

## **Fermi 3: A Critique of the Resource Options Comparing Fermi 3 to Efficiency and Renewable Generation**

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Detroit Edison proposes to build a nominal 1600 MW nuclear plant at the existing Fermi site, named Fermi 3. The proposed plant would produce 1535 MW's of net generating capacity.

Should this plant operate at 90% capacity factor, a level which is often stated as a reasonable value for the function of a new nuclear plant, it would generate 12,108,847 MWH's per year. This would represent 29.7% of Detroit Edison's 2010 sales.

However, based on our review of available data, Michigan's nuclear fleet operates at a mere 66% capacity factor. While this may be due to economic sales opportunities and a poor fit between Michigan's general consumption pattern and nuclear generation rather than poor operation of the plants in question it creates an overwhelming burden of proof that a new nuclear plant which is massive relative to the proposing utility will not create an unacceptable negative economic impact. It may be possible for Detroit Edison to show that its operation of Fermi II has a better track record, but the recent years do not give that suggestion much support.

Since Michigan's overall electric industry has a similarly low capacity factor it is extremely likely that Michigan and Detroit Edison have a "needle peak" problem, meaning that more than twenty or thirty percent of its peak MW demand level exists for less than ten percent of the year.

This presentation challenges the appropriateness of the Fermi 3 proposal on economic grounds, by comparing it on several terms with available clean energy alternatives. Natural gas is not clean energy, but it is regarded as very important these days. It will be discussed briefly, and shown to have important limitations.

To address a low capacity factor or "needle peak", the lowest cost option is efficiency, which can easily be oriented to address peak demand (high efficiency commercial lighting and all air conditioning efficiency and all refrigerator efficiency in air-conditioned space will have high impact on demand). Load management programs are considered to be similarly inexpensive, but there may be limits on the level of participation which is available at low cost when real curtailment of service is required.

One of the key issues in comparing Fermi 3 to alternatives is the current pace of price shifts. During the last ten years the cost of new coal plants has increased three to four times. The cost of new natural gas plants has increased nearly that much. The cost of wind turbines has more than doubled (although it has dropped 30% in the last three years), and the cost of a new nuclear plant remains speculative, but is unquestionably at least three or four times as much as it was the last time a nuclear plant was completed in the United States. By contrast, efficiency has held pretty steady in cost over thirty years, gaining ground through better technologies and the rising value of the savings. In other words, the cost of efficiency has held steady, while the efficiency

potential has increased faster than U.S. citizens and businesses have installed the technologies. Photovoltaics have fallen almost ten percent in price per year for almost twenty years, and are cheaper than new natural gas in the Southwest U.S. The same cost/benefit can be expected in three to five years in the Midwest, due to our lower sunlight index.

Since the value of wind and photovoltaic technology is a function of the available wind or solar resource as well as the equipment, there is a real revolution in U.S. electric technology under way. In 2011 the price of electricity from a new wind turbine became unequivocally cheaper than any new fossil resource generation in most of the U.S. With the wind production tax credit, new wind costs less than four cents per KWH in many states with good wind resources. The wind production tax credit is under fire, but in 2011, the tax credit was 2.11 cents per KWH, while the cost of coal per KWH was 2.35 cents, so the tax credit pays for itself.

Similarly photovoltaics are crossing paths with fossil and nuclear options. In the Southwest U.S. where solar resources are better than across the Midwest, photovoltaics are deemed cheaper than natural gas by several State regulatory orders. Following the long term trend of price reductions, photovoltaics are likely to become cheaper than new coal in the Midwest in three to five years. When the current market price of photovoltaics is compared to the marginal cost of peak energy in summer peaking utilities, it is already cheaper than existing supply in most places. Since this analysis is not consistently performed in utility planning, there is a huge potential relative to the current size of the photovoltaic market in nearly all of the U.S. Even if the peaking service which is cost-effective today is small compared to total U.S. consumption, meeting it will drive the price of the technologies even lower, and make a much larger fraction of the market cost-effective from PV. This isn't theory. It is what is happening today.

Comparing all these factors is challenging. The biggest uncertainty is the price of a new nuclear plant. Estimates range from \$6,000 to \$12,000 per KW of capacity. But even if this amount were fixed, it understates the cost of a plant which takes ten to twelve years to construct. Engineering costs, which must be expended before ground is broken, can be thirty to forty percent of the plant cost, but accrue interest and carrying charges for the eight or nine years during which the plant is under construction, as does much of the early heavy construction itself. And then once the plant is completed the unamortized debt continues to accrue interest and carrying costs. Although these are factored into rates and do not increase the unpaid balance of the plant cost, they extend the amortization period substantially. Like a home mortgage carried to completion after thirty years, the new power plant will actually cost two to three times its initial "price".

