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AN HISTORICAL GEOGRAPHY OF MICHIGAN'S
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AN HISTORICAL GEOGRAPHY OF MICHIGAN'S ELECTRICITY LANDSCAPE

By

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ABSTRACT

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By

Jordan Patterson Howell

Michigan's utility companies and rural cooperatives, along with the federal government, national, and multi-national corporations have traditionally been held responsible for the development of the state's electricity infrastructure. In contrast, I argue that it has actually been Michigan's utilities oversight regime and the specific actions of the state's regulatory body, the Michigan Public Service Commission, that have played a central role in shaping the state's electricity landscape. Underlying this scheme was a particular notion of "progress," shared by utilities, cooperatives, and the Commission alike, which linked the deployment of massive, complex electricity infrastructure to the state's social advancement. These factors prompted utility companies to invest in new facilities of dubious necessity, producing an electricity landscape that is today characterized by dirty, ageing, fossil-fuelled power plants. Despite reforms, the artifacts of years past continue to block the implementation of both meaningful conservation programs and renewable fuels.

Through an examination of regulatory hearings, Commission and utility publications, and similar materials with a sub-national focus, this thesis employs narrative analysis to extend, temper, and illustrate the more common, national-level studies of the U.S. electricity system. In so doing, it recognizes the importance of scale in analysis and highlights the unique economic and social context surrounding Michigan's electricity landscape.

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NB: Images in this thesis are presented in color. Contact author for more information.

LIST OF ABBREVIATIONS

DOE..U.S. Department of Energy

DSM..Demand-Side Management

EIA..Energy Information Administration

EPAct..Energy Policy Act (1992)

FERC..Federal Energy Regulatory Commission

G+T..Generation and Transmission Cooperative

IRP..Integrated Resource Plan

MEOS..Michigan Electricity Options Study

MRC..Michigan Railroad Commission

MPSC..Michigan Public Service Commission

MPUC..Michigan Public Utilities Commission

NEA..National Energy Act (1978)

PURPA..Public Utilities Regulatory Policies Act (1978)

REA..Rural Electrification Administration

REC..Rural Electric Cooperative

USDA..U.S. Department of Agriculture

Introduction

Once taken for granted as a stable and secure consortium of publicly regulated and efficiently run monopolies the electric utility industry in the United States has over the past three decades become increasingly unstable, fragmented, unreliable, insecure, inefficient, expensive, and harmful to our environment and public health.

-- B.K. Sovacool, The Dirty Energy Dilemma, 2008 (2)

The infrastructure responsible for the provision of electricity represents the single largest investment sector of the United States' economy, worth over $800bn (Sovacool 2008, 16-17). Sales of electricity topped $360bn in 2007 (ibid). Surpassing all monetary impacts, however, is electricity's role as facilitator for almost every economic, governmental, academic, and social transaction in the country. Ubiquitous, bountiful electricity is all but expected in 21st century America, and the processes underlying its production and consumption are typically considered only periodically, during blackouts or other shortages. In reality, the contemporary electricity landscape -- collectively referring to all generation, transmission, and distribution infrastructure -- is the outcome of more than a century's worth of near-continuous processes of investment, regulation, construction, and planning.

A common perception is that utility companies and electricity cooperatives are directly responsible for the physical electricity infrastructure that serves us today. While they are the all-but-exclusive builders and operators of that infrastructure, in this thesis I argue that state-level utilities oversight regimes and the actions of public regulators like the Michigan Public Service Commission have been the most powerful forces shaping the electricity landscape. The structure of utilities regulation, and in particular the rate-of-return accounting system, has contributed to an electricity landscape characterized by large, complex, and centralized projects relying on coal, nuclear fuel, and, increasingly, natural gas. Decisions affecting the planning and deployment of this infrastructure were made in the context of a specific "progress imperative" that dominated regulatory, cooperative, and utility company thinking through the 1980s, and traces of which can still be found today. This mode of thought, growing out of the type of "modernization" paradigm described and critiqued by Marshall Berman (1982), linked the deployment of new electricity infrastructure, particularly generating facilities, with social advancement and economic growth. Even with reforms in the past 20 years, the infrastructural and organizational artifacts produced by such policies continue to dominate the electricity landscape today, and inhibit the deployment of both conservation programs and renewable fuels.

I have chosen to focus on the state of Michigan for three reasons. With regards to electricity infrastructure, Michigan hosts a diverse set of facilities: there are some of the largest coal and nuclear power plants in the United States, as well as numerous small-scale hydroelectric projects. The state has been influenced by municipal utilities, large private companies, and federally-funded rural cooperatives. If we accept that electricity consumption mirrors changes in economic and industrial activity, then during its economic zenith, Michigan was a world-beater in terms of the amount of electricity produced and the pace at which new facilities came online; however now, during a period of deepening economic malaise, the state must find ways to deal with an ageing glut of electricity infrastructure while addressing new -- and costly -- environmental concerns.

This thesis focuses on the Lower Peninsula of Michigan. Most of the population and economic activity is concentrated in the Lower Peninsula, and accordingly, so is most of the electricity infrastructure. Additionally, the electricity landscape in the Upper Peninsula has been shaped by a much different set of forces than the Lower Peninsula -- in particular, the federal government, municipally-owned utilities, and utilities from neighboring Wisconsin and Minnesota. The focus of this project further tightens in its concern primarily with the activities of the state's two largest private utilities, Consumers Power and Detroit Edison. In spite of the fact that one can compile a long list of companies selling electricity in the state of Michigan, Consumers Power and Detroit Edison supply most of it, and have done so since the turn of the 20th century. As such, their historical and contemporary influence in shaping the electricity infrastructure in the state cannot be overstated

The conclusions I have reached in this thesis could only be arrived at through a careful consideration of scale: in contrast to most studies of the electricity landscape, this thesis has an explicitly sub-national focus. This not only recognizes the fact that the most critical decisions surrounding electricity infrastructure in the United States have historically been made at the state level, but also draws attention to the unique circumstances surrounding electricity system development in each state. In conducting this study, I have relied upon the records of regulatory hearings and orders produced by the Commission, as well as publications and archival materials produced by the Commission and the state's largest utilities. This has been augmented with analysis of state and federal utilities laws and field visits to sites important in the development of Michigan's electricity landscape.

0.2 Research in Context

Electricity is frequently the subject of academic research and debate. Studies range from engineering and materials research to economics and policy studies to the ecological impacts of power generation. Rare, however, are syntheses of these factors into an holistic explanation of the current spatial composition of the electricity system, and rarer still are those which place the development of the electricity landscape into a wider political, economic, and social context. Geography's integrative nature, however, means that it might be the ideal discipline in which to conduct such an analysis. In this study of Michigan's electricity landscape, I have drawn on research in economics, public policy studies, and history, focusing on information directly related to the state wherever possible. A brief overview of these "external" contributions follows.

0.2A Research Outside Geography

Economic considerations of the electricity industry are many, and cover everything from historic price structures and the financial roots of governmental regulation (Hausman and Neufeld 2002), to the economic efficiency of transmission network expansion projects (Fang and Hill 2003). Economic research on the electricity system typically traces the historical development of the industry and considers the impacts of both governmental regulation and aspects of "deregulation." Much of the best work is drawn directly from the pool of energy statistics maintained by state and federal agencies like the Energy Information Administration (EIA). Accordingly, many studies analyze economic problems and trends both before and after new regulations, market failures, or major blackouts have occurred (e.g. Ayres, Ayres, and Pokrovsky 2005; or Kwoka 2008).

Studies of federal electricity policies, as well as those of large states like California, New York, or Texas are also quite common (eg. Kingsley 1992). The prevalence of domestic federal-level studies is somewhat perplexing given the fact that federal oversight of electricity generation and transmission has been quite limited, historically speaking. Other research comparing national electricity policies (like Chick 2007) can help put U.S. treatment of the electricity sector in perspective with other countries, which can be a useful analytical tool. The relatively less-common studies of electricity policy at the state level tend to focus on a single aspect of the electricity system, like wind energy in California (Gipe 1991), a state's response to an incident like the "California Energy Crisis" (Timney 2002) or the massive 2003 northeast blackout (DeBlasio et al. 2004).

Historians of electricity systems and the utilities sector offer important insights into the chronology of electricity landscape development. Many (e.g. Doyle 1979; Hyman 1988; Brigham 1998) are broad national or regional outlines, but there exists a considerable body of historical research on state-level electricity landscapes as well. In Michigan, some of the first histories were written by the state's own utilities (Miller 1957; 1971; Bush 1973) and provide details about the growth of the industry that more general studies would have to omit. Later scholarship (most importantly, Anderson 1994) draws on these sources to analyze several theories of regulatory oversight that were thrust into the spotlight during the telephone and electricity industry crises of the 1970s and 1980s. More recently, Kuhl (1998) has examined the history of rural electric cooperatives in the state, both in their own right and in the context of the larger federal rural electrification program.

0.2B Research in Geography

Unfortunately, studies of electricity infrastructure that draw on such sources are not commonly found within geography journals. In fact, only recently have geographers started to directly address electricity systems at all, let alone in a critical fashion. Geographers working on energy problems have traditionally focused on geopolitical and economic issues surrounding the extraction and trade of fossil fuels in an international context (e.g. Conant and Gold 1978; Mitchell, Beck, and Grubb 1996; Peters 2004; or Pacheco 2005). More general geographic studies of energy have tended towards descriptive writing emphasizing resource reserves and production data (e.g. Manners 1964; Guyol 1971; or Chapman 1989), with little to no attention paid to the processes driving the development of those resources and systems. Early research in geography examining specifically the evolution of the electricity landscape has continued this trend. Two of the earliest works in this vein consider the structure of the United States' electric power industry and the importance of coal in electric power generation, both at the national scale, and both with a strong emphasis on the hand of the federal government (Elmes 1996; Elmes and Harris 1996 respectively). Both pieces argue that the U.S. electricity landscape cannot be understood apart from the geography of the primary fuels used to supply it.

More progressive research has only begun to emerge, considering not only the importance of scale in the analysis of energy issues but also the interrelated factors of politics, ecology, economics, and culture in configuring the electricity landscape. Serrallés' (2004) study of popular perceptions of electricity infrastructure examines conflicts tied to the siting of renewable energy projects like wind turbines in the United States and European Union. Vogel (2008) similarly analyzes the interaction between political policy and environmental conservation efforts at different scales in the Pacific Northwest. These two studies demonstrate not only the very real power geometries that link utilities, government, interest groups, and the deployment of energy infrastructure but also the central role that scale must take in framing environmental research. Other studies have also emerged from geography in the past 10 years emphasizing particular aspects of the electricity landscape, like renewables or rural electrification in Latin America (e.g. Heiman and Solomon 2004; Taylor 2005; Heiman 2006; Taylor 2006). This has followed the trend towards more critical research into the development of other infrastructural systems like communications and urban water facilities (Hillis 1998; Kaika and Swyngedouw 2000; Vojnovic 2006; Malecki and Wei 2009).

0.3 Methodologies

It is with the goal of contributing to this growing body of critical geographic literature that I have undertaken the present thesis. In conducting this research, I have examined the case records, public statements, position papers, project studies, policy briefs, and archival materials produced by and for the Michigan Public Service Commission (MPSC, Commission) and the state's two largest utility companies, Consumers Power and Detroit Edison. Additionally, I have considered similar material from the federally-funded Rural Electrification Administration (REA), U.S. Department of Agriculture (USDA), U.S. Department of Energy (DOE), and EIA. To augment these sources I have analyzed state and federal laws related to the regulation of the electric power industry and also visited several sites important to the history of Michigan's electricity landscape.

To structure this tranche of sources in a meaningful way, I have employed a narrative (or discourse) analytic approach. Narrative analysis recognizes that phenomena such as the development of the electricity landscape are contingent upon environmental, political, cultural, and geographic particularities and motives that tend to go unexamined. It differs from other qualitative analytic methods because of its emphasis on the impacts of the texts -- not simply their content. Indeed, "the methodological strength of discourse analysis lies in its ability to move beyond the text...to uncover issues of power relationships." (Waitt 2005, 166) This approach has proven quite valuable in contemporary political ecology (cf. Dalby 1996; Peet and Watts 2004; Robbins 2004), and is becoming increasingly popular in other areas of critical geographic and environmental policy research as well (e.g., Sharp and Richardson 2001).

Such a "constructionist" approach is a marked departure from earlier studies of the electricity landscape. While most are concerned primarily with the *impact* of a given construction program, fiscal innovation, or regulatory initiative, I employ narrative analysis to excavate the *foundations* of those same programs, innovations, and regulations. The ultimate significance and value of this technique lies in the explosion of taken-for-granted concepts and arguments, analysis of their component parts, and ability to offer alternatives that are environmentally and socially responsible (Roche 2005).

0.4 Structure of the Present Work

Chapter One traces the development of Michigan's electricity landscape from the late 19th century to the present day, considering the different factors that have contributed to its current configuration, including the efforts of the state's utilities companies and federally-funded rural cooperatives. Chapter Two focuses on the most important aspects of the regulatory regime -- rate of return accounting, territorial monopolies, and electricity pricing policies -- and the devastating structural flaws contained therein as exposed by the 15-year Midland Nuclear Facility debacle. Chapter Three explores the underlying motivation of utilities, cooperatives, and the MPSC alike in shaping the electricity landscape -- namely, a particular ideal of "progress" -- and how this ideal has impeded necessary reforms to Michigan's electricity system. The concluding chapter considers the future of the state's electricity landscape, and pays particular attention to the outlook for both meaningful electricity conservation programs and renewable fuels in the state. The thesis is completed with appendices detailing specific information about Michigan's power plant inventory and other electricity infrastructure.

This project has been guided by a simple question: why is Michigan's electricity landscape configured the way it is, with such heavy emphasis on massive, centralized facilities and imported fossil fuels? This initial question prompted several others related to the political, economic, ecological, and social processes responsible for that configuration. Few people take the time to interrogate the physical nature of the electricity landscape, and most of those that do are already inside the electric power industry or the bits of government that ostensibly oversee it. This makes independent investigation critical for holding Commissions, companies, and even entire regulatory regimes to account.

While it is undeniable that the spread of electricity infrastructure has improved the lives of literally billions of people around the world, it is equally irrefutable that there are serious ecological and social consequences for electricity's use that must be addressed *right now*. Generating electricity from fossil fuels -- which accounts for more than two-thirds of power generation in Michigan -- releases toxic emissions and waste materials into the natural environment, contributing to global climate change, the loss of biodiversity, and degradation of human health. The extraction of these fossil fuels poses additional, well-documented environmental, social, and geopolitical problems. My concern for the protection of both the natural environment and the health of those members of our society *forced* to bear the externalities of electric power production forms the core of this research.

The ultimate success of this project will be measured by the improvements made to Michigan's electricity landscape: both in terms of transparency in its governance and sensitivity to the unique gifts that are the natural environment and the people who live here.

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Chapter One

The Historical Development of Michigan's Electricity Landscape

Coal dominates electricity generation in Michigan...Although Michigan is a major generator of electricity from wood and wood waste, has many small hydroelectric plants, and has several plants that generate electricity using methane recovered from landfills and anaerobic digesters, renewable power generation contributes minimally to the State electricity grid. Electricity generation in Michigan is high, as is overall per capita electricity consumption.

-- *EIA State Energy Profile, Michigan (2009a)*

The above epigraph offers a straightforward assessment of Michigan's electricity production and consumption patterns. Though official statements like these, and related figures designed to demonstrate the configuration of the electricity system (e.g., Figure 1.1 and Table 1.1) can be useful inventories, they overlook the complexities that have shaped the system since its inception in the later part of the 19th century.

1.2 *Early Days of Electric Power in Michigan*

In Michigan, electricity provision began in the early 1880s. Initially, anyone with adequate financing could sell electricity, but technology limited the

Figure 1.1: Michigan's power plants, 2000

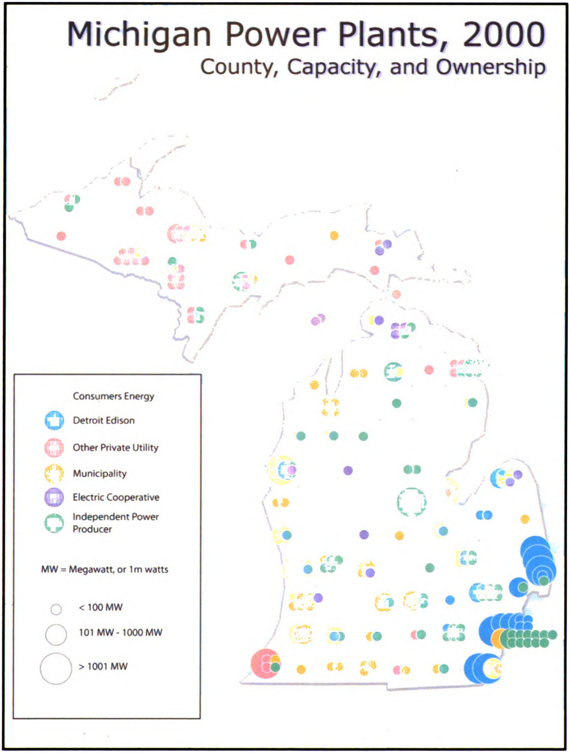


Table 1.1: The electricity landscape in context (after MPSC 2008; EIA 2009a)

Attribute	Value	U.S. Rank
Net Electricity Generation	8,232 GWh	2.6% of total
Net Summer Capacity	30,305 MW	10th
Per Capita Energy Consumption	313 m BTU	35th
Population	10.0 m	8th
State GDP	$382.0 bn	12th

scope of early generation projects and distribution networks. This constraint concentrated electric service in densely populated areas and spurred the proliferation of power companies. The rush to profit from this new technology is typified by the city of Grand Rapids, Michigan, which by 1905 hosted no fewer than four electric power companies, each with its own generating capacity and distribution lines (Anderson 1994). By 1919, Michigan had over 150 utilities, most with their own generation and distribution infrastructure (MPUC 1919, 12).

The explosion in the numbers of electricity providers was matched by improvements in generation and transmission technology. Advances in the understanding of electricity's physical properties permitted new developments of the size and complexity required to meet surging demand from the state's industries. These advances were seized upon by the emerging giants in Michigan's electricity market, Consumers Power and Detroit Edison. Between 1907 and 1930, Consumers Power built 11 new dams and over 300 miles of transmission line (Bush 1973). Though small by today's standards, these hydroelectric projects were some of the largest in the world at the time, attracting a stream of international engineers and industrial tourists alike (ibid). In southeast Michigan, limited hydroelectric potential precluded Detroit Edison from repeating Consumers Power's success with large dams. Accordingly, Detroit Edison turned to fossil fuels, and in particular coal, building four large power plants and an accompanying transmission network by 1925 (Miller 1971). Transmission facilities allowed utilities to build power plants outside of the communities they actually served, taking advantage of comparatively remote hydroelectric resources and less-expensive land.

These advances in system size led to economies of scale which encouraged industry consolidation. Consumers Power employed its expansive new network to control the electricity market in all of Michigan's major cities except Detroit and Lansing, which were in turn dominated by Detroit Edison and a municipal utility, respectively. By 1925, the number of companies providing electric service in the state had fallen by about 25%, to approximately 115 (MPUC 1925). Such consolidation was described as "the logical trend of the development of the electric industry" by state officials (ibid, 8).

1.3 Utility Boom Years, 1930 - 1978

Corporate giants like Consumers Power and Detroit Edison dominated the urban areas of the Lower Peninsula by 1930. During the Depression years, however, all of Michigan's utilities experienced a sharp drop in demand, leaving them with excess capacity. Nevertheless, in the build-up to World War II, Michigan's utility companies continued to grow. The war effort prompted rapid and significant growth in Michigan's electricity infrastructure. Additional means of generating electricity had to be found as the completion of Consumers Power's Allegan and Hardy Dams in the mid 1930s tapped the remaining significant hydroelectric resources in the state. Accordingly, new, state-of-the-art coal facilities were added to the landscape between 1939 and 1943: Consumers Power constructed four 35-MW units and two 50-MW units, and Detroit Edison expanded existing facilities by 225 MW (EIA 2000).

The installation of these facilities initiated a utilities construction boom that continued uninterrupted for nearly thirty years, fuelled by increased residential, commercial, and industrial consumption and an overall population influx into the state. This prolonged construction effort was responsible for a major proportion of the infrastructure still in use today, especially when the generating capacity itself is considered (Figure 1.2, Figure 1.3). Between 1944 and 1978, Consumers Power added 50 generating units, including the company's four largest facilities, while Detroit Edison added 109 new generating units to its system (EIA 2000). Each facility trumped its predecessor in size and complexity. In 1949, Detroit Edison built its St. Clair plant, which combined with the company's River Rouge facility to produce nearly 2.5 percent of all electricity in the United States. After expansion in 1960, it became the single largest generating facility in the country (Miller 1971, 88). Geographic distribution of the fuel, in conjunction with federal subsidies for its production, ensured that coal and the massive power plants like St. Clair that burned it (Figure 1.4) became the industry standard (Elmes and Harris 1996). Appendix A offers greater details of Michigan's power plant inventory.

The explosion in infrastructure during this time cannot be overstated. Between 1950 and 1959 alone, Consumers Power made over $400m worth of capital additions to its electricity system, an unprecedented sum at the time.

