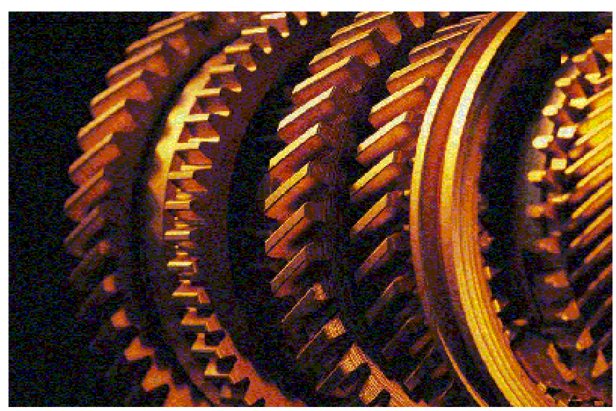
Informing the Debate

Michigan's Energy Future

An Examination of Costs and Technologies Impacting Policy which will influence Michigan's Energy Future



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Executive Summary

The Department of Energy expects electrical energy consumption internationally to almost double by 2030. The world as we know it in the 21st Century will not be the same as what we, particularly in the U.S., have experienced in the 20th Century. The combinations of climate change, urbanization, and materials/energy demand make this a dangerous century for humanity. Population and resource demand worldwide will drive up electrical generation prices faster then are currently being expressed in the public sector.

Renewable energy companies invest in countries and states that are committed to the development of renewable energy for the long haul. The traditional argument of letting “market forces” operate is not a reliable approach in the energy market for several reasons. Establishing energy policy by government to guide the future of electricity is at this time extremely important to the utilities and related industries. Since China and Middle Eastern nations are the largest holders of U.S. dollars, and they are aggressive investors, as a result they may have the power to supplant or redirect the path of the energy technology world. Energy sources generally require large sums of capital over longer time horizons with relatively high technology risk, which calls for more government involvement to support that research and development. The United States needs to provide a stable regulatory structure to foster renewable energy research and development (or centralized generation). Energy technology, developing at a prodigious rate, requires a stable ten- year policy and investment environment to be implemented.

The 2008 summer combined peak demand for electricity in Detroit Edison and Consumers Energy service areas is projected to be 21,136 mW. Edison and Consumers have and will purchase additional power to assure a reserve of nearly 14 percent above the projected peak demand. The cost of new plant construction has been found by several studies to be very costly. For new plants an anticipated a cost of 30 cents per kWh over 12-13 years of construction with a long – term operating cost of 18 cents per kWh is expected. The utility and renewable energy industries are facing a major labor problem as the baby boomers approach retirement age. The industry is growing so rapidly that enough trained workers are not being supplied by the traditional community college system.

The “smart grid” is a precursor to the implementation and restructuring of electrical future with demand management and distributed generation. The primary interface to the consumer is an electrical meter that is capable of communicating and controlling electrical usage within the consumer’s home or business. When AMI is implemented, each consumer will have usage interval data which provides them with a clear presentation of how they are using electricity and gives consumers the opportunity to make better choices. Utilities can then offer to the consumer a variety of time-based pricing which can further enhance consumer demand choices. The two most important immediate returns should be fewer problems with flow, and quality of electricity. Hybrid machinery connected to a smart grid is potentially a powerful adaptation. If the grid is smart enough, the electrons could be generated any place and delivered efficiently

Currently, the United States obtains just under 1% of electricity from wind, but massive growth is possible because of the much superior wind resources of the U.S. when compared to the generating capacity of Europe. Compared to centralized generation, wind and solar power can be built for 14 cents per kWh. States with a Renewable Portfolio Standard (RPS) tend to have markedly higher wind installation rates than states without an RPS.

Deep and shallow geothermal power is available throughout the U.S. for residential and business use. Solar thermal and photovoltaic systems can provide hot water and electrons and contribute to developing business and job growth. In-stream electrical generators can also provide electrons in a distributed generation system without many of the aquatic ecosystem impacts of dams. Technology is now available which provides electron storage and can therefore overcome the intermittency or variability making them dispatchable or useful as base load generation.

Efficiency continues to be the most cost effective energy management investment. Efficiency models that allow utilities to profit from demand/load management of electrical consumption are now available. Studies continue to reiterate that efficiency grows the economy and fosters job growth. Many states are moving aggressively to foster improved efficiency with diverse strategies.

None of the traditional “certificate” pathways in vocational training centers, return-from-prison work centers or community colleges are oriented toward an energy efficient renewable or green economy. Yet, these arenas and the utility industry offer a tremendous opportunity for post-high school education and the high paying jobs that are available. Tapping the “green economy” will require a renewed educational/job training structure that provides guidance and training beginning in high school and continuing on to community college .

For the immediate future an RPS or feed-in-tariffs seem necessary to foster renewable energy investment in Michigan. However, it is imprudent at this time to invest in centralized generation, given the unpredictability of cost and federal climate change requirement. But the future is extremely positive because of the rapidly developing new technologies that will very likely revolutionize the energy/electrical world as we know it.

Introduction

The Department of Energy expects electrical energy consumption internationally to almost double by 2030. This doubling will take place in the context of an unknown world affected by climate change and threatened by terrorism which is often fed by economic differentiation. To meet this need in the U.S. alone, it is projected that 1500 to 3000 new large, very capital-intensive generating plants will be needed with an estimated cost of some 400 billion dollars. Three of these plants have already been proposed for Michigan. By comparison, implementation of a distributed generation system controlled by a smart grid can be accomplished at a fraction of that cost. And as importantly, this system would diversify investment opportunities and spread jobs across Michigan and the U.S. This divergent pathway from the centralized generation model of the 20^{th} century contains a major opportunity for the Michigan to become a major contributor to our electrical grid and the income connected to it. To capitalize on this opportunity with policy, Michigan should aggressively pursue an efficiency/distributed energy model policy that anticipates a break from the centralized, fossil fuel oriented electrical generation system of the past.

Under such a policy, Michigan can expect a burst of investment and job growth that could rival the auto industry growth of the early 20^{th} century.

It is the purpose of this paper to provide the reader with a perspective of the national and state electrical market that emerges from a sampling of the current energy literature. This literature represents both divergent and parallel views that are characteristic of the energy discussion in Michigan. This paper includes an overview of current national and international influences, followed by an over view of Michigan’s generation capacity. Centralized generation, smart grid, alternative technologies, renewable energy options, energy efficiency methods, and job impacts are then discussed. The paper ends with short and long term policy recommendations focused on efficiency and a distributed energy system.

Background

The world as we know it in the 21^{st} Century will not be the same as what we, particularly in the U.S., have experienced in the 20^{th} Century. The trends apparent in the data indicate that this crossing of trends (population growth, resource consumption, environmental impact, etc.) will make human life challenging and tenuous. This will be true for humanity’s supporting cast as well. The natural world’s plethora of free ecological services is likely to become less and less available to us. These perspectives on the future have become so imperative in the scientific community that they are commonly expressed in the open literature. A most recent example from a *Science Magazine* article states:

“If humanity wishes to preserve a planet similar to that on which civilization developed and to which life on earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO_2 will need to be reduced from its current 385 ppm to at most 350 ppm." Jim Hansen, NASA Climatologist, cites six irreversible tipping points – massive sea level rise and huge changes in rainfall patterns among them – that we’ll pass if we don't get back down to 350 soon; and the first of them, judging by last summer's insane melt of Arctic ice, may already be behind us.”(1)

Other examples: cite that our current path is not sustainable: If governments around the world continue with policies in place to date, the underlying premise in the
Energy Technology Perspectives Baseline scenario to 2050, CO2 emissions will rise by 130% and oil demand will rise by 70 %. (2)

The risk of global warming is much higher than the risk of your home burning down. We need planet insurance, because the probability of a disaster is so much higher. (3)

Warnings such as these should not taken as the traditional doom and gloom future (Chicken Little Syndrome), but as an attention-getting tap on the shoulders telling us to pay attention now or the consequences might be irreversible.

