Union of Concerned Scientists

Ripe for Retirement

NOVEMBER 2012

The Case for Closing Michigan's Costliest Coal Plants

Michigan faces a once-in-a-generation opportunity to modernize its electric supply and transition to a cleaner energy future. Retiring old coal-fired power plants that are no longer economic to operate, and investing in new energy-saving technologies and clean, renewable sources of energy, offers important economic, public health, and environmental benefits to the state.

More than half of Michigan's electricity is generated by burning coal—a larger share than the national average of 42 percent (EIA 2012; MI PSC 2012). Michigan is also home to one of the oldest and least efficient coal power plant fleets in the nation: 87 percent of the state's coal capacity exceeds the 30-year design lifetime within which coal plants were engineered to operate. More than half of Michigan's coal plants are older than 40 years (built before 1970), and nearly a third began operation more than 50 years ago.

Most of the state's old coal plants lack essential modern pollution controls. The sulfur they emit causes acid rain. The mercury they release poisons waterways and fish and causes neurological damage in children (EPA 2012). The soot they emit causes lung disease and premature death, and triggers asthma attacks (EPA 2010a; NRC 2010). Air pollution from Michigan coal plants caused more than 650 deaths and almost 1,100 heart attacks in 2010 alone, according to one detailed study (CATF 2010). Another analysis estimated that air pollution from Michigan's oldest coal units[1]—those dating from before 1968—caused $5.4 billion in annual health damages (EH&E 2011).

Many of Michigan's coal generators have reached the end of their useful life—it simply makes no economic sense to keep them running.

Coal-fired power plants are also Michigan's largest single source of heat-trapping carbon dioxide emissions, the primary contributor to global warming (EIA 2011a).

These well-documented environmental and public health impacts are reason enough to reduce dependence on coal in Michigan. With the availability of affordable renewable technologies, burning coal to produce power is not only the dirtier choice, but often the more expensive choice as well. Less widely appreciated is the fact that many of Michigan's coal generators have reached the end of their useful life—it simply makes no economic sense to keep them running.

Many Michigan Coal Plants Are Ripe for Retirement

A new analysis from the Union of Concerned Scientists (UCS), *Ripe for Retirement: The Case for Closing America's Costliest Coal Plants*,[2] examines and evaluates the economic viability of coal generators across the nation (including Michigan's fleet) compared with cleaner energy alternatives.[3] The report finds there are many uncompetitive coal generators in Michigan—and nationwide—that operators should consider closing. In an independent, peer-reviewed economic

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[1] A power plant comprises one or more generating units or generators.

[2] *Ripe for Retirement: The Case for Closing America's Costliest Coal Plants* is available online at *www.ucsusa.org/ripeforretirement*. A fully referenced version of this fact sheet is also available online at *www.ucsusa.org/ripeforetirement/Michigan*.

[3] Coal-fired power plants may comprise one or more generating "units." A unit is the power production components of a power plant: a generator and the turbine and steam loop that drive it. Many power plants have multiple units that can operate independently. We refer to "units" and "generators" interchangeably. UCS analyzed each utility coal unit in Michigan.

analysis, **UCS identified a range of 16 to 32 coal-fired generating units in Michigan—constituting 1,190 MW to 3,532 MW of power generation capacity—as ripe for retirement.** These uneconomic coal units represent 10 to 29 percent of Michigan's total coal generation capacity. All are good candidates for closure because they are economically uncompetitive compared with cleaner, more affordable energy sources. Of all the states, Michigan ranks fifth in the amount of coal generating capacity identified as economically uncompetitive and thus ripe for retirement.[4]