By contrast, efficiency, wind and photovoltaics are added incrementally, and in today's world are more often financed by independent power producers. They have nearly fixed operation and maintenance costs and zero fuel price uncertainty. These carry real and important long term economic value which is obscured by the practice of calculating "net present value" of investments with varying timeframes. "Net Present Value" calculation diminishes the future cost or future benefits of a given choice by adjusting the future year price for interest and inflation. It tends to discount everything beyond twelve or fifteen years as having zero value. Net Present Value calculations are useful when applied thoughtfully and correctly. They are often applied without full consideration of the future value of real future economic benefits. For

example, the value of superinsulation in a new home is considered not to exist after twelve to fifteen years. Yet the value of that insulation in thirty or forty or fifty years is not only significant, but it can easily exceed the entire cost of the initial application each year, for the life of the structure, due to the known and predictable inflation of fuel costs.

Southeast Michigan's electricity future is uncertain, highly variable, and promises some tremendous economic benefits if options are kept open to the rising wave of cheap clean energy. Fermi 3 is a good choice for only one very specific, very rigid, and increasingly unlikely possible future. Even that possible future won't favor Fermi 3 if the cost of the plant rises too high.

### The Death Spiral:

In the 1980's a number of nuclear plants were completed after having exceeded initial cost predictions by multiple times. Utilities discovered the "death spiral", which was the point, around 14 to 15 cents per KWH, where it became impossible to raise revenues by raising rates. Customer conservation was and is induced by high electricity costs. While one might hypothesize that the trigger point has risen due to inflation, it is more likely that the present trend of electricity consumption in Michigan is evidence that it has lowered due to economic pressures from other factors.

One important aspect of this is that a nuclear plant project, even with Federally backed loan guarantees, cannot make a profit for its owners if it cannot sell power into the wholesale market, unless a regulatory or legislative mandate is made to force ratepayers to take power above the market rate. The cost of nuclear power is highly debated, and highly speculative, especially because of the lack of real life experience in the United States during the last quarter century. Many references suggest that a nuclear power plant which has an "overnight" cost of \$6,000 per KW can sell power at slightly more than six cents per KWH. That general set of assumptions is used widely in industry "levelized cost" comparisons such as Lazard and recent (not current) EIA comparisons and those produced by many other government and private entities.

The principle of levelized costs is a legitimate one. The problem is that few publications allow the reader to review the basic assumption, and fewer are available outside of proprietary groups, which are less than four or five years out of date. For example the EIA levelized cost graph which is presently a part of the 2011 Annual Energy Outlook is based on 2009 data<sup>1</sup>. Although it shows that a new nuclear plant would sell power at 11.39 cents (compared to today's wholesale market price of slightly less than four cents) per KWH, it also shows that wind would sell power at 9.7 cents (all the end values are 2016 values). This fails to reflect the modest peak in wind turbine prices in 2009 followed by a 30% drop by early 2011.

