected DG systems. Under this model, utilities would be the only grid-connected entity that is able to take advantage of the economics and benefits from DG. Given the economics of DG solar in Michigan, this could catalyze grid defection [89] with utility customers choosing to produce their own power with a hybrid system that is made of up solar, batteries, and gas cogeneration units [11]. This risks creating a utility death spiral [90].

4.2. Legal Maneuvers

Utilities can use litigation strategies, such as maneuvering or stalling, to delay legal proceedings to change public perception. One specific example is the use of the narrative that DG customers that

are enrolled in net metering place extra cost burdens on traditional and lower income customers; put another way, some claim that traditional customers subsidize DG customers [91,92]. For example, DTE states that DG “customers are not supporting the costs of the infrastructure required for their service” [93]. However, as shown above, DG can actually reduce the costs for the utility and its customers [88], yet DTE appears to make the above claim without conducting its own study assessing the benefits of DG. In response to a cross-examination question regarding analyses on beneficial impacts of DG on the electrical grid, a DTE witness stated, “we have not performed those studies” [94]. DTE’s proposed DG tariff seeks to reflect the discrepancy between DG and non-DG customers costs. However, in response to including DG cost assessments in historical or projected figures to justify the proposed higher costs for DG customers, another DTE employee and witness stated that such evidence was “not in mine [testimony]” [94].

A second example of IOU tactics to hinder DG is to use lobbying as a way to influence new legislation or amend existing legislation. Electric utilities fund organizations and committees to elect governors, state legislators, and attorneys general, who can enact laws and implement rules to support utility positions. The electric utility industry has the third largest lobbying contribution, spending roughly \$2.4 billion [95]. Utilities have contributed some of the highest amounts of campaign money this current election cycle [96] as compared to the election cycles from 2010 onward. While utilities contributions typically lean towards the Republican Party [96], they generally support candidates in the lead, evenly contributing when elections are competitive [97].

Utilities can also use stalling tactics to buy more time during negotiation periods. This can come in the form of requesting new information [98], establishing arbitrary timelines [99], or advocating for the need for additional research before a decision can be made [30]. Utilities can slow legal proceedings to support a traditional cost recovery model where they own and operate generation [100].

In many states, the prices of utility scale DG have decreased dramatically, matching a utility’s avoided costs. There has been recent pushback regarding PURPA’s contract lengths, rates, and other changes, such as the need for capacity. The MPSC recently underwent a process to revise and redefine the avoided costs of qualifying facilities under PURPA, which had not been done in roughly 30 years. The MPSC revised the PURPA contract length to 20 years and increased the capacity to 2 MW; the previous contract project size was capped at 100 kW [101]. They halted implementations to work out challenges with utilities. Specifically, the Consumers Energy Company argues that they should not be required to purchase power from PURPA qualified facilities because they do not need any new generation in the next 10 years, yet they plan to close two coal fired power plants and ramp up RE energy generation to 40% and utilize clean energy, meaning both RE systems and energy efficiency projects [102]. This could be in response to the number of PURPA projects Consumers is facing (Per personal communication with MPSC staff, Consumers Energy has 2700 MW of potential contracts in the PURPA queue.). Even if regulators rule against Consumers Energy, this legal maneuver has the potential to halt any progress or implementation of PURPA projects, as it could take several months for the MPSC to successfully argue whether Consumers Energy needs capacity.

4.3. *Shifting Control*

Diversification activity is another response by utilities to maneuver around regulations. Specifically, utilities can expand their business dealings into loosely regulated arenas [94]. Put another way, utilities can attempt to shift control away from PSCs. They can do this through implementing various forms of demand charges, over which PSCs can have little control. They also have discretion with treating minimum legislative targets as caps and with shifting to fixed charges for energy use. All of these can function to increase the costs for customers that are interested in installing DG systems [94], but they can also be detrimental if they do not accurately reflect the costs that are imposed by DG systems [42]. Instituting arbitrary net metering caps without fully factoring in DG impacts to cost recovery can lead to further issues and ultimately “under-deployment of distributed generation” [94]. Shifting control using these price signals inaccurately assigns and misrepresents the

costs and benefits that are associated with DG, resulting in lower adoption levels. Michigan already lags in DG installations as compared to the neighboring states of Minnesota (~750 MW [103]) and Illinois (400 MW by 2030 [104]), both of which employ supportive DG policies [105,106]. Shifting control away from regulators in this way could function to halt DG development in Michigan.

4.3.1. Demand Charges

Michigan utilities are shifting costs over to demand charges [79,80,107]. This portion of their rate of return has traditionally only been implemented on large industrial users with high demand. However, utilities are now moving to implementing various demand equivalent charges on commercial consumers as well as all types of DG customers (residential, commercial, and industrial). A utility must maintain enough capacity to satisfy all customers and demand charges cover the cost of supplying energy at peak times. Typically, commercial and industrial consumers with a large energy demand at certain times of day face demand charges. Currently, Michigan utilities impose charges on systems that are above 150 kW, which is known as standby service [31]. Utilities contract standby service to provide energy supply to DG customers when their system experiences outages. Michigan utilities charge DG customers when this occurs. DTE included a “System Access Contribution (SAC)” for residential and commercial DG consumers in its most recent proposed Distributed Generation Tariff [79]. Specifically, “customers attaching to this rider to residential secondary rate schedules, or to commercial secondary rate schedules that do not have delivery demand charges, shall be subject to the SAC charge.” This is essentially a demand charge that is imposed onto residential and commercial consumers who do not typically require the same amount of demand when compared to larger industrial consumers.

4.3.2. Utility Discretion with Net Metering “Caps”

The original P.A. 295 legislation included a minimum peak load percentage who could participate in net metering. “An electric utility or alternative electric supplier is not required to allow for net metering greater than 1% of its in-state peak load for the preceding calendar year.” In 2016, the legislature amended this to include a five-year average: “An electric utility or alternative electric supplier is not required to allow for a distributed generation program that is greater than 1% of its average in-state peak load for the preceding 5 calendar years.”

First, the limit that is discussed in this legislation is at the discretion of the utility. UPPCo was the first Michigan utility to reach the 1% minimum [108], as the peak generation load is much smaller when compared to other Michigan utilities. The UPPCo service area struggles economically and consumers pay some of the highest base electricity rates in the nation, sometimes amounting to >\$0.25/kWh [109]. According to UPPCo’s CEO, rates are high due to the rural nature and sparse population of UPPCo’s service territory [109]. This can contribute to reliability and vulnerability issues during harsh winter months in the UP. UPPCo is also the incumbent utility in the Western Upper Peninsula region. Because of the 10% cap on choice that is used by large institutions, no alternative power suppliers are available to allow for residents to seek alternative power supply at lower rates. Alongside this, IOUs are for profit entities that must bring money back to their shareholders. Municipalities, such as the Village of L’Anse discussed above, have lower electricity rate prices due to their non-profit designation. Additionally, they participate in member ownership of a power supply company with many different municipalities to offer more competitive pricing to their customers.