Promotional materials produced by the state celebrated Michigan's vast quantity of power plants (number two in the nation), and rapidly growing

Figure 1.2: Existing generator units by year (after EIA 2008)

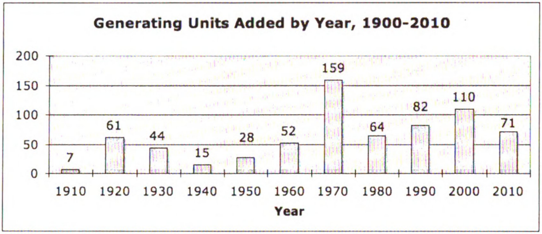
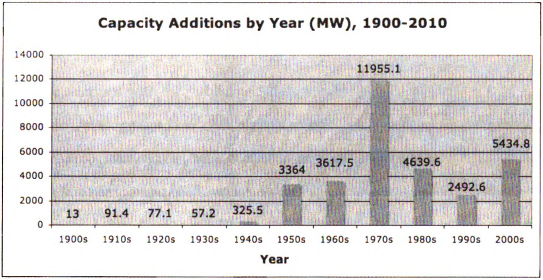


Figure 1.3: Existing capacity by year (after EIA 2008)



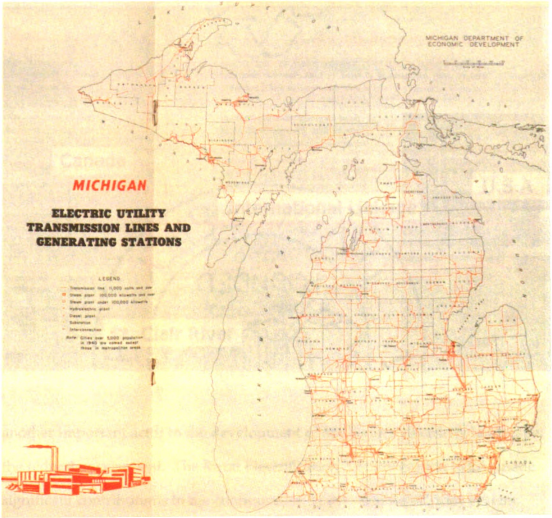
capacity base (sixth in the nation), praising the state's "investor-owned and locally managed power companies," for their "sound policies, progressive leadership, strong financing, forecasting and planning, up-to-date engineering,

Figure 1.4: Detroit Edison's St. Clair power plant. Photo by author (2009).

excellent relations with the public, and civic-mindedness." (MI Dept. of Economic Development 1949) Michigan's utilities had created one of the largest, most technologically advanced electricity systems in the country.

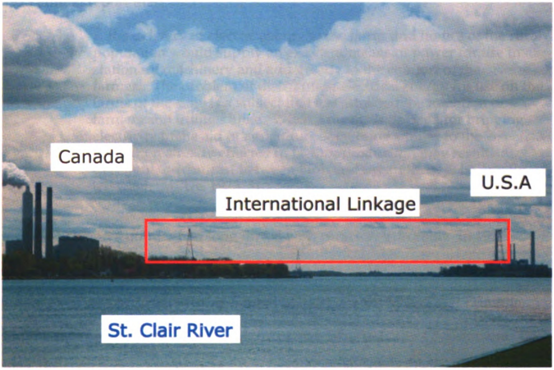
A key component of the state's electricity system was its long-distance transmission network (Figure 1.5). As generating facilities grew in both size and complexity, so too did these linkages between power plants and customers: initially proprietary systems designed to deliver one company's generating capacity to its exclusive customer base, transmission links between Consumers Power and Detroit Edison were established first for emergency purposes in the 1920s, but quickly opened to the wholesale transfer of electricity between utilities by the 1930s. The companies connected Michigan's power supply to utilities in

Figure 1.5: Michigan's electricity system ca. 1950 (MI Dept. of Economic Development, 1949)



Ohio, Indiana, and the Canadian province of Ontario (Figure 1.6), which was in turn connected to upstate New York and the New England states. This integrated transmission network, coupled with the "energy crises" and deregulatory push that characterized the industry during the 1970s and 1980s spurred the move towards "market liberalization." But before discussing the impacts of this era, however, it is worthwhile to pause and consider the role of

Figure 1.6: International transmission link between the U.S. and Canada. Photo by author (2009).



another important actor in the development of Michigan's electricity landscape: the federal government. The Rural Electrification Administration (REA) made significant contributions to the configuration of the state's electricity system, particularly its transmission and distribution networks, and it is to this unique aspect of Michigan's electricity landscape that we will briefly turn.

1.4 Rural Electrification in Michigan

Corporate giants like Consumers Power and Detroit Edison dominated Michigan's electricity landscape through their control of the state's population and industrial centers. But by 1934, fewer than a quarter of Michigan's farms had electricity (Kuhl 1998, 10). The Commission was well aware of the transformative power of electricity on the state's farms, however, noting in its 1923 annual report that

> ...the delivery of electric energy to the farms and homes of the rural population would supply an excellent means of power for use in stationary machinery and add greatly to the comfort of the farmer...The problem of distributing electrical energy for use on the farms of the state is a subject that has attracted the attention of farmers and utilities alike. When a means is devised for bringing electricity to the aid of agriculture something similar to the revolution already effected in factory production may result. Certainly the contrast between farm and urban life will be greatly lessened. (MPUC 1923, 8)

Michigan's utilities had long flirted with rural electrification. In 1927, Consumers Power in association with the Michigan State College (forerunner of Michigan State University) strung 7 miles of line between Mason and Danville, southeast of Lansing (Figure 1.7), but the project attracted only 12 customers. By 1929, the state had approximately 7,000 farms with electrical service (Kuhl 1998, 9), but the majority of farmers interested in electric power were still forced to choose between self-generation (as in the case of large, commercial dairy farms [Figure 1.8]) or a steep premium for the construction of power lines, sometimes in excess of $2,000 per mile. A New Deal-era program, the Rural Electrification Administration (REA), sought to change this by extending low-interest loans to farmers who had organized into cooperatives for the purpose of attaining electricity service.

By 1936, the REA had $6m ready for rural distribution projects in Michigan. Farmers and rural leaders had started organizing rural electric cooperatives (RECs) in 1935, but met stiff resistance from the large investor-

Figure 1.7: Michigan's first rural electric power line. Photo by author (2009)

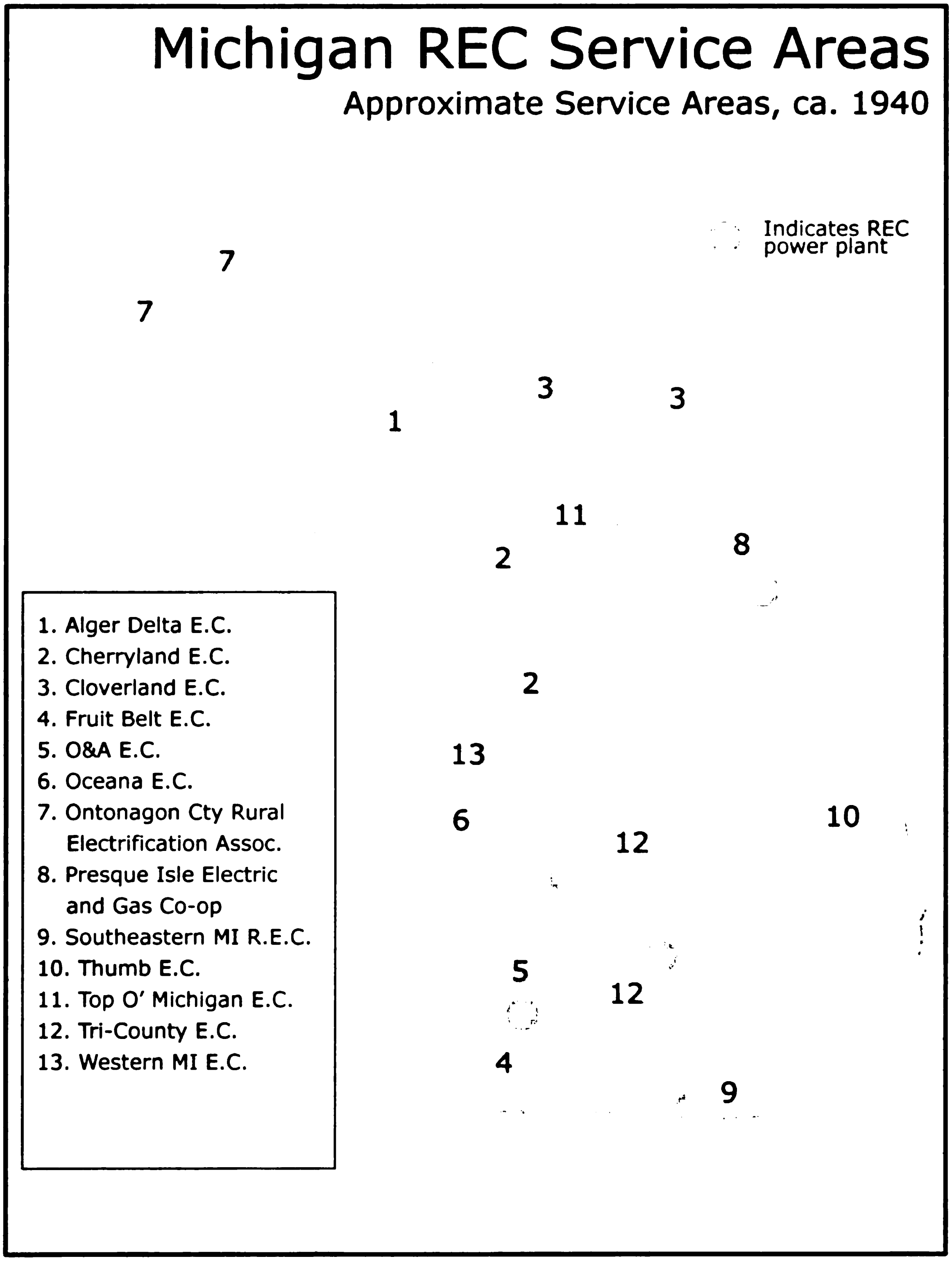
Figure 1.8: One of Eaton Rapids, MI historic dams associated with the town's commercial dairy farm. Photo by author (2009)

owned utilities and their associates. Evidence abounds that Consumers Power and Detroit Edison teamed up with county agricultural extension agents and the Michigan Farm Bureau to actively disrupt several pro-REA gatherings, even resorting to tactics of physical intimidation and violence to break up organizational meetings (Kuhl 1998).

It might be expected that the utilities would resist any perceived encroachment on their turf. But rural electrification in Michigan also encountered political resistance from the regulatory Commission, which in spite of its earlier position, argued against REA money for the state since the rural areas were at least nominally served by the big utilities. Both the MPUC and the governor refused to recognize the cooperatives as utilities, subsequently barring them from accepting loans and selling electricity. But in 1937 the state Attorney General rendered an opinion that RECs are not, in fact, "public utilities" -- they are cooperatives -- and thus not subject to Commission oversight anyway (Kuhl 1998). That same year, RECs started building both distribution networks and generating facilities in the state. In only five years, more than 14,400 km (9,000 mi.) of line had been electrified and over 70 percent of Michigan's farms serviced; some two times the national average (REA 1941a; REA 1941b). Figure 1.9 illustrates the early service areas and generating facilities of Michigan's cooperatives.

By 1950 almost 95% of Michigan's farms were receiving electric service, compared with 77% nationally (REA 1958), and by 1960 that number had reached 99% in Michigan and 96% nationally (REA 1960, 14). The work of making electric power available in rural areas had been completed, but tension remained high between the cooperatives and utilities over two important issues.

Figure 1.9: Service areas of Michigan's RECs, ca. 1940



The first was the "right" of each to serve customers in the areas where service territories met or overlapped. Hearkening back to the early days of electricity service, there were several instances when utilities and cooperatives built parallel sets of distribution lines to reach new customers or else poach from the other company (Kuhl 1998). This situation was eventually resolved in the early 1960s when Michigan's RECs issued a formal request for state regulation, premised on the same "deal" that the utilities had made with the state 30 years earlier, to exchange oversight of rates for a protected service area (discussed further in Chapter Two).

The second, contemporaneous issue was that of adequate electricity supply. As RECs grew in both membership and electricity consumption, securing enough electricity to meet customer demand became an issue of critical importance. Initially, the REA was hesitant to make loans for new power plants, but as the utilities demonstrated their reluctance to sell bulk electricity to cooperatives, the federal agency pursued two new means of strengthening REC systems.

The first tactic was to encourage -- and finance -- the formation of "Generation and Transmission" (G+T) cooperatives, umbrella organizations that would channel larger pools of money into the construction of power plants and transmission systems on behalf of member RECs. Two G+Ts formed in Michigan by the early 1960s: the Wolverine Electric Cooperative (O&A E.C., Tri-County E.C., Western Michigan E.C., and Oceana E.C.) and the Northern Michigan Electric Cooperative (Presque Isle E.C., Cherryland E.C., and Top O' Michigan E.C.). Between the two of them, these organizations added 57 MW of new generating capacity and over 480 km (300 mi.) of high-voltage transmission lines to Michigan's electricity landscape (Kuhl 1998).

Despite these new facilities, rural cooperatives still faced power shortages as electricity usage grew by nearly 14% per year (REA 1959, 1). Michigan's cooperatives sought to meet the rest of their power demand through "power pools" and electricity transfer agreements with each other as well as municipalities within and on the margins of their service areas. In 1968, the G+Ts made a pooling arrangement with Traverse City and the City of Grand Haven to take advantage of the urban-rural demographic swings that affected electricity consumption patterns (Bailey 1979, 420). This also ensured a measure of reserve capacity in the event of an emergency.

The agreement was extended to other municipal systems, and also the Consumers Power transmission system, by 1973. All of the Lower Peninsula's electricity providers were connected to a single transmission network, while the numerous external connections established earlier by Consumers Power and Detroit Edison meant that Michigan's electricity landscape was now fully linked to a broader, regional network wherein electricity produced in one state could theoretically meet demand in another.

1.5 The Era of Market Liberalization

The potential of an electricity marketplace where producers could thus compete on the costs of generation, and consumers could purchase electricity from a wide geographic area, generated significant excitement. This excitement, coupled with new concerns about the environmental impacts of electricity generation, various energy crises (most notably, the "Arab Oil Embargo"), and the experience of regulatory failures like Midland (discussed in Chapter Two), produced the *climate* for changes to the configuration of Michigan's electricity landscape that has characterized the industry from the 1970s to the present day. (Whether or not these changes have been realized is the subject of the concluding chapter of this thesis). This era is frequently labeled as a period of "deregulation" or "liberalization."

"Deregulation" took its first steps in 1978, with the federal passage of the National Energy Act (NEA). Aside from being the first significant attempt at addressing the country's energy policy, it contained several provisions directly affecting the electricity sector. With regards to infrastructure, the most important aspect of the legislation was the Public Utilities Regulatory Policies Act (PURPA), which encouraged small power production, renewable, non-fossil fuels and cogeneration in the interests of environmental protection. Symbolically, it was also intended to loosen the monopoly grip that utilities had enjoyed on electricity markets since the 1930s by introducing generating facilities that were explicitly *not* owned by utilities like Consumers Power and Detroit Edison.

Michigan's regulators took great interest in the proposed changes, particularly with regards to industrial cogeneration (Anderson 1994). The Commission believed that Michigan's huge industrial base -- with over 60,000 boilers registered with the Department of Labor -- would significantly impact both the price and security of electricity supply (MPSC 1982, 15). However, the uptake of both cogeneration and small power production was limited, as was the adoption of non-fossil fuels. Between the implementation of PURPA in Michigan and the passage of the next significant piece of energy legislation just 31 new power plants came online as cogenerators or small power producers,

Table 1.2: Non-utility generating capacity, 1978-1991 and 1992-2000 (after EIA 2000)

<u>**Non-Utility Capacity**</u>	<u>**1978-1991**</u>	
Fuel Type	**Capacity (MW)**	**Number of Facilities**
Biomass	15.4	5
Coal	28.9	1
Hydro	11.7	6
Landfill Gas	12.2	3
Municipal Solid Waste	90.1	3
Natural Gas	1,912.2	9
Other (Fuel Oil, Hospital Waste, undefined)	7.9	3

<u>**Non-Utility Capacity**</u>	<u>**1992-2000**</u>	
Fuel Type	**Capacity (MW)**	**Number of Facilities**
Biomass	117.1	3
Fuel Oil	3.9	1
Landfill Gas	70.6	14
Municipal Solid Waste	22	1
Natural Gas	1157.4	4

representing some 2,219 MW of capacity, or about 8% of Michigan's total at the time (Table 1.2; EIA 2009b). If the outlier of the group -- the massive Midland Cogeneration Venture -- is removed, the amount of new, non-utility capacity drops to only 364.9 MW, or about 1% of the state's total in 1992.

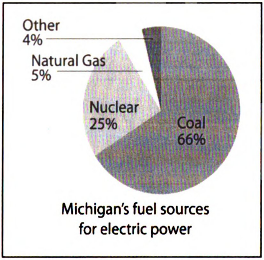
The passage of the federal Energy Policy Act (EPAct) that same year was designed to increase uptake in non-utility electricity generation. The law created a new class of electricity companies free from the cogeneration, fuel, and ownership restrictions imposed by PURPA. Additionally, EPAct gave the Federal Energy Regulatory Commission (FERC) the authority to order uniform, open access to transmission facilities, a process called "wheeling." In theory, the EPAct should have made significant impacts by spurring both construction of new, efficient (technologically and economically) power plants and expanded transmission capacity while also freeing customers to choose their electricity providers based on competitive costs, environmental sensitivity, or any other attribute, rather than their mailing address. In practice, the response to EPAct reforms was as muted as that of PURPA, with just 20 new facilities coming online before the turn of the millennium.

Despite the intentions of the EPAct and subsequent moment of transmission access *perestroika*, the nuts and bolts of implementing the proposed reforms proved far more contentious than anticipated. The MPSC, utility companies, new electricity generation and power marketing companies, and the general public alike all turned their attention towards purchasing and licensing agreements, transmission access tariffs, and the formation of a regional market for bulk power sales. Accordingly, the spotlight moved away from the upgrade and replacement of electricity infrastructure -- despite the fact that some of it was nearing 50 years of continuous use. The fine points of this organizational, financial, and regulatory overhaul, however, are outside the scope of this thesis (cf. Brennan, Palmer, and Martinez 2002; EIA 1993, et al.).

It has been only recently, as the state of Michigan seeks to recover from a string of economic and demographic calamities by capitalizing on "green" development that any interest has returned to electricity generation from alternative and renewable fuels. As of 2002, the governor's office, state legislature, and the MPSC have all promoted programs in this arena, including a statewide renewable portfolio standard of 10 percent for all utilities and a streamlined net metering program to encourage distributed generation. These programs have yet to make a meaningful impact on Michigan's sources of electricity (Figure 1.10).

As the epigraph at the beginning of this chapter noted and Table 1.2 corroborates, Michigan does have a fair number of wood-, biomass-, and solid-waste-powered facilities, and is arguably a national leader in landfill gas capture and conversion technology (Ralph Nuerenberg, Personal Communication 2009; see also Figure 1.11 and Figure 1.12). Yet, the state continues to lag behind others in terms of conventional "clean energy" like wind, solar, and geothermal.

Figure 1.10: Michigan's "Fuel Mix" (after MSPC 2008)



Even as commitments to expand Michigan's renewable infrastructure mount, it seems likely that the state's electricity landscape will continue to be dominated by massive, fossil-fuelled power plants for some years to come. Most studies argue that the eagerness to maintain existing facilities -- despite dubious environmental and efficiency credentials -- and the rush to install easily "dispatchable" natural gas-fired turbines are simply a function of expense relative to other options, particularly renewables (Elmes 1996; Heiman and Solomon 2004; Sovacool 2008). While I do not reject these arguments, I contend that many other factors have coalesced to limit the deployment of renewables in the state, not least of which have been the actions and policies of the state regulatory Commission.

Indeed, the Commission has played a central role throughout the history of Michigan's electricity landscape. The prevalence of massive, centralized facilities and reliance on dirty, imported fossil fuels are the direct consequence of the state's regulatory policies regarding rate of return accounting, electricity pricing, and capacity planning. In order to better understand the infrastructural and organizational features that dominate Michigan's electricity landscape today, it is to an analysis of the regulatory regime that we now turn.

Figure 1.11: Granger Electric's landfill gas collection system. Collectors are laid during landfill construction. Gas is pumped directly to generators. Photo by author (2009).

Figure 1.12: Granger's generators. This facility, along with another near Grand Ledge, provide fully 10% of Lansing's electricity needs. Photo by author (2009).

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Chapter Two

The Impacts of Michigan's Regulatory Regime

The public service commission is vested with the power and jurisdiction to regulate all rates, fares, fees, charges, services, rules, conditions of service, and all other matters pertaining to the formation, operation, or direction of public utilities. The public service commission is further granted the power and jurisdiction to hear and pass upon all matters pertaining to, necessary, or incident to the regulation of public utilities, including electric light and power companies, whether private, corporate, or cooperative.

-- Michigan Compiled Laws, 1939 (Section 460.6[1])

Selected from Michigan's compilation of laws covering utility companies, the above epigraph suggests that the Michigan Public Service Commission's (MPSC, Commission) oversight of electricity provision is, at a minimum, comprehensive. Yet, a number of gaps exist between regulatory oversight and the operations of utilities. The most critical of these is the Commission's inability to approve or deny a utility's construction plans. In conjunction with serious flaws in the nature of the state's oversight -- particularly, a reliance on rate-of-return accounting, variable pricing structures, and the guarantee of territorial monopolies for market incumbents -- the Commission regularly found itself in an awkward role as both protector of electricity consumers and guarantor of utility company finances.

These structural flaws were exposed at key moments in the development of Michigan's electricity landscape, most famously during the hearings tied to Consumers Power's proposed Midland Nuclear Facility in the 1970s and 1980s. However, they had already been worsened by the specific actions and attitudes of the Commission throughout its history, contributing directly to an electricity landscape now dominated by massive, ageing, and dirty fossil-fuelled power plants.