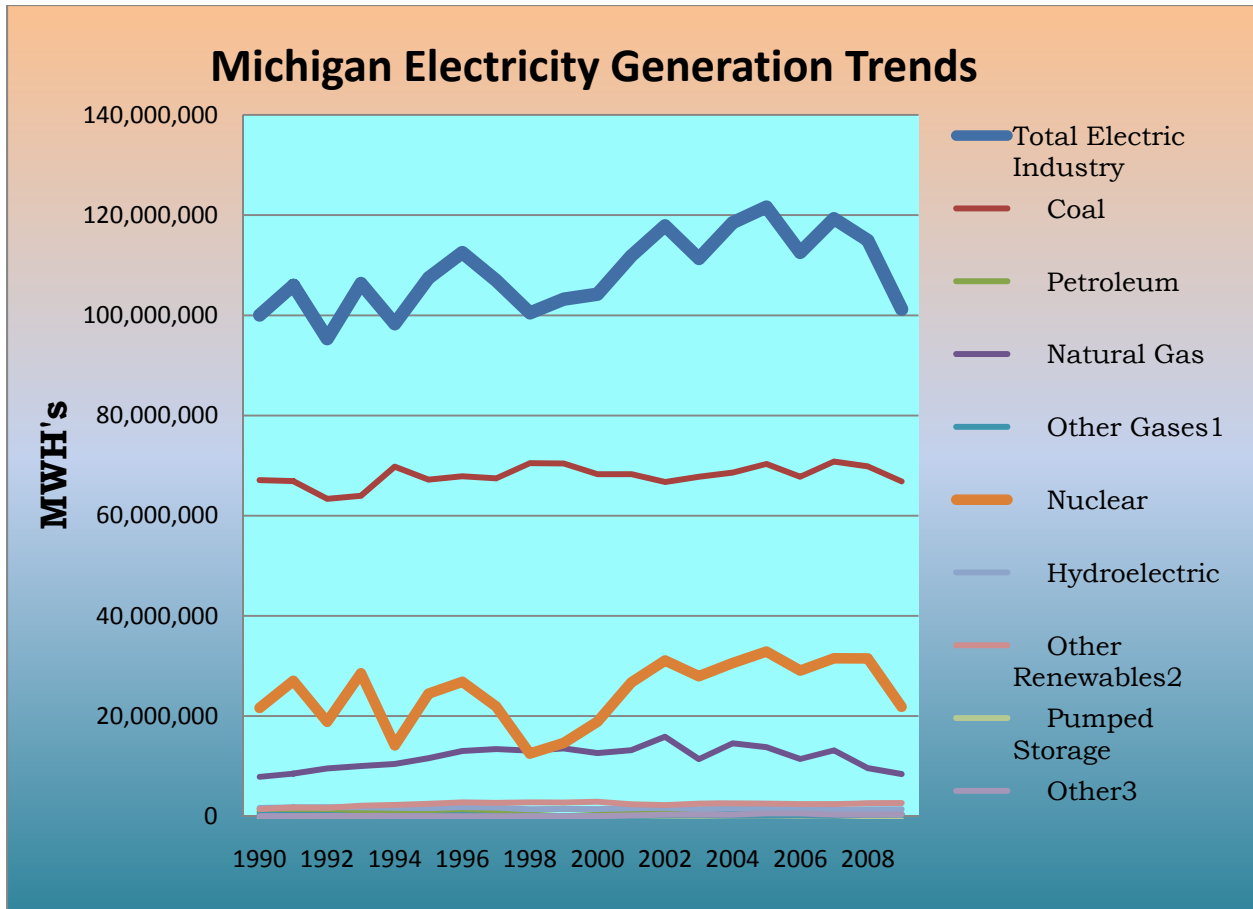
And while it might be possible to follow the data trail which EIA is particularly good at presenting, find out the assumed cost per KWH *and* the size of the assumed reference facility, it is extremely unlikely that the assessment presented by EIA reflects the true cost of a plant which takes twelve years to complete, since the example is presented in 2009 dollars, in 2011, projecting a 2016 in-service date. The much longer construction timeframe increases the cost logarithmically.

## Overview:

The proposed Fermi 3 station would represent a 14% addition to Detroit Edison's reported 10,757 MW's<sup>ii</sup> capacity in 2011. However, comparing the proposed capacity to the existing capacity is an inadequate means of determining need. Factors which should be considered include the relative capacity factors of various choices, their cost, the timing of availability and the historical pattern of consumption. Doing this with great accuracy is challenged by the fact that Federal information on individual utility off-system sales is not reported as clearly as most statewide data, and the DEIS seems to be considering this plant in the context of "The Southeast Michigan Area" which is a jurisdiction which is not reported on by the Federal Energy Information Administration. Based on Exhibit A-3 Schedule C3 in the 2010 Detroit Edison rate case filing<sup>iii</sup> Detroit Edison's 2009 off-system sales appear to be no greater than 7.6% of their total revenues, and thus presumably a similar fraction of their total generation.

Fortunately, great accuracy is not especially valuable here, given the long term trend in Michigan electricity consumption and the rapidly shifting price relationships of various resource options. Much more important than five or six digit precision is a good understanding of the economics of the electric industry and how rapid changes in the industry are making long-held conventional assumptions obsolete.

The lack of growth in Michigan's electric industry is illustrated in the graph of generation from 1990 to 2009 below. Some documents in the DEIS suggest an assumed increase in electricity consumption of nearly 50% over the next thirteen years, but that would imply a 3.8% annual growth rate, which is a rate not seen in the United States since 1970. The current long term projection by EIA is hovering around 1.1%.



Michigan's 2009 nuclear capacity was 4,314 MW's. Having generated 21,851,009 MWH's in 2009 this indicates that Michigan's nuclear industry operates at a 63% capacity factor. This is, to put it bluntly, miserable compared to the national average. To be fair, 2008 saw 31,484,428 MWH's and 2010 saw 29,624,580 MWH's, but the 21 year average, from 1990 to 2010 is a mere 66.01% capacity factor.