In P.A. 295, the 1% was calculated based on a one-year average, whereas the 2016 amendment is calculated based on a five-year average. A second amendment to P.A. 295 limits which technology can participate in the new DG program. Specifically, only methane digesters that are above 150 kW can participate in the DG program. The MPSC conducted a cost of service study to determine a fair and reasonable rate for DG customers; however, a full study is still needed, as this study only analyzed the inflow pricing effects. In this cost of service study, MPSC staff found that DG customers were overcharged roughly \$106/year [29]. Once the MPSC conducts a full study, and the fair and reasonable

rate is determined, it will arguably no longer make sense to set a limit on the number of customers or the type of technology that can participate in the DG program.

4.3.3. Utility Shifting from Rate to Monthly Charges

Typically, utilities charge customers in two ways: a fixed charge (\$/month) and an electric rate based on electric consumption (\$/kWh). The fixed charge usually comes in the form of a “system access” fee (or equivalent) for monthly connection to the utility’s electricity infrastructure. This allows for the utility to recover some of the costs that come with serving a customer, regardless of whether they use electricity or not. However, electricity demand has been plateauing, requiring utilities to seek alternative ways to continue profiting from cost recovery mechanisms [110–112]. Some examples across the U.S. include transferring distribution charges to fixed charges and including equipment costs in the time of use rate schedules [113]. A Michigan example can be found in DTE’s most recent rate case [79]. DTE proposed two pilot programs, the Weekend Flex Pilot and the Fixed Bill Pilot. These pilots propose two different types of fixed charges on a weekend and monthly basis for electricity consumption. Customers pay a fixed charge, regardless of their actual electricity consumption. This can provide incentive for customers to use more electricity [114], as well as discouraging the use of customer-owned DG and allowing DTE opportunities to maximize profits without providing a direct benefit to consumers.

4.4. Modeling in Cost of Service Studies

Finally, utilities can alter the regulatory process through choice of modeling scenarios. Michigan energy legislation requires utilities to forecast and issue a plan for generation and capacity needs several years into the future. Utilities use cost benefit analysis (CBA), risk analysis, and scenario comparisons to determine their trajectory. Utilities also use CBA to assess the impacts that are associated with infrastructure investments. These analyses can help to determine which projects a utility should pursue, how to recover costs, what technologies to invest in, etc. Utilities manipulate modeling scenarios by choosing which factors to include in an assessment.

Specifically, many Michigan utilities create scenarios to maintain their control of generation. Consumers Energy Company used modeling with assumptions such as market prices, future energy demand, and varying levels of clean energy resources to determine the best strategy to meet customer’s needs [102]. As a result of the declining costs of RE, Consumers Energy plans to focus on RE generation through Power Purchase Agreements (PPAs), alongside energy efficiency measures and demand response strategies. These strategies allow Consumers Energy to maintain all control over generation resources. With regard to utility scale RE generation, Consumers Energy proposed a financial compensation mechanism that would allow them to continue profiting from generation in the PPA as if they owned the asset [102].

Additionally, Detroit Edison (DTE) conducted a CBA and risk analysis in preparation for their proposed IRP. The CBA includes assumptions that heavily weight generation without time of generation being considered (Information obtained from personal attendance at DTE IRP workshop on November 12th 2018). DTE chose to include factors and assumptions in their methodology that resulted in increased costs associated with more RE generation [114]. This allows for them to implement demand response programs, conservation voltage reduction, and additional demand charges without considering options to help in demand reduction that actually decrease the total or peak load.

5. Policy Implications and Recommendations

This review of existing regulations and laws regarding DG installations in Michigan finds that utilities interpret and implement legislation in ways that can be detrimental to DG proliferation. This section will use specific examples regarding how utilities interpret these laws to inform policy recommendations to assist decision makers to support an energy transition with DG. Specific recommendations include the removal of net metering caps, support for time of use rates, electric choice, annual avoided cost calculations, transparent bookkeeping, and municipalization.

5.1. Net Metering Cap Removal

The December 2016 energy laws P.A. 341 and 342 maintain language that allows utilities to keep the net metering capacity at 1%. Utilities rely on the narrative that traditional utility customers subsidize net metering customers to prevent any further net metering DG proliferation. The 2016 legislation required the MPSC to conduct a cost of service study to place a value on distributed generation for the inflow/outflow model [25]. The MPSC cost of service report concluded the opposite—that DG customers subsidize all other utility customers [29]. This is consistent with other studies [41,42,115,116] that DG customers provide a net benefit not only to non-DG customers but also to the overall electrical grid [42]. If the MPSC value is considered to be a fair and reasonable value, per utility ratemaking, there should be no need to place a cap on net metering. Additionally, most values of solar studies conclude that net metering programs undervalue solar [42], which also provides support for the removal of a net metering cap. State legislation such as in Massachusetts [117] and South Carolina [118] recently failed to lift caps on net metering capacity, arguably to the utility's benefits to halt DG growth. A policy change could lift the cap, allowing for increased DG proliferation in Michigan for the benefit of all electricity customers.

5.2. Support for Time-of-Use Rates

Both DTE and UPPCo's recently submitted DG Tariff Rate Case proposed charging residential DG customers demand charges, a charge that usually falls upon heavy end users such as industrial or commercial consumers. This demand charge is reflective of the traditional utility goal: cost recovery. However, cost recovery does not provide any information regarding the real cost of electricity. Regulators and policymakers could turn to a commonly used rate design that attends to other objectives, such as transparency, peak and overall load reduction, and customer awareness. Time-of-use rates can be used to properly compensate for DG, as they more accurately reflect the electricity cost variations [119]. Additionally, time-of-use rates can help to change customer's behavior to actually reduce demand and overall usage [120]. Pennsylvania's time-of-use rate pilot saw success in reducing peak load demand along with saving customer's money, especially in senior and low-income populations [121]. After the tweaking and massaging of their time-of-use program, a south Mississippi utility's customers began to see significant savings, both on an individual level and a consumer type level [122]. While Michigan utilities do offer time-of-use rates, utilities such as Consumers Energy place a focus on strategies such as demand response and conservation voltage reduction to maintain control over energy supply and demand. Utilizing a time-of-use rate can help reduce utility costs by preventing the ramp up of additional generation and satisfying legislation to support energy efficiency and decrease use while allowing for continued support and proliferation of DG.