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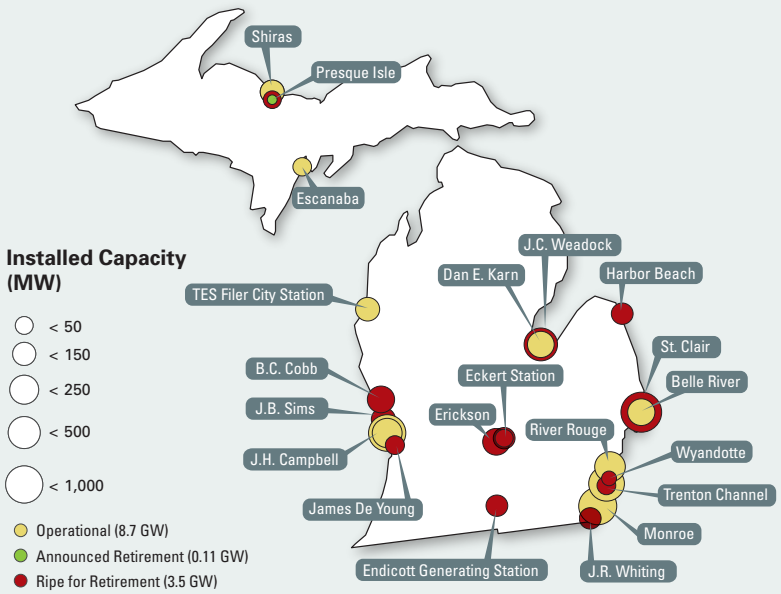
The retirement of old coal generators represents an opportunity to accelerate Michigan's transition to a cleaner energy future by shifting more of the electricity sector's investment dollars away from old coal plants and toward renewable energy resources, energy-saving technologies, an expanded and modernized electric grid and—to a more limited extent—natural gas power plants.

A fork in the road. Over the next several years, power companies in Michigan and across the nation must choose whether to make expensive upgrades to their oldest and dirtiest coal plants or retire them and instead invest in newer, cleaner technologies. *Ripe for Retirement* attempts to characterize which coal generators in Michigan are most economically vulnerable under current and possible near-term economic and regulatory conditions in the electric power market. Our analysis can help utilities, state and federal regulators, and banks decide whether it makes more economic sense to retire certain coal-fired generators and potentially replace them with cleaner energy alternatives, or to sink hundreds of millions—and in some cases billions—of dollars in additional capital into retrofitting them with modern pollution controls.

To evaluate the economic competitiveness of coal generators, we compared the cost of electricity from each of Michigan's coal-fired electricity generating units with the cost of electricity generated from an average natural gas power plant. Specifically, if a coal-fired generator—after installing any needed pollution controls—would be more expensive to operate than a typical cleaner-burning and more efficient natural gas combined-cycle (NGCC) plant, then we consider that coal generator ripe for retirement.

Michigan's Ripe-for-Retirement Coal Generators
(High Estimate by Size of Generators: 32 Generators Totaling 3,532 MW)



There are 20 coal-fired power plants in Michigan that house a total of 49 operating coal generators (excluding industrial and educational facilities and certain small units for which information was incomplete). This map shows the plants by capacity (in megawatts), and identifies those that have generating units already slated for retirement (green) or deemed ripe for retirement (red) compared with existing NGCC plants.

[4] State ranking is based on the high estimate case that compares the cost of producing electricity from coal-fired generators with the cost from existing natural gas combined-cycle power plants.

It is important to note that the analysis conducted for *Ripe for Retirement* is not an evaluation of the coal industry's compliance with federal clean air standards; instead, the report estimates the cost of modernizing the coal fleet to protect public health and the environment by installing the most effective pollution control technologies available.

While some owners are spending hundreds of millions of dollars per plant to add pollution controls, retrofitting old plants may not make sound economic sense. For example, in New Hampshire, the utility owning the Merrimack Station plant just spent $422 million adding pollution controls to two 1960s-era generators. However, in February 2012 the utility decided to idle Merrimack Station for months at a time because it costs substantially more to run the plant than to buy electricity from natural gas power plants elsewhere in New England (Loder 2012).

Coal is losing market share to cleaner energy sources. While coal plants are still the largest source of the nation's electricity, coal's dominance has been eroding for years, shrinking from 52 percent of electricity generation in 2000 to 45 percent in 2010, and is expected to drop to 40 percent in 2012 (EIA 2012a; EIA2012b). In Michigan, coal has slipped from 66 percent of generation as recently as 2009 to 54 percent in 2011 (EIA 2012a; EIA 2011a). One likely reason has been the rising cost per ton of delivered coal, which on a national level has increased every year since 2000. For Michigan utilities, the cost of delivered coal rose 34 percent just between 2010 and 2011 (EIA 2012a). Another factor making coal plants less competitive is the falling cost of alternative sources of energy such as natural gas and wind.