2.2 *The Roots of Regulation in Michigan*

Despite loud and passionate cries to the contrary, governmental oversight of economic activity has a long history in the United States. A U.S. Supreme Court case from the 19th century, *Munn vs. Illinois*, established that government has the right to make rules for, and control prices of, companies that provide public goods like transportation or telegraph service. Subsequent laws, like the 1890 Sherman Anti-Trust Act, authorized the establishment of regulatory commissions to oversee prices and commercial activities in monopolistic environments. The state of Michigan had been drawing on these laws as the legal basis for regulating the activities and prices of railroad services through the Michigan Railroad Commission (MRC), established in 1873. With the passage of the Transmission of Electricity Act of 1909, the MRC was granted oversight of the state's burgeoning electric power industry.

While ostensibly to protect the consuming public, utilities regulation was also intended to stabilize a volatile industry. High construction costs, cutthroat competition, and low margins made financing electricity projects difficult; furthermore, rapid advances in technology made systems quickly obsolete or otherwise inadequate. By 1910, industry leaders like Samuel Insull and Detroit Edison's Alex Dow had publicly argued that the industry ought to exchange control of its prices for a territorial monopoly and guaranteed rate-of-return from a state regulator (Hausman and Neufeld 2002; Yakubovich, Granovetter, and McGuire 2005). The new price for electricity would be determined by the costs of production plus a small profit set by the state -- the so-called "rate-of-return."

In Michigan, shoddy construction practices and accidents associated with booming electric train lines, along with the frequent mergers and acquisitions among utilities were among the initial motives for state oversight. The Commission was given the authority to enforce safety parameters for new line construction, and more importantly, to set the rate companies could charge for electricity in order to prevent monopoly abuses. Documents published by the MRC make it clear, however, that state supervision of the electric utilities' finances was, from the very outset, at least as important as public safety. The MRC published accounting rules which explicitly defined assets, liabilities, and revenue -- along with 30 more pages of detailed instruction on accounting practices for everything from plant maintenance to employee wages (MRC 1914). Not long after, the Commission argued that electricity "is of sufficient importance so that the State should enact regulatory laws which would remove the uncertainty, unfairness, and discrimination that now exists throughout the State." (MPUC 1919, 12)

The subsequent consolidation of all utilities oversight into a single body, along with the assurance that any new capital investments would be made profitable, removed much of the uncertainty that had limited investment in the state's electricity landscape. In terms of infrastructure, Chapter One documented how Michigan's largest utilities grew considerably during the 1920s; Consumers Power through a massive dam building program and Detroit Edison on account of its new coal-fired power plants. Both companies, however, undertook significant organizational expansion as well. Consumers Power's corporate history notes that during the mid and late 1920s, the company enjoyed "a shopping spree among the many, mostly run-down little municipal and privately operated plants in Western Michigan." (Bush 1973, 221) Consumers Power would acquire no fewer than 12 municipal and private systems between 1923 and 1929, tripled the raw number of customers it served, and closed additional industrial contracts equivalent to the usage of 100,000 people. (ibid, 222)

For its part, the Commission encouraged such consolidation, citing the "almost prohibitive rates necessary in communities served by...smaller plants." (MPUC 1923, 7) Accordingly, the Commission noted that

> ...the absorption of distribution areas heretofore served by small, local utilities by the large utilities of the State...has been common. During 1925 the Consumers Power Company acquired the properties of...smaller utilities and have or will bring such distribution districts into connection with their transmission system...By this means only can the benefits of increased efficiency of production by large units be diffused to all the communities within the field of its economical transmission...(MPUC 1925, 6-8)

Because these consolidations resulted in lower prices for customers and greater profits for utilities, the Commission would impede neither company as Consumers Power and Detroit Edison leveraged their new infrastructural and organizational dominance to carve out exclusive service areas in the Lower Peninsula (Figure 2.1). Confident that the Commission's control over

Figure 2.1: Michigan's utility service areas (approximate)

utility company prices would defeat any sort of abusive pricing, the state legislature cemented these exclusive service areas into *de jure* monopolies with the passage of the Convenience and Necessity Law of 1929, decreeing that:

> no public utility shall hereafter begin the construction or operation of any public utility plant or system thereof nor shall it render any service for the purpose of transacting or carrying on a local business either directly, or indirectly...until such public utility shall first obtain from the commission a certificate that public convenience and necessity requires or will require such a construction, operation, service, or extension. (MCL 460.502, 1929)

The passage of this law formalized the regulatory "deal" that Insull, Dow, and others had proposed nearly 30 years earlier: an exchange of price controls for a guaranteed market and guaranteed profit.

2.3 *Key Components of Michigan's Regulatory Regime*

Territorial monopolies influenced the development of Michigan's electricity landscape in an obvious way: in a given service area, all decisions regarding new construction, operating procedures, and other aspects of electricity provision were left to the discretion of a single company. Less obvious -- though even more influential -- are the ways in which "rate-of-return" accounting and electricity pricing schemes ultimately shaped the configuration of Michigan's electricity landscape.

Underlying all three factors is the logic of the "natural monopoly." Because of its capital-intensive nature, electricity service is frequently offered as an example of a natural monopoly, which can be understood as a situation wherein resources in the market for a certain good or service are most efficiently allocated when only one seller is present. With regard to the provision of electricity, it is argued that customers would be better served if the costs of duplicating another company's distribution infrastructure (wires, poles, and meters) were instead spent on the construction of new, more efficient generating facilities. With only one seller present, a larger pool of customers could distribute these costs, and thus benefit from lower per-unit electricity prices achieved through an economy of scale. The 1929 Convenience and Necessity Law implementing territorial monopolies served as the state's endorsement of the natural monopoly logic.

In exchange for that protected market, utility companies handed over control of the prices they could charge for electricity. The ratemaking procedure in most states, including Michigan, was based on a simple formula -- the cost of generating the electricity and getting it to the end user, plus a small profit. The profit, or rate-of-return, would be a percentage determined by the state regulator based on an accounting of utility investments in infrastructure. In Michigan, the Commission could also approve or deny utility requests to raise money through equity or debentures. Requests for either rate adjustments or the flotation of new shares would be followed by the utility company's presentation of its recent costs, changes in demand for electricity, and capital expenditures. These figures would then be compared with the MPSC's estimates of the same, and a new rate, block of shares, mortgage, or bond issue would be approved or denied.

The Commission also supervised the collection of revenue, approving rate structures for different classes of customers (residential, industrial, etc.). In the first part of the 20th century, Consumers Power and Detroit Edison sold electricity at a flat monthly rate to customers regardless of how much they used, since metering technology had not yet been adopted. Once meters came into wide use, flat rates were replaced with a "declining block" structure, where electricity costs less, per unit, after certain thresholds are passed. In order to achieve the cheapest price per unit, the user must consume increasing amounts of electricity. In the interest of economic growth, the Commission also regularly approved special prices for large energy users (typically heavy industries), wherein the recipient paid far below the retail price for electricity (e.g MPSC 1962).

This regulatory regime functioned exactly as designed during the boom years of electricity system growth. Between 1920 and 1960, electricity consumption increased amidst falling prices as utilities achieved economies of scale through the construction of numerous large generating facilities. As utilities acted to meet surging demand, Michigan's regulatory structure streamlined the planning process. The Commission had no say in individual utility projects, meaning that with appropriate financing, companies could begin construction on new facilities confident that all costs would be recovered later through the ratemaking process. New efficiencies prompted the state Economic Development Office to boast that "even the smallest savings...are passed on to customers." (MI Dept. of Economic Development 1949) Such public pressure from the Commission and other arms of the state government to keep electricity prices low encouraged utility companies to continue taking risks on increasingly massive, complex generation and transmission projects.

The physical characteristics of electricity meant that new economies in electricity production had to be matched by greater consumption -- electricity cannot be stored for use at a future time. Utilities had no problems matching supply to demand since overall consumption was rising on account of a growing customer base (due to a general population influx) and proliferating linkages between utility companies permitting the bulk transfer of power between transmission systems. Nevertheless, Consumers Power and Detroit Edison actively encouraged consumption by subsidizing appliances, even offering in-home demonstrations for using electric ovens, refrigerators, and microwaves (Bush 1973; Kuhl 1998). Consumer Power's corporate history cites the importance of appliance sales "less as a direct profit function than as a means of stimulating additional power consumption." (Bush 1973: 213) In many cases, these appliances were paid for in monthly installments through the regular bill, and customers were given a price break on the electricity needed to operate them (c.f. MPSC 1961 for an example of special rates for electric water heaters).

While many companies make promotional offers to generate sales, the problem with regulated utilities offering such incentives is that it produces an artificial build-up in demand. By inflating the amount of electricity that consumers used, either through direct subsidy or by penalizing them for conservation (as in the "declining block" price structure), utilities easily justify the expansion -- and expenses -- of new infrastructure. As the late 1960s saw the first of many economic problems unfold in the state, suppressing consumption of electricity, a significant gap between supply and demand appeared that no level of subsidy or bulk transfer of power could close. By 1974, electricity demand actually declined for the first time since the Great Depression (Anderson 1994), yet, curiously, the state's utilities continued plans for new capacity unabated.

This is attributable directly to the structure of Michigan's regulatory regime. The rate-of-return accounting system central to utilities oversight elevated capital expenditures like plant construction and depreciation to the utmost importance, making any challenge or limit to the construction program a frontal assault on a company's long-term financial health. In rate hearings, the Commission made precisely this argument, claiming that any move to withhold or deny rate increases would seriously endanger Michigan's supply of electricity (e.g., MPSC 1978a, 18-19). Accordingly, the only means by which companies could maintain profitability -- and literally, keep the lights on -- was to invest in new, progressively larger, and more expensive pieces of infrastructure, *even if they could not be justified to meet actual demand.*

Perversely, the MPSC's repeated commitment to low prices precluded the state's utilities from simply charging more per unit of electricity as a means to maintain revenue amidst falling demand (MPSC 1972). At any rate, there was no incentive for utilities to either temper demand or make transmission more efficient anyway, in spite of the obvious savings found in deferring new construction, since their short-term revenue was based entirely on the sale of electricity.

The Commission's awkward position as both protector of electricity users and guarantor of the utilities' financial health snapped sharply into focus during the late 1960s. Nowhere is this issue, nor the linkages between rate-of-return accounting, territorial monopolies, electricity pricing, and the development of the electricity landscape better illustrated than in the cases surrounding Consumers Power's proposed Midland Nuclear Facility, a 15-year episode costing all parties involved several billion dollars.

2.4 *The "Midland" Hearings*

By the late 1960s, Consumers Power's total revenues for electricity had increased by 71.5% over the past decade, on account of an increasing customer base and greater sales to cooperatives, in spite of the fact that per-unit prices for electricity continued to fall (Anderson 1994, 113). The company looked to continue this trend as it built its third nuclear facility near Midland, Michigan. Slated to be one of the largest power plants in the country, it was designed to supply not only electricity but also industrial steam to nearby Dow Chemical -- a first for an industry that had described cogeneration as "dream" that "died hard." (Miller 1971, 149) Consumers Power indicated that it needed more money to combat the effects of inflation, and so approached the MPSC in 1968 seeking the first in a series of rate increases (Table 2.1), arguing that the costs of new generating facilities were no longer matched by increasing sales and an expanding customer base (MPSC 1969). Additionally, the company's previous nuclear project, Palisades, was over-budget and plagued by delays, dragging down the company's balance sheet.

This was one of the first instances in which the Commission was forced to consider a rate increase for the price of electricity, suggesting that economies of scale for new power plant construction had been tapped out. The MPSC agreed that the rate increases sought by Consumers Power were in many ways the product of inflation and higher construction costs, but also a direct result of the company's emphasis on building large, complex facilities (MPSC 1974a, 27). The Commission also noted that these problems were magnified by the company's rate schedules, which were still dominated by "declining block" pricing, as well as its special industrial contracts (ibid; MPSC 1978a). Fearing the worst,

Table 2.1: Rate hearings surrounding Consumers Power's Midland Nuclear Facility

Case #	Year	Consumers Power Request	Outcome
U-3179	1969	$16m rate increase	$16m increase approved
U-3749	1970	$28.5m rate increase	$10.6m increase approved
U-4174	1972	$56m rate increase	$29m increase approved
U-4324	1973	15% increase on rate of return	Request Rejected
U-4332	1974a	$36m rate increase	$31m increase approved
U-4576	1974b	$72.2m rate increase	$56m increase approved
U-4840	1976	Interim "rate relief": $66.8m Final rate increase: $106.6m	$34m total increase approved
U-5353	1977a	Issue 500,000 shares of stock and $125m worth of first mortgage bonds	Approved
U-5388	1977b	Issue 3.5m shares of stock	Approved
U-5438	1977c	Issue: 1) $75m unsecured note 2) 2m shares of preferred stock 3) $46m worth of Pollution Control Revenue Bonds	All approved
U-5331	1978a	$164.2m rate increase	$55m increase approved
U-5734	1978b	Issue up to $60m worth of bonds	Approved
U-5979	1979	Step 1: Interim "rate relief: $52m Step 2: $195.3m rate increase Step 3: $124.7m rate increase (upon	$70.3m total increase approved, Steps 1&2 $97.4m increase approved when plant comes online

Table 2.1, Continued

		completion of Campbell 3 coal plant)	
U-6923	1982a	Interim "rate relief": $172.5m Final rate increase: $339m	$120.5m total increase approved
U-7263	1982b	Issue $30m worth of Pollution Control Revenue Bonds	Approved
U-7830 (et seq.)	1983-5	Step 1: Interim "rate relief: $155.8m Step 2: $212.4m final increase Step 3: $564.3m rate increase (when Midland 2 comes online)	$94m per year, for six years, rate increase approved *Note: This order intended to stave off the company's impending bankruptcy*
Totals		**Rate Increases:** $1.9bn **Bonds and Securities:** $336m	**Rate Increases:** $1.08bn **Bonds and Securities:** $336m

however, the MPSC argued that "if there is to be sufficient electric energy available to the citizens of Michigan, it is essential that all parties soberly address themselves to...finance the new construction which the public requires." (MPSC 1972, 26) Accordingly, the Commission assented to the rate increases, claiming that "it must continue to pursue responsible regulatory policies which will ensure an adequate supply of electricity in the future." (MPSC 1978a, 17)

During these hearings, the Commission allowed for the first time "projected-data test years" as evidence for the plant's necessity: Consumers Power could present estimated *future* costs and electricity demand as justification for a rate increase *now*. In spite of the recent negative trends, the company (perhaps unsurprisingly) forecast a significant increase in both. The state Attorney General and others vehemently disagreed, arguing that the company's forecasts were outright wrong -- and had been for some time; that the Midland facility was un-necessary to meet demand; and that it should be excluded from any rate increase considerations (MPSC 1978a).

The Commission admitted that

> ...the Applicant's [Consumers Power's] past forecasts have often been too high. However...it does not necessarily follow that because previous forecasts were too high that the present forecasts are likewise too high.
>
> Perhaps even more important, even assuming Applicant's forecasts are somewhat high, it does not follow that the Midland project is unneeded and therefore an imprudent investment to be totally excluded from the rate base...The Midland project is designed to be a major baseload plant and if it runs properly it should provide power at a price which is comparable to many other units (MPSC 1978a, 18).

The MPSC returned to the argument that blocking utility construction plans (in this case, the Midland facility) would have dire implications for electricity service into the unforeseeable future,

> ...not only for the Applicant's retail customers but also for the whole State of Michigan. Moreover, the forced abandonment of all of the Midland plant would be a financial disaster for Applicant [Consumers Power] and would seriously compromise Applicant's ability to finance any additional construction, including coal-fired and cogeneration facilities. Finally, to the extent that the financial community perceived the Commission as acting irresponsibly by enforcing the abandonment...all other utilities in Michigan would have increased difficulty in financing their construction projects. (MPSC 1978a, 18-19)

In spite of the rate increases and approved securitizations, Midland's costs had exploded to over $3bn and by 1982 Consumers Power was facing a financial meltdown. The company's credit rating had been downgraded and securing external financing was all but impossible. Couched in the terms of an overall rate *decrease* when the plant came online, the MPSC, "Although...not bound by the actions of Wall Street," approved a massive $120.5m *annual* rate increase, essentially co-signing the loan, on the state's electricity users' behalf, to continue work on the Midland project (MPSC 1982a, 8).

Outraged, the state Attorney General argued that "the awarding of...relief can do irreparable harm to the consumers' interests" and asserted that Michigan courts "require that this Commission perform a balancing test between the interests of the investor and the ratepayer." (MPSC 1982a, 5) Even one of the MPSC's own commissioners, Edwyna Anderson, dissented from the majority opinion, accusing the others of sticking their "heads in regulatory sands" and arguing that "the majority [of MPSC Commissioners] have created a void that will enable any utility company to show it has an immediate revenue deficiency and thus automatically receive partial rate relief monies." (Anderson 1982, 19; 2).

Anderson directed the spotlight squarely to the issues that advocacy groups, the Attorney General, and even private citizens had been decrying for years, noting that

> ...over the last several years, up to and including today, the Commission has failed to undertake a comprehensive review of that massive construction project...Nowhere in 14 years, according to the record, has an Opinion been issued concerning whether:
>
> 1. The Midland plant continues to be needed,
> 2. The plant is cost efficient,
> 3. Construction costs overruns are justified,
> 4. There are viable alternatives for energy generation at Midland,
> 5. The Commission should place a cap or ceiling on construction expenditures for this plant, and
> 6. There may be extreme rate implications to all Consumers Power Company customers once Midland comes on line.
>
> ...the Michigan Public Service Commission...does not examine these relevant issues before or during construction. Instead, it allows a utility company's investors to put millions, or in this case, billions of dollars into facilities that it claims will be evaluated for viability at the time a company requests inclusion of such facilities in its rate base.

> The majority says such issues should be examined in power plant siting proceedings, not securities proceedings. Yet this state has no power plant siting legislation and thus no such proceedings. (Anderson 1982, 8-10)

Anderson described the Midland project as an "albatross around Consumers' [Power's] neck" and demanded a "comprehensive review of the construction of this plant and its attendant problems." (Anderson 1982, 12) As it would happen, however, the review never took place. In 1983, Consumers Power teetered on the brink of bankruptcy, threatening to halt electricity and natural gas service to most of the state. The MPSC took emergency action to stabilize the company's finances, ordering a six-year, $99m per year rate increase, on the condition that the company officially abandon all work on the Midland facility (MPSC 1985).

After 15 years of construction delays, $4bn of cost overruns, *and more than $1bn of Commission-approved rate increases and securitizations*, the remains of what would have been among the largest nuclear facilities in the U.S. was sold at 85 percent completion to a consortium of buyers (including a Consumers Power subsidiary) who would later transform the facility into the massive Midland Cogeneration Venture. Testimony presented by various advocacy groups as well as the state Attorney General during this hearing again argued that "Consumers' forecasts of electricity sales were seriously flawed," and that "new capacity would not be required before the year 2000...additional need could be covered by purchased power, refurbished existing power plants and cogeneration, each at a much lower cost than new construction." (MPSC 1985, 15)

Nevertheless, shortly before the bailout orders were in place, the largest coal-fired unit ever built in the state -- Campbell III, another Consumers Power project -- came online. Not long after, Detroit Edison's Enrico Fermi II project started up as the state's second largest nuclear facility. These massive, complex generation facilities are just a portion of the infrastructure glut that continues to impact the state's electricity landscape today, and are the direct consequence of a regulatory regime which punished both technological and fiscal efficiency.

The tripartite combination of rate-of-return accounting, wasteful electricity pricing schemes, and territorial monopolies represent the most potent forces shaping the historical development of Michigan's electricity landscape. Rate-of-return accounting encouraged utilities to continually add new infrastructure, while electricity pricing policies like the "declining block" (which remained in place in Michigan until 1978, cf. MPSC 1974a; MPSC 1978a) provided the avenues by which to match increasing electricity production with additional consumption. The territorial monopolies implemented by the state to ease companies' financing concerns also eliminated any sort of backstop electricity system (in the form of a competing service provider) should the company fail.

The inevitable outcome of this scheme, as witnessed in the Midland hearings, is that neither customers nor utility companies are adequately protected from exploding costs, while the landscape is polluted, both literally and figuratively, by extraneous infrastructure. Concerns were raised about the sustainability of the rate-of-return model as early as the 1960s (Anderson 1994), yet it remained in place, virtually unmodified, through the mid 1990s. In order to understand this, we must examine the societal context underlying and surrounding its continued use: namely, the idea of "progress."

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Chapter Three

The "Progress" Paradigm

Thus, energy output is the basis (and a measure) of a nation's standard of living, not because of gadgets like electric toothbrushes and can openers, but because of the productivity it generates.

-- George Bush, Future Builders, 1973 (10)

The exterior of the plant showed clearly its form and purpose, and no effort was made to give it artificial beautification. The external walls were metallic, with pre-attached insulation for speedy and economical construction. It was frankly a machine, designed to utility and built to stand in a world of work. To many, the angular functional approach proved to be artistically successful as well.

-- Raymond Miller, The Force of Energy, 1971 (89)

Michigan's utilities were eager to meet surging demand for electricity, and thereby revolutionize both industrial activities and private life. Electric cooperatives, as well as their parent organization, the REA, desired the same for the U.S.' rural areas. Many would argue that both parties were justified in their pursuit of large, high-capacity power plants and interconnected transmission facilities, and that the MPSC's policies contributed directly to these goals while maintaining generally low prices. The implementation of mandatory electricity conservation, distributed generation, or renewable fuels would only have served to make power -- and its myriad benefits -- more expensive.

At the same time, arguments like these in defense of the current configuration of the electricity landscape overlook several obvious questions regarding efficiency, the environment, and the wisdom of centralized services. For instance, considering that the Commission's legal charge emphasized protecting customers from abusive pricing, why was the inefficient "declining block" pricing structure maintained for as long as it was -- since most users never attained the cheapest per-unit prices, thus paying above their true costs of service? Or, for what reason did utilities, cooperatives, and the Commission alike avoid the adoption of smaller-scale generating technology that relied on indigenous fuels, such as wood residues and wind, instead preferring to pay increasing production and transport costs for the imported fossil fuels that Michigan's power plants required (and represent nearly 70¢ of every "energy dollar" spent in the state [MPSC 2008])?