5.3. Electric Choice

Michigan's electric choice legislation caps the capacity to participate in choice at 10%. This excludes residential and commercial consumers from participating, as the larger industrial consumers demand more power that is more favorable to the utility, as they sell larger amounts of power to one customer in addition to implementing demand charges to the large users. Stating that individuals, for example, in the Upper Peninsula, have the freedom to choose their electric suppliers, however, does not mean that they will actually be able to voluntarily choose an alternative electric supplier. This is because they do not have an alternative to choose from. While these customers are "free to choose," they are unable to due to the lack of alternatives [123] unless they actually opt to grid defect. Ultimately, utility consumer choices will be considered to be voluntary when they make these choices on the basis that there are viable alternatives; not having an alternative choice preempts an ability to choose from multiple electric suppliers. As larger industrial and commercial consumers are able to choose their alternative supplier, the 10% cap is swiftly used, leaving no electric choice options for smaller residential consumers or small and medium sized enterprises (SMEs). Policy recommendation to fix

this oversight include considering incremental increases to the electric choice structure in Michigan. Michigan schools' energy usage come to roughly 1% of Michigan's energy load. Legislation could be changed to target different sectors, providing them with an opportunity for choice. This steady increase would come at greater ease when compared to a drastic increase in choice, which proved disastrous in other states [124–126].

5.4. Annual Avoided Cost Calculations

PURPA-based contracts remain critically important in diversifying electrical generation while decreasing generation costs. Non-utility power producers also provide more jobs in more diverse locations than utility projects [127,128]. Utilities argue that long stable contracts for power increase power rates, but that is simply not true, especially if the MPSC conducts more frequent cost of service studies to accurately reflect the avoided costs. Utility companies such as Consumers Energy argue that they do not need capacity from PURPA contracts, yet Consumers Energy plans to close two coal-fired power plants [102].

The PURPA rate was established by the MPSC using a “cost of service” study that results in a lower cost for the utilities to operate and, though conditions might change in the future, those stable contracts will, by nature, produce capacity and energy at a lower cost than the utility themselves would have created them. Alongside this, the cost of service studies should be annually conducted for each type to accurately reflect fuel costs and appropriately assign avoided rate costs.

5.5. Transparent Bookkeeping

The regulatory compact that exists between a government and utility guarantees a service territory to the utility. This ensures that the utility does not have competition with other energy providers. Increasingly, utilities view DG customers as another form of competition [129,130]. If regulators and utilities want to maintain an energy system by continuing this monopoly, transparency should be in place for regulators to assist utilities in making better decisions regarding energy generation, transmission, and distribution. Regulated utilities are guaranteed a 10% rate of return [50] on energy infrastructure investments. This is guaranteed on top of electric utility executive compensation that reaches into the millions of dollars per year and it is currently not structured to maximize benefit for customers or the greater society [131]. Utilities that wish to operate in a minimally competitive environment should provide full transparency of their bookkeeping. This would allow the state to see exactly how money is being spent and where it is allocated. This could translate into more informed financial models to better serve the utility customer base.

5.6. Municipalization

In Michigan, IOUs must comply with policies and laws regarding DG proliferation. Electric cooperatives and municipalities have an obligation to their customers rather than strictly to shareholders. As a result, they have flexibility in offering DG programs to satisfy their customers. One route for cities that currently receive power from a regulated utility is to municipalize. With respect to electricity, municipalization is a transfer of electric service from an IOU to municipal ownership and service [132]. This can allow the municipality to lower the electricity rates [133] through member ownership of energy supply (e.g.). Additionally, they can explore DG programs and opportunities that are currently unexplored in existing IOU territories. In 2010, Boulder, Colorado began the process of exploring municipalization as an option to reach their clean energy goals. The process of municipalization typically involves an initial feasibility study and subsequent decision-making. Every state varies in the regulatory and legal channels that are required to municipalize. Michigan law allows cities to municipalize to provide electricity [134,135], among other services; however, the price of facility infrastructure is typically determined through an agreement with the IOU [82]. The municipalization process can take time (10+ years for Boulder, Colorado [136]), but can also allow cities more control over what DG programs they offer to customers.

6. Conclusions

A recent study has noted that 42% of the world's coal plants are currently operating at a loss and that the proportion is estimated to rise to ~ 75% by 2040 [137]. In the U.S., 70% of coal plants run at a higher cost than new RE and by 2030 all of them will [137]. Thus there is a clear need, not only in Michigan but throughout the rest of the U.S. and the world, to move away from coal technology as rapidly as possible on economic grounds alone. While RE DG has the potential to provide reliable electricity that benefits consumers and electrical grid, Michigan's DG proliferation remains low in favor of antiquated coal plants. This study reviewed existing energy policies and laws with respect to DG to obtain a sense of institutional support surrounding the continued use of coal or RE DG. PURPA contestations have placed a hold on the release of several hundred to thousand MW contracts of DG. Recent legislation has sparked deliberations in Michigan's RE rulemaking. Similarly, net metering and electric choice caps prevent customers from seeking energy from renewable sources. The results of this study clearly show that DG proliferation is hindered by Michigan regulated utilities exercising political power within the existing legal and regulatory regimes.

This review highlights the need to think about how utilities interpret and implement rules for developing legislation and policies to better suit the needs of consumers. Specifically, Michigan utilities hinder DG proliferation through rate cases, legal maneuvers, shifting control from regulators, and selective modeling in the cost of service studies. Utilities can propose little compensation as well as added fees on DG customers, making DG customers' investment in RE technologies unattractive. To prevent headway in building systems under PURPA contracts, utilities utilize legal maneuvers to slow or even halt the process. Utilities can attempt to shift control away from regulators by implementing demand equivalent charges on DG customers, instituting caps on program participation, and shifting to fixed charges for a customer's energy use. Finally, utilities can conduct biased cost of service studies by including factors that provide little support for DG system adoption.