Coal produced 56 percent of Michigan's electricity in 2011, down from 66 percent in 2009, due to higher coal costs, lower natural gas prices, and increasing competition from renewable energy resources like wind power.

Still big polluters. While some plant owners are considering retrofitting old coal generating units with pollution controls that would dramatically improve air quality and save countless lives, those retrofitted generators would still emit enormous amounts of heat-trapping carbon dioxide (CO_2) (see the box). Coal plants are the nation's largest source of the carbon dioxide emissions causing climate change.

Much-needed reductions of CO_2 emissions can be achieved by replacing Michigan's ripe-for-retirement coal generators with cleaner alternatives such as wind and solar power that do not emit CO_2. Boosting production from existing natural gas power plants can cut smokestack emissions on an interim basis because burning natural gas emits about half the CO_2 of coal-fired

Coal's Ongoing Threat to the Climate

The U.S. National Academy of Sciences warns, **"The need for urgent action to address climate change is now indisputable"** (NAS 2009). Human activities, especially our burning of fossil fuels, are changing the climate, causing more extreme weather and posing a grave threat to human health, food and water supplies, global ecosystems, and national security.

Michigan's coal-fired power plants are the state's biggest source of carbon pollution by far, emitting more than all its transportation sources combined (Strait et al. 2008). Coal plants are the largest single source of carbon dioxide (CO_2) at the national level too, contributing one-third of energy-related CO_2 emissions (EIA 2011d).

Deep cuts in CO_2 emissions from coal plants are therefore critical to slowing climate change. Carbon capture and storage (CCS)—a technology that might reduce the amount of CO_2 emissions released into the air by liquefying the CO_2 and storing it underground—is being investigated, but it is an energy-intensive process that also faces serious cost hurdles. A better use of this large capital expense could be made by investing it in cleaner, low- or no-carbon alternatives.

plants. Further reductions can be realized by reducing overall power demand through energy-efficient technologies.

Prudent foresight. Many owners of old coal plants around the country have already made the prudent choice to retire their generators. Since 2009, 288 coal-fired generators—about 12 percent of the U.S. coal fleet—have been scheduled for closure. The targeted retirees are among the oldest (with an average age of 50 years), dirtiest, and least-used coal generators. This wave of coal plant closures continues to grow as more and more power plant owners recognize that their old plants can no longer compete. Despite the age of Michigan's coal fleet and compelling economic arguments, the announced retirements in the state are so far quite modest.

State regulators and utilities should begin planning for coal retirements, with a particular focus on the coal generators designated as ripe for retirement in this analysis.

Big decisions ahead. Consumers Energy (CMS), Michigan's second-largest power provider, has announced it will suspend operations at three Michigan coal plants with units dating to the 1950s, though stopping short of officially scheduling their retirement (Consumers 2011). However, the owners of many other old and poorly controlled coal plants have yet to announce whether they will sink more money into them or finally retire them. These owners include Detroit Edison (DTE) (the state's largest power provider, it also owns 64 percent of Michigan's coal capacity), Wisconsin Energy, and several municipally owned utilities (including Lansing, Wyandotte, Holland, and the Michigan South Central Power Agency).

Planning the path forward. State regulators and utilities—including municipal utilities that own some of the oldest, most costly coal units—should begin planning for coal retirements, with a particular focus on the coal generators designated as ripe for retirement in this analysis. Systematic planning will help ensure that Michigan maximizes the many benefits of modernizing its power system, while at the same time ensuring reliable and affordable electricity.

Stronger clean energy policies are needed. Michigan is reaping the early rewards of the energy efficiency and renewable electricity standards it adopted in 2008.[5] The state could greatly strengthen those standards, as other midwestern states have already done.

Courtesy of Sierra Club

Consumers Energy, Michigan's second-largest power provider, has announced that it will suspend operations at its B.C. Cobb plant, located at the eastern end of Muskegon Bay, in 2015, along with two other plants (J.R. Whiting and J.C. Weadock). The two currently operational coal generators at the B.C. Cobb plant, which have been identified as ripe for retirement in our analysis, began operations in 1956 and 1957.

What Makes a Coal Generator Ripe for Retirement?