The problem for us as Americans is that the 20th century was one of phenomenal growth in every sense of the word. Except for a few hiccups along the way (usually related to war) that growth benefited most of us and created expectations that our world will continuously get bigger and better well into the future. So when the price of gasoline starts to approximate real costs, we complain bitterly and demand that the political system respond by taking us back to the 20th century. Meanwhile, the developing world, through the spread of electronic media and globalization, sees our lifestyle and through their inexpensive labor and heavy resource consumption that they are bettering their own populations’ welfare while also continuing to feed the voracious demand of the Western World. Because of the large populations (and policies) of China and India and their economic growth, they have dramatically changed the resource consumption and pollution indices of the world. We would be wise as a nation to face this new resource reality as soon as possible.

The “more and cheaper” lifestyle of the 20th Century is unlikely to ever be with us again. Sachs, in his book *Common Wealth: Economics for a Crowded Plane,* identifies four major trends that will make this century different. Those trends are: human pressure on earth, a dangerous rise in population, extreme poverty, and a political climate of out-dated institutions, cynicism and defeatism. He argues that 2.6 billion people cannot be added to earth without facing a continuing series of disasters such we have recently experienced in China and Burma. The

combinations of climate change, urbanization, and materials/energy demand make this a dangerous century for humanity.
(4) To illustrate these trends, the U.S. Census Bureau has projected that the world population will increase to 9 billion people by 2042 from approximately 6.6 billion people today. The resulting competition for scarce resources as other countries pursue the economic benefits of globalization and development will only accelerate as more people in the world strive for a better life. E.O. Wilson refers to this as the bottleneck of the 21st Century.

This context of population growth and resource consumption with related impacts creates a massive challenge to the democratic/representative form of government. Running our environmental and energy policy on election year cycles is no way to provide enough consistency for the implementation of new policy. In *Energy History*, Smil claims the that major energy transitions (e.g. wood to coal) each required a century for the conversion to occur.(5) The trends of the 21st Century, clearly present in the world, do not allow us that amount of time. Changing human expectations and behavior may be the most difficult of all, since we are coming off of the abundant century. We must now begin to the see the future differently and with hope.

The traditional argument of letting "market forces" operate is not a reliable approach in the energy market for several reasons. First of all, efficiency of energy use is the least costly and has the best rate of return, yet this approach is often not taken unless energy price changes dramatically, as it did in the 70s and 80s. Without big price changes, energy users require a very short pay back period or a special economic stimulus to make the initial high capital investment for efficiency adoption. Secondly, investment in energy generation has a long time line. Investment in centralized generation (new coal or nuclear plants) has a 40-60 year time line. So the choices made now will be with us for a long time. The problem is that we are in a period of dramatic change in the energy industry. The costs of traditional construction are rising so dramatically that cost estimates for plant construction are unpredictable as are the availability and cost of fuels. Thirdly, competitive states within the Midwest have concluded that renewable energy is worth of investment through several investment stimuli. For renewable energy generation, as of 2006 Minnesota ranked 19th and Wisconsin 26th compared to Michigan's 29th ranking, whereas Indiana, Illinois and Ohio all rank in the forties. What is also important in that data is that the Michigan is well below Minnesota and Wisconsin in summer renewable generating capacity the time when peak energy demand is its highest.

Renewable energy companies invest in countries and states that are committed to the development of renewable energy for the long haul. For example, the major wind company Vestas currently has seven factories in China, and because they have increased their renewable target to 15% by 2020, they have decided to add three more plants there. This same company is going to invest heavily in the U.S. since recent reports suggest that the U.S. could achieve as much as

20% of its energy from wind. With stable renewable portfolio standards(RPS) requirements and production tax credit, Vestas will invest heavily in this country.(6) If Michigan chooses not to follow a renewable portfolio standard or a feed-in-tariff, it is likely that the industry development and job opportunities connected to renewable industry will occur in other states rather than in Michigan.(8)

Establishing energy policy by government to guide the future of electricity is at this time extremely important to the utilities and related industries. This industry, in an attempt to meet demand, is getting ready to invest in over $400 billion over the next 25 years and the current investment rate is ratcheting up at 25% annually. This investment might support the building of 1500 large-scale centralized generation facilities or 150,000 distributed generators such as wind farms, solar arrays and battery/ capacitor systems. (7)(9) By 2015, this sector will have spent $30 billion not just for increased generation capacity, but to reduce emissions from a fleet of coal-fired plants that supply 50% of current electrical generating capacity. Much of this investment is going to the high economic growth areas of the U.S., but despite slower growth in Michigan, investment is needed just to maintain existing infrastructure and replace aging coal fired and nuclear reactors that currently provide Michigan's electricity. This need for infrastructure assessment is met with of public resistance to various environmental and property impacts in the placement of new wires, pipes and plants to meet those energy needs. The expectation by the regulating community is that these industries will meet the extended lack of 20^{th} century investment, within a context of public opposition to price increases and infrastructure upgrades. In addition, the utility industry faces unprecedented challenges in the form of pollution control and climate change which drives up construction pricing and the price of fuels used to meet the increasing demand.

The world of nuclear reactors provides an excellent example of what is faced by the utilities and related industries. The world currently has 439 nuclear reactors generating 371.7 Gigawatts or 16% of world electrical generation. Thirty-two additional plants are being built. The average age of these plants is 23 years out of a 40 year life expectancy. The Greens (political party in Germany) in examining this report says " it is practically impossible to maintain or even increase the number of operating nuclear power plants over the next 20 years"…. with manufacturing limitations and lack of trained workers being the limiting factors.(reference)

The U.S. is the largest energy consumer per capita in both electricity and consumption of liquid fuels. As a result the market leadership currently falls to the U.S. The U.S. also has an important role in energy research and development (R&D). At present, the U. S. and Japan account for 35% of global GDP yet provide more than 80% of R&D for renewable energy. (10) The U.S. government has spent more than $12 billion to research, develop and promote alternative energy sources. Energy sources generally require large sums of capital over longer time horizons with relatively high technology risk, which calls for more government involvement to support that research and development. (11) For comparison, Google has stated that the average IT investment costs $25 million, but returns a profit typically in about five years. Conversely, energy investment requires more capital ($250 million) and takes about 10 years to reach a profitable state. The high capital requirements, long return time and high risk usually translates into debt providers being more reticent to extend the needed capital. This inaction tends to raise the cost, making it more difficult for renewable energy projects to compete with the much longer history of conventional power generation. But the potential to investors is huge. Because there was a $6 trillion market worldwide for energy last year, the right investment has a huge profit potential. The markets for green technology are larger than IT opportunities by an order of magnitudes. Since China and Middle Eastern nations are the largest holders of U.S. dollars, and that they are aggressive investors, as a result they may have the power to supplant or redirect the path of the energy technology world.(12) Three example technologies that are in the pipeline with huge potential that are in need of consistent energy policy are: a carbon-negative cement which could be cheaper than Portland cement; steel mill exhaust gases that could be converted into 50 billion gallons of biofuels; or winter cover crops that could replace 100% of our oil imports alone, with no additional land use.(3)