There are several policy recommendations that can support higher DG proliferation in Michigan that are relevant to other states and regions in the rest of the world. If an appropriate cost of service study finds fair and reasonable compensation for net metering customers, then the Michigan legislature should increase the minimum requirement in net metering programs. Michigan utilities can place increased emphasis on time of use rates to accurately reflect electricity cost variations and help to determine appropriate DG compensation. The cap on electric choice should be increased to allow for more participation from non-industrial consumers. Annual avoided cost calculations can help in reflecting fuel costs to appropriately compensate for PURPA contracts. More broadly, regulated utilities that wish to remain a natural monopoly should utilize transparent bookkeeping to allow for state legislatures and regulators to monitor spending to determine the best way to serve a utility customer base. Finally, cities that set clean energy goals can explore municipalization if the incumbent utility is reluctant to support satisfying these goals through DG proliferation. Just as there are several strategies that Michigan utilities use to prevent the large proliferation of DG systems, this study has shown there are several strategies to explore shifting existing legal and regulatory regimes towards the support of DG proliferation.

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References

- Michigan Profile. Available online: <https://www.eia.gov/state/print.php?sid=MI> (accessed on 6 December 2018).
- Energy Information Administration. Annual Coal Report. Available online: <https://www.eia.gov/coal/annual/pdf/acr.pdf> (accessed on 17 November 2018).
- Energy Information Administration. Michigan—State Energy Profile Analysis. Available online: <https://www.eia.gov/state/analysis.php?sid=MI> (accessed on 2 January 2019).
- Milbrandt, A. National Renewable Energy Laboratory: A Geographic Perspective on the Current Biomass Resource Availability in the United States. Available online: <https://www.nrel.gov/docs/fy06osti/39181.pdf> (accessed on 4 February 2019).
- National Hydropower Association. Midwestern U.S. Hydro Generation Profile. Available online: <https://www.hydro.org/waterpower/why-hydro/available/hydro-in-the-states/midwest/> (accessed on 2 January 2019).
- National Renewable Energy Laboratory. 2012 Renewable Energy Data Book. Available online: <https://www.nrel.gov/docs/fy14osti/60197.pdf> (accessed on 4 January 2019).
- Gagnon, P.; Margolis, R.; Melius, J.; Phillips, C.; Elmore, R. *Rooftop Solar Photovoltaic Technical Potential in the United States. A Detailed Assessment*; National Renewable Energy Lab.: Golden, CO, USA, 2016; pp. 1–69.
- Adelaja, S.; Shaw, J.; Beyea, W.; McKeown, J.C. Renewable energy potential on brownfield sites: A case study of Michigan. *Energy Policy* **2010**, *38*, 7021–7030. [CrossRef]
- Energy Information Administration. Electricity Data. Available online: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt (accessed on 2 January 2019).
- Richard, C. New Wind and Solar Cheaper Than Existing Coal and Gas. Available online: <https://www.windpowermonthly.com/article/1491146> (accessed on 4 December 2018).
- Branker, K.; Pathak, M.J.M.; Pearce, J.M. A review of solar photovoltaic levelized cost of electricity. *Renew. Sustain. Energy Rev.* **2011**, *15*, 4470–4482. [CrossRef]
- Sing-Lai, C.; McCulloch, M. Levelized cost of electricity for solar photovoltaic and electrical storage. *Appl. Energy* **2017**, *190*, 191–203.
- Hee Kang, M.; Rohatgi, A. Quantitative analysis of the levelized cost of electricity of commercial scale photovoltaic systems in the U.S. *Sol. Energy Mater. Sol. Cells* **2016**, *154*, 71–77. [CrossRef]
- International Renewable Energy Agency. Renewable Power Generation Costs in 2017. Available online: <https://www.irena.org/publications/2018/Jan/Renewable-power-generation-costs-in-2017> (accessed on 3 December 2018).
- Dudley, D. Renewable Energy Will Be Consistently Cheaper Than Fossil Fuels By 2020, Report Claims. Available online: <https://www.forbes.com/sites/dominicdudley/2018/01/13/renewable-energy-cost-effective-fossil-fuels-2020/#7f925b2f4ff2> (accessed on 4 December 2018).
- Banerjee, B.; Islam, S. Reliability based optimum location of distributed generation. *Int. J. Electr. Power Energy Syst.* **2011**, *33*, 1470–1478. [CrossRef]
- Liu, L.; Bao, H.; Liu, H. Siting and sizing of distributed generation based on the minimum transmission losses cost. In Proceedings of the 2011 IEEE Power Engineering and Automation Conference, Wuhan, China, 8–9 September 2011; pp. 22–25.
- Lovins, A.B. Soft energy technologies. *Annu. Rev. Energy* **1978**, *3*, 477–517. [CrossRef]
- Jenkins, K.; McCauley, D.; Heffron, R.; Stephan, H.; Rehner, R. Energy justice: A conceptual review. *Energy Res. Soc. Sci.* **2016**, *11*, 174–182. [CrossRef]
- Sovacool, B.K.; Drupady, I.M. *Energy Access, Poverty, and Development: The Governance of Small-Scale Renewable Energy in Developing Asia*; Routledge: London, UK, 2016.
- Sovacool, B.K.; Sidortsov, R.V.; Jones, B.R. *Energy Security, Equality and Justice*; Routledge: London, UK, 2013.
- Pearce, J.M. Photovoltaics—A path to sustainable futures. *Futures* **2002**, *34*, 663–674. [CrossRef]
- Edison Electric Institute. U.S. Investor-Owned Electric Companies. Available online: <http://www.eei.org/about/members/uselectriccompanies/Pages/default.aspx> (accessed on 2 December 2018).
- Michigan Public Service Commission. Electric Utility Company Annual Reports. Available online: <https://www.michigan.gov/mpsc/0,4639,7-159--411837--,00.html> (accessed on 2 December 2018).