The answer is that the aforementioned parties shared, as a fundamental guiding principal for all operations, the pursuit of "progress." While themes of "progress" are by no means uncommon in histories and geographies of infrastructure in the West (cf. Berman 1982; Mitchell 1988; Brigham 1998; Scott 1998; Wainwright 2008 for just a handful of examples.), there is a particular notion of "progress" that shaped Michigan's electricity landscape. This idea, developed and propagated by the utilities, cooperatives, and regulatory Commission alike up through the Midland crisis, linked the deployment of *centralized, complex, and massive* electricity infrastructure with Michigan's social advancement. The impacts of this program continue to affect the state today.

3.2 *Origins of the "Progress" Paradigm*

This particular idea of "progress" can be traced all the way back to the industry's earliest days in the state. Promotional material from the company that would later become Consumers Power promised customers "nights as bright as day" and that "every street will have its own moon regardless of the weather" by the turn of the 20th century, on account of the company's plans for tower-mounted street lighting in Jackson (Bush 1973, 48). Early regulatory commissioners argued in favor of utility consolidation as well as the construction of large hydroelectric projects because of the "advancement of the general welfare of the State" that would result (MPUC 1925, 8). As the rural electrification movement gathered steam, the benefits that electric power brought to U.S. industries were promised as well to the farmer, who "still depends in too large a degree upon manual labor." (USDA 1939) Electrification was made to be irresistible, and adapting it to farm use inevitable, since a farmer whose "brawny back is his power plant...cannot compete with electric motors." (ibid.)

As the electricity landscape grew and consumption increased, the flowery prose (and even songs -- Figure 3.1) highlighting electricity's potential to transform both rural and urban economies gave way to thoroughly Modern paeans celebrating the vast social change it was bringing about and impatience towards those who might stand in the way. Detroit Edison's corporate history describes the post-War construction boom as emblematic of the fact that the utilities "had an interest in recreating a world of order" (Miller 1971, 297), hailing the "mystery and an excitement about the power plant. The cathedral like vistas, the awesome might and majesty of the flaming furnace, and, above all, the turbine generator room, where almost unbelievable power is marshaled in

Figure 3.1: The Song of Croton Dam (National Park Service, no date)

The Song of Croton Dam

lyrics: H. Vander Ploeg, Holland, MI
tune: "Marching Through Georgia"

Sing a song of Croton Dam
the biggest in the State.
Where the water sizzles through
and things are up to date.
Sing it with a hearty cheer
as long as you can make
While we are riding to Croton.

***Chorus**: Hurrah! Hurray! We shout for Croton Dam.*
Hurrah! Hurrah! The biggest dam what am.
And so we shout the chorus of the dam
that gives us light,
As we are riding to Croton

How the water dashed o'er
the dam that fills the creek.
How it surges through the gates
that sends it on its work
How the wheels are turning
as the water rushes through
While we are riding to Croton

Chorus

Oh, the power, the light, the heat
that dam does furnish us.
Oh, the industries that hum
that feel the electric touch
Oh, the cities that are built
Where'er the power is used
While we are marching to Croton

Chorus

dramatic orderliness." (ibid, 105) New power plants represented "milestones of progress, not only for the utility company that built the plants, but even more so for the people, for the consumption of electric power is a measure of the nation's standard of living: power means prosperity." (Bush 1973, 341)

Cooperatives and their parent agency, the REA, made strikingly similar arguments:

> Electricity takes its place in the natural evolutionary progress made by man in his efforts to produce sustenance from the soil. It has not been grafted artificially on to our rural way of life...The farmer has come to recognize, as a result, that electricity offers one means by which he may catch up and keep pace with technological advances in industry...[and] a chance for survival on many hundreds of thousands of family-size farms. (REA 1944, 18)

In more grandiose terms, "The wheels of progress are turned by power. It is the thing that sends civilization forward...Always tireless, always on tap, electricity offers farmers greater opportunities for economical and diversified production than any other force available." (REA 1947, 33)

Even the literal brick-and-mortar construction of new generating plants and distribution systems was shot through with glory. An experimental pumped-storage facility on Lake Michigan near Ludington, co-financed by Consumers Power and Detroit Edison, was described as "almost unequalled as an earthmoving job since the Panama and Suez Canals were built." (Bush 1973, 418) Skeptics were quickly dismissed, awash in a "tepid sea of essential miscomprehension." (Bush 1973, 440) Not to be outdone, the REA claimed that "Rural Electrification is a form of modern pioneering. The men who clear the rights-of-way for today's cross country power lines are but extending the work of their forebears who tamed the early wilderness." (REA 1947, 30) The importance of this work could not be overstated:

> The cooperative is part of the important legacy that has come to us from the old frontiers of American development. It is one we as a Nation will do well to preserve and strengthen as we move ahead on the new frontiers. The rural electric cooperatives stand today as one of the vital institutions of rural democracy. In a Nation of rapidly changing population patterns they offer a means of carrying over into the more complex...communities of the present and future the spirit of basic democracy from which they grew. (Clapp 1963, 12)

It may seem as though the advances wrought by electricity were only truly realized in those domains of men; in heavy industry, intensive agriculture, and hard-nosed civil engineering. This, however, is highly inaccurate: "to the housewife," the new wave of appliances made possible by electricity "constituted the welcome beginnings of domestic emancipation." (Miller 1971, 120) Such a paternalistic attitude might be expected from a company (Detroit Edison) that through the late 1950s, fired, without exception, any female employee engaged to be married. But the strongest proponent of the "electricity as liberation" argument was the REA, which printed dozens of "home-economics" guides for using electricity, such as *The Electrified Farm of Tomorrow* (1939), *Electricity for the Farm through REA* (1940), and *A Better Home* cookbook (1941, Figure 3.2). Electrification, and conveniences that came with it was "an occasion ranking with the stature of the feasts of Thanksgiving and Christmas." (Kuhl 1998, 39)

Much of this gendered, social boosterism was undoubtedly the result of attempts to build demand, as suggested by the subsidy on new appliances that many utilities offered to their customers. However, the premium that

Figure 3.213: Cover, A Better Home (REA 1941).

"progress"' placed on raw growth, economic prosperity, and imposing physical infrastructure translated through a typically grandiose tone and agreeable regulatory Commission to make real impacts on Michigan's electricity landscape.

3.3 *The Development and Impacts of "Progress"*

It would be easy to dismiss the self-righteous concern with "progress" as nothing more than hubris. However, an uncritical belief in the correlation between the consumption of electric power, economic prosperity, and social advancement directly and significantly affected Michigan's electricity landscape, and most importantly, was shared by utilities, cooperatives, and the Commission alike. With specific regards to infrastructure, the pursuit of "progress" in the context of the state's regulatory regime led to both a massive surplus in generating capacity and a highly centralized electricity system, as well as the associated heavy reliance on imported fossil fuels.

Both outcomes centered on the concept of scale, and in particular, the economy of scale: in a direct equivalent to manufacturing, it was believed that the production of greater quantities of electricity would result in lower per-unit prices, which in turn would spur greater consumption and thus social advancement. Accordingly, utilities and cooperatives were interested in expanding the capacity base as quickly as possible. By 1949, the state Economic Development Office boasted that utility-owned generating capacity already exceeded "any load ever experienced or anticipated" by 15 percent, and promised that "by 1952, generation capacity will be expanded by another 15 percent" (MI Dept. Economic Development 1949).

The utility companies argued that some slack was necessary to meet unforeseen spikes in consumption. The surplus was crucial, and even

> defined the [Detroit Edison] Company's obligation, for if the electricity cannot be stored neither can it be improvised. For 3, 4, or even 5 years, the planning, financing, and building of the entire system had been aimed at this one 15-minute period in a late December afternoon, or in a summer heat wave. (Miller 1971, 172)

This practice was regularly endorsed by MPSC, and rightfully so: the electric power industry standard for reserve capacity hovers around 10 percent. However, the Commission oversaw the creation of extreme surpluses, in spite of the fact that financing extraneous capacity lie at the heart of the utilities' problems, as exemplified in the Midland Nuclear Facility hearings.

With Midland,

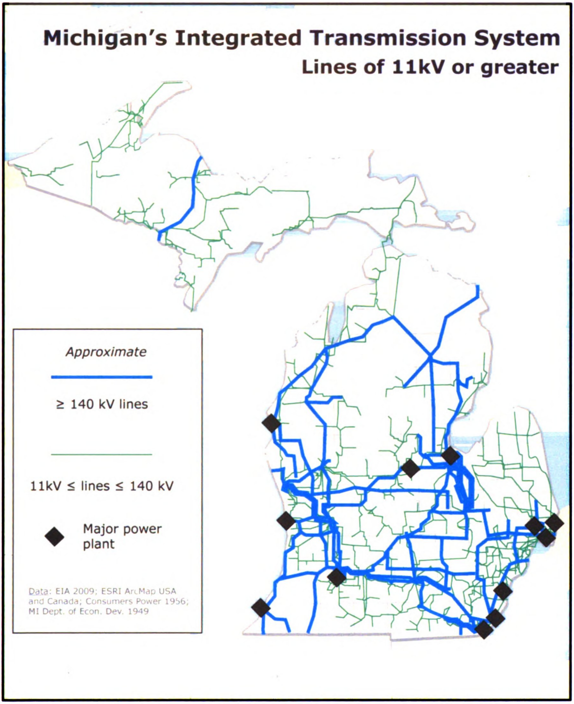
> Consumers' own data point to its substantial excess reserve capacity. It shows that Midland units 1 and 2 will generate approximately 1350 megawatts of electricity as they come online in 1984. **This data indicates a 35.4% excess <u>summer</u> generating capacity (1842 MW) and a 56.6% winter generating capacity (2323 MW) are anticipated for 1984.** In 1985, projected excess capacity increases to 38.3% (2113 MW) during the summer and 50.1% (2609 MW) in the winter.
>
> Additionally, all demand forecasts are based on <u>increasing</u> electric usage, which currently is not taking place...If such demand increases do not materialize then reserve capacity percentages will be even greater. (Anderson 1982, 9; **emphasis added**)

Nevertheless, the shared vision of "progress" in the context of Michigan's regulatory regime led the Commission to defend its position on the project's financing with the claim that "a temporary minor overcapacity would not be a justification for excluding the plant from the rate base." (MPSC 1978, 18)

The massive glut of excess generating capacity went hand-in-glove with the centralization of the electricity system, as revealed in two distinct ways. First, in the formation of a fully-integrated transmission network (Figure 3.3; and second, with the consolidation of generating capacity in fewer, and larger, power plants. Organizationally, control of Michigan's electricity landscape has also become more centralized over time, despite the illusion of "market liberalization," through various mergers and buy-outs. However this is largely a function of the aforementioned infrastructural centralization than any other factor.

Interest in the development of a comprehensive electricity system began early. As new dams and power plants came online, "high-voltage power sources could be utilized to supply distant communities, and by the same token the

Figure 3.3: Michigan's integrated transmission system (approximate)



electrical services in these communities could be interconnected," with these transmission linkages "forming a network of usefulness for the citizens of Michigan." (Bush 1973, 83) The "network of usefulness" precipitated the buyout of small utilities by larger ones, according to the Commission, "invariably with a view to extend their markets for [electric] current which they are unable to produce beyond the demands they have for utilization..." (MPUC 1925, 7)

Cooperatives also expressed great interest in wide-ranging transmission networks. As early as 1939 -- just four years after its inception -- the REA had plans for "by far the longest cooperative generating system in the world" in Wisconsin (REA 1939, 91). That same year in Michigan, the Tri-County E.C. was praised by the REA for its "interconnected system with at least six generating plants and in excess of 3,000 miles of distribution lines," designed to "ultimately serve perhaps 10,000 rural families." (ibid, 92) Administrators claimed that "the maximum benefits from the industry can come only from a high degree of cooperation and coordination among its various segments -- commercial, cooperative, and public," (Clapp 1963, 14) linked through the transmission system.

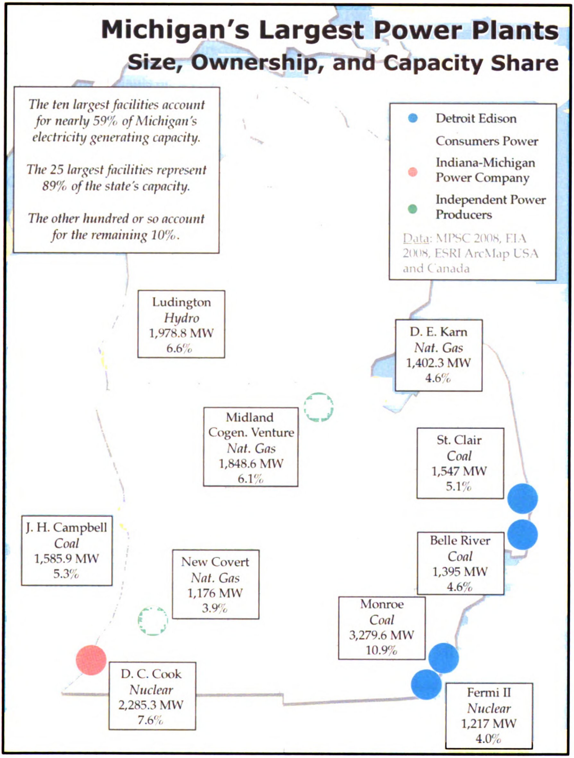
Likewise, Michigan's major utilities pursued centralization policies through the interconnection and pooling of resources. The completion of Consumers Power's Au Sable dam complex and subsequent connection to the company's transmission network "fulfilled a vision that the two brothers [the Foote brothers, founders of Consumers Power] had had all along -- that of an interconnected system, operated on a system-wide basis." (Bush 1973, 161) By 1928 the company forged a transmission linkage with Detroit Edison, initiating a decades long "search for economies from pooled reserves, the mass production of electrical energy, and...jointly planned extensions." (Miller 1971, 206)

Though they would remain distinct business entities, the merger of Consumers Power and Detroit Edison's systems shifted control of Michigan's electric power market from a duopoly to essentially a monopoly, for while "in administration and financial matters, the integrity of the two companies was complete...in operating matters, involving current supply of bulk power, transmission, and planning for future growth, the entire two systems were to be operated as one." (Miller 1971, 194). A "joint dispatch center" was established near Ann Arbor in 1962, from which power plants, transmission lines, and other facilities belonging to either company could be remotely operated.

Yet it was not only the ownership and operation of entire electricity systems that was being centralized, but also the physical production of electric power within those systems (Figure 3.4). As early as 1939 the REA noted this ""tendency...toward large-scale developments -- power plants...serving more than one system" among its utility company competitors (REA 1939, 89). In Michigan, this was certainly true: by 1956, while Consumers Power operated 50 power plants in the state, more than 90% of all the electricity the company generated was produced at its four largest facilities (Consumers Power 1956, 1)

Not long after, the REA itself began "moving with the technology of the industry toward larger scale generation, which offers lower costs," (Clapp 1962, 5), claiming that cooperatives "will have to build generating plants of larger capacity than ever before...[and] construct higher voltage transmission lines which will interconnect with the facilities of neighboring systems." (REA 1965, 4). In 1968 alone, more than 2.5GW of REA-funded capacity was under

Figure 3.4: The centralization of generating facilities.



construction, more than the combined total of all cooperatively-owned capacity built in the Administration's 27-year history (REA 1968, 6). Michigan's RECs and G+T cooperatives were not directly responsible for the construction of any such massive power plants on account of the purchasing agreements they had made with the state's other providers of electricity. However, they still contributed to this centralization by channeling REA funding into Detroit Edison and Consumers Power projects like the Enrico Fermi II nuclear facility and Campbell III coal plant, respectively (Bailey 1979). The cooperatives' contribution to Fermi II topped $220m, equating to a 20% stake in the second-largest nuclear project in the state (Kuhl 1998).[1]

The "progress" paradigm dominated utility, cooperative, and regulatory thought in Michigan through the 1980s, contributing to a centralized and massively overbuilt electricity landscape. However, as the financial and regulatory crises surrounding the Midland Nuclear Facility unfolded, many started to question the logic of increasing electricity consumption and its links to economic and social advancement.

3.4 *Challenges to the "Progress" Paradigm*

In the context of financial disasters like Midland and later, Detroit Edison's Fermi II, greater public concern with Michigan's electricity landscape was forthcoming. Equally forthcoming was a new tone from the MPSC, which was forced to admit to the flaws in the regulatory regime that had become

[1] As the costs of the project skyrocketed, the cooperatives' ownership share was eroded to 10%, and then eventually 0% as Detroit Edison reached an agreement to buy out their stake for $550m in the early 1990s.

apparent during the Midland episode. New attention from both the public and the MPSC focused on three distinct, yet interrelated concerns: the cost of the electricity system, its impacts on the natural environment, and electricity conservation. All of these concerns hinged on the recognition that Michigan's electricity landscape had been over-built, and that supply would outstrip demand for many years to come.

The impetus for change can be first spotted during the hearings related to Midland. Shortly thereafter the state Department of Commerce organized the Michigan Electricity Options Study (MEOS), a multi-year undertaking with the express goal of "making economically sound judgments...for meeting Michigan's uncertain electricity needs over the next 20 years." (MEOS 1987a, 1-1) The central component of the MEOS was determining the "least cost" options for meeting demand, where

> Least-cost is defined as the lowest cost (i.e., economic cost that can be stated in dollar terms) to Michigan individuals and businesses (i.e., 'societal' versus 'utility' costs) under specified constraints (e.g., financial, regulatory, etc.) and specific assumptions about the future (e.g., contextual factors such as rate of demand growth, changes in environmental emissions limits, et.). (MEOS 1987b, 3 emphasis and parentheses in original)

In addition to a consideration of the costs for future electricity planning, MEOS represents one of the first considerations of the electricity landscape's environmental impacts, including explicit references to global warming and even a calculation that Michigan's electricity sector accounts for 0.85 percent of global carbon dioxide emissions and 0.34 percent of global fossil fuel usage (MEOS 1987a, 6-18). Accordingly, the study paid particular attention to options for meeting demand with minimal recourse to the expanded consumption of fossil fuels, and especially through electricity conservation ("Demand-Side Management", DSM). Given Michigan's capacity surplus, the study found that DSM could play a central role in offsetting future demand growth, and "may well be able to provide up to 20% or more of the incremental resource requirements...for capacity and generation over the next 20 years. Demand-side options were found to be important within all the resource scenarios..." (MEOS 1987a, 7-4)

In the 70 years prior, neither the MPSC nor Michigan's major utilities had ever seriously considered electricity conservation as a way to meet demand -- the "progress" paradigm would not allow it. At one point, the Commission actually argued that it was not within its "legislative or constitutional mandate...to pursue a draconian and socially disruptive program of forced conservation" (MPSC 1978, 17). In fact, DSM was actively avoided in the state: at the end of the Midland crisis, Michigan was spending just $1.32 per capita on electricity conservation efforts, while the nation on average spent nearly $5.30 per person (Audubon Society 1991, D-15).

One outcome of the MEOS was that both Consumers Power and Detroit Edison were ordered by the MPSC to produce comprehensive integrated resource plans (IRPs) demonstrating ways of meeting future demand with minimal, if any construction. In spite of the explicit aims of the assignment, both companies returned IRPs arguing for additional construction and making only minimal attempts to incorporate DSM. The MPSC commented that Detroit Edison's plan "discounts the view that shrewd selection and aggressive implementation of demand-side resource options (including conservation) can delay investment in new capacity, improve efficiency, reduce undesirable environmental impacts...without significant affects on rates, sales, or earnings." (MPSC 1990a, i)

While Detroit Edison made a token inclusion of bulk power purchases and distributed generation as a means to offset new construction, Consumers Power anticipated the addition of more than 2 GW of new fossil-powered capacity (MPSC 1991a, 19) and developed an overall planning strategy which relied on "extended operation of its aging, predominantly coal-fired generating plants...whether Commission approved or not." (ibid, 21) The company would round out additional demand growth (its estimate of which was some 12% higher than the MPSC's) with electricity purchased primarily from its subsidiary, the Midland Cogeneration Venture, in one of the most blatant instances of utility self-dealing in Michigan's history (ibid, 22-24). Furthermore, the Commission noted that

> Consumers Power's plan did not mention or analyze 'demand-side' programs designed to <u>increase</u> future load even though this is an activity in which the Company is significantly involved... In the [MPSC] Staff's view, engaging in load building/sales marketing activities while claiming to need to acquire additional supply resources seems contradictory...the bottom line is that Consumers Power's planned incorporation of DSM is many orders of magnitude away from achieving a meaningful integration of DSM as a utility resource. (ibid, 47-48)

Both companies came under fire from advocacy groups and even private citizens for their respective plans' environmental insensitivity, refusal to consider DSM measures, and general lack of creativity. ABATE, a corporate interest group, argued that "Edison's IRP should be expanded to include a real look at the efficacy of changes in rate design and allocation methodologies. This will counter the normal utility preference to simply add more rate base." (ABATE

1990, D-16) Another comment, from a cogeneration engineering firm, related incidents when Detroit Edison had "given customers special deals so that they would not buy a cogeneration plant," right under the Commission's nose (Hale Engineering Corp 1990, D-41).