Our *Ripe for Retirement* analysis identifies the most economically marginal coal generators—those that should be candidates for closure rather than costly retrofits—by following a four-step methodology similar to the approach used by Synapse Energy Economics in its analysis of the economic merit

[5] Michigan law currently requires the state's utility companies to obtain 10 percent of their energy from renewable resources by 2015. Utilities are also required to reduce annual energy consumption 1.5 percent by 2015, through investments in energy efficiency programs.

of coal-fired power plants in the West (Fisher and Biewald 2011).[6,7]

We first calculated the current operating costs of each coal generator by adding the cost of the coal itself (including transportation) to operations and maintenance (O&M) costs, measured in dollars per megawatt-hour of power production. Next, we identified which coal generators are currently lacking key pollution control technologies to reduce emissions of sulfur dioxide, nitrogen oxides, particulate matter, mercury, and other toxic air pollution (further discussed below), and calculated the costs of installing such controls on each generator.

In the third step, we compared the costs of operating each coal generator with—and without—these pollution controls to the costs of readily available and cleaner alternatives, notably new and existing NGCC power plants and wind power. If a coal generator's total cost of power production is higher than at least one of these competing energy alternatives, we deem that generator ripe for retirement. This comparison allowed us to estimate a range of ripe-for-retirement generators in the operational fleet. The lower bound of that range is defined by comparing the costs of each coal generator with *new* NGCC plants, which are more expensive to operate because they are still recovering their capital and financing costs. The upper bound of that range is defined by comparing the costs of each coal generator with *existing* NGCC plants, which are less expensive to operate because their capital and financing costs have been largely recovered.

Natural gas serves as the bounds of our low and high estimates because, in many parts of the country, it is currently the most readily available low-cost power generation option capable of rapidly replacing coal-fired power plants in the near term, and many utilities are already taking steps to make this switch. However, we believe that retiring coal capacity could and should be replaced by a mix of alternatives including renewable energy technologies and reduced demand through energy efficiency.

A wholesale switch to natural gas is not a long-term solution to the climate problem: natural gas is cleaner-burning than coal but still leads to significant carbon dioxide emissions.

As the last step of our analysis, we examined the effect of several variables that could influence the economic competitiveness of the remaining operational coal fleet, including natural gas prices, the availability of federal tax credits for wind power, and a price on carbon emissions.

Natural gas prices. Because fluctuations in the price of natural gas have a substantial impact on the entire electric power industry, we also examined the effect that a lower and higher natural gas price forecast for both new and existing natural gas facilities would have on the economics of coal generators. Our core analysis assumes a 20-year, levelized national natural gas price of $4.88 per million British thermal units (MMBtu), based on the U.S. Energy Information Administration's (EIA's) reference case projections for the electricity sector in its *Annual Energy Outlook 2012* (EIA 2012c). Our low-price case assumes a 25 percent decrease in the EIA's reference case projections to $3.66/MMBtu, while the high-price case represents a 25 percent increase to $6.10/MMBtu.

Wind production tax credit (PTC). We also compared the cost of generating electric power from upgraded coal units with the cost of a new wind facility at a location with average wind resources, under two different scenarios. The federal PTC currently provides a 2.2-cent-per-kilowatt-hour benefit for the first 10 years of a wind power facility's operation. This policy, which has contributed to the significant growth of domestic wind power, is set to expire at the end of 2012. Our PTC scenario assumes the tax credit will be renewed, while our other scenario assumes it expires.

A price on carbon. Nationally and in Michigan, coal plants are one of the largest sources of the CO_2 emissions driving global warming. Our analysis examined the effect of putting a price on carbon as a generic proxy for a constraint on these emissions. We assume a carbon price of $15 per ton, which is consistent with more conservative price forecasts from several government, industry, and expert analyses (Johnston et al. 2011).

[6] A detailed discussion of our cost assumptions and methodology can be found in the full *Ripe for Retirement* report, available online at *www.ucsusa.org/ripeforretirement*.

[7] This analysis focuses on operational plants and excludes certain very small generators for which the data were incomplete (see Table 2); as a result some totals vary slightly from the Michigan totals presented in the full *Ripe for Retirement* report.

All of Michigan's ripe-for-retirement coal generators are good candidates for closure because they are old and economically uncompetitive compared with cleaner, more affordable energy sources.