25. Michigan Legislature. Act No. 341. Available online: <https://www.legislature.mi.gov/documents/2015-2016/publicact/htm/2016-PA-0341.htm> (accessed on 18 December 2018).
26. Michigan Legislature. Clean and Renewable Energy And Energy Waste Reduction Act. Available online: [https://webcache.googleusercontent.com/search?q=cache:Q2t3Ck_vZR0J:https://www.legislature.mi.gov/\(S\(040jglr0zvzh5eqelqcbgmoi\)\)/documents/mcl/pdf/mcl-Act-295-of-2008.pdf+&cd=1&hl=en&ct=clnk&gl=us](https://webcache.googleusercontent.com/search?q=cache:Q2t3Ck_vZR0J:https://www.legislature.mi.gov/(S(040jglr0zvzh5eqelqcbgmoi))/documents/mcl/pdf/mcl-Act-295-of-2008.pdf+&cd=1&hl=en&ct=clnk&gl=us) (accessed on 5 January 2019).
27. Michigan Public Service Commission. Distributed Generation Program. Available online: https://www.michigan.gov/mpsc/0,4639,7-159-16393_48212_58124---,00.html (accessed on 2 December 2018).
28. Michigan Legislature. Enrolled Senate Bill No. 937. Available online: <https://webcache.googleusercontent.com/search?q=cache:qxs35bIgjz4J:https://www.legislature.mi.gov/documents/1999-2000/publicact/pdf/2000-PA-0141.pdf+&cd=2&hl=en&ct=clnk&gl=us> (accessed on 5 January 2019).
29. Michigan Public Service Commission. Report on the MPSC Staff Study to Develop a Cost of Service-Based Distributed Generation Program Tariff. Available online: <https://webcache.googleusercontent.com/search?q=cache:eScf0ME6IGAJ:https://mi-psc.force.com/sfc/servlet.shepherd/version/download/068t00000016WftAAE+&cd=1&hl=en&ct=clnk&gl=us> (accessed on 5 January 2019).
30. Energy Information Administration. State Electricity Profiles. Available online: <https://www.eia.gov/electricity/state/Michigan/> (accessed on 6 December 2018).
31. Ackermann, T.; Andersson, G.; Söder, L. Distributed generation: A definition. *Electr. Power Syst. Res.* **2001**, *57*, 195–204. [CrossRef]
32. Pepermans, G.; Driesen, J.; Haeseldonckx, D.; Belmans, R.; D'haeseleer, W. Distributed generation: Definition, benefits and issues. *Energy Policy* **2005**, *33*, 787–798. [CrossRef]
33. US Environmental Protection Agency. Distributed Generation of Electricity and Its Environmental Impacts. Available online: <https://www.epa.gov/energy/distributed-generation-electricity-and-its-environmental-impacts> (accessed on 2 January 2019).
34. Pearce, J.M. Expanding photovoltaic penetration with residential distributed generation from hybrid solar photovoltaic and combined heat and power systems. *Energy* **2009**, *34*, 1947–1954. [CrossRef]
35. Gulli, F. Small distributed generation versus centralised supply: A social cost–benefit analysis in the residential and service sectors. *Energy Policy* **2006**, *34*, 804–832. [CrossRef]
36. Pipattanasomporn, M.; Willingham, M.; Rahman, S. Implications of on-site distributed generation for commercial/industrial facilities. *IEEE Trans. Power Syst.* **2005**, *20*, 206–212. [CrossRef]
37. Prehoda, E.W.; Schelly, C.; Pearce, J.M. US strategic solar photovoltaic-powered microgrid deployment for enhanced national security. *Renew. Sustain. Energy Rev.* **2017**, *78*, 167–175. [CrossRef]
38. Bayod-Rújula, A.A. Future development of the electricity systems with distributed generation. *Energy* **2009**, *34*, 377–383. [CrossRef]
39. El-Khattam, W.; Salama, M.M. Distributed generation technologies, definitions and benefits. *Electr. Power Syst. Res.* **2004**, *71*, 119–128. [CrossRef]
40. Nehrir, M.H.; Wang, C.; Strunz, K.; Aki, H.; Ramakumar, R.; Bing, J.; Miao, Z.; Salameh, Z. A review of hybrid renewable/alternative energy systems for electric power generation: Configurations, control, and applications. *IEEE Trans. Sustain. Energy* **2011**, *2*, 392–403. [CrossRef]
41. Bajpai, P.; Dash, V. Hybrid renewable energy systems for power generation in stand-alone applications: A review. *Renew. Sustain. Energy Rev.* **2012**, *16*, 2926–2939. [CrossRef]
42. Revesz, R.; Unel, B. The future of Distributed Generation: Moving past net metering. *Environ. Law Inst.* **2018**, *48*, I0719–I0725.
43. Institute for Energy Innovation. Solar in Michigan: The Economic Impact of Distributed Generation on Non-solar Customers. Available online: <https://mieibc.org/reports/solar-in-michigan-the-economic-impact-of-distributed-generation-on-non-solar-customers/> (accessed on 2 January 2019).
44. Environment America Research and Policy Center. Shining Rewards: The Value of Rooftop Solar Power for Consumers and Society. Available online: <https://environmentamerica.org/reports/ame/shining-rewards> (accessed on 2 January 2019).
45. U.S. Department of Energy. Methods for Analyzing the Benefits and Costs of Distributed Photovoltaic Generation to the U.S. Electric Utility System. Available online: <http://www.osti.gov/servlets/purl/1159357/> (accessed on 2 January 2019).