Further data gives some insight as to the potential influence of China in the 21st century world of electricity. The capacity China installed this year has reached 700,000 megawatts which will go up to 900,000 megawatts in the year 2010. Only 22% will be hydro whereas seventy percent will be conventional thermal power. Law requires ten percent to be nuclear or renewable energy by 2010, rising to fifteen percent in the year 2020. The total installed capacity for wind power for China Power International Development has reached 941 megawatts, and is planned to reach 20,000 by 2010.(18) Clean energy (nuclear power and renewables as defined in China) currently provides less than 2% of electrical generation, but should reach 10% by 2010. To accommodate this level of infrastructure development, by 2010 China will need 950,000 megawatts of transmission capacity, a one-third jump from today. State Grid in China will invest $180 billion between 2006 and 2010 to serve 88% of China. (12) This is important to the U.S and Michigan because this level of investment by China will put tremendous pressure on the resources and costs of future energy development, but will also provide direction for electrical generation technology and investment.

The inconsistency of the regulatory framework between and among countries and regions is often a limiting factor to the dissemination of renewable energy technology. The U.S. could show leadership by creating standards and codes around buildings, biofuels, and grid interconnectivity which would contribute to a “build once – distribute everywhere” approach that would tend to decrease costs and accelerate dissemination of renewable energy technology.(10) The United States needs to provide a stable regulatory structure to foster renewable energy research and development (or centralized generation). Because energy projects can take up to five to ten years to achieve profitability, the two-year sunset tax incentives for wind, geothermal and other distributed generation has cost the U.S. economic development, investments and jobs compared to countries with a stable support structure.(13)

Another aspect where the U.S. needs federal leadership is in the unevenness of regulations faced by new companies and utilities from state to state. According to Laurie Aylsworth, Vice President of transmission projects, engineering and maintenance at Northeast Utilities, every project faces confusing sets of local, state, and national regulations that are time consuming and therefore costly to companies as they attempt to implement innovative technology and projects. (11) The utility industry considers their most important uncertainties involving the political environment to be: deregulation, environmental requirements such as air pollution and CO2 controls, the consistency and direction of subsidies, and the instability rendered by new politicians due to the constraints of term limits. (14)

Michigan's Current Energy Capacity and Challenges

The 2008 summer combined peak demand for electricity in Detroit Edison and Consumers Energy service areas is projected to be 21,136 mW. Excluding retail open access and interruptible loads, the peak demand is projected to be 19,985 mW. The in-state generating capacity including existing capacity contracts totals 20,061 mW so the difference between projected summer peak demand and available capacity is only 76 MW. Edison and Consumers have and will purchase additional power to assure a reserve of nearly 14 percent above the projected peak demand.

To meet summer demand Detroit Edison and Consumers Energy currently must purchase reserve capacity from outside the state. Assuming increased summer consumption in future years, this indicates that there is already a need for additional generation capacity. Purchasing this capacity from outside the state represents a movement of funds out of the state. (43)

Recent projection efforts from the MPSC provide excellent recommendations.

The conclusions and recommendations in the 2006 Capacity Need Forum Report are as follows:

Electric power demand in Michigan is projected to increase at approximately
2.1% annually over the 20-year study period.
The development of additional resources, in both the short-term and the long-term, would be reasonable and prudent in light of this anticipated increase in demand.

In the short-term, we recommend a portfolio of low-cost options that can be implemented within the next five years, including: (1) enhanced energy efficiency, (2) additional renewable resources, (3) additional capacity, (4) combustion turbines for peaking, and (5) load management. These options (particularly energy efficiency, renewable resources, and transmission enhancements) will have beneficial effects for the Michigan economy in both the short- and long-term.

In the long-term, we recommend commencing a program to build one or two additional base load coal generating plants in Michigan on a staggered basis, with the first becoming operational about 2011 or shortly thereafter. The further need for additional base load plants (if any) should be assessed on a regular basis in the future.

From discussions among the Forum participants, it is clear that, due to the risk involved, a new base load generating plant is unlikely to be financed or built without ratemaking changes to support construction. Accordingly, Staff recommends adoption of a Reliability Option ratemaking model, which emphasizes the need to preserve system reliability and recognizes the public benefit that all customers receive from a new base load plant.

Under the Reliability Option, a utility would file an application indicating its need for additional capacity and its plan for meeting that need. If, after a public hearing, the Commission concludes that the utility's plan is the best method of addressing the need, the Commission would authorize the utility to collect a reliability charge from all customers and to include the construction work in progress in its rate base without an AFUDC offset. The Reliability Option would only be available if ownership rights in the plant are extended to other stakeholders and the plant construction is done through a competitive process.

The least expensive plan selected by the resource model for meeting Michigan's expected electricity demand over the next ten years produces a present value revenue requirement of approximately $ 29.6 billion. The present cost of meeting Michigan's single year 2005 electricity demand using existing resources is estimated to be $ 3.3 billion. However, current resources will not be able to meet the projected growth over the next ten years and the State's electric reliability will be compromised unless some action is taken. (42)

These selected comments from the 21st Century Energy Plan update future planning.

Michigan's total electric generation requirements are expected to grow at an annual average rate of 1.3 percent from 2006 to 2025 – from 112,183 gigawatt hours (GWh) to 143,094 GWh. Southeast Michigan's generation requirements are expected to grow 1.2 percent annually, and growth for the balance of the Lower Peninsula is expected to average 1.4 percent. The Upper Peninsula's annual average growth rate is 0.9 percent for this period. Summer peak electricity demand is likewise expected to grow from 23,756 MW in 2006 to 29,856 MW in 2025, an annual average rate of growth of 1.2 percent. The expected peak load growth for Southeast Michigan and the balance of the Lower Peninsula is 1.2 percent per year, and for the Upper Peninsula it is 0.9 percent.

Although the combined METC and ITC regions satisfy general reliability standards for 2009, reliability modeling shows that the ITC region, analyzed separately, does not meet these standards beginning in 2009. (12) These results occur under a normal growth scenario. Though forecasting is never perfect and the projected violation is small, this result indicates that additional generating resources will be required in the near future, and, as annual load growth of 1.2 percent continues, in the long-term as well.

Nuclear power was also eliminated from consideration as a long term energy source during the first half of the planning period, due to the extremely long lead-time (assumed to be 12 years) required to bring a nuclear plant online. No new nuclear plants have been started in almost three decades, and issues regarding the permanent disposal of spent nuclear fuel remain unresolved.