Consumers Power's IRP was the subject of even greater concern. The Lansing Board of Water and Light criticized Consumers Power for not coordinating any future transmission planning or power purchasing with its municipal system. One private citizen wrote to "urge the Commission to dismiss with prejudice the CPCo's proffered proposal and to insist that the utility produce a meaningful plan that addresses in a realistic way the efficiency and conservation goals that have been a matter of state and national priority for over a decade." (Norris 1991, D-37), while environmental advocacy groups lambasted the company's continued "confidence in supply-side options…[that] are becoming less profitable, and irrelevant, for the future." (Audubon Society 1991, D-16)

In their defense, Detroit Edison and Consumers Power appealed again to finances, arguing that under Michigan's regulatory regime, implementing any sort of serious DSM would harm their earnings and thus ability to provide electricity. Consumers Power pointed to three very specific "economic disincentives to implementing demand-reducing resource options: recovery of program costs, under-recovery of its fixed costs, and the need for an incentive encouraging utility management to invest in DSM activities and alleviate certain DSM associated risks." (MPSC 1991a, 45) The MPSC had no choice but to agree: "Unquestionably, one of the major barriers to utility implementation of DSM options has been...the adverse economic effects of energy efficiency on utility earnings under traditional regulation." (ibid, 44)

But for the first time in its history, the MPSC took a firm stance against "utility plans which meet forecasted demand with new power plants," because such plans "are no longer sufficient to address rapid and fundamental changes occurring in the electric power industry." (MPSC 1990a, 1) Accordingly, the Commission ordered the utilities to spend no less than $63m on DSM over two years (MPSC 1991b). The Commission suggested progressive modifications to the state's regulatory regime by offering rate increases to offset aggressive DSM implementation and a 2 percent rate-of-return on capital invested in conservation efforts (ibid).

The Commission also placed new emphasis on environmental issues, adopting as its mission "to formulate and administer policies and regulations necessary to ensure that state energy...services are provided in an efficient, reliable, safe, and environmentally acceptable manner. The mission includes supporting a healthy economy and coordinating...activities related to energy conservation and efficiency, renewable resources, and energy emergency situations" (MPSC 1988, 4). By 1990 the Commission had set a target to reduce Michigan's carbon dioxide emissions by 10% by 2010, and set up study groups to promote cogeneration, wood biomass, solid waste combustion, and alternative fuel vehicles (MPSC 1990b; 1993)

Yet, nearly all of these efforts were de-railed by the "market liberalization" programs that began in earnest during the mid-1990s, halting any progress towards meaningful electricity conservation or increased environmental sensitivity. Attention from all parties, from utilities to the MPSC to the general public and even academic researchers turned quickly to hashing out new access agreements, tariffs, stranded costs, and the formation of a regional market for electric power sales. It is not entirely clear why the shift in emphasis was so sudden or so drastic, with the only plausible explanation being that the task of implementing "market liberalization" was so great that the limited human resources available in the electric power and regulatory communities could not adequately address the issues of market restructuring and mandatory conservation programs simultaneously.

Accordingly, by 1996 the DSM and renewables programs so ardently fought for just five years earlier were phased out completely (MPSC 1996, 7). The preoccupation with "market liberalization" has pushed such issues to the background until only recently, when they have become the focus of new efforts to resuscitate Michigan's economy and recover from an economic implosion. Nevertheless, the state's electricity landscape will continue to be dominated by the ageing, dirty artifacts of years past well into the foreseeable future. While new programs have been unveiled since 2002 by all branches of the state's government to encourage investment in renewable fuels and distributed generation technologies, tellingly, the overwhelming majority of these programs seek further infrastructural development, revealing a continued apprehension towards conservation and the reduction of overall electricity consumption. Before meaningful changes to the state's electricity landscape can be implemented, a serious and far-reaching conservation program must be devised.

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Conclusion

There are also significant opportunities for cost-effective, non-utility generation sources such as cogeneration, renewable resources, and municipal solid waste. As in the case of other options, economic, environmental, and site-specific political factors will be important in determining how much of these resources actually will be developed in Michigan and over what period of time.

-- *MEOS Final Report, 1987 (7-5)*

It is hopeful that the state officials commissioned to examine Michigan's electricity system believe alternatives to the traditional "tax-and-spend" infrastructural expansion can be realistically employed to meet future demand. The pinch of salt included towards the end of the epigraph, however, is an unwelcome -- but unfortunately accurate -- dose of reality. Despite the fact that some cogeneration and renewables facilities have come online in Michigan, such resources remain underutilized on account of the very economic, environmental, and "site-specific political factors" that the MEOS report hints at.

There are a number of disincentives to new investment in Michigan's electricity landscape, not least of which is the state's questionable economic outlook. Additionally, a number of questions remain about the implementation of many "market liberalization" policies, and more recently, uncertainty about the future of any carbon tax or cap-and-trade initiative handed down from the federal government. The tenuous nature of most tax-incentive programs to encourage "green" and infrastructural investment in the state also acts as a deterrent. More significant than any of these, however, is the continued recalcitrance of the state's major utilities to embrace any sort of reform. Consumers Power (now, Consumers Energy) and Detroit Edison have retained their dominant roles in Michigan's electricity marketplace. Their incumbency (Figure 4.1), still, essentially, cemented by state law, means that Detroit Edison and Consumers Power continue to supply most of Michigan's electricity, and thus play a major role in the effectiveness of any new energy initiative. That the companies have waited for *orders* from the Commission or the federal government to take part in all pricing reform, transmission access, and conservation programs since the early 1990s rather than willfully implement them is indicative of their hesitance to move forward.

Perhaps even more troublingly, the utility companies remain firmly -- and ostentatiously -- rooted in the "progress" paradigm of years past (Figure 4.2). While the shortcomings of this model were thoroughly exposed during the Midland hearings, "progress" persists in a very literal sense as Consumers Power and Detroit Edison regularly extend the life of inefficient, centralized, and aging facilities while actively opposing the implementation of distributed generation, electricity conservation, and renewable fuels programs in the state.

Figure 4.1: Consumers Power's depiction of its service area, ca. 2009. The white areas represent territory that the company does not serve (Consumers Energy 2009).

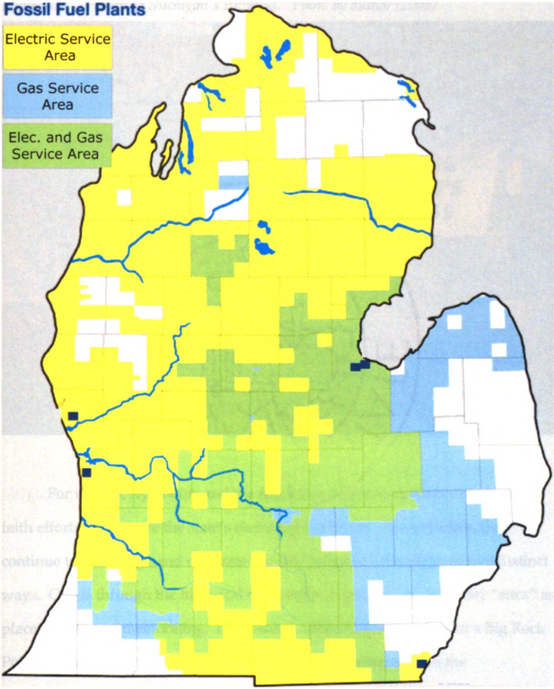

Figure 4.2: "Powering Michigan's Progress." Photo by author (2009)

For its part, legislators and the regulatory Commission have made good-faith efforts to improve the state's electricity landscape. Nevertheless, they continue to encourage and celebrate the old "progress" paradigm in two distinct ways. One is through the historical recognition of prominent electricity "sites" as places worth commemorating: for instance, when Consumers Power's Big Rock Point Nuclear Facility received a State Historical Marker, or with the establishment of a "Rural Electric Park" in Ingham County (Figure 4.3).

The other is through the continued linkage of new electricity

Figure 4.3: "Rural Electric Park" commemorating the first rural electrification project in the state in 1927. Photo by author (2009).

infrastructure with social advancement -- though currently, the equation substitutes "green" infrastructure for the "massive and complex" component of years past. An array of "renewable energy programs," (MPSC 2001) "21st century electric energy plans," (MPSC 2007) "planning consortia," (MPSC 2008a), and "wind energy resource zone boards" (MPSC 2008b) and myriad other master plans for the deployment of additional energy infrastructure have all been brought forth in the past decade in the hope that simply adding more generating capacity will cure both economic and energy infrastructure problems.

Echoing an earlier period, the promotion of new infrastructure is still matched by policies to encourage electricity consumption. Conservation programs remain voluntary, even as Michigan's utility customers spend 70 cents of every energy dollar on imported fossil fuels, and fully one quarter of all electricity generated is lost during transmission (MPSC 2008c). The MPSC *still* approves preferential pricing contracts allowing heavy users to pay less than the full cost of generation (e.g., MPSC 2005). At any rate, conservation looks particularly unpalatable in light of the (growing) gap between generating capacity and stagnating or even declining electricity consumption. This makes the argument for deploying more, albeit "clean," electricity infrastructure -- particularly wind, one of the most expensive and least efficient means of power generation -- as a means to reverse the state's decline seem especially bankrupt.

Accordingly, meaningful "progress" in Michigan's electricity landscape must come in the form of a mandatory, aggressive conservation program that reduces waste and radically improves efficiency. In this way, the gap between capacity and demand will be lessened, making it more feasible to remove the oldest and dirtiest generating facilities from the electricity landscape. Furthermore, by creating a marketplace in which consumers pay something closer to the price that electricity costs to generate, economic efficiency will be rewarded. As new capacity is inevitably needed (even if precipitated only by the complete collapse of the oldest power plants), facilities with high levels of efficiency -- such as alternatively-fuelled facilities employing landfill gas and solid waste incinerators, small-scale hydroelectric, and *building-scale* geothermal, solar, and wind -- will become prized. It is only through such long-term planning and an approach to reform which addresses both economic and infrastructural inefficiencies simultaneously that Michigan's electricity landscape can meet future demand in a sustainable way.

It has been the goal of this thesis to explore the forces that have shaped Michigan's electricity landscape and led to its current configuration in terms of both infrastructure and organization. This project has demonstrated that the massive, fossil-fueled power plants and complex, integrated transmission network that dominate the state's electricity landscape are the legacy of a regulatory regime which rewarded new construction and punished conservation. The rate-of-return accounting system central to Michigan's utilities oversight, alongside pricing policies which artificially inflated consumption and territorial protections which excluded alternative service providers, all but ensured the highly-centralized infrastructure that grew out of the pursuit of economies of scale. Contentious hearings, like those associated with the Midland Nuclear Facility, comprehensively illustrate the problems with such a system. Furthermore, they underscore the regulatory Commission's complicity in it, and demonstrate that the Commission's willingness to "approve" (through rate increases and other means) extraneous capacity was premised on the fear that the entire electricity system would collapse if utility company finances were challenged.

This thesis has also demonstrated that Michigan's electricity landscape is permeated by a particular ideal of "progress" that linked the deployment of complex electricity infrastructure to social advancement. This ideal, shared by utilities, regulators, and cooperatives alike, is readily apparent throughout the historical development of the electric power industry in the state, and can still be readily witnessed today. Such an analysis has only been possible on account of the research's single-state focus, which has revealed some of the trends, exceptions, and particularities that more prevalent national-level analyses are all but forced to overlook.

In conducting this research, I have looked back on the history of Michigan's electricity infrastructure. This was done with the hope of illuminating the forces, processes, and attitudes that have influenced the form and configuration of the state's electricity landscape, with the goal of making it more efficient, equitable, and ecologically-sensitive in the years to come.

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Appendix A

An Inventory of Michigan's Generating Units

Table A.1: Michigan's existing coal-fired generating units (after EIA Form 860, 2008 <http://www.eia.doe.gov/cneaf/electricity/page/eia860.html>, accessed 31 March 2010)

County	Plant Name	Company	Initial Year	Nameplate MW
Alger	Neenah Paper Munising Mill	Neenah Paper Michigan Inc.	1930	6.2
Muskegon	S D Warren Muskegon	S D Warren Co	1938	3.5
St Clair	Marysville	Detroit Edison Co	1943	75
St Clair	Marysville	Detroit Edison Co	1947	75
Wayne	Wyandotte	Wyandotte Municipal Serv Comm	1948	11.5
Wayne	Trenton Channel	Detroit Edison Co	1949	120
Menominee	Menominee Acquisition	Cellu Tissue Holdings Inc	1950	2.5
Wayne	Trenton Channel	Detroit Edison Co	1950	120
Ottawa	James De Young	City of Holland	1951	11.5
Monroe	J R Whiting	Consumers Energy Co	1952	106.3
Monroe	J R Whiting	Consumers Energy Co	1952	106.3
Alpena	LaFarge Alpena	Lafarge Corp	1952	12
Monroe	J R Whiting	Consumers Energy Co	1953	132.8
St Clair	St Clair	Detroit Edison Co	1953	156.2
St Clair	St Clair	Detroit Edison Co	1953	168.7
St Clair	St Clair	Detroit Edison Co	1954	156.2
St Clair	St Clair	Detroit Edison Co	1954	168.7
Ingham	Eckert Station	Lansing Board of Water and Light	1954	44
Ontonagon	White Pine Electric Power	White Pine Electric Power LLC	1954	20
Ontonagon	White Pine Electric Power	White Pine Electric Power LLC	1954	20
Ontonagon	White Pine Electric Power	White Pine Electric Power LLC	1954	20
Bay	J C Weadock	Consumers Energy Co	1955	156.3
Alpena	LaFarge Alpena	Lafarge Corp	1955	10
Muskegon	B C Cobb	Consumers Energy Co	1956	156.3
Muskegon	B C Cobb	Consumers Energy Co	1957	156.3
Alpena	Decorative Panels	Decorative Panels	1957	7.5

Table A.1, continued

	Intl	International, Inc.		
Wayne	River Rouge	Detroit Edison Co	1957	292.5
Bay	J C Weadock	Consumers Energy Co	1958	156.3
Wayne	River Rouge	Detroit Edison Co	1958	358.1
Ingham	Eckert Station	Lansing Board of Water and Light	1958	44
Delta	Escanaba	Upper Peninsula Power Co	1958	11.5
Delta	Escanaba	Upper Peninsula Power Co	1958	11.5
Wayne	Wyandotte	Wyandotte Municipal Serv Comm	1958	22
Bay	Dan E Karn	Consumers Energy Co	1959	136
Bay	Dan E Karn	Consumers Energy Co	1959	136
Ingham	Eckert Station	Lansing Board of Water and Light	1960	47
Bay	Dan E Karn	Consumers Energy Co	1961	136
Bay	Dan E Karn	Consumers Energy Co	1961	136
St Clair	St Clair	Detroit Edison Co	1961	352.7
Menominee	Menominee Acquisition	Cellu Tissue Holdings Inc	1962	1.5
Ottawa	James De Young	City of Holland	1962	22
Ottawa	J H Campbell	Consumers Energy Co	1962	265.2
Ingham	Eckert Station	Lansing Board of Water and Light	1964	80
Marquette	Presque Isle	Wisconsin Electric Power Co	1964	54.4
Ingham	T B Simon Power Plant	Michigan State University	1965	12.5
Ingham	T B Simon Power Plant	Michigan State University	1966	12.5
Ontonagon	Stone Container Ontonagon Mill	Smurfit-Stone Corp MI Plant	1966	15.6
Marquette	Presque Isle	Wisconsin Electric Power Co	1966	57.8
Marquette	Shiras	City of Marquette	1967	12.5
Ottawa	J H Campbell	Consumers Energy Co	1967	403.9
St Clair	Cargill Salt	Cargill Inc	1968	2
Huron	Harbor Beach	Detroit Edison Co	1968	121

Table A.1, continued

Wayne	Trenton Channel	Detroit Edison Co	1968	535.5
Ingham	Eckert Station	Lansing Board of Water and Light	1968	80
Muskegon	S D Warren Muskegon	S D Warren Co	1968	19.1
Ottawa	James De Young	City of Holland	1969	29.3
St Clair	St Clair	Detroit Edison Co	1969	544.5
Wayne	Wyandotte	Wyandotte Municipal Serv Comm	1969	7.5
Ingham	Eckert Station	Lansing Board of Water and Light	1970	80
Monroe	Monroe	Detroit Edison Co	1971	817.2
Marquette	Shiras	City of Marquette	1972	21
Monroe	Monroe	Detroit Edison Co	1973	822.6
Monroe	Monroe	Detroit Edison Co	1973	822.6
Eaton	Erickson Station	Lansing Board of Water and Light	1973	154.7
Monroe	Monroe	Detroit Edison Co	1974	817.2
Ingham	T B Simon Power Plant	Michigan State University	1974	15
Marquette	Presque Isle	Wisconsin Electric Power Co	1974	90
Marquette	Presque Isle	Wisconsin Electric Power Co	1975	90
Marquette	Presque Isle	Wisconsin Electric Power Co	1978	90
Marquette	Presque Isle	Wisconsin Electric Power Co	1978	90
Marquette	Presque Isle	Wisconsin Electric Power Co	1979	90
Ottawa	J H Campbell	Consumers Energy Co	1980	916.8
Hillsdale	Endicott Station	Michigan South Central Pwr Agy	1982	55
Delta	Escanaba Paper Company	NewPage Corporation	1982	54
Ottawa	J B Sims	City of Grand Haven	1983	80
Marquette	Shiras	City of Marquette	1983	44
St Clair	Belle River	Detroit Edison Co	1984	697.5
St Clair	Belle River	Detroit Edison Co	1985	697.5
Wayne	Wyandotte	Wyandotte Municipal Serv Comm	1986	32
Oakland	GM WFG Pontiac Site Power Plant	DTE Energy Services Pontiac	1987	28.9

Table A.1, continued

		North		
Muskegon	S D Warren Muskegon	S D Warren Co	1989	28.3
Manistee	TES Filer City Station	TES Filer City Station LP	1990	70
Alpena	LaFarge Alpena	Lafarge Corp	1991	11
Ingham	T B Simon Power Plant	Michigan State University	1993	21
Alpena	LaFarge Alpena	Lafarge Corp	1994	11
Alpena	LaFarge Alpena	Lafarge Corp	1999	3.2
Ingham	T B Simon Power Plant	Michigan State University	2006	24

Table A.2: Michigan's existing petroleum-fired generating units (after EIA Form 860, 2008 <http://www.eia.doe.gov/cneaf/electricity/page/eia860.html>, accessed 31 March 2010)

County	Plant Name	Company	Initial Year	Nameplate MW
Huron	Ubly	Thumb Electric Coop of Mich	1938	0.7
Huron	Ubly	Thumb Electric Coop of Mich	1938	0.7
Huron	Ubly	Thumb Electric Coop of Mich	1938	0.6
Lenawee	Clinton	Clinton Village of	1939	0.5
Lenawee	Clinton	Clinton Village of	1939	0.5
Ottawa	Diesel Plant	City of Grand Haven	1942	2.7
Calhoun	Marshall	City of Marshall	1942	1
Gratiot	St Louis	City of St Louis	1945	0.6
Huron	Main Street	City of Sebewaing	1947	0.9
Hillsdale	Hillsdale	Hillsdale Board of Public Wks	1947	2.7
Huron	Ubly	Thumb Electric Coop of Mich	1947	0.9
Luce	Newberry	Newberry Water & Light Board	1948	0.7
Cheboygan	Tower	Wolverine Pwr Supply Coop, Inc	1948	1.3
Cheboygan	Tower	Wolverine Pwr Supply Coop, Inc	1948	1.3
Tuscola	Caro	Thumb Electric Coop of Mich	1949	1.3
Tuscola	Caro	Thumb Electric Coop of Mich	1949	1.3
Ionia	Frank Jenkins	City of Portland	1950	0.8
Gratiot	St Louis	City of St Louis	1951	0.9
Cheboygan	Tower	Wolverine Pwr Supply Coop, Inc	1951	1.3
Ottawa	Diesel Plant	City of Grand Haven	1952	5.5
Tuscola	Caro	Thumb Electric Coop of Mich	1952	1.3
Ottawa	Diesel Plant	City of Grand Haven	1954	3
Lenawee	Clinton	Clinton Village of	1955	0.4
Lenawee	Clinton	Clinton Village of	1955	0.4
Lenawee	Clinton	Clinton Village of	1955	0.4
Chippewa	Dafter	Cloverland	1955	1

Table A.2, continued

		Electric Co-op		
Chippewa	Dafter	Cloverland Electric Co-op	1955	1
Chippewa	Dafter	Cloverland Electric Co-op	1955	1
Gratiot	St Louis	City of St Louis	1958	1.3
Montcalm	Vestaburg	Wolverine Pwr Supply Coop, Inc	1959	3
Chippewa	Dafter	Cloverland Electric Co-op	1960	3
Chippewa	Dafter	Cloverland Electric Co-op	1960	3
Schoolcraft	Manistique	Edison Sault Electric Co	1960	2
Montcalm	Vestaburg	Wolverine Pwr Supply Coop, Inc	1960	3
Wayne	Dayton	Detroit Edison Co	1966	2
Wayne	Dayton	Detroit Edison Co	1966	2
Wayne	Dayton	Detroit Edison Co	1966	2
Wayne	Dayton	Detroit Edison Co	1966	2
Wayne	Dayton	Detroit Edison Co	1966	2
Monroe	Fermi	Detroit Edison Co	1966	16
Monroe	Fermi	Detroit Edison Co	1966	16
Monroe	Fermi	Detroit Edison Co	1966	16
Monroe	Fermi	Detroit Edison Co	1966	16
Washtenaw	Superior	Detroit Edison Co	1966	16
Washtenaw	Superior	Detroit Edison Co	1966	16
Washtenaw	Superior	Detroit Edison Co	1966	16
Washtenaw	Superior	Detroit Edison Co	1966	16
Huron	Harbor Beach	Detroit Edison Co	1967	2
Huron	Harbor Beach	Detroit Edison Co	1967	2
Wayne	River Rouge	Detroit Edison Co	1967	2.7
Wayne	River Rouge	Detroit Edison Co	1967	2.7
Wayne	River Rouge	Detroit Edison Co	1967	2.7
Wayne	River Rouge	Detroit Edison Co	1967	2.7
Ottawa	J H Campbell	Consumers Energy Co	1968	18.6
Monroe	J R Whiting	Consumers Energy Co	1968	18.6
Wayne	Slocum	Detroit Edison Co	1968	2.7
Wayne	Slocum	Detroit Edison Co	1968	2.7
Wayne	Slocum	Detroit Edison Co	1968	2.7
Wayne	Slocum	Detroit Edison Co	1968	2.7
Wayne	Slocum	Detroit Edison Co	1968	2.7
St Clair	St Clair	Detroit Edison Co	1968	18.5
Tuscola	Wilmot	Detroit Edison Co	1968	2.7