46. Interstate Renewable Energy Council. A Regulator's Guidebook: Calculating the Benefits and Costs of Distributed Solar Generation. Available online: <https://irecusa.org/publications/a-regulators-guidebook-calculating-the-benefits-and-costs-of-distributed-solar-generation/> (accessed on 2 January 2019).
47. Ellabban, O.; Abu-Rub, H.; Blaabjerg, F. Renewable energy resources: Current status, future prospects and their enabling technology. *Renew. Sustain. Energy Rev.* **2014**, *39*, 748–764. [CrossRef]
48. Prehoda, E.W.; Pearce, J.M. Potential lives saved by replacing coal with solar photovoltaic electricity production in the US. *Renew. Sustain. Energy Rev.* **2017**, *80*, 710–715. [CrossRef]
49. Panwar, N.L.; Kaushik, S.C.; Kothari, S. Role of renewable energy sources in environmental protection: A review. *Renew. Sustain. Energy Rev.* **2011**, *15*, 1513–1524. [CrossRef]
50. GIS Open Data. Michigan Counties. Available online: <http://gis-michigan.opendata.arcgis.com/datasets/counties-v17a> (accessed on 31 January 2019).
51. Michigan Public Service Commission. Electric Rate Books. Available online: https://www.michigan.gov/mpsc/0,4639,7-159-16377_52818_53477-214344--,00.html (accessed on 31 January 2019).
52. National Renewable Energy Laboratory. Geospatial Data Science Solar Maps. Available online: <https://www.nrel.gov/gis/solar.html> (accessed on 31 January 2019).
53. Federal Energy Regulatory Commission. About FERC. Available online: <https://www.ferc.gov/about/about.asp?csrt=4722771855184626275> (accessed on 18 December 2018).
54. Cornell Law School. 16 U.S. Code § 825h—Administrative Powers of Commission; Rules, Regulations, and Orders. Available online: <https://www.law.cornell.edu/uscode/text/16/825h> (accessed on 18 December 2018).
55. Federal Energy Regulatory Commission. Order Nos. 888 and 889 Compliance Matters. Available online: <https://www.ferc.gov/legal/maj-ord-reg/land-docs/rm95-8-0aj.txt> (accessed on 6 December 2018).
56. Pennsylvania New Jersey Maryland. Territory Served. Available online: <https://www.pjm.com/about-pjm/who-we-are/territory-served.aspx> (accessed on 2 January 2019).
57. Michigan Legislature. Act 167 of 2008. Available online: [http://www.legislature.mi.gov/\(S\(chsy4bnmn5sssou4wbps3wac\)\)/mileg.aspx?page=getObject&objectName=mcl-Act-167-of-2008](http://www.legislature.mi.gov/(S(chsy4bnmn5sssou4wbps3wac))/mileg.aspx?page=getObject&objectName=mcl-Act-167-of-2008) (accessed on 18 December 2018).
58. Michigan Electric Cooperative Association. Michigan's Electric Cooperatives. Available online: <http://www.meca.coop/electric-cooperatives/> (accessed on 2 December 2018).
59. Cook, D. Michigan Electric Cooperative Latest Move in Continuing Shift to Member Regulation. Available online: <http://ahclaw.com/cooperative-blog-posts/2015/08/michigan-electric-coop-latest-move-in-continuing-shift-to-member-regulation/> (accessed on 2 January 2019).
60. Michigan Legislature. Public Act 342. Available online: <https://www.legislature.mi.gov/documents/2015-2016/publicact/htm/2016-PA-0342.htm> (accessed on 18 December 2018).
61. Michigan Department of Licensing and Regulatory Affairs. MPSC E-Dockets. Available online: <https://mi-psc.force.com/s/> (accessed on 2 January 2019).
62. Department of Energy. Public Utility Regulatory Policies Act of 1978 (PURPA). Available online: <https://www.energy.gov/oe/services/electricity-policy-coordination-and-implementation/other-regulatory-efforts/public> (accessed on 3 December 2018).
63. Michigan Public Service Commission. PURPA. Available online: https://www.michigan.gov/mpsc/0,4639,7-159-80741_80743-406273--,00.html (accessed on 3 December 2018).
64. Union of Concerned Scientists. Public Utility Regulatory Policy Act (PURPA). Available online: https://www.ucsusa.org/clean_energy/smart-energy-solutions/strengthen-policy/public-utility-regulatory.html (accessed on 3 December 2018).
65. LaFleur, C.A.; Honorable, C.D. 157 FERC 61,211 Notice of Intent to Act and Declaratory Power. Available online: <https://dms.psc.sc.gov/Attachments/Matter/b0608d84-022f-4281-a037-53ff07f5709d> (accessed on 2 January 2019).
66. Cory, K. FERC Ruling Changes Course and Assists Renewables | Renewable Energy Project Finance. Available online: <https://financere.nrel.gov/finance/content/ferc-ruling-changes-course-and-assists-renewables> (accessed on 2 January 2019).
67. Lazard. Levelized Cost of Energy. 2017. Available online: <https://www.lazard.com/perspective/levelized-cost-of-energy-2017/> (accessed on 4 December 2018).

68. Girouard, C. The Top Utility Regulation Trends of 2017—So Far. Available online: <https://www.greentechmedia.com/articles/read/top-10-utility-trends-regulation-of-2017-ae> (accessed on 19 December 2018).
69. Maloney, P. Montana Regulators Vote to Cut PURPA Payment Rates by 40%. Available online: <https://www.utilitydive.com/news/montana-regulators-vote-to-cut-purpa-payment-rates-by-40/445751/> (accessed on 19 December 2018).
70. Bade, G. Resilience, Pipelines & PURPA: FERC Regulators Preview Major Issues at NARUC. Available online: <https://www.utilitydive.com/news/resilience-pipelines-purpa-ferc-regulators-preview-major-issues-at-naru/517065/> (accessed on 19 December 2018).
71. One Energy Wind. Electricity Rate Historical Analysis 1990–2014 Michigan. Available online: <http://oneenergywind.com/wp-content/uploads/2017/08/michigan-electricity-rate-historical-analysis-1990-2014.pdf> (accessed on 5 January 2019).
72. Roselund, C. Consumers Energy Tries to Evade PURPA in Michigan. Available online: <https://pv-magazine-usa.com/2018/01/26/consumers-energy-tries-to-evade-purpa-in-michigan/> (accessed on 3 December 2018).
73. Parag, Y.; Sovacool, B.K. Electricity market design for the prosumer era. *Nat. Energy* **2016**, *1*, 16032. [CrossRef]
74. Ritzer, G. Focusing on the Prosumer. In *Prosumer Revisited*; Blattel-Mink, B., Hellmann, K.U., Eds.; Springer: Berlin/Heidelberg, Germany, 2010.
75. 109th Congress. Energy Policy Act of 2005. Available online: <https://www.congress.gov/bill/109th-congress/house-bill/6> (accessed on 5 January 2019).
76. Schelly, C.; Louie, E.P.; Pearce, J.M. Examining interconnection and net metering policy for distributed generation in the United States. *Renew. Energy Focus* **2017**, *22*, 10–19. [CrossRef]
77. Talberg, S.A.; Saari, N.J.; Eubanks, R.A. Distributed Generation Program Report. Available online: https://www.michigan.gov/documents/mpsc/DG_report_cal_yr_2017_636048_7.pdf (accessed on 2 January 2019).
78. Michigan Public Service Commission. Report on the Implementation of the Public Utility Regulatory Policies Act of 1978 (PURPA). Available online: https://www.michigan.gov/documents/mpsc/PURPA_report_Final_4-18-2018_621098_7.pdf (accessed on 2 January 2019).
79. Michigan Public Service Commission. Integrated Resource Plan Filing Requirements/Schedule. Available online: https://www.michigan.gov/mpsc/0,4639,7-159-80741_80743-406249--,00.html (accessed on 2 January 2019).
80. Michigan Department of Licensing and Regulatory Affairs. Case U-20162. Available online: <https://mi-psc.force.com/s/case/500t0000009hEHeAAM/in-the-matter-of-the-application-of-dte-electric-company-for-authority-to-increase-its-rates-amend-its-rate-schedules-and-rules-governing-the-distribution-and-supply-of-electric-energy-and-for-miscellaneous-accounting-authority> (accessed on 2 January 2019).
81. Michigan Department of Licensing and Regulatory Affairs. Case U-20276. Available online: <https://mi-psc.force.com/s/case/500t000000B12EhAAJ/in-the-matter-of-the-application-of-upper-peninsula-power-company-for-authority-to-increase-electric-rates-in-the-state-of-michigan> (accessed on 2 January 2019).
82. Public Sector Consultants. Electricity Restructuring in Michigan: The Effects to Date of Public Act 141 and Potential Future Challenges. Available online: <https://publicsectorconsultants.com/2006/11/30/electricity-restructuring-in-michigan-the-effects-to-date-of-public-act-141-and-potential-future-challenges/> (accessed on 2 January 2019).
83. Tomain, J.; Cudahy, R. *Energy Law in a Nutshell*, 2nd ed.; Thomson Reuters: Egan, MN, USA, 2011.
84. The Mining Gazette. L’Anse and UPPCO Agree to Deal in Court. Available online: <http://www.mininggazette.com/news/local-news/2018/10/lanse-and-uppco-agree-to-deal-in-court/> (accessed on 3 December 2018).
85. Yergin, D. *The Quest: Energy, Security, and the Remaking of the Modern World*; Penguin: London, UK, 2011.
86. Mazur, A. *Energy and Electricity in Industrial Nations: The Sociology and Technology of Energy*; Routledge: London, UK, 2013.
87. Midwest Independent System Operator. Real-Time Displays. Available online: <https://www.misoenergy.org/markets-and-operations/real-time-displays/> (accessed on 2 January 2019).