Furthermore, in its 2010 application for a rate increase, Detroit Edison included a projected sales path through 2020 which shows a decline in sales from today. This is a reasonable expectation given the early strong success of the Michigan Energy Optimization program, and Detroit Edison's high quality performance in 2010 in developing energy efficiency.

Even with a substantial post-recession bounce in consumption Michigan and Detroit Edison are unlikely to see anything like a three or four percent annual growth rate. A more germane reason to examine new capacity additions is the fact that Detroit Edison's fleet includes several dozen ancient, dirty and expensive fossil fuel plants. In fact it may be prudent to retire more than the 2,039 MW's identified in the DEIS.

This report seeks to emphasize relative costs, availability and timing issues associated with electricity supply, and the critical importance of flexibility in planning. The generation potential of Fermi 3 will be used as a benchmark, not because there is any evidence that it is the right amount or the right sort, but because if the right economic signals are identified and responded too, Detroit Edison may seek to develop a larger amount of different sorts of resources, or

alternatively (with less positive impact we believe) a smaller amount of different sorts of resources, and in either case is likely to map out an energy supply for Southeast Michigan which is preferable to the one which would result from Fermi 3.

### **Detroit Edison and Efficiency:**

Michigan's current efficiency programs are growing robustly in accordance with PA 295. Detroit Edison is shown to have spent approximately \$75 million in 2010, and to have saved approximately \$374 million<sup>iv</sup>. (Chart 5 in the report referenced here details the Detroit Edison experience). This 1:5 cost:benefit ratio is typical of the lifecycle savings resulting from well run efficiency programs, and similar to results in Ohio, where a similar law is being implemented in a similar timeframe.

It is important to note that these programs typically install hardware in homes, businesses and factories, which save energy for an average life of about 12 years, with a wide range depending on the specific technology. Therefore, the total benefits are accrued over those years, with the single year savings being those set by the standard, or by the standard plus overcompliance. Thus, Michigan required Detroit Edison to save 0.3% in 2009, 0.5% in 2010, 0.75% in 2011, and 1% in 2012. Leaving aside the actual overcompliance, this standard would nominally create a net benefit which is expressed as the lifecycle savings (i.e. the \$5 saved for every \$1 spent) or alternatively, as the sum of the previous years' achievements. So by year end 2012, Michigan's standard would create an annual reduction in system energy requirements of 2.05%. PA 295's electric standard stops increasing at 1% in 2012, and holds steady. So each additional year adds an additional one percent to the cumulative savings. Since 1% is exactly what the most recent EIA Annual Energy Outlook projects for new growth in the U.S. a flat generation path is a reasonable prediction.

Efficiency savings are not permanent, but in practice over the last forty years the Federal efficiency standards plus gradual shifts in the marketplace have made most efficiency program savings permanent. It is only in the last four years that total U.S. savings from utility efficiency programs have passed the half-percent per year mark that the impact of this has become large enough to have a visible impact on the total electricity trend. The dynamic of efficiency programs creating savings and appliance standards shoring them up is likely to persist for several decades at least.

### **Efficiency Potential Is Not Limited:**

Illinois, Indiana and Ohio all have standards that increase to 2% annual savings. There are five or six states whose utilities are presently actually achieving between one and a half and two percent per year, and there are historical examples of programs ranging from 4% to as high as 7% for periods of one or more years<sup>v</sup>. Ironically, all but two of these historical examples followed in the wake of nuclear plant construction project failures. One of those two was Three Mile Island (a plant failure, as opposed to a construction failure) and the other was the California natural gas crisis in 2001. The California crisis is instructive, because California had operated programs between one and two percent for over twenty years at the time, and the result was that California citizens and businesses had a better understanding of efficiency, and the delivery

systems were in place to facilitate a sudden large increase in demand for efficiency. California's experience in 2001 simultaneously disproves claims which are often heard that efficiency potential is small, constrained, and will diminish over time. Certainly, it didn't do so in California after twenty years at a higher percentage savings level than Detroit Edison achieved in 2010. California is one of the states which has since increased program activity and is now approaching the 2% annual savings mark.

This is not the place for an extended discussion of the upward side of efficiency potential, but it is in the interest of Detroit Edison, and its customers, to be aware of the value of proper shared savings and cost recovery mechanisms. In this era the gulf between the cost of saving electricity and the cost of using it is widening rapidly. This is due to the increasing cost of energy and the falling cost of efficiency technologies.