This leaves Michigan reliant on coal. Coal-fired generation is a major source of air pollutants, including mercury, nitrogen oxides and sulfur dioxide. (14) Perhaps more significantly, coal-fired plants are the major stationary source of carbon dioxide – the primary component of greenhouse gas. Michigan's coal fired generating units emit approximately 70 million tons of carbon dioxide emissions annually, or an estimated 40% of the state's total emissions.
In sum, reliability modeling indicates that additional resources (from renewables, energy efficiency programming, or short-term generation options) will be needed to meet Michigan's electric needs by 2009, and additional base load generation will be needed as soon as practicable but no later than 2015.

From these major long-term planning efforts at the state level it is clear that Michigan is under time constraints to assure that Michigan's electrical supply is met with an adequate reserve capacity over the next two decades. (44)

Relevant Research, Practices and Directions

Centralized Generation Considerations

"The average person in the United States burns 20 pounds of coal per day" says Hockfield, President of the Massachusetts Institute of Technology. The United States consumes 1 billion pounds of coal per year. Most coal plants were built during the 1970s and 1980s and are not environmentally friendly. U.S. coal-fired capacity may increase by as much as 120 gigawatts, which will have a tremendous effect on the nation's carbon dioxide emissions. The growing scientific consensus is that U.S. companies have perhaps 40 years to drastically reduce their greenhouse gas emissions below current levels to avoid catastrophic consequences. Currently, the international institutions are not built to face the issues that now face us.(11)(12) While proposed coal plant projects in the United States are being cancelled, coal plant construction is up around the world, and so is demand for the black fuel. Inevitably, that means utility companies in the United States, and their customers, face higher prices. Recently, spot prices according to some indexes were up by as much as 64% to 93%.U.S. coal exports have tripled between 2006 and 2008.(15) Carbon capture and storage for power plants are anticipated to cost 20-50% more. But widespread deployment is not likely and therefore these anticipated costs may not occur until 2020-2025. (16)

The utility and renewable energy industries are facing a major labor problem as the baby boomers approach retirement age. The industry is growing so rapidly that enough trained workers are not being supplied by the traditional community college system. The unique demands of the energy world, requires the basics of electronics, math, hydraulics, engineering, the ability to work outdoors in diverse weather, plus climb poles and 200-foot wind towers. These work requirements are often extremely difficult for the traditional education system to provide an adequate experience for new students and also upgrade existing employee skills. It is fortuitous that coalitions of Unions, utilities and community colleges are providing financing and curriculums that will attempt to meet this need. An example is the International Brotherhood of Electrical Workers, which has proposed training centers in Arizona, Florida, Kansas, Michigan and Washington at closed utility facilities. The curriculum will include best practices, training methods and courses that can be translated through apprenticeships, community colleges or employment programs into greatly improved training programs. Utilities and unions will contribute with both expertise and training with the potential for employment if the program is completed successfully. Assistance in English, and math and other basics are given by community colleges which often can also provide the needed facilities and administration for programs support. (17)

Nuclear Power

The nuclear power industry again serves as an example of need for new employees in a growing industry.

“Between 2007 and 2012 about 35% or 19,600 current nuclear utility workers will be eligible to retire. Over the same five-year period, it is projected that an additional 11% or 6,300 nuclear workers will leave the workforce due to attrition. The highest peak of current workers is between the ages of 45 and 65. There is a lack of workers between the ages of 32 and 45 and a small peak for workers between the ages of 20 and 32.”(19) This translates into a major peak of retirements over the next 10-20 years in the nuclear power industry. This is an industry which during this time period is likely to experience explosive growth. The shortage of qualified nuclear engineering faculty nationwide translates into a slow startup time for new degree programs and the related infrastructure. Some of this shortfall might be made up by engineers from Europe and Asia. Although, in this case, outsourcing of engineering expertise in this arena carries with it some serious safety risks. Be reminded that this part of the power industry that provides 20% of the country's energy needs.

The nuclear power industry faces other daunting problems other than labor as the fleet ages. In a survey about licensing requirements, 55% of respondents considered it very likely that their company would be seek license renewal beyond 60 years and an additional 32% thought it likely that the company would apply to extend beyond 60 years. (20). The 40 – 60 year potential extensions create some very interesting research voids:

1. Corrosion, wear and fatigue of metal components may increase with longer exposure to high temperatures, radiation and thermal cycles.

2. Aging of concrete structures... containment buildings, foundations, water intake structures…life limiting characteristics, monitoring and mitigation

3. Materials degradation in electric cable. Buried piping and large components encompass a host of disparate materials and service environments. (20)

This extension of existing plants becomes very important since the cost of new plant construction has been found by several studies to be very costly. The cost of a new plant depending on escalating material costs could be $12 billion or higher. For two plants at Turkey Point Florida Power and Light, current costs for both of them are anticipated to be $24 billion or about $8000 per kilowatt hour. West Florida's Progress energy estimates their construction costs for two plants at $14 billion with $3 billion needed for additional transmission capacity. (21). Twenty seven respondents to a survey, by a Nuclear Power Joint Fact Finding Committee, saw their projected costs rise from $2950 per kWh to $3600-4000 with interest due to rising construction costs. (21). Moody's Investment Services estimate overnight costs (includes interest costs) even higher at $5000 -6000 per kwh if this interest is included. Jim Harding, an energy consultant for the Nuclear Power Joint Fact Finding Committee anticipates a cost of 30 cents per kWh over 12 -13 years of construction with a long –term operating cost of 18 cents per kWh. Of course, the actual costs will not be known until the plants come online. This price escalation will likely apply to both coal and combined cycle natural gas-powered facilities, which will compete with coal. (14) At this time, 17 companies or groups of companies are preparing license application for as many as many as 31 new reactors. Five companies have filed with NRC in 2007 and 11-15 in 2008. (16) The Nuclear Energy Institute expects that it will be 2016 before new nuclear plants will be operating and facing this price escalation.(16) For comparison, American Electrical Power is investing in two integrated-gasification combined cycle coal plants at a cost of $2.23 billion and can be constructed under a much quicker time frame.(14)

Smart Grid Contributions

The Smart Grid is an electrical transmission and distribution network that uses computer chips, two-way communications, advanced sensors, and distributed computer management systems to improve the efficiency, reliability and safety of power delivery and use of the electrical system. The primary interface to the consumer is an electrical meter that is capable of communicating and controlling electrical usage within the consumer's home or business. This advanced metering infrastructure (AMI), previously has been largely available only to commercial and industrial customers. Implementation to businesses and residences represents a huge potential to manage electricity demand at an attractive benefit/cost ratio. When AMI is implemented, each consumer will have usage interval data which will provide them with a clear presentation of how they are using electricity and therefore allowing the opportunity to make better choices. Utilities can then offer to the consumer a variety of time-based pricing which can further enhance consumer demand choices. This "load management" or "demand response" effort from the utility allows the spread of electrical usage over a broader time scale and potentially avoid the dreaded "blackout" which results when demand exceeds the available electrical supply. Utilities are moving rapidly to time-based pricing which can spread out demand if consumers choose to use less electricity during higher priced time periods. These advanced meters can also house computer chips that will allow either the customer or the utility to control the use of in-home or farm appliances and equipment if the devices are also chipped appropriately. The ability to control especially peak demand translates to the need for less generation capacity or electrical purchase for the utility. Those companies moving forward with AMI through the regulatory system attempt to pay for the differential of AMI implementation costs and operation savings by:

- Building AMI costs with incremental rate increases over the time needed for deployment.
- A special surcharge (36)

The initiation of the smart grid begins with the deployment of the smart meter at the consumer level. But the utilization of computer and related technologies enable many more components of an optimized grid.

This smart grid should have seven primary characteristics:

Self-healing. A grid able to rapidly detect, analyze, respond and restore from perturbations.

Empowers and incorporates the consumer. The ability to incorporate consumer equipment and behavior in the design and operation of the grid.

Tolerant of attack. A grid that mitigates and stands resilient to physical and cyber security attacks.

Provides power quality needed by 21st century users. A grid that provides the quality of power consistent with consumer and industry needs.

Accommodates a wide variety of generation options. A grid that accommodates a wide variety of local and regional generation technologies (including green power).

Fully enables maturing electricity markets. Allows competitive market for those who want them.

Optimizes assets. A grid that uses Intelligent Technology and monitoring to continually optimize its capital assets while minimizing operations and maintenance costs (37).

Smart Grid Benefits

The two most important immediate returns should be fewer problems with flow, and quality of electricity. This will mean that users will be less dependent on back-up generation in black-outs caused by extreme weather events. Any problems within the system will be much more easily identified. As the cost of electricity increases, the smart grid will provide the ability to manage electrical usage costs with AMIs and web accessible management tools. Alternatively, the utility will be able to manage when and how electricity will be used in applications where short down times are not debilitating.

Hybrid machinery connected to a smart grid is potentially a powerful adaptation. Batteries can be recharged when excess electrons are available from that grid. Furthermore, electrons can be released from the batteries when grid requires it. Having hundreds, even thousands of battery storage units allows the flattening out of a widely fluctuating electrical demand curve and creates less need for new peak generation capacity. Assuming the appropriate financial arrangements, you should be able to charge batteries while running or at lower cost periods and then sell to the grid at peak times for a much higher rate. Monitoring and controlling thousands of these small storage systems will require the computer power of the smart grid.

Advanced monitoring and control is also imperative in a distributed generation system. A landscape exists of many anaerobic digesters using the produced methane to provide excess electricity to the grid from dairy operations, sewage treatment plants, food processing operations and community digesters. A similar potential exists for photovoltaic systems, small or individual wind generators, or small-engine driven cogeneration systems to supplement electrical need of the grid. This is a bigger management problem than the few centralized plants typical of most utilities. All of these technologies are available now, just waiting for the economic incentives and the deployment of the smart grid to be massively implemented nationwide.

Transmission

The deployment of massive wind generation on the Plains states and large solar systems in the Southwest will likely need high-voltage direct-current transmission lines(HDVC) or other advanced cabling to deliver the electrons to the centers of high demand. But this technology potential depends on a reliable and, above all, a cost effective means of getting the power from the deserts to major population centers. That transmission technology does exist in the form of high voltage direct-current transmission lines which are feasible and cost effective to transmit electricity for 3,000 kilometers or more. Modern high-voltage direct-current transmission lines (HVDC) lose only about 3% of power for every 1000 kilometers. This HVDC super grid can be integrated relatively easily into existing high voltage alternating current (HVAC) transmission grids to facilitate, for example, the use of electric vehicles and plug-in hybrids, extension of electrified railways, and expanded heat pumps. HVDC super grid also has the advantage of a secure electrical supply, spare capacity movement, and the reduction of generation variability impact as a result of integrating across a wide area. (25) Although at present this technology is not economically feasible for Michigan, the reader should be aware that electricity from this technology will be available on the grid from the Southwest and that Michigan companies are already producing components of these developing systems.

Superconductor cables carry roughly ten times the electrons of commonly used standard copper wires. Though very costly, maximizing existing right-of-ways to carry more electricity decreases land use controversy, permitting time needed to obtain permits, construction time, and ultimate availability. The implementation of such lines in Michigan would allow more development of wind farms in the “Thumb area” and even potential utilization of Great Lake wind generation capability. The second benefit that comes with the implementation of superconducting transmission lines is their unique ability to minimize “fault currents”. These “smart materials” in superconducting cable are capable of carrying large quantities of electricity, but becomes like a resistor when excessive current flows. Thus the HTSC cables counter the fault problems that are more and more prevalent in an ever-expanding grid system. This characteristic will be more important as a multiplicity of distributed generation systems are added. So, to improve the quality and quantity of electricity for consumers and provide distributed energy opportunities in the agriculture community, investment in the superconducting cables in the context of the smart grid is imperative.

Dealing with Intermittency

The sun doesn't always shine and wind doesn't always blow. A capacity factor for wind of 30% is considered a very good investment and any increment above that is an exceptional investment. The traditional method of dealing with the intermittency is tripling the number of generators and then expecting the wind to be blowing or the sun shining someplace. If the grid is smart enough, the electrons could be generated any place and delivered efficiently. Now, distributed generation is largely confined to local micro grids and those specific utilities. Another way to deal with intermittency is adding storage capability to the grid.

American Electric Power is going to invest some $27 million into megawatt-sodium sulfur batteries to improve grid reliability, do peak-load shaving and store intermittent generation sources. Batteries of this type can provide up to eight hours of storage and are movable from substation to substation. On the other hand, compressed-air storage or water-pump storage require specific geological situations to be implemented economically. The mobility of large battery systems allow placement so that reduction of power outages can be reduced or additional capacity where demand requires.

The Ludington Pump Storage Facility is an example of an electrical storage system. In this case, excess base load electricity (low cost), is used to pump water uphill to a small lake. Released water spins hydroelectric generators during the high demand periods. This system also creates a steep gradient to drop the water flow at a faster rate and therefore supply more energy. Proposals are now being contemplated that would utilize existing lakes that are well above Great Lakes levels to serve as energy storage systems. Water could be pumped up into those lakes and then be released to run generators as the water flowed back into the big lakes. Structures are now being developed which can accomplish the same height differential within the body of water thus avoiding the land use controversies connected to terrestrial pump storage. It is now possible to avoid dam controversies by creating tunnels parallel to the river to carry the water past the turbine, rather than holding the water behind a large dam for generator release. This approach to hydro generation avoids the blocking of anadromous fish (trout, salmon and others) as they migrate upstream to spawn, but must deal with entrapment and entrainment by the spinning turbines.

The salt caves of Michigan could be used to store compressed air that is compressed by wind generators during hours when electrical demand is at low ebb or the wind is blowing. The air is then released, mixed with a combustible gas to spin turbines which generate electricity. These hybrid systems can also integrate solar thermal energy to reheat the very cold compressed air so that they become a very interesting hybrid system that is stable enough for base load generation. Though many of these salt caves are currently used for natural gas storage, in the case of a massive electricity need, these caves could provide relatively inexpensive energy storage throughout the Great Lakes region. But these storage systems are not evenly distributed throughout the region, so the control and management of this storage as a contributor to a distributed generation system would require the control of smart grid technology. (45)

Renewable Energy Opportunities

Wind Energy

Compared to centralized generation, wind and solar power can be built for 14 cents per kWh. (11) Currently, the United States obtains just under 1% of electricity from wind, but massive growth is possible because of the much superior wind resources of the U.S. when compared to the generating capacity Europe. This translates to about 15,000 megawatts of wind generated electricity, but many believe or have the goal of the U.S. generating 20 % (about 300,00 megawatts) of its electricity from wind.**(**14**)** According to Tim Hudgens, developing 20% of America's electricity from wind generation would allow PPM Energy to avoid the importing of $250 million per day of natural gas. (22) Wind has the potential to grow in the United States today at about 5,000 megawatts per year, with an increase up to 10,000 megawatts per year for the long term, consistent renewable energy policy in the U.S. To move in this direction, the U.S. needs to change their tax priorities, since they collectively provide a mere $33 billion of subsidies for nuclear power and renewable energy while heaping $200 billion a year on coal, oil and gas producers.

From a world perspective, the most successful strategies have been to require states to utilize a renewable portfolio standard or have a feed-in tariff. States without much in the way of apparent renewable power should opt for feed-in tariffs, and accept all the renewable power they can get at, say, 10 cents a kilowatt-hour which is much higher rate of return than current net metering returns per kilowatt-hour in most states and Michigan. We already have 28 states with a renewable portfolio standard in some form. Just to meet the level that has already been set by those 28 states, the wind industry needs to grow at about 5,000 megawatts a year. In states that have a renewable portfolio, standard prices will not rise to the same level if the production tax credit is lost.(22) The production tax credit does require companies to have a substantial taxable incomes to utilize the tax credit. A national RPS rather then the current state-by-state approach would set the standards for a longer period and provide the stability those investors and developers need to achieve the 5,000 – 10,000 mW per year growth.

The analysis from the Land Policy Institute (23) at Michigan State University is based on a 50-state model of wind installations by RPS adopters and non-adopters. States with an RPS tend to have markedly higher wind installation rates than states without an RPS. Based on their model, the following impacts of wind industry development are projected for Michigan, the majority of which are attributable to the adoption of RPS:

Approximately 780 megawatts (mW) per year in added installed wind capacity in the foreseeable future.

Under specific assumptions, Michigan will reach 16,000 mW of deployed capacity by 2029.

Based on state level projected economic multiplier information available through the Jobs and Economic Development Impacts Model, the following economic impacts associated with wind capacity deployed will be realized as a result of RPS adoption:

Approximately 1,100 construction jobs per year for the next two decades.
Approximately 318 recurring or permanent jobs related to the management and maintenance of wind installations by 2010.
Approximately 3010 recurring or permanent jobs related to the management and maintenance of wind installations by 2029.
Approximately $1.25 billion per year in construction related new investments and spending over the next two decades or so.
Approximately $464 million in recurrent spending in maintenance and management by 2010 and $4.4 billion by 2029.
Approximately $21 million per year in new construction wages for the next decade or so.
Approximately $7.6 million in permanent annual wages by 2010 and $96 million by 2029. These earnings will be concentrated on the coastal areas of Michigan.
Approximately $4.8 million in lease payments to landowners per year by 2010 and $47 million per year by 2029. These earnings will be concentrated on the coastal areas of Michigan and represent a major boost in the economic plight of such landowners, the vast majority of whom will be farmers.

The above estimates do not include the following:

Secondary employment, wage and spending impacts related to current and potential wind component manufacturing.

Impacts of RPS on property taxes paid to local units of government, or business or income taxes paid to the state government. These tax impacts depend, to some extent, on how the various components of wind energy installations are classified for property tax purposes.
Impacts on Michigan if Michigan's manufacturing capacity were to be deployed toward the production of wind turbines and components.

Michigan's manufacturing capacity could be brought to bear on producing wind components. Michigan could capture a large percentage of the total spending on wind components by developers. It is concluded that $1.25 billion per year of the construction investment and spending dollars and $4.4 billion per year in recurrent spending could be internalized in Michigan by 2029. So the employment and income impact of Michigan manufactured wind components for installations in Michigan could be as high as $6 billion a year if secondary impacts are included. Given these projected impacts, state policy makers must carefully balance the benefits against the concerns of opponents to RPS. However, it is clear that without strong RPS legislation, it will be difficult for Michigan to develop its wind capacity and pursue energy sustainability. (23)

Michigan could utilize wind generation capacity from the central part of the country. But the development of the large wind generation from North Dakota to Texas will require massive transmission upgrades to provide the areas of high electrical usage. The location of offshore wind to large urban users would reduce the transmission costs, but the cost for offshore wind is still not competitive with the onshore wind. Presently, the Midwest including Michigan offers plenty of good terrestrial–based areas for wind generation. Public opposition, especially in densely populated areas, as well as state statutes and regulations, has made the location of generators and transmission lines among the most difficult to site. (16) Streamlining siting regulations would facilitate development greatly.

Despite this tremendous potential of wind and solar power, they is still intermittent or variable resources that usually require fossil-fuel base load generation, which are subject to the dramatically increased costs discussed earlier. (16) Alternatively, development of storage technology could make renewables into dispatchable power that is a necessity for the power needs of utilities. (24)

Geothermal Power

From 42 inches to six kilometers deep local geothermal power is available throughout the U.S. Deep geothermal power is available even in Washington, D.C. that is currently powered by a coal plant. The deep oil well drilling technology is applicable in this context. (24) The best example is Iceland, which produces 99.95% from renewable hydro and geothermal power. This covers 98% of space heating requirement and all electricity. Only liquid fuels (20%) are imported for transportation and the fishing fleet. A single geothermal resource can provide Icelandic owners 12 sources of revenue beyond generating electricity. Their research is adapting to the abundance of cheap and green electricity to develop synthetic fuels and hydrogen as well as the direct use of electricity for the transportation sector. (26)

Iceland's research has a focus on deep drilling, drilling through high-temperature rocks, broadening the temperature range of water used for generation, and stimulating the water flow through reservoirs and the improvement of down-hole pumping of return water. In the right location, there is a huge unused geothermal potential on the sea floor. The geysers erupting on the boundaries of submerged tectonic plates look like black smoke whose potential is yet unexplored. Depleted oil fields, with their well researched geology and hydrology, are particularly suitable candidates for geothermal generation. As an example, in Chena, Alaska, electricity is even produced at 72.4 degrees Celsius. Refining the methods to produce power on a large scale at low temperatures would be an important advance to geothermal power as well as other renewable sources. (26)

Stream Generation

In-stream free flow generation also has tremendous potential as a renewable energy source. The company, Free Flow Power, plans to spend $3 billion to generate 1,500 megawatts of electricity from 57 permitted locations in the Mississippi River from St. Louis, MO to the mouth of the Mississippi. Other companies propose smaller-diameter turbines in river water to capture the energy from the river current. Free Flow chose the Mississippi River because of the high flow rate and proximity to end users. Free Flow installs turbines on pilings along the river bottom. Hydro Green on the other hand suspends the turbines from the bottom of barges along the river. River currents can be tapped in just about any river. In fact, Free Flow has applied for permits on the Niagara River and Detroit River. The Electric Power Research Institute estimates that 3,000 megawatts of new power will be generated by in-river hydrokinetic technology by 2025. The National Hydropower Association (NHA) says that number is likely too conservative. As Dan Irwin of Free Flow claims "It's clean, renewable power that's cost effective. If you level the playing field, this stuff will really take off." (27)

Solar Energy

Solar thermal and electrical generations are the two solar energy opportunities available in Michigan. Thermal solar heating can contribute to any operation that uses hot water. Home owners that have installed systems to provide their hot water report that their systems provide as much as 50% of their hot water needs. Since Michigan is not viewed as a high solar-gain state, this method of heating water is undervalued. Yet broader adaptation of this technology can provide an important incremental savings in fossil fuel use. Wide spread deployment of roof top photovoltaic's, whose cost is now edging down towards $.20 per kHz, has tremendous potential to contribute to electricity especially during middle of the day high peak demand hours of the day. Leasing photovoltaic systems operations have unlimited potential to avoid the high initial capital costs of residential use. (39) Widespread opportunities for this approach through out the U.S. and Michigan could drive costs down more quickly as well as well as dramatically increases solar-generated electrons to the grid. The management of such a widespread system certainly would require the adoption of a smart grid infrastructure in Michigan. The business and jobs developed by such an approach is both local and job intensive.

CHP

Combined heat and power applications for the home and business are another distributed generation opportunity that is very near wide adoption. Small internal-combustion powered CHP units have been available for several years for utilization in residential homes. But these units are relatively inefficient and dependent mostly on liquid fossil fuels for combustion, with the pollution and supply limitations that come with these fuels. They do, however, provide hot water and electricity at the residential level. A company in the UK has developed a scalable fuel cell base CHP unit that dramatically increases efficiency using natural gas as fuel. These units uniquely provide an opportunity to reduce emissions, lower energy costs, improve grid stability and therefore national grid security. The UK has concluded that widespread application of these units has the potential to supply 30-40% of the UK's electrical supply. (47)

Energy Efficiency

Additional generation is not the only way to meet future electricity needs. The right choices and investments in energy efficiency technologies for the U.S. have the potential to decrease energy consumption over the next quarter century by 25-30%. Since 1970 three-fourths of energy demand has been met by efficiency improvements, whereas only one-quarter has been from new generation. In 2004, efficiency technologies are believed to have replaced 1.7 quads of energy, which is the output of 40 medium-sized conventional power plants. In 2004 the $300 billion efficiency investment was triple conventional power plant investment. This investment annually supports 1.6 million jobs in the U.S. The State of New York has recently begun "a far reaching, ground breaking energy efficiency initiative" with the goal of decreasing electrical use by 15% by 2015. The program will provide $4 billion to New Yorkers and stimulate thousands of jobs in the process. When implemented, the natural gas aspect of the program with $13 billion in costs is expected to add $160 million the New York economy. (41)

An important study from American Council for an Energy Efficient Economy (ACEEE) concludes that two-thirds of efficiency-related jobs occurred in the building sector. 380,000 jobs were connected to the appliance/electronics arena, and 348,000 in residential construction and renovation, 332,000 in commercial construction and renovation. The industrial sector generated 416,000 jobs, but the transport sector generated/provided/created only 151,000 jobs in 2004. While current investments in energy efficiency are having an important impact on our economy, efficiency remains under-funded, and the potential benefits of efficiency remain unrealized. (28)

The utility companies, often expected to offer demand management or energy efficiency programs, usually view energy efficiency investment as a catch-22 since it asks them to make investments that actually decrease the sale of electricity, which is their primary source of revenue. So, for utility companies, a policy milieu that equivocates energy efficiency with generation is an imperative. Utilities are now developing a new business models that:

- Allows the recovery of costs associated with promoting energy efficiency.
- Addresses the impact on revenues and the recovery of fixed costs that arise as a result of the sales lost due to the efficiency programs.
- Offers financial return for pursuing energy efficiency goals that is on a par with building generation and transmission assets.(16)

Creating state policy that encourages utility companies to move rapidly to implement this model would allow Michigan to more quickly tap into the investment and job creation that energy efficiency offers.

Some examples of recent state action from diverse parts of the U.S. include:

- New York State's Department of Public Service issued a preliminary plan to meet the governor's target of reducing electricity usage in the state by 15% in 2015. (ACEEE provided technical assistance to the commission in developing and estimating impacts of recommended programs and policies.)
- North Carolina's legislature passed a bill in late summer that creates a Renewable Portfolio Standard, in which up to 40% of resource requirements can be met through energy efficiency.
- The Illinois legislature enacted a bill last summer that creates an Energy Efficiency Resource Standard (EERS), requiring utilities to achieve energy savings reaching as high as 2% of electricity sales. Important details, including program cost limits, are to be worked out.
- Minnesota lawmakers passed the New Generation Energy Act this year, which includes an EERS target reaching 1.5% of electricity sales—roughly equivalent to current load

growth rates. Utility programs, building codes, and other approaches can be used to meet the resource requirement.

Iowa's legislature appointed an Energy Efficiency Study Committee, which held hearings last fall that may lead to a major increase in utility efficiency programs, already among the most effective in the Midwest.

Texas lawmakers acted this year to double the state's EERS target, from 10% to 20% of load growth. A study was also commissioned to consider raising the target to as high as 50% of load growth.

Virginia's State Corporation Commission held a stakeholder process in the summer of 2007, gathering input for a report to the legislature on ways to meet the 10% utility energy savings target that was enacted as part of legislation passed in April.

In Colorado, Xcel Energy responded to a number of legislative, regulatory, and gubernatorial initiatives with its Colorado Resource Plan. The plan will double the current capacity of its customer programs to 694 MW, while tripling the amount of annual energy sales (49)

Job Impacts

The traditional American middle class that has been supported by our industrial/energy-rich economy of the 20th century has been down-sized and out-sourced to the point that many are struggling to afford health care (up 71%), college costs (up 44%) and energy bills. Job loss every month is often in the thousands creating a bleak job/economic outlook. As the auto industry was blossoming at the beginning of the 20th century, it is the green economy that is now just beginning to develop. It has the promise of good-paying manufacturing, sales and management opportunities. More and more CEOs and CFOs are dedicating themselves to careers in wind power, solar energy, hydropower, ocean energy, geothermal energy, biomass and waste energy, and biofuels and leaving the conventional power and energy industries. Whether these career paths are going to trickle down is yet unclear. (30)

This green economy is anchored in the local food, sustainability, renewable energy and non-toxic, or energy efficiency economic sector (this is not met to be a comprehensive list). This is believed to be a $229 billion market sector according to the Lifestyles of Health and Sustainability Journal. Clean and green technology is the third largest venture capital investment category in 2006 according to Cleanedge.org. California projects 114,000 new jobs in these categories by 2010. Wisconsin argues that 340,000 workers would benefit from renewable/efficiency investments. In the Clean Edge report, 45 occupations are particularly connected to six renewable/efficiency approaches. (31) The big advantage of the green sector is that because these jobs/companies/industries tend to be local, they come with a huge multiplier effect and the money stays within the community. In addition, these jobs usually do not create health and environmental externalities and they can not be outsourced. (32) (33)

A recent report from ACEEE tells us that:

> 23% energy efficiency creates a 2 to 1 benefit cost ratio.
> A 20 % efficiency gain by 2030 would provide 800,000 net jobs, 30% 1.3 million net jobs
> Efficiency policies would increase GDP by 0.1 by 2030

The study concludes that energy efficiency offers the potential to grow the economy and jobs and not harm them. (34)

Job bursts, like the dot-com era, tend not to bring opportunity to urban communities of low income and color. Green jobs will not be unskilled labor. It will be a major challenge to include America's urban youth or they will yet again be trapped in the gang/mafia culture or low paying retail or fast food jobs with limited opportunity for advancement. Van Jones, President of the Ella Baker Center, gives important insight. "The work of saving the polar bears and poor kids is the same work. If we give jobs to the people who need them, we solve two problems."

None of the traditional "certificate" pathways in vocational training centers, return-from-prison work centers or community colleges are oriented toward the green economy. They are still training night school attendees for the pollution-based fossil-fuel world that is disappearing in the 21st century. Entrepreneurs and companies, already taking a substantial risk in developing new technology, are going to be reticent to also take on the training of this unskilled workforce without significant incentives. (35)

The utility industry offers a tremendous opportunity for post-high school education and the high paying jobs that are available. Bill Johnson, Progress Energy's Chairman and CEO support this: "Finding craft labor and technicians is the biggest challenge". As he suggests, engineers are needed but they are pay dependent. The article suggests that a massive reeducation is needed beginning with early high school and up for teachers and counselors to guide students toward an economically rewarding career in an industry that is desperately in need of new recruits, but does not require a college level education.(40)

The public school system, in a mad rush to prepare students for the high tech world, have drastically increased academic requirements while decreasing opportunities for manual skills education. The green world will not be just employing computer and financial wizards but the traditional electricians, plumbers and building skill sets will be needed to install photovoltaic's, geothermal systems, solar thermal heating systems and improving energy efficiency throughout our infrastructure. The related utility world foresees a tremendous need for lineman with outdoor working skills that will replace the boomers as they retire.

A Summary Table of Other State Policy Approaches

http://www.dsireusa.org/summarytables/financial.cfm?&CurrentPageID=7&EE=1&RE=1

Policy Options for Michigan

Table 1: Three Possible Michigan Energy Policy Approaches for the Near-Term Future

	Incremental Progress Policy Approach	Current Common Practices Policy Approach	Sweeping Change Policy Approach
Major Purpose and Goals	Minimize change from the status quo Address major interest group present concerns through modest, incremental policy changes Improve IRP capabilities	Match other states' energy policies regarding DSM and renewables	Enable maximum statewide utilization of DSM and renewable energy Achieve rapid transition to a low-carbon energy sector, in keeping with recommendations aligned with the best available global climate change science
Economic	Use minimal intervention to establish and support markets for DSM and renewable energy Assign a portion of future emissions risks to shareholders Develop valid and reliable economic multipliers for use in IRP modeling **MI**[1] Property tax assessments based on value of energy produced	**MI** Establish system benefits fund for DSM and renewables[2] **MI** Provide tax incentives to support DSM and renewable energy[3] Provide financial incentives to support DSM and renewable energy Establish low-cost financing for DSM and renewables Special property tax credits or exemptions	Systematically remove energy related "bad" subsidies and replace them with "good" subsidies[4] Assign all future emissions risks to shareholders Engage in systematic ecological tax reform[5]
Employment	Develop valid and reliable employment multipliers for use in IRP modeling	**MI** Payroll tax incentives or credits for specific industries **MI** Apply state and local government economic development tools to promote DSM and distributed energy technology employment	Integrate employment policies with economic and energy policies Engage in systematic ecological tax reform[5]
Environmental	Keep separate from energy policy Meet but do not exceed federal environmental policies Inventory and make public emissions data, including greenhouse gases	**MI** Match other states' beginning actions on global climate change **MGA**[1] Establish voluntary greenhouse gas emissions trading platform, and prepare to implement a cap & trade platform	Drive both economic and energy policies using integrative sustainability policies Lead other states in policies to address global climate change mitigation and adaptation

Energy	Utilize IRP to support utility ratepayer funded energy resource acquisition Establish smart power grid infrastructure and demand-response capability **MI** Implement cost-of-service based net metering	Establish statewide DSM program Revise regulatory incentives Strengthen energy construction codes and state appliance energy efficiency standards Establish clean energy portfolio standard with special treatment for solar & DG, including combined heat & power Implement customer-friendly net metering and avoided cost feed-in tariffs Complete state renewable resource inventory and build-out plan	Coordinate and strategically integrate policies for DSM and renewables Socialize costs associated with renewable resource build-out Establish cost-plus feed-in tariffs for renewable energy and high-efficiency combined heat & power

[1] "**MI**" represents policies already at least partially implemented in Michigan and "**MGA**" indicates policies at least partially adopted for implementation by the Midwestern Governors Association ([MGA], 2007), including Michigan's Governor Jennifer Granholm.

[2] Michigan presently has a system benefits fund called the Low-Income and Energy Efficiency Fund (LIEEF) and administered by the MPSC ([MPSC], 2007). The LIEEF receives contributions from ratepayers of Michigan's two largest electric utilities and one of Michigan's largest natural gas utilities. Different from system benefits funds in most other states, however, a large majority of Michigan funds thus far have been dedicated exclusively to low-income customer bill-payment (76.7%) and low-income weatherization (17.2%) assistance, and only 6.1% of the total LIEEF has been available to support energy efficiency programming for other customer classes.

[3] Tax incentives can be made selectively available to provide either producer or consumer incentives, or both. Michigan presently offers among the best state tax incentive programs in the U.S. for renewable energy technology producers (i.e., manufacturers and firms engaged in research and development), but offers practically nothing for DSM producers or consumers, nor for renewable energy technology consumers (North_Carolina_Solar_Center, 2007).

[4] Definitions of bad and good subsidies are drawn from Roodman, 1997, 1998.

[5] The recommendation for ecological tax reform appears twice in this listing, included as both economic and employment policy.

(48)

Recommendations for immediate action

It is imperative the Michigan implement a longer term energy policy as soon as possible.
Energy policy in Michigan should anticipate carbon reduction and mercury control.
A feed-in- tariff approach would put Michigan in a national leadership role and foster renewable energy growth and its benefits whereas adoption of an RPS standard only catches Michigan up with 29 other states.
Energy policy should have a ten year life to promote a stable energy investment environment.
The first investment for Michigan should be in smart grid components that facilitate the development of demand management, efficiency opportunities, and distributed generation and dramatically decrease grid downtimes should have priority in energy policy.
Michigan energy policy should provide utilities the opportunity to profit from providing demand management services and energy efficiency savings.
Vocational training for high school and community colleges focused toward the energy industry needs a special emphasis in the state education system.

Conclusion

Michigan, like many other states, is still in the classical argument of centralized generation versus distributed energy that has been with us since the energy problems of the Carter years. The utility companies are pushing the centralized system with which they have had historical success. On the horizon is a behemoth of a distributed/efficiency era that with the right policy structure will very likely change the world. This discussion is set in the context of extraordinary resource demands by the developing world that are driving the prices of construction materials to unprecedented levels that make future price predictions difficult, and therefore price rise predictions are usually understated. Since energy technology development requires a longer timeline then IT, a ten-year stable national policy and state policy is necessary. With a positive long-term financial situation, the potential for an energy revolution is possible. With this revolution will come a burst of investment and job growth to Michigan that could rival the auto industry growth of the early 20th century. Often not realized is that this revolution will require a numerous job opportunities for “craft” employees as efficiency and renewables are expanded. The educational system focusing on college directed learning will leave the personnel needed for this future unprepared. Therefore, the educational system needs to reinvent the vocational system to prepare the non college-bound student for this burgeoning of job potential.

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