88. Mississippi Public Service Commission. Mississippi Net Metering Study. Available online: <http://www.synapse-energy.com/project/mississippi-net-metering-study> (accessed on 22 December 2018).
89. Kantamneni, A.; Winkler, R.; Gauchia, L.; Pearce, J.M. Emerging economic viability of grid defection in a northern climate using solar hybrid systems. *Energy Policy* **2016**, *95*, 378–389. [CrossRef]
90. Laws, N.D.; Epps, B.P.; Peterson, S.O.; Laser, M.S.; Wanjiru, G.K. On the utility death spiral and the impact of utility rate structures on the adoption of residential solar photovoltaics and energy storage. *Appl. Energy* **2017**, *185*, 627–641. [CrossRef]
91. Bernstein, L. Utilities and Solar Advocates Square off over the Future. Available online: https://www.washingtonpost.com/national/health-science/utilities-and-solar-advocates-square-off-over-the-future/2013/06/09/580c0ad8-c3b6-11e2-914f-a7aba60512a7_story.html?noredirect=on&utm_term=.ab26b6317307 (accessed on 21 December 2018).
92. Dillon, J. Small Utilities Say Subsidized Net-Metering Projects Could Trigger Rate Increases. Available online: <http://digital.vpr.net/post/small-utilities-say-subsidized-net-metering-projects-could-trigger-rate-increases> (accessed on 21 December 2018).
93. Roselund, C. DTE Seeks to Increase Fixed Charges on Solar Customers in Rate Case. Available online: <https://pv-magazine-usa.com/2018/07/16/dte-seeks-to-increase-fixed-charges-on-solar-customers-in-rate-case/> (accessed on 2 January 2019).
94. Michigan Department of Licensing and Regulatory Affairs. Case U-20162 Transcripts Volume 5&7. Available online: <https://mi-psc.force.com/s/case/500t0000009hEHeAAM/in-the-matter-of-the-application-of-dte-electric-company-for-authority-to-increase-its-rates-amend-its-rate-schedules-and-rules-governing-the-distribution-and-supply-of-electric-energy-and-for-miscellaneous-accounting-authority> (accessed on 31 January 2019).
95. Frankenfield, J. Which Industry Spends the Most on Lobbying. Available online: <https://www.investopedia.com/investing/which-industry-spends-most-lobbying-antm-so/> (accessed on 31 January 2019).
96. Kasper, M. Campaign Finance Reports Reveal Utility Industry Again Spending Big This Election Cycle. Available online: <https://www.energyandpolicy.org/campaign-finance-reports-reveal-utility-industry-contributions/> (accessed on 31 January 2019).
97. Bade, G. Where Electric Utilities Are Putting Their Money in the 2016 Election. Available online: <https://www.utilitydive.com/news/where-electric-utilities-are-putting-their-money-in-the-2016-election/429484/> (accessed on 31 January 2019).
98. Underwood, R.H. Legal Ethics and Class Actions: Problems, Tactics and Judicial Responses. *Kentucky College of Law* **1982**, *71*, 787.
99. Garth, B. From Civil Litigation to Private Justice: Legal Practice at War with the Profession and Its Value. *Brooklyn Law Review* **1993**, *59*, 931.
100. Pearce, J.M.; Harris, P.J. Reducing greenhouse gas emissions by inducing energy conservation and distributed generation from elimination of electric utility customer charges. *Energy Policy* **2007**, *35*, 6514–6525. [CrossRef]
101. Michigan Department of Licensing and Regulatory Affairs. Case: U-18090. Available online: <https://mi-psc.force.com/s/case/500t0000008efyHAAQ/in-the-matter-on-the-commissions-own-motion-establishing-the-method-and-avoided-cost-calculation-for-consumers-energy-company-to-fully-comply-with-the-public-utilities-regulatory-policy-act-of-1978-16-usc-2601-et-seq?> (accessed on 4 January 2019).
102. Michigan Department of Licensing and Regulatory Affairs. Consumers Energy Case: U-20165. Available online: <https://mi-psc.force.com/s/case/500t0000009haqBAAQ/in-the-matter-of-the-application-of-consumers-energy-company-for-approval-of-its-integrated-resource-plan-pursuant-to-mcl-4606t-and-for-other-relief> (accessed on 2 January 2019).
103. Minnesota Department of Commerce. Minnesota Value of Solar Methodology. Available online: <https://www.cleanpower.com/wp-content/uploads/MN-VOS-Methodology-2014-01-30-FINAL.pdf> (accessed on 17 November 2018).
104. Illinois Power Agency. About IL Adjustable Block Program. Available online: <http://illinoisabp.com/about/> (accessed on 19 December 2018).
105. Minnesota Public Utilities Commission. Distributed Generation or Distributed Energy Resources in Minnesota. Available online: <https://mn.gov/puc/energy/distributed-energy/> (accessed on 31 January 2019).