Table A.2, continued

Tuscola	Wilmot	Detroit Edison Co	1968	2.7
Tuscola	Wilmot	Detroit Edison Co	1968	2.7
Tuscola	Wilmot	Detroit Edison Co	1968	2.7
Tuscola	Wilmot	Detroit Edison Co	1968	2.7
Livingston	Colfax	Detroit Edison Co	1969	2.7
Livingston	Colfax	Detroit Edison Co	1969	2.7
Livingston	Colfax	Detroit Edison Co	1969	2.7
Livingston	Colfax	Detroit Edison Co	1969	2.7
Livingston	Colfax	Detroit Edison Co	1969	2.7
Monroe	Monroe	Detroit Edison Co	1969	2.7
Monroe	Monroe	Detroit Edison Co	1969	2.7
Monroe	Monroe	Detroit Edison Co	1969	2.7
Monroe	Monroe	Detroit Edison Co	1969	2.7
Monroe	Monroe	Detroit Edison Co	1969	2.7
Delta	Escanaba Paper Company	NewPage Corporation	1969	27.2
Huron	Oliver	Detroit Edison Co	1970	2.7
Huron	Oliver	Detroit Edison Co	1970	2.7
Huron	Oliver	Detroit Edison Co	1970	2.7
Huron	Oliver	Detroit Edison Co	1970	2.7
Huron	Oliver	Detroit Edison Co	1970	2.7
Oakland	Placid 12	Detroit Edison Co	1970	2.7
Oakland	Placid 12	Detroit Edison Co	1970	2.7
Oakland	Placid 12	Detroit Edison Co	1970	2.7
Oakland	Placid 12	Detroit Edison Co	1970	2.7
Oakland	Placid 12	Detroit Edison Co	1970	2.7
St Clair	St Clair	Detroit Edison Co	1970	2.7
St Clair	St Clair	Detroit Edison Co	1970	2.7
Wayne	Conners Creek	Detroit Edison Co	1971	2.7
Wayne	Conners Creek	Detroit Edison Co	1971	2.7
Macomb	Northeast	Detroit Edison Co	1971	21.2
Macomb	Northeast	Detroit Edison Co	1971	23.4
Macomb	Northeast	Detroit Edison Co	1971	21.2
Tuscola	Putnam	Detroit Edison Co	1971	2.7
Tuscola	Putnam	Detroit Edison Co	1971	2.7
Tuscola	Putnam	Detroit Edison Co	1971	2.7
Tuscola	Putnam	Detroit Edison Co	1971	2.7
Tuscola	Putnam	Detroit Edison Co	1971	2.7
Cheboygan	Tower	Wolverine Pwr Supply Coop, Inc	1971	21.3
Schoolcraft	Manistique	Edison Sault Electric Co	1972	2.8
Chippewa	Detour	Cloverland Electric Co-op	1973	3
Houghton	Portage	Upper Peninsula Power Co	1973	22.6

Table A.2, continued

Wayne	Mistersky	City of Detroit	1974	35
Ottawa	Sixth Street	City of Holland	1974	24
Branch	Coldwater	Coldwater Board of Public Util	1974	2.5
Luce	Newberry	Newberry Water & Light Board	1974	3
Delta	Gladstone	Upper Peninsula Power Co	1975	22.6
Chippewa	Detour	Cloverland Electric Co-op	1976	3
Marquette	Plant Four	City of Marquette	1979	24
Wayne	Oakwood Hospital & Medical Center	Oakwood Hospital Med Center	1979	0.5
St Clair	Belle River	Detroit Edison Co	1981	2.7
St Clair	Belle River	Detroit Edison Co	1981	2.7
St Clair	Belle River	Detroit Edison Co	1981	2.7
St Clair	Belle River	Detroit Edison Co	1981	2.7
St Clair	Belle River	Detroit Edison Co	1981	2.7
Sanilac	Croswell	City of Croswell	1982	0.6
Sanilac	Croswell	City of Croswell	1984	0.7
Tuscola	Caro	Thumb Electric Coop of Mich	1984	1.5
Oceana	Hart	City of Hart Hydro	1985	2
Oceana	Hart	City of Hart Hydro	1985	1.7
Huron	Ubly	Thumb Electric Coop of Mich	1987	1.5
Sanilac	Croswell	City of Croswell	1988	1.2
Huron	Pine Street	City of Sebewaing	1988	1.1
Huron	Pine Street	City of Sebewaing	1988	1.1
Wayne	Hutzel Hospital	Hutzel Hospital	1988	0.8
Wayne	Hutzel Hospital	Hutzel Hospital	1988	0.8
Luce	Newberry	Newberry Water & Light Board	1988	1.8
Sanilac	Croswell	City of Croswell	1990	1.3
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1990	5.2
Washtenaw	Warner Lambert	Warner Lambert Co	1992	1
Oakland	William Beaumont Hospital	William Beaumont Hospital	1992	1.9
Oakland	William Beaumont Hospital	William Beaumont	1992	1.9

Table A.2, continued

		Hospital		
Osceola	George Johnson	Wolverine Pwr Supply Coop, Inc	1993	1
Ionia	Frank Jenkins	City of Portland	1995	2
Sanilac	Croswell	City of Croswell	1996	1.3
Gratiot	St Louis	City of St Louis	1996	1.1
Tuscola	Caro	Thumb Electric Coop of Mich	1999	2
Charlevoix	Beaver Island	Great Lakes Energy Coop	2000	1.2
Charlevoix	Beaver Island	Great Lakes Energy Coop	2000	1.2
Tuscola	Caro	Thumb Electric Coop of Mich	2000	2
Huron	Ubly	Thumb Electric Coop of Mich	2000	2.5
Charlevoix	Beaver Island	Great Lakes Energy Coop	2001	0.9
Branch	State St Generating	Michigan South Central Pwr Agy	2001	1.8
Branch	State St Generating	Michigan South Central Pwr Agy	2001	1.8
Branch	State St Generating	Michigan South Central Pwr Agy	2001	1.8
Branch	State St Generating	Michigan South Central Pwr Agy	2001	1.8
Branch	State St Generating	Michigan South Central Pwr Agy	2001	1.8
Branch	State St Generating	Michigan South Central Pwr Agy	2001	1.8
Branch	State St Generating	Michigan South Central Pwr Agy	2001	1.8
Branch	State St Generating	Michigan South Central Pwr Agy	2001	1.8
Branch	State St Generating	Michigan South Central Pwr Agy	2001	1.8
Huron	Ubly	Thumb Electric Coop of Mich	2001	2.5
Ionia	Frank Jenkins	City of Portland	2002	1
Huron	Ubly	Thumb Electric Coop of Mich	2002	1.5
Washtenaw	Warner Lambert	Warner Lambert Co	2002	1.5
Gratiot	St Louis	City of St Louis	2003	1.3
Gratiot	St Louis	City of St Louis	2003	1.5
Delta	Escanaba	Upper Peninsula Power Co	2003	17.9

Table A.2, continued

Washtenaw	Warner Lambert	Warner Lambert Co	2005	2.3
Washtenaw	Warner Lambert	Warner Lambert Co	2005	2.3
Hillsdale	Endicott Station	Michigan South Central Pwr Agy	2006	1.6
Hillsdale	Endicott Station	Michigan South Central Pwr Agy	2006	1.6
Wayne	Oakwood Hospital & Medical Center	Oakwood Hospital Med Center	2006	2
Wayne	Oakwood Hospital & Medical Center	Oakwood Hospital Med Center	2006	0.5
Wayne	Oakwood Hospital & Medical Center	Oakwood Hospital Med Center	2006	2
Washtenaw	Warner Lambert	Warner Lambert Co	2007	2.3
Wayne	Wyandotte	Wyandotte Municipal Serv Comm	2007	1.8
Wayne	Wyandotte	Wyandotte Municipal Serv Comm	2007	1.8
Wayne	Wyandotte	Wyandotte Municipal Serv Comm	2007	1.8

Table A.3: Michigan's existing natural gas-fired generating units (after EIA Form 860, 2008 <http://www.eia.doe.gov/cneaf/electricity/page/eia860.html>, accessed 31 March 2010)

County	Plant Name	Company	Initial Year	Nameplate MW
Ottawa	Diesel Plant	City of Grand Haven	1948	2.7
Calhoun	Marshall	City of Marshall	1948	1.7
Muskegon	B C Cobb	Consumers Energy Co	1948	69
Muskegon	B C Cobb	Consumers Energy Co	1948	69
Wayne	Mistersky	City of Detroit	1950	44
Muskegon	B C Cobb	Consumers Energy Co	1950	69
Wayne	Conners Creek	Detroit Edison Co	1951	135
Wayne	Conners Creek	Detroit Edison Co	1951	135
Calhoun	Marshall	City of Marshall	1953	1.1
Hillsdale	Hillsdale	Hillsdale Board of Public Wks	1954	3.5
Kent	Lowell	City of Lowell	1956	1.1
Wayne	River Rouge	Detroit Edison Co	1956	282.6
Ottawa	Zeeland	City of Zeeland	1957	2
Wayne	Mistersky	City of Detroit	1958	50
Kalamazoo	Graphic Packaging	Graphic Packaging Corp	1959	10
Hillsdale	Hillsdale	Hillsdale Board of Public Wks	1960	4.1
Huron	Main Street	City of Sebewaing	1961	1
Ottawa	Zeeland	City of Zeeland	1963	1.7
Oceana	Hart	City of Hart Hydro	1964	1.4
Kent	Lowell	City of Lowell	1965	1.1
Huron	Main Street	City of Sebewaing	1966	1.3
Huron	Main Street	City of Sebewaing	1966	1.1
Ottawa	Zeeland	City of Zeeland	1966	1.4
Otsego	Gaylord	Consumers Energy Co	1966	16
Otsego	Gaylord	Consumers Energy Co	1966	16
Otsego	Gaylord	Consumers Energy Co	1966	16
Otsego	Gaylord	Consumers Energy Co	1966	16
Oakland	Hancock	Detroit Edison Co	1966	41.8
Macomb	Northeast	Detroit Edison Co	1966	16
Macomb	Northeast	Detroit Edison Co	1966	16

Table A.3, continued

Macomb	Northeast	Detroit Edison Co	1966	16
Huron	Main Street	City of Sebewaing	1967	0.6
Ottawa	Zeeland	City of Zeeland	1967	1.1
Oakland	Hancock	Detroit Edison Co	1967	19
Oakland	Hancock	Detroit Edison Co	1967	19
Oakland	Hancock	Detroit Edison Co	1967	19
Macomb	Northeast	Detroit Edison Co	1967	16
Allegan	Claude Vandyke	Wolverine Pwr Supply Coop, Inc	1967	23
Kalamazoo	B E Morrow	Consumers Energy Co	1968	18
Otsego	Gaylord	Consumers Energy Co	1968	16
Bay	J C Weadock	Consumers Energy Co	1968	18.6
Huron	Pine Street	City of Sebewaing	1969	1.1
Huron	Pine Street	City of Sebewaing	1969	1.1
Branch	Coldwater	Coldwater Board of Public Util	1969	3.5
Kalamazoo	B E Morrow	Consumers Energy Co	1969	18
Emmet	Straits	Consumers Energy Co	1969	20
Oakland	Hancock	Detroit Edison Co	1969	19.6
Genesee	Thetford	Consumers Energy Co	1970	33.6
Genesee	Thetford	Consumers Energy Co	1970	33.6
Genesee	Thetford	Consumers Energy Co	1970	33.6
Genesee	Thetford	Consumers Energy Co	1970	33.6
Oakland	Hancock	Detroit Edison Co	1970	41.8
Ottawa	Zeeland	City of Zeeland	1971	4.5
Genesee	Thetford	Consumers Energy Co	1971	17.6
Genesee	Thetford	Consumers Energy Co	1971	17.6
Genesee	Thetford	Consumers Energy Co	1971	17.6
Genesee	Thetford	Consumers Energy Co	1971	17.6
Genesee	Thetford	Consumers Energy Co	1971	17.6
Montcalm	Vestaburg	Wolverine Pwr Supply Coop, Inc	1972	23.7
Kent	Lowell	City of Lowell	1973	1.4

Table A.3, continued

Calhoun	Marshall	City of Marshall	1973	2.1
Hillsdale	Hillsdale	Hillsdale Board of Public Wks	1973	5.6
Ottawa	Diesel Plant	City of Grand Haven	1974	7
Ottawa	Zeeland	City of Zeeland	1974	5.6
Bay	Dan E Karn	Consumers Energy Co	1975	692.5
Washtenaw	University of Michigan	University of Michigan	1975	12.5
Washtenaw	University of Michigan	University of Michigan	1975	12.5
Hillsdale	Hillsdale	Hillsdale Board of Public Wks	1976	6
Bay	Dan E Karn	Consumers Energy Co	1977	709.8
Calhoun	Marshall	City of Marshall	1978	5.7
Lenawee	Clinton	Clinton Village of	1978	2
Branch	Coldwater	Coldwater Board of Public Util	1978	6
Wayne	Mistersky	City of Detroit	1979	60
Huron	Main Street	City of Sebewaing	1979	1.1
St Clair	Greenwood	Detroit Edison Co	1979	815.4
Bay	Water Street Station	City of Bay City	1980	5.7
Ottawa	Zeeland	City of Zeeland	1980	6
St Joseph	Diesel Plant	City of Sturgis	1981	6
Bay	Water Street Station	City of Bay City	1984	6.9
Washtenaw	Ford Motor Co Rawsonville Plant	Ford Motor Co	1985	4.5
Wayne	Romulus Operations Powertrain	General Motors Corp-Powertrain	1986	10.7
Oakland	Parkedale Pharmaceuticals	JHP Pharmaceuticals LLC	1986	2.8
Washtenaw	University of Michigan	University of Michigan	1986	12.5
Macomb	Powertrain Warren General Motors	General Motors Corp-Warren	1988	4
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1989	87.1
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1989	87.1

Table A.3, continued

Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1989	87.1
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1989	87.1
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1989	87.1
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1989	87.1
Washtenaw	Warner Lambert	Warner Lambert Co	1989	3
Kent	Ada Cogeneration LP	Ada Cogeneration Ltd Partnership	1990	10.1
Kent	Ada Cogeneration LP	Ada Cogeneration Ltd Partnership	1990	23
Isabella	Central Michigan University	Central Michigan University	1990	3.8
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1990	87.1
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1990	87.1
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1990	87.1
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1990	87.1
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1990	410
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1990	87.1
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1990	380
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1990	87.1
Washtenaw	University of Michigan	University of Michigan	1990	3.5
Allegan	491 E 48th Street	City of Holland	1992	39.1
Allegan	491 E 48th Street	City of Holland	1992	39.1

Table A.3, continued

Kalamazoo	Graphic Packaging	Graphic Packaging Corp	1992	1.8
Washtenaw	University of Michigan	University of Michigan	1992	3.5
Bay	Henry Station	City of Bay City	1993	7.7
Bay	Henry Station	City of Bay City	1993	7.7
Huron	Ubly	Thumb Electric Coop of Mich	1993	1.5
Mason	Michigan Power LP	DPS Michigan, LLC	1995	96.1
Mason	Michigan Power LP	DPS Michigan, LLC	1995	58
Allegan	Otsego Mill Power Plant	Otsego Paper Inc	1995	10.6
Allegan	Otsego Mill Power Plant	Otsego Paper Inc	1995	10.6
Huron	Pine Street	City of Sebewaing	1996	1.3
Huron	Pine Street	City of Sebewaing	1996	1.3
Washtenaw	Arbor Hills	Gas Recovery Systems Inc	1996	10
Midland	Midland Cogeneration Venture	Midland Cogeneration Venture	1998	13.4
Kalamazoo	Kalamazoo River Generating Station	CMS Generation MI Power LLC	1999	73.1
Otsego	Livingston Generating Station	CMS Generation MI Power LLC	1999	42.4
Otsego	Livingston Generating Station	CMS Generation MI Power LLC	1999	42.4
Otsego	Livingston Generating Station	CMS Generation MI Power LLC	1999	42.9
Otsego	Livingston Generating Station	CMS Generation MI Power LLC	1999	42.4
Wayne	Dearborn Industrial Generation	Dearborn Industrial Gen Inc	1999	170
St Clair	Belle River	Detroit Edison Co	1999	85.3
St Clair	Belle River	Detroit Edison Co	1999	85.3
St Clair	Belle River	Detroit Edison Co	1999	85.3
St Clair	Greenwood	Detroit Edison Co	1999	85.3
St Clair	Greenwood	Detroit Edison Co	1999	85.3
St Clair	Greenwood	Detroit Edison Co	1999	85.3
Allegan	491 E 48th Street	City of Holland	2000	83.5
Wayne	Delray	Detroit Edison Co	2000	71.1
Wayne	Delray	Detroit Edison Co	2000	71.1
Osceola	George Johnson	Wolverine Pwr Supply Coop, Inc	2000	25

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Table A.3, continued

Osceola	George Johnson	Wolverine Pwr Supply Coop, Inc	2000	25
Ottawa	Zeeland Generating Station	Consumers Energy Co	2001	188.7
Ottawa	Zeeland Generating Station	Consumers Energy Co	2001	188.7
Wayne	Dearborn Industrial Generation	Dearborn Industrial Gen Inc	2001	170
Wayne	Dearborn Industrial Generation	Dearborn Industrial Gen Inc	2001	250
Wayne	Dearborn Industrial Generation	Dearborn Industrial Gen Inc	2001	170
Allegan	Claude Vandyke	Wolverine Pwr Supply Coop, Inc	2001	24.8
Otsego	Gaylord	Wolverine Pwr Supply Coop, Inc	2001	23.4
Otsego	Gaylord	Wolverine Pwr Supply Coop, Inc	2001	23.4
Otsego	Gaylord	Wolverine Pwr Supply Coop, Inc	2001	23.4
Ottawa	Zeland-Washington	City of Zeeland	2002	1
Ottawa	Zeland-Washington	City of Zeeland	2002	1
Ottawa	Zeeland Generating Station	Consumers Energy Co	2002	188.7
Ottawa	Zeeland Generating Station	Consumers Energy Co	2002	188.7
Ottawa	Zeeland Generating Station	Consumers Energy Co	2002	213.3
St Clair	DTE East China LLC	DTE East China LLC	2002	89.4
St Clair	DTE East China LLC	DTE East China LLC	2002	89.4
St Clair	DTE East China LLC	DTE East China LLC	2002	89.4
St Clair	DTE East China LLC	DTE East China LLC	2002	89.4
Wayne	Sumpter	FirstEnergy Generation Corp	2002	85
Wayne	Sumpter	FirstEnergy Generation Corp	2002	85
Wayne	Sumpter	FirstEnergy Generation Corp	2002	85

Table A.3, continued

Wayne	Sumpter	FirstEnergy Generation Corp	2002	85
Jackson	Kinder Morgan Power Jackson Facility	Kinder Morgan Power Co	2002	60
Jackson	Kinder Morgan Power Jackson Facility	Kinder Morgan Power Co	2002	79
Jackson	Kinder Morgan Power Jackson Facility	Kinder Morgan Power Co	2002	60
Jackson	Kinder Morgan Power Jackson Facility	Kinder Morgan Power Co	2002	60
Jackson	Kinder Morgan Power Jackson Facility	Kinder Morgan Power Co	2002	105
Jackson	Kinder Morgan Power Jackson Facility	Kinder Morgan Power Co	2002	60
Jackson	Kinder Morgan Power Jackson Facility	Kinder Morgan Power Co	2002	105
Jackson	Kinder Morgan Power Jackson Facility	Kinder Morgan Power Co	2002	60
Jackson	Kinder Morgan Power Jackson Facility	Kinder Morgan Power Co	2002	60
Kalkaska	Kalkaska CT #1	Michigan Public Power Agency	2002	75
Montcalm	Renaissance Power LLC	Renaissance Power LLC	2002	170
Montcalm	Renaissance Power LLC	Renaissance Power LLC	2002	170
Montcalm	Renaissance Power LLC	Renaissance Power LLC	2002	170
Montcalm	Renaissance Power LLC	Renaissance Power LLC	2002	170
Van Buren	New Covert Generating Facility	New Covert Generating Company LLC	2003	245
Van Buren	New Covert Generating Facility	New Covert Generating Company LLC	2003	147
Van Buren	New Covert Generating Facility	New Covert Generating Company LLC	2003	245

Table A.3, continued

Van Buren	New Covert Generating Facility	New Covert Generating Company LLC	2003	245
Van Buren	New Covert Generating Facility	New Covert Generating Company LLC	2003	147
Van Buren	New Covert Generating Facility	New Covert Generating Company LLC	2003	147
Ottawa	Zeeland-Riley	City of Zeeland	2006	2
Ottawa	Zeeland-Riley	City of Zeeland	2006	2
Ottawa	Zeeland-Riley	City of Zeeland	2006	2
Ottawa	Zeeland-Riley	City of Zeeland	2006	2
Ottawa	Zeeland-Riley	City of Zeeland	2006	2
Ingham	T B Simon Power Plant	Michigan State University	2006	14.3

Table A.4: Michigan's existing hydroelectric generating units (after EIA Form 860, 2008 <http://www.eia.doe.gov/cneaf/electricity/page/eia860.html>, accessed 31 March 2010)