Should Michigan's efficiency standard not be increased above 1%, but preserved at 1% beyond the specific years stated in PA 295 the Southeast Michigan region will have seen 15% of its total electricity sales met with efficiency by 2025. The actual impact will be net of new growth. Efficiency programs such as those in Michigan are saving electricity at a cost of approximately 2 cents per KWH or less. The logic of restricting efficiency measures to those which cost less than three cents per KWH when construction of a massive new plant which will cost 9 or 12 or 18 cents per KWH is being considered, or even built, is not likely to have great appeal as we advance through this decade.

There remains some reason to believe that Michigan has not properly incentivized Detroit Edison to consider efficiency as a serious resource. Again, this is not the time or place to dig in to that issue, but the struggle to advance efficiency in the United States has always had its opposition rooted in the fact that we pay utilities quite handsomely to generate electricity, and regardless of the public benefit, the utility will conform to its own economic interest, rather than that of the public, unless the benefits are appropriately shared.

### A much larger context for Efficiency:

Although this report addresses Fermi 3, the larger context in the U.S. electric industry is the pending pollution controls which will make the remaining 30% of the coal fleet impossible to operate without massive new expenditures. Efficiency is unquestionably a cheaper resource than a new nuclear plant. Efficiency is able to save energy at a quarter or less of the cost of new natural gas generation and a fifth or less of the cost of new coal generation. But the real economic question which faces most of the Eastern U.S. and the lower Midwest more than anywhere else is the comparison of the cost of efficiency versus the cost of pollution controls and sustained fuel and operation of the remaining unscrubbed fraction of the coal fleet.

Given the timing of engineering and construction, compliance decisions must be nearly completed for most high coal utilities in the next 24 months. That means that regulatory support and proper compensation for strong efficiency programs must be sufficient to allow the utility to decide how large the programs should be, and to find out how large they can be, and all on a fairly short timeline.

Ironically, the decision point on all these pollution controls and plants is almost completely independent of the presence or absence of Fermi 3. The nuclear plant cannot be completed in time to make any difference in the coal plant utilization question.

The point of making these comments here is that all of this revolves around a comprehensive understanding of the economics, not just the simplistic cost per MW or the price of the output, but the economic impact on customer, utility, and the effect of time and timing on cost and availability. Fermi 3 should be part of an Integrated Resource Planning Process which is in place in Michigan. There seems to be a requirement for an Integrated Resource Plan to be developed before Fermi 3 can be approved by the MPUC. Unfortunately, the time for such a process to provide maximum benefit is nearly past, without reference to Fermi 3, but with reference to the pollution regulations. This is not the NRC's responsibility, but it does underscore the lack of planning which is associated with the proposal of a 1600 MW nuclear generating station for this utility in this region at this point in time.

### **Detroit Edison and Wind:**

Michigan has a massive potential for onshore wind energy development, approximately 175,000 MW's of potential at 30% capacity factor and 100 meter hub heights<sup>vi</sup>. (This reference includes a wind map which shows that most of Michigan's better wind resource is in and around the Detroit Edison Service area). Offshore wind development is still in a pilot stage, and is irrelevant to the question of resource decisions through this decade and into the early years of the 2020's.

At 30% capacity factor, 175,000 MW's of wind could theoretically generate the same amount of power as 58,000 MW's of nuclear power. At today's prices for wind turbines, large swaths of the United States are prime candidates for generation of new wind power that can be sold at wholesale for six cents per KWH or less. The 30% capacity factor measure indicates economic viability at today's prices, and the point here is that Michigan's wind resource is equivalent to at least thirty-seven Fermi 3's, when what is called for is approximately one percent of that resource, in conjunction with a strong efficiency program and a few other resource decisions.

In other words, we are not suggesting that Fermi 3's potential generation be met with wind power. We are suggesting that approximately a third of it can be met with wind power, while the other two-thirds of it can be met with efficiency and other renewable resources, and that we suspect that photovoltaics will be the most important of those other resources by 2025.

The average cost of wind sold in the U.S. from 2003 through 2007 was under four cents per KWH<sup>vii</sup>. 2010 prices for wind turbines were 19% lower than in 2007. In early 2011, turbine prices were under \$1,350/KW<sup>viii</sup>. This allows 30% capacity factor wind to generate electricity for less than six cents per KWH in any location. The 30% capacity factor criterion is the determinant factor in the cost of the power, with some reservation about locations remote from wind manufacturing (not applicable to Michigan, which may be the U.S. leader in wind component manufacturing).