106. Database of State Incentives for Renewables and Efficiency. Available online: <http://www.dsireusa.org/> (accessed on 31 January 2019).
107. Russo, M.V. Power plays: Regulation, diversification, and backward integration in the electric utility industry. *Strateg. Manag. J.* **1992**, *13*, 13–27. [CrossRef]
108. Maloney, P. Upper Peninsula Utility First in Michigan to Hit Solar Net Metering Cap. Available online: <https://www.utilitydive.com/news/upper-peninsula-utility-first-in-michigan-to-hit-solar-net-metering-cap/423963/> (accessed on 2 January 2019).
109. Matheny, K. Power Bills Are Whoppers for Some in Michigan's U.P. Available online: <https://www.freep.com/story/news/local/michigan/2016/09/07/power-outrage-electric-bills-upper-peninsula/89593302/> (accessed on 19 December 2018).
110. Davis, L.W. Evidence of a decline in electricity use by US households. *Econ. Bull.* **2017**, *37*, 1098–1105.
111. U.S. Power Demand Flatlined Years Ago, and It's Hurting Utilities—Bloomberg. Available online: <https://www.bloomberg.com/news/articles/2017-04-25/u-s-power-demand-flatlined-years-ago-and-it-s-hurting-utilities> (accessed on 19 December 2018).
112. Electricity Demand Is Down, but We Keep Building Power Plants Anyway—Mother Jones. Available online: <https://www.motherjones.com/kevin-drum/2018/02/electricity-demand-is-down-but-we-keep-building-power-plants-anyway/> (accessed on 19 December 2018).
113. Trabish, H. Are Regulators Starting to Rethink Fixed Charges. Available online: <https://www.utilitydive.com/news/are-regulators-starting-to-rethink-fixed-charges/530417/> (accessed on 31 January 2019).
114. Michigan Department of Licensing and Regulatory Affairs. DTE Testimony Case U-18419. Available online: <https://mi-psc.force.com/sfc/servlet.shepherd/version/download/068t0000001dYJ4> (accessed on 31 January 2019).
115. Net Metering by State. Available online: <https://www.seia.org/research-resources/net-metering-state> (accessed on 2 December 2018).
116. Net Metering. Available online: http://puc.nv.gov/Renewable_Energy/Net_Metering/ (accessed on 2 December 2018).
117. Massachusetts Passes Energy Bill without Lifting Net Metering Caps. Available online: <https://pv-magazine-usa.com/2018/08/01/massachusetts-passes-energy-bill-without-net-metering-cap-increase/> (accessed on 2 December 2018).
118. South Carolina Net Metering Cap Increase Derailed. Available online: <https://pv-magazine-usa.com/2018/06/28/south-carolina-net-metering-cap-increase-derailed/> (accessed on 2 December 2018).
119. Muratori, M.; Rizzoni, G. Residential demand response: Dynamic energy management and time-varying electricity pricing. *IEEE Trans. Power Syst.* **2016**, *31*, 1108–1117. [CrossRef]
120. Albadi, M.H.; El-Saadany, E.F. A summary of demand response in electricity markets. *Electr. Power Syst. Res.* **2008**, *78*, 1989–1996. [CrossRef]
121. Inside the Surprising Lessons from PECO's Time-Of-Use Rate Pilot. Available online: <https://www.utilitydive.com/news/inside-the-surprising-lessons-from-pecos-time-of-use-rate-pilot/399629/> (accessed on 2 December 2018).
122. Rasheed, B. Coast Electric Power Association Residential Time of Use Program. 6. Available online: https://www.smartgrid.gov/files/Coast_Electric_Power_Association_Residential_Time_Use_Program.pdf (accessed on 2 December 2018).
123. Olsaretti, S. *Liberty, Desert and the Market: A Philosophical Study*; Cambridge University Press: Cambridge, MA, USA, 2004.
124. Is California Risking Another Energy Crisis with Community Choice Programs? Available online: <https://www.desertsun.com/story/tech/science/energy/2018/05/08/california-risking-another-energy-crisis/586750002/> (accessed on 3 December 2018).
125. The California Crisis | Blackout | FRONTLINE | PBS. Available online: <https://www.pbs.org/wgbh/pages/frontline/shows/blackout/california/> (accessed on 3 December 2018).
126. Staff, S.G. Energy Crisis Overview: How We Got Here. Available online: <https://www.sfgate.com/news/article/Energy-Crisis-Overview-How-we-got-here-2921562.php> (accessed on 3 December 2018).
127. The Energy Sector Is Driving Job Growth, but Not Where You Think. Available online: <https://www.utilitydive.com/news/energy-sector-is-driving-job-growth-but-not-where-you-think/524600/> (accessed on 3 December 2018).

128. 2018 U.S. Energy and Employment Report (USEER). Available online: <https://www.usenergyjobs.org/> (accessed on 3 December 2018).
129. Patel, H. Utility Solar Is Dead; Long Live Distributed Generation. Available online: <https://www.greentechmedia.com/articles/read/utility-solar-is-dead-long-live-distributed-generation> (accessed on 2 January 2019).
130. Utility Involvement in Distributed Generation: Regulatory Considerations White Paper. Available online: http://webcache.googleusercontent.com/search?q=cache:5t3_OkE4wNIJ:pubs.naruc.org/pub/536EF3DF-2354-D714-510E-B20295D42469+&cd=1&hl=en&ct=clnk&gl=us (accessed on 5 January 2019).
131. Cavallaro, C.M.; Pearce, J.M.; Sidortsov, R. Decarbonizing the boardroom? Aligning electric utility executive compensation with climate change incentives. *Energy Res. Soc. Sci.* **2018**, *37*, 153–162. [CrossRef]
132. Sharp, P. Text—H.R.776—102nd Congress (1991–1992): Energy Policy Act of 1992. Available online: <https://www.congress.gov/bill/102nd-congress/house-bill/776/text/enr> (accessed on 21 December 2018).
133. Kelly, S.G. Municipalization of Electricity: The Allure of Lower Rates for Bright Lights in Big Cities. *Nat. Resour. J.* **1997**, *37*, 43.
134. Survey of State Municipalization Laws. Available online: https://webcache.googleusercontent.com/search?q=cache:t6YF-pbKASQJ:https://www.publicpower.org/system/files/documents/municipalization-survey_of_state_laws.pdf+&cd=1&hl=en&ct=clnk&gl=us (accessed on 5 January 2019).
135. Michigan Legislature. The Home Rule City Act. Available online: <https://law.justia.com/codes/michigan/2012/chapter117/act279of1909/section117-4f/> (accessed on 31 January 2019).
136. Boulder Municipalization Persists after Surprise Election Comeback. Available online: http://www.dailycamera.com/boulder-election-news/ci_31439744/boulder-municipalization-persists-after-surprise-election-comeback (accessed on 21 December 2018).
137. 42% of Global Coal Power Plants Run at a Loss, Finds World-First Study. Available online: <https://www.carbontracker.org/42-of-global-coal-power-plants-run-at-a-loss-finds-world-first-study/> (accessed on 9 January 2019).



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