County	Plant Name	Company	Initial Year	Nameplate MW
Chippewa	Edison Sault	Edison Sault Electric Co	1901	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1901	0.6
Dickinson	Norway	City of Norway	1905	1.2
Dickinson	Norway	City of Norway	1905	2
Newaygo	Croton	Consumers Energy Co	1907	3
Newaygo	Croton	Consumers Energy Co	1907	3
Ionia	Webber	Consumers Energy Co	1907	3.3
Menominee	Grand Rapids	Wisconsin Public Service Corp	1910	1.1
Menominee	Grand Rapids	Wisconsin Public Service Corp	1910	1.1
St Joseph	Hydro Plant	City of Sturgis	1911	0.4
St Joseph	Hydro Plant	City of Sturgis	1911	0.4
Iosco	Cooke	Consumers Energy Co	1911	3
Iosco	Cooke	Consumers Energy Co	1911	3
Iosco	Cooke	Consumers Energy Co	1911	3
Newaygo	Croton	Consumers Energy Co	1912	1.5
Iosco	Five Channels	Consumers Energy Co	1912	3
Iosco	Five Channels	Consumers Energy Co	1912	3
Dickinson	Twin Falls	Wisconsin Electric Power Co	1912	1.6
Dickinson	Twin Falls	Wisconsin Electric Power Co	1912	1.6
Dickinson	Twin Falls	Wisconsin Electric Power Co	1912	1.6
Menominee	Grand Rapids	Wisconsin Public Service Corp	1912	1.5
Iosco	Loud	Consumers Energy Co	1913	2
Iosco	Loud	Consumers Energy	1913	2

Table A.4, continued

		Co		
Gogebic	Saxon Falls	Northern States Power Co	1913	0.6
Gogebic	Saxon Falls	Northern States Power Co	1913	0.6
Iron	Crystal Falls	City of Crystal Falls	1914	0.3
Dickinson	Big Quinnesec 61	Wisconsin Electric Power Co	1914	2.2
Dickinson	Big Quinnesec 61	Wisconsin Electric Power Co	1914	2.2
Newaygo	Croton	Consumers Energy Co	1915	1.4
Oscoda	Mio	Consumers Energy Co	1916	2.5
Oscoda	Mio	Consumers Energy Co	1916	2.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric	1916	0.5

Table A.4, continued

		Co		
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Chippewa	Edison Sault	Edison Sault Electric Co	1916	0.5
Dickinson	Twin Falls	Wisconsin Electric Power Co	1916	1.2
Dickinson	Twin Falls	Wisconsin Electric Power Co	1916	1.6
Jackson	Superior Falls	Northern States Power Co	1917	0.6
Jackson	Superior Falls	Northern States Power Co	1917	0.6
Manistee	C W Tippy	Consumers Energy Co	1918	6.7
Manistee	C W Tippy	Consumers Energy Co	1918	6.7
Manistee	C W Tippy	Consumers Energy Co	1918	6.7
Iosco	Foote	Consumers Energy Co	1918	3
Iosco	Foote	Consumers Energy Co	1918	3
Iosco	Foote	Consumers Energy Co	1918	3
Menominee	Grand Rapids	Wisconsin Public Service Corp	1918	1.9
Marquette	James R. Smith	City of Marquette	1919	1.6
Gratiot	St Louis	City of St Louis	1919	0.2
Berrien	Buchanan	Indiana Michigan Power Co	1919	0.4
Berrien	Buchanan	Indiana Michigan Power Co	1919	0.4
Berrien	Buchanan	Indiana Michigan Power Co	1919	0.4
Berrien	Buchanan	Indiana Michigan Power Co	1919	0.4
Berrien	Buchanan	Indiana Michigan Power Co	1919	0.4
Berrien	Buchanan	Indiana Michigan Power Co	1919	0.4
Berrien	French Paper Hydro	French Paper Co	1921	0.2

Table A.4, continued

Marquette	James R. Smith	City of Marquette	1922	1.6
Mecosta	Rogers	Consumers Energy Co	1922	1.7
Mecosta	Rogers	Consumers Energy Co	1922	1.7
Mecosta	Rogers	Consumers Energy Co	1922	1.7
Mecosta	Rogers	Consumers Energy Co	1922	1.7
Berrien	French Paper Hydro	French Paper Co	1922	0.3
Gladwin	Edenville	Boyce Hydro Power LLC	1923	2.4
Gladwin	Edenville	Boyce Hydro Power LLC	1923	2.4
Midland	Sanford	Boyce Hydro Power LLC	1923	1.2
Midland	Sanford	Boyce Hydro Power LLC	1923	1.2
Midland	Sanford	Boyce Hydro Power LLC	1923	1.2
Gladwin	Secord	Boyce Hydro Power LLC	1923	1.2
Gladwin	Smallwood	Boyce Hydro Power LLC	1923	1.2
St Joseph	Constantine	Indiana Michigan Power Co	1923	0.3
St Joseph	Constantine	Indiana Michigan Power Co	1923	0.3
St Joseph	Constantine	Indiana Michigan Power Co	1923	0.3
St Joseph	Mottville	Indiana Michigan Power Co	1923	0.4
St Joseph	Mottville	Indiana Michigan Power Co	1923	0.4
St Joseph	Mottville	Indiana Michigan Power Co	1923	0.4
St Joseph	Mottville	Indiana Michigan Power Co	1923	0.4
Menominee	Grand Rapids	Wisconsin Public Service Corp	1923	1.9
Iron	Crystal Falls	City of Crystal Falls	1924	0.3
Alcona	Alcona	Consumers Energy Co	1924	4
Alcona	Alcona	Consumers Energy Co	1924	4
Menominee	Menominee Mill	N E W Hydro Inc	1924	0.4

Table A.4, continued

	Marinette			
Menominee	Menominee Mill Marinette	N E W Hydro Inc	1924	0.4
Dickinson	Kingsford	Wisconsin Electric Power Co	1924	3
Dickinson	Kingsford	Wisconsin Electric Power Co	1924	3
Dickinson	Kingsford	Wisconsin Electric Power Co	1924	3
Wexford	Hodenpyl	Consumers Energy Co	1925	9.5
Wexford	Hodenpyl	Consumers Energy Co	1925	9.5
Berrien	French Paper Hydro	French Paper Co	1927	0.4
Berrien	Buchanan	Indiana Michigan Power Co	1927	0.5
Berrien	Buchanan	Indiana Michigan Power Co	1927	0.5
Berrien	Buchanan	Indiana Michigan Power Co	1927	0.5
Berrien	Buchanan	Indiana Michigan Power Co	1927	0.5
Menominee	Chalk Hill	Wisconsin Electric Power Co	1927	3.3
Menominee	Chalk Hill	Wisconsin Electric Power Co	1927	3.3
Menominee	Chalk Hill	Wisconsin Electric Power Co	1927	3.3
Menominee	White Rapids	Wisconsin Electric Power Co	1927	3.3
Menominee	White Rapids	Wisconsin Electric Power Co	1927	2.5
Menominee	White Rapids	Wisconsin Electric Power Co	1927	3.3
Calhoun	Marshall	City of Marshall	1928	0.1
Calhoun	Marshall	City of Marshall	1929	0.1
St Joseph	Constantine	Indiana Michigan Power Co	1929	0.3
Berrien	French Paper Hydro	French Paper Co	1930	0.4
Newaygo	Hardy	Consumers Energy Co	1931	10
Newaygo	Hardy	Consumers Energy Co	1931	10
Newaygo	Hardy	Consumers Energy Co	1931	10

Table A.4, continued

Baraga	Prickett	Upper Peninsula Power Co	1931	1.1
Baraga	Prickett	Upper Peninsula Power Co	1931	1.1
Ontonagon	Victoria	Upper Peninsula Power Co	1931	6
Ontonagon	Victoria	Upper Peninsula Power Co	1931	6
Chippewa	Saint Marys Falls	USACE-Detroit District	1932	2
Allegan	Allegan Dam	Consumers Energy Co	1935	0.5
Allegan	Allegan Dam	Consumers Energy Co	1935	0.9
Iron	Peavy Falls	Wisconsin Electric Power Co	1943	7.5
Iron	Peavy Falls	Wisconsin Electric Power Co	1943	7.5
Allegan	Allegan Dam	Consumers Energy Co	1945	1.2
Ionia	Webber	Consumers Energy Co	1949	1
Cheboygan	Kleber	Tower Kleber Ltd Partnership	1949	0.7
Cheboygan	Kleber	Tower Kleber Ltd Partnership	1949	0.7
Dickinson	Big Quinnesec 92	Wisconsin Electric Power Co	1949	8.9
Dickinson	Big Quinnesec 92	Wisconsin Electric Power Co	1949	8.9
Iron	Way Dam	Wisconsin Electric Power Co	1949	1.8
Chippewa	Saint Marys Falls	USACE-Detroit District	1951	4.8
Chippewa	Saint Marys Falls	USACE-Detroit District	1951	4.8
Chippewa	Saint Marys Falls	USACE-Detroit District	1952	4.8
Iron	Hemlock Falls	Wisconsin Electric Power Co	1953	3.1
Iron	Michigamme Falls	Wisconsin Electric Power Co	1953	5.3
Iron	Michigamme Falls	Wisconsin Electric Power Co	1953	5.3
Iron	Crystal Falls	City of Crystal Falls	1954	0.4
Chippewa	Saint Marys Falls	USACE-Detroit District	1954	2

Table A.4, continued

Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric	1963	0.6

Table A.4, continued

		Co		
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6

Table A.4, continued

Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Chippewa	Edison Sault	Edison Sault Electric Co	1963	0.6
Menominee	Menominee Mill Marinette	N E W Hydro Inc	1978	0.5
Menominee	Menominee Mill Marinette	N E W Hydro Inc	1978	0.5
St Joseph	Hydro Plant	City of Sturgis	1983	0.7
St Joseph	Hydro Plant	City of Sturgis	1983	0.7
Cheboygan	Cheboygan	Great Lakes Tissue Co	1984	1.5
Kent	Ada Dam	STS HydroPower Ltd	1984	1.4
Dickinson	Norway	City of Norway	1986	1.2
Kent	Cascade Dam	STS HydroPower Ltd-Cascade Dam	1986	1.6
Dickinson	Norway	City of Norway	1988	1.2
Wayne	French Landing Dam	STS HydroPower Ltd-French LDam	1988	1.6
Marquette	Cataract	Upper Peninsula Power Co	1988	2
Marquette	Hoist	Upper Peninsula Power Co	1988	2
Marquette	Hoist	Upper Peninsula Power Co	1988	1.4
Marquette	McClure	Upper Peninsula Power Co	1988	4
Marquette	McClure	Upper Peninsula Power Co	1988	4
Alpena	Four Mile Hydropower Project	Thunder Bay Power Co	1990	0.6
Alpena	Four Mile Hydropower Project	Thunder Bay Power Co	1990	0.6
Alpena	Four Mile Hydropower Project	Thunder Bay Power Co	1990	0.6
Alpena	Ninth Street Hydropower Project	Thunder Bay Power Co	1990	0.4
Alpena	Ninth Street	Thunder Bay Power	1990	0.4

Table A.4, continued

	Hydropower Project	Co		
Alpena	Ninth Street Hydropower Project	Thunder Bay Power Co	1990	0.4
Alpena	Norway Point Hydropower Project	Thunder Bay Power Co	1990	1.2
Alpena	Norway Point Hydropower Project	Thunder Bay Power Co	1990	2.8
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Berrien	Berrien Springs	Indiana Michigan Power Co	1996	0.6
Alpena	Four Mile Hydropower Project	Thunder Bay Power Co	2005	0.2

Table A.5: Michigan's existing nuclear generating units (after EIA Form 860, 2008 <http://www.eia.doe.gov/cneaf/electricity/page/eia860.html>, accessed 31 March 2010)

County	Plant Name	Company	Initial Year	Nameplate MW
Van Buren	Palisades	Entergy Nuclear Palisades LLC	1972	811.8
Berrien	Donald C Cook	Indiana Michigan Power Co	1975	1152
Berrien	Donald C Cook	Indiana Michigan Power Co	1978	1133.3
Monroe	Fermi	Detroit Edison Co	1988	1217

Table A.6: Michigan's existing wind generating units (after EIA Form 860, 2008 <http://www.eia.doe.gov/cneaf/electricity/page/eia860.html>, accessed 31 March 2010)

County	Plant Name	Company	Initial Year	Nameplate MW
Emmet	Bay Windpower I	Bay Windpower LLC	2001	1.8
Huron	Harvest Windfarm LLC	Harvest Windfarm LLC	2008	52.8
Huron	Noble Thumb WindPark	Noble Thumb Windpark 1 LLC	2008	69

Table A.7: Michigan's existing wood- and wood-waste-fired generating units (after EIA Form 860, 2008 <http://www.eia.doe.gov/cneaf/electricity/page/eia860.html>, accessed 31 March 2010)

County	Plant Name	Company	Initial Year	Nameplate MW
Baraga	John H Warden	L'Anse Warden Electric Company LLC	1959	18.7
Delta	Escanaba Paper Company	NewPage Corporation	1972	22.1
Dickinson	Verso Paper Quinnesec Mich Mill	Verso Paper - Quinnesec	1985	28
Isabella	Central Michigan University	Central Michigan University	1987	1
Montmorency	Hillman Power LLC	Hillman Power Co	1987	20
Missaukee	Viking Energy of McBain	Viking Energy Corp	1988	18
Alcona	Viking Energy of	Viking Energy	1989	18

Table A.7, continued

	Lincoln	Corp		
Crawford	Grayling Generating Station	CMS Generation Operating LLC	1992	38
Wexford	Cadillac Renewable Energy	Cadillac Renewable Energy LLC	1993	44
Genesee	Genesee Power Station LP	CMS Generation Operating LLC	1995	39.5

Table A.8: Michigan's existing landfill gas and municipal solid waste-fired generating units (after EIA Form 860, 2008 <http://www.eia.doe.gov/cneaf/electricity/page/eia860.html>, accessed 31 March 2010)

County	Plant Name	Company	Initial Year	Nameplate MW
Wayne	EQ Waste Energy Services	EQ-Waste Energy Services Inc	1986	0.3
Wayne	EQ Waste Energy Services	EQ-Waste Energy Services Inc	1986	0.5
Wayne	EQ Waste Energy Services	EQ-Waste Energy Services Inc	1986	0.3
Wayne	EQ Waste Energy Services	EQ-Waste Energy Services Inc	1986	0.3
Jackson	Jackson County Resource Recovery	Jackson County Res Recovery	1987	3.7
Wayne	Greater Detroit Resource Recovery	PMCC Leasing Corp	1988	68.4
Wayne	Riverview Energy Systems	Riverview Energy Systems	1988	3.3
Wayne	Riverview Energy Systems	Riverview Energy Systems	1988	3.3
Kent	Kent County Waste to Energy Facility	Kent County	1989	18
Clinton	Granger Electric Generating Station #2	Granger Electric Co	1991	0.8
Clinton	Granger Electric Generating Station #2	Granger Electric Co	1991	0.8
Shiawassee	Venice Resources Gas Recovery	Bio-Energy Partners	1992	0.8

Table A.8, continued

Shiawassee	Venice Resources Gas Recovery	Bio-Energy Partners	1992	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1992	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1992	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1992	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1992	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1992	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1992	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1992	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1992	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1992	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1992	0.8
Oakland	Lyon Development	Gas Recovery Systems Inc	1993	1
Oakland	Lyon Development	Gas Recovery Systems Inc	1993	1
Oakland	Lyon Development	Gas Recovery Systems Inc	1993	1
Oakland	Lyon Development	Gas Recovery Systems Inc	1993	1
Oakland	Lyon Development	Gas Recovery Systems Inc	1993	1
Clinton	Granger Electric Generating Station #1	Granger Electric Co	1993	0.8
Clinton	Granger Electric Generating Station #1	Granger Electric Co	1993	0.8

Table A.8, continued

Genesee	Grand Blanc Generating Station	Granger Electric Co	1994	0.8
Genesee	Grand Blanc Generating Station	Granger Electric Co	1994	0.8
Genesee	Grand Blanc Generating Station	Granger Electric Co	1994	0.8
Clinton	Granger Electric Generating Station #1	Granger Electric Co	1994	0.8
Ottawa	Ottawa Generating Station	Granger Electric Co	1994	0.8
Ottawa	Ottawa Generating Station	Granger Electric Co	1994	0.8
Ottawa	Ottawa Generating Station	Granger Electric Co	1994	0.8
Ottawa	Ottawa Generating Station	Granger Electric Co	1994	0.8
Ottawa	Ottawa Generating Station	Granger Electric Co	1994	0.8
Ottawa	Ottawa Generating Station	Granger Electric Co	1994	0.8
Lenawee	Adrian Energy Associates LLC	Michigan Cogeneration Sys Inc	1994	0.8
Lenawee	Adrian Energy Associates LLC	Michigan Cogeneration Sys Inc	1994	0.8
Lenawee	Adrian Energy Associates LLC	Michigan Cogeneration Sys Inc	1994	0.8
Calhoun	C & C Electric	Gas Recovery Systems Inc	1995	1
Calhoun	C & C Electric	Gas Recovery Systems Inc	1995	1
Calhoun	C & C Electric	Gas Recovery Systems Inc	1995	1
Genessee	Peoples Generating Station	North American Natural Res	1995	3.2
Washtenaw	Arbor Hills	Gas Recovery Systems Inc	1996	5
Washtenaw	Arbor Hills	Gas Recovery Systems Inc	1996	5
Washtenaw	Arbor Hills	Gas Recovery Systems Inc	1996	5
Clinton	Granger Electric Generating Station #2	Granger Electric Co	1996	0.8

Table A.8, continued

Clinton	Granger Electric Generating Station #1	Granger Electric Co	1997	0.8
Clinton	Granger Electric Generating Station #2	Granger Electric Co	1997	0.8
Genesee	Brent Run Generating Station	Granger Electric Co	1998	0.8
Genesee	Brent Run Generating Station	Granger Electric Co	1998	0.8
Macomb	Pine Tree Acres	Michigan Cogeneration Sys Inc	1998	0.8
Macomb	Pine Tree Acres	Michigan Cogeneration Sys Inc	1998	0.8
Macomb	Pine Tree Acres	Michigan Cogeneration Sys Inc	1998	0.8
Macomb	Pine Tree Acres	Michigan Cogeneration Sys Inc	1998	0.8
Macomb	Pine Tree Acres	Michigan Cogeneration Sys Inc	1998	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1998	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1998	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1998	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1998	0.8
Wayne	Sumpter Energy Associates	Michigan Cogeneration Sys Inc	1998	0.8
Genesee	Grand Blanc Generating Station	Granger Electric Co	2000	0.8
Genesee	Grand Blanc Generating Station	Granger Electric Co	2003	0.8
Macomb	Pine Tree Acres	Michigan Cogeneration Sys Inc	2003	0.8
Macomb	Pine Tree Acres	Michigan	2003	0.8

Table A.8, continued

		Cogeneration Sys Inc		
Washtenaw	Arbor Hills	Gas Recovery Systems Inc	2005	5.3
Ottawa	Ottawa Generating Station	Granger Electric Co	2006	0.8
Calhoun	C & C Electric	Gas Recovery Systems Inc	2007	2.7
Clinton	Granger Electric Generating Station #1	Granger Electric Co	2008	1.6
Clinton	Granger Electric Generating Station #1	Granger Electric Co	2008	1.6
Clinton	Granger Electric Generating Station #1	Granger Electric Co	2008	1.6

Table A.9: Michigan's existing pumped storage units (after EIA Form 860, 2008 <http://www.eia.doe.gov/cneaf/electricity/page/eia860.html>, accessed 31 March 2010)

County	Plant Name	Company	Initial Year	Nameplate MW
Mason	Ludington	Consumers Energy Co	1973	329.8
Mason	Ludington	Consumers Energy Co	1973	329.8
Mason	Ludington	Consumers Energy Co	1973	329.8
Mason	Ludington	Consumers Energy Co	1973	329.8
Mason	Ludington	Consumers Energy Co	1973	329.8
Mason	Ludington	Consumers Energy Co	1973	329.8

Appendix B

An Electricity Atlas

Figure B.1: Michigan's power plants, 2000

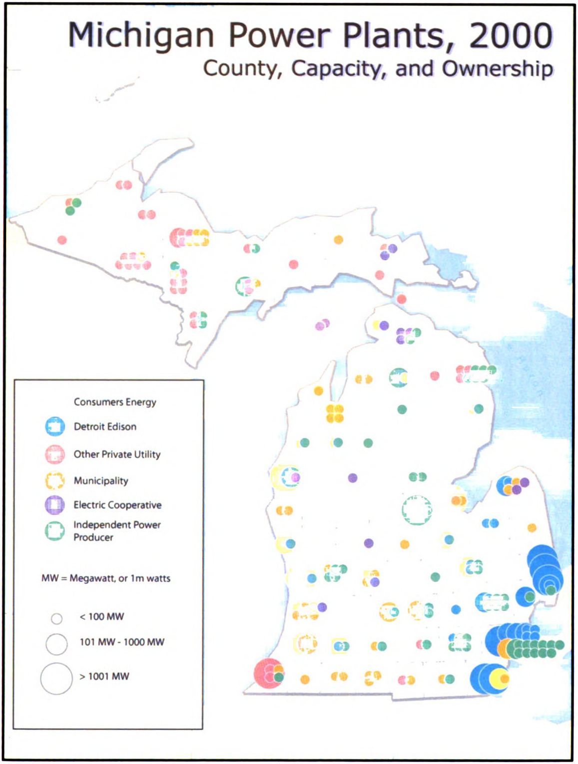

Figure B.2: Michigan's transmission system

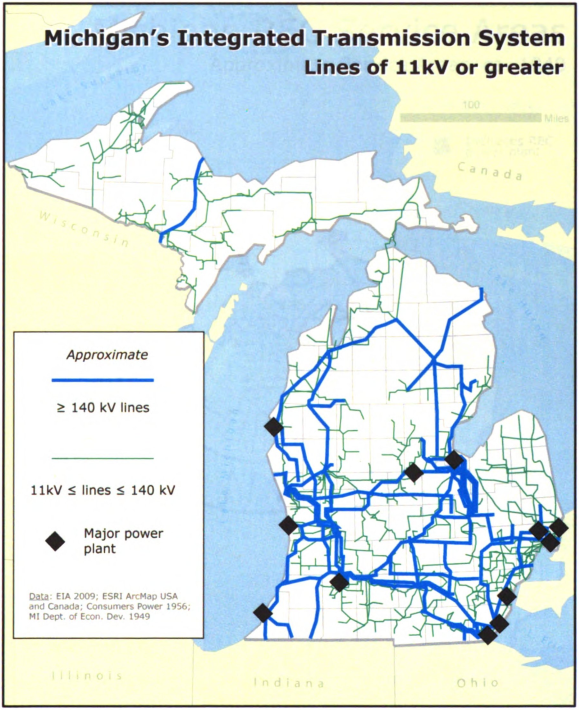

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Figure B.3: Michigan's REC service areas