Michigan's renewable energy standard calls on Detroit Edison to develop 300 MW of new renewables by 2013 and 600 MW by 2015<sup>ix</sup>, or ten percent of its sales<sup>x</sup>. Ten percent in five years is a fairly strong goal, but it must be sustained beyond 2015, not only to produce optimum results, but also to ensure the investment in manufacturing capability which is required to get there in the first place. By continuing to build wind at the same rate until 2025, Detroit Edison will have thirty percent of its capacity in wind. That may seem like a tall order today, but it will likely look better and better as the region moves toward it.

The combination of efficiency plus wind which we sketch out here, is a net zero cost strategy to meet Michigan's future electricity requirements. No other strategy can meet Michigan's future electricity needs without substantial increases in the price of electricity and the total cost. Efficiency savings are large enough to permit the full replacement of nuclear and fossil fuel generation as needed, provided the right balance of efficiency and renewables is achieved.

One of the primary objections to wind power is that it is not dispatchable. We observed above that Detroit Edison has a "needle peak" problem, and with a load shape like that, a massive nuclear plant, a single generating unit upon which the region would depend for 29.7% of its power or more, is simply a grossly inappropriate choice. To respond to the load shape issues, we advocate efficiency, load management, and exploration of photovoltaics as prices continue to fall, but in fact the variability of wind might allow Detroit Edison to utilize its existing peak generation resources more efficiently. With a daily rise and fall in the consumption of electricity that is certainly more than 50% of the peak on most days, the development of twenty or thirty percent of Detroit Edison's total generation in the form of windpower cannot possibly challenge the existing peaking capacity. Based on Michigan's fuel use pattern, we assume that most of that is natural gas, and is not among the large group of plants that seem to be slated for closure.

In addition to existing load management resources that make the first thirty to forty percent of wind benign without substantial new load management resources to most utilities, there are a group of emerging technologies that store energy. The list is long, but two deserve mention: Compressed Air Energy Storage is a process which is fully technologically available. There are only a handful of completed utility-scale CAES projects in the world, and perhaps only one in operation in the U.S. (Louisiana) and one recently announced new project (Nebraska). But pricing is such that wind plus CAES can provide a 100% dispatchable electric resource at half the cost of a new coal plant per MW of capacity. Since a single MW of Compressed Air Energy Storage would typically provide storage for two or more MW's of wind generation this is likely to erupt into a major new energy resource in the very near future.

The other energy storage technology which deserves mention is Ice Storage Thermal Cooling for large commercial buildings. It is cheap enough to produce a net benefit merely by allowing utilities to provide cooling for buildings when demand is low.

These and the other energy storage technologies are not household names or concepts, but we are either going to develop them rapidly to protect ourselves from higher electric costs due to more expensive resource choices, or we are going to develop them less rapidly in response to higher electric costs due to more expensive resource choices.

A decision to invest in an extremely expensive power plant which provides 29% or more of the utility's total capacity is pretty plainly putting all of one's eggs in a single basket.

### A word about the Wind Production Tax Credit:

It is reasonable to wonder if the price of wind is low enough to be economic if Congress repeals the Wind Production Tax Credit (WPTC). The WPTC is inflation adjusted, and in 2011 was 2.11 cents per KWH. Also in 2011, the average price of coal in the U.S. was 2.35 cents per KWH. In other words, every penny of WPTC expenditure produces real net benefits. Not large, if compared to the price of coal alone, but then the wind generation produces electricity that undercuts many other resources. And in Michigan, electricity which costs six or seven cents per KWH, which will never experience a fuel cost increase, which will never be incapacitated by a single event at a single location, and which can bring billions of dollars of new investment and thousands of jobs should be seriously considered. The fact that Michigan is one of the top two manufacturers of wind turbine components in the United States is probably well known to most of the parties concerned with this matter.

### **Photovoltaics:**

Photovoltaics (PV) are not economic in Michigan in 2012, without tax abatement support or some other form of subsidy – if the value of the electricity generated is compared to the average retail cost of electricity. But that is hardly the end of the story. Photovoltaics have experienced a two decade sustained drop in cost, and are now becoming almost ten percent cheaper each year. During 2011 several Southwest U.S. states recognized that PV today is cheaper than the likely cost of power from a new efficient Combined Cycle natural gas power plant, given likely fluctuation in natural gas fuel prices. This is also a function of the greater sunlight available in those states. But as prices drop, the region where PV is competitive against the average cost of power sweeps across the nation. As the trend continues it suggests that within three to five years PV will be competitive with fossil resources here in the Midwest.