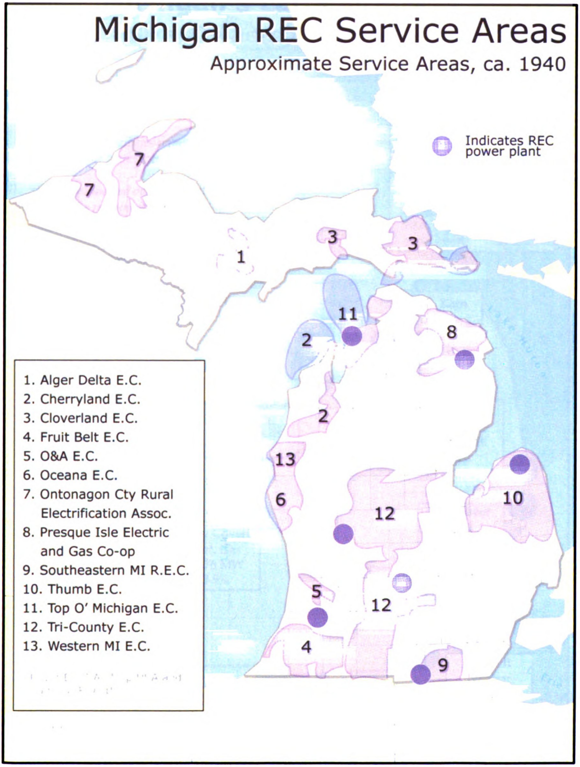


Figure B.4: Michigan's ten largest power plants

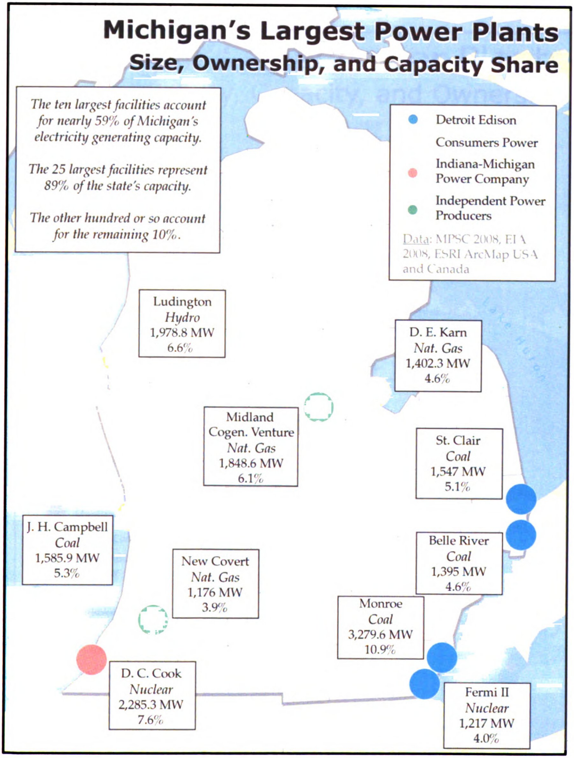


Figure B.5: Michigan's coal-fired power plants

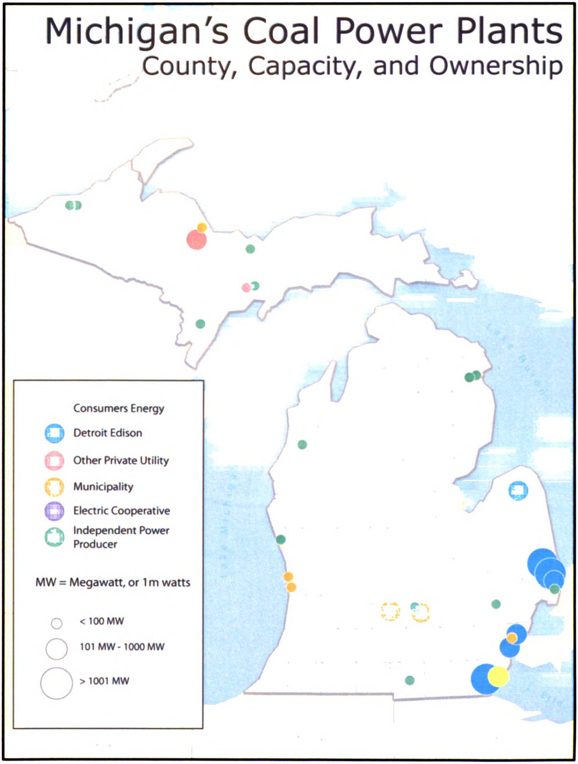


Figure B.6: Michigan's hydroelectric plants

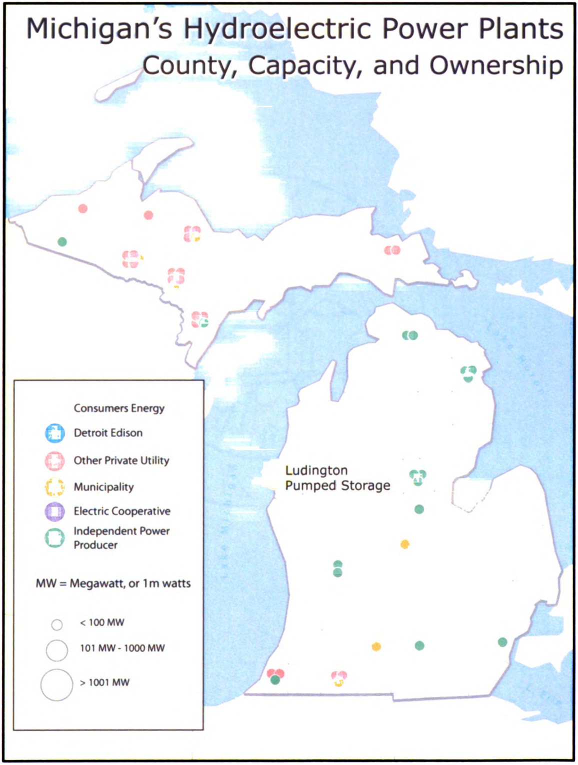


Figure B.7: Michigan's natural gas-fired power plants

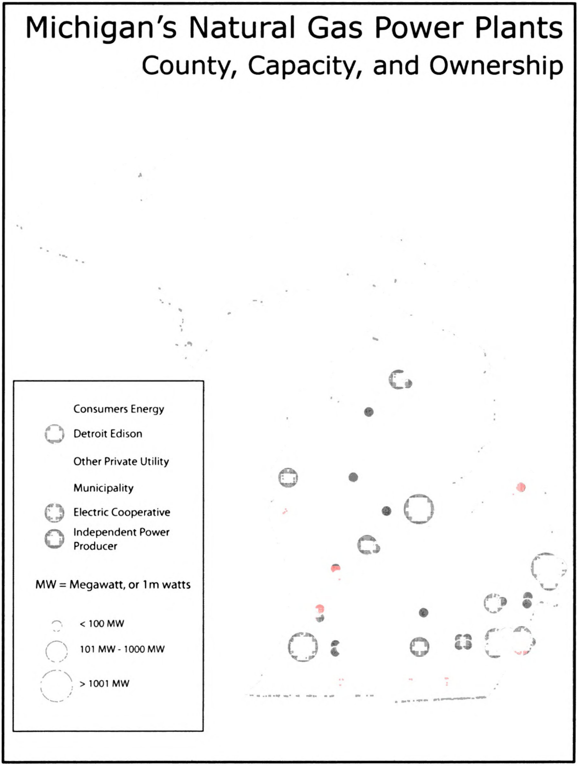


Figure B.8: Michigan's petroleum (distilled fuel oil) power plants

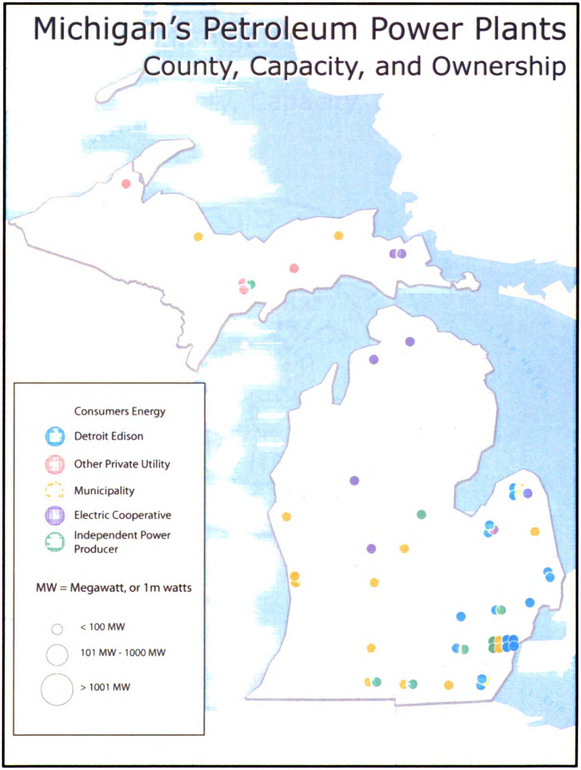


Figure B.9: Michigan's nuclear facilities and commercial wind generators. The nuclear plants are the three largest symbols.

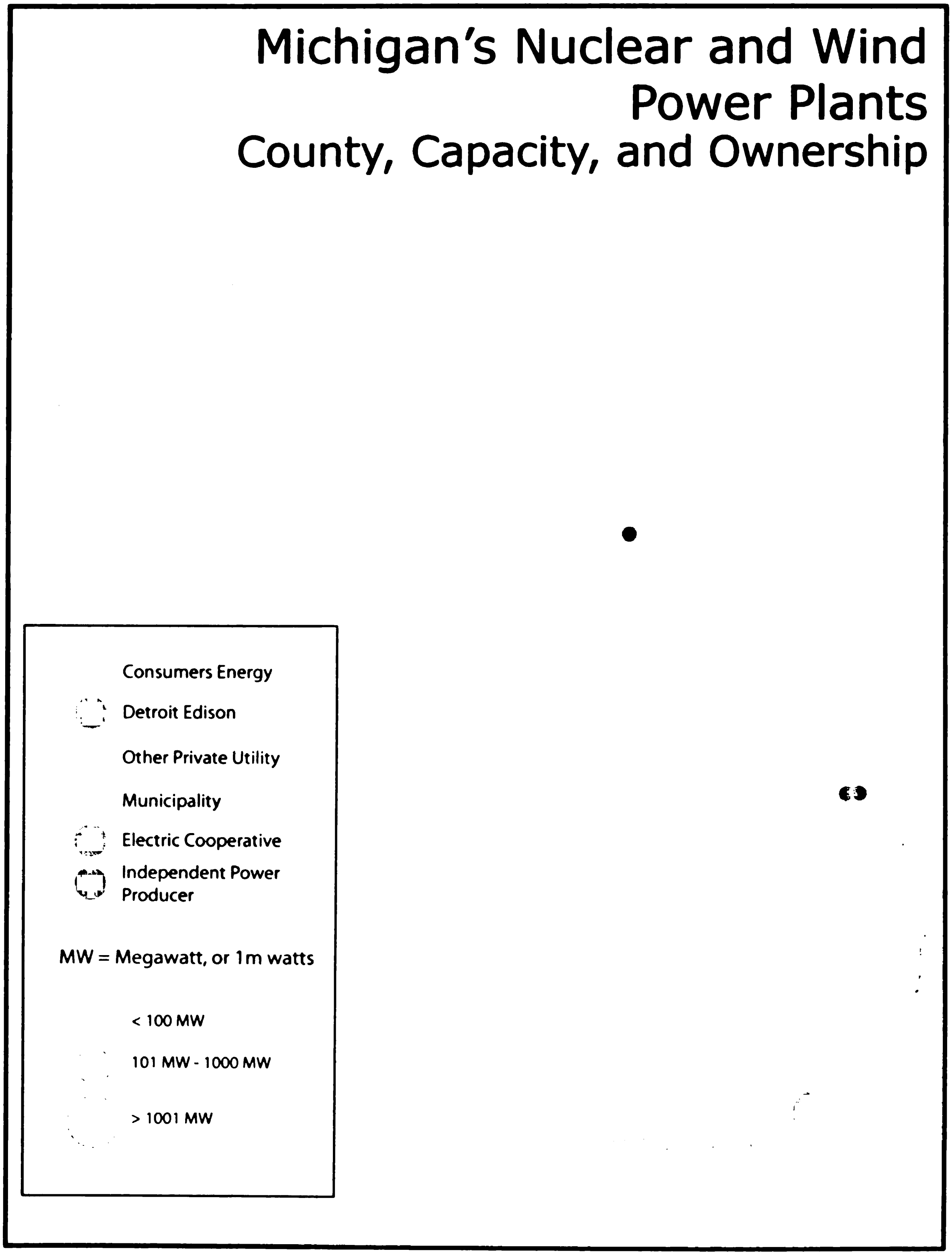


Figure B.10: Michigan's wood- and wood-derived fuel power plants

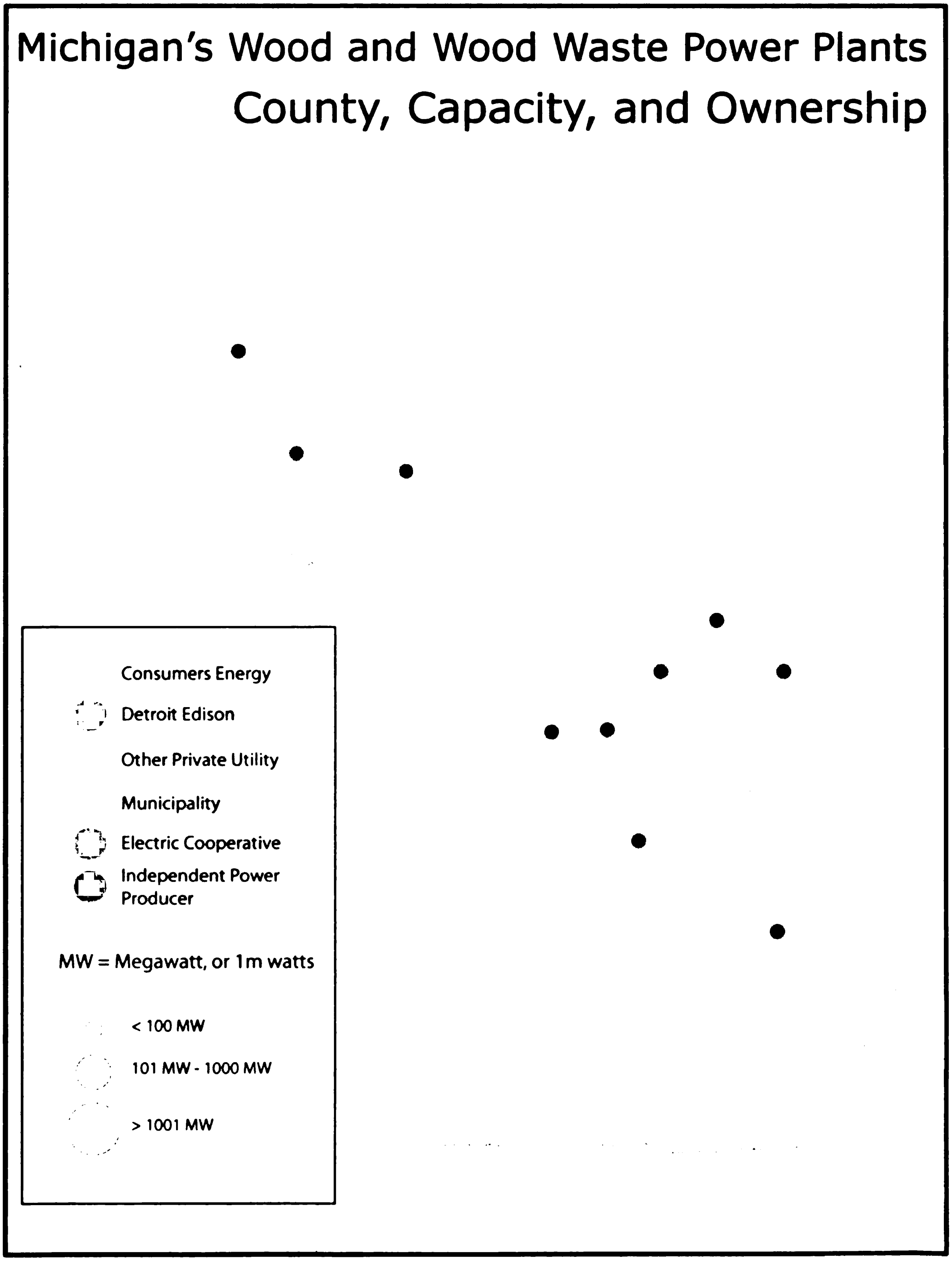
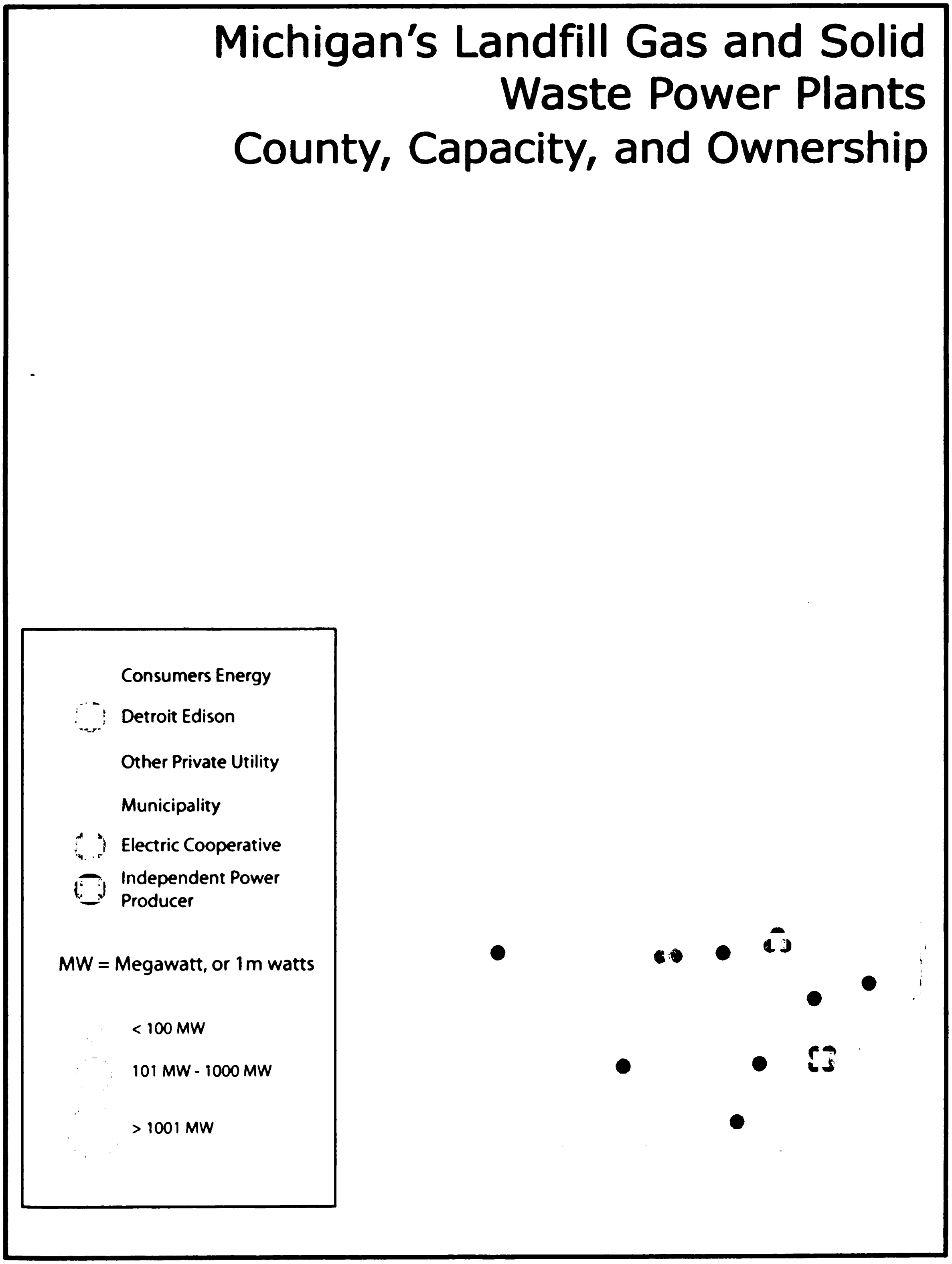


Figure B.11: Michigan's landfill gas and municipal solid waste-powered electricity generating facilities



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