And that is still not the end of the story. PV is already economic if it is recognized as a peaking resource. PV always works best when the local utility experiences its daytime peak energy loads, because both are driven by sunlight. The regional market for peak power can reach multiples of the retail price of electricity very quickly. For Detroit Edison, with so much capacity needed for so few hours of the year, PV may be more economic than elsewhere in the U.S.

Like wind, the opportunity for Detroit Edison and for the Michigan economy is not just the potential for low cost power, but the potential for manufacturing and installation jobs. And to complete the circle, creating a foundation for those jobs and that economic activity in the Detroit Edison Service Area creates economic health which will ensure Detroit Edison's own future.

PV, unlike wind, has no clear barrier to sustained cost reduction for some time to come. Wind has been close to its technological peak efficiency in terms of harvesting energy from moving air, for several decades. The recent huge cost reductions have resulted from economies of scale in production, and from the substantially greater energy in moving air at higher hub heights.

Experts feel there is room for perhaps another 20% drop in turbine cost before wind costs stabilize. But for PV there are multiple approaches to converting sunlight to electricity, and multiple opportunities to make each approach better and cheaper.

Nuclear power advocates used to claim that it would make electricity “too cheap to meter”. Well, efficiency actually has achieved that goal. By various measures, efficiency has provided between 40 and 77% of all new energy added to the U.S. economy over the last forty years, and it is not recognized as an energy resource by most people, let alone the resource which has provided the most economic benefit in the entire energy sector. Now we see experimental development of photovoltaics produced on printing presses, photovoltaic films built into windows, roof shingles, siding, perhaps even a photovoltaic paint will come along. It’s premature to suggest that this will happen, but it is equally clear that we can move in that direction, if we choose to explore the opportunity.

And in that light, Fermi 3 is a door-closer. With a massive \$15 to \$20 billion dollar loan to pay off, what incentive will Detroit Edison have to explore these resources?

### **Combined Heat and Power:**

Combined Heat and Power or Waste Heat Recovery is another area which Detroit Edison should consider carefully. Michigan is relatively advanced in its development of these resources compared to other states, but there is a substantial untapped resource compared to even Michigan’s several thousand MW’s of CHP.

### **Problems Facing the Natural Gas Industry:**

EIA projects that by 2035, about 47% of U.S. natural gas will come from fracking<sup>xi</sup>. But they simultaneously project that about half of that will replace aging conventional natural gas wells. Total growth is projected to be 26%, a mere one percent above expected population growth.

At the present time we use about 30% of our natural gas to generate about 20% of our electricity. Obviously, if the projection over 25 years allows only one percent of increased production over population growth there isn’t a lot of room for new uses. Mathematically, the EIA projection allows for natural gas to increase to 26.6% of total U.S. electricity.

Natural gas is extremely volatile in price, and the biggest factor in that volatility is any mismatch between supply and demand. A 2% increase in demand over supply results in a doubling of the retail price of natural gas. This has been demonstrated in both natural gas and petroleum about six or eight times in the last twenty years. Similarly, a 2% decrease in demand over supply results in a 50% drop in the price. And around \$7/mmbtu, which is double the current price of natural gas, but only about a dollar over the price twenty months ago, all utilities stop using natural gas for every generator they can possibly find an alternative for.

Thus any shortage of gas will be met by a surge of production which will in turn be met with a drop in consumption, resulting in prices falling down to the minimum the producers can afford to sell at. Aside from the problems which would be created for generation of electricity, this high price volatility will be extremely hard for the general public due to current dependence on natural gas for space heating.

There is only one rational response to this set of conditions: The United States must learn to reduce natural gas consumption in order to avoid the need to press up against the limits of production at any time. There are powerful efficiency alternatives to increased natural gas use.

This is pertinent to the Fermi 3 question only that natural gas is experiencing a heyday of popularity, but it does not necessarily offer a good fit with the particular needs of Detroit Edison as a new resource alternative to Fermi 3.

## **Summary:**

The key to a positive outcome of this question is to understand that nuclear power has no inherent value if it does not improve the community, and that a proper assessment of alternatives will rule the plant out.

Michigan and Detroit Edison must determine how to meet the pending air pollution regulations, which requires decisions affecting about 61% of Detroit Edison's generation resources, to be completed in the next two years or so, and the implementation of those decisions to be largely completed by the end of 2015, none of which can be affected by Fermi 3. However, if those decisions favor rapid expansion of efficiency and renewables in concert with the real economics and the real flexibility of those resources, it is entirely possible to provide more capability than Fermi 3 offers for a fraction of the cost.

The right mix of efficiency plus renewables is likely to cost less than the current cost of electric generation from existing fossil fuel plants or a new nuclear unit through the next fifteen years and beyond. This right mix is not just cheaper than new nuclear power, it is cheaper than any other resource strategy which meets the needs of the service area. This strategy is highly robust in the face of any sort of unanticipated change in the service area conditions, and is highly flexible in the face of unanticipated change in the availability of other generation.

Although we have identified efficiency and wind, plus photovoltaics in the near future as the core strategy that performs better than a single massive new nuclear unit, there is ample room for additional resources – hydropower should any be available, biomass, should it prove economic, combined heat and power, and even some new natural gas generation should it prove possible to secure a long term fuel resource at an affordable cost, the characteristic of this strategy that deserves attention is the flexibility, as much or more than the fact that these resources are largely clean and renewable.

None of us know the future. Finding ourselves in a situation five years from now which shows our chosen path to be flawed is much less painful if we have hundreds of thousands of efficiency technologies and thousands of distributed generation resources, all of which are paid for already,

than if we get to the same point and have one single massive facility which has several billion dollars committed, no immediate benefit to offer, and another five or so years and another many billions of dollars to go before a single KWH can be generated.

Ignoring the fuel choice or the technology, a single large generator creates problems either because it must be oversized for the load that exists when it goes into service, or it must go into service after some years of inadequate capacity. Simply put, this would be bad management of the responsibility to provide electric service.

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### **End Notes:**

<sup>i</sup> [http://205.254.135.7/oiaf/aeo/electricity\\_generation.html](http://205.254.135.7/oiaf/aeo/electricity_generation.html)

See Table 1, about halfway down the web page.

<sup>ii</sup> Testimony of Paul Fessler in DTE-2011-Hearing-Vol6 page 429 Case No. U-16472

<sup>iii</sup> <http://efile.mpasc.state.mi.us/efile/docs/16472/0005.pdf>

<sup>iv</sup> [http://www.michigan.gov/documents/mpasc/eo\\_legislature\\_report2011\\_369985\\_7.pdf](http://www.michigan.gov/documents/mpasc/eo_legislature_report2011_369985_7.pdf)

<sup>v</sup> <http://www.aceee.org/research-report/e115>

The top ranked states shift places from one year to the next. Figure 2 shows eight states with budgets and actual spending over 2%. Figure 4 shows actual savings exceeding 1.5% for only one state, but also shows the variation from 2008. Since 2009 several states have implemented policy intended to reach or exceed 2%, and prior to this report at least four states have passed the 2% mark for a year or more. Among the historical programs discussed in this section, only the California 2001 experience is recent enough to be included in these recent reviews.

<sup>vi</sup> [http://www.windpoweringamerica.gov/wind\\_resource\\_maps.asp?stateab=mi](http://www.windpoweringamerica.gov/wind_resource_maps.asp?stateab=mi) The map at this link shows that much of the best wind in Michigan is in or near the Southeast Michigan region. The graph below the map shows the doubling of wind generation potential which results from raising the hub height from 80 meters to 100 meters.

<sup>vii</sup> <http://eetd.lbl.gov/ea/ems/reports/lbnl-275e.pdf>

(see top of page 17 for price history)

<sup>viii</sup> <http://www.grist.org/article/2011-02-07-report-wind-power-now-competitive-with-coal-in-some-regions>

<sup>ix</sup> [http://dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=MI16R&re=1&ee=1](http://dsireusa.org/incentives/incentive.cfm?Incentive_Code=MI16R&re=1&ee=1)

<sup>x</sup> There is some sort of mathematical error in the presentation of PA 295 at this reference. 600 MW's of any form of renewable generation is not going to produce ten percent of Detroit Edison's retail sales. It would take about a 70% capacity factor, and while some biomass generation technologies might operate at that level, wind, photovoltaics and hydropower are all variable resources with lower capacity factors. There might be enough

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biomass in Michigan to fuel 600 MW's but it would be terribly expensive, devastating to the State's forests, and would provide a negative carbon impact, due to the water in wood, which reduces the efficiency of combustion, and makes biomass generation a larger source of CO2 per KWH than coal. There is unquestionably not enough wood in the Detroit Edison service area to fuel 600 MW's of biomass.

<sup>xi</sup> [http://www.eia.gov/forecasts/aeo/chapter\\_executive\\_summary.cfm](http://www.eia.gov/forecasts/aeo/chapter_executive_summary.cfm)

Figure 2 at this link, and the data which is accessible from that part of the page, provide a clear sense of the limits of U.S. shale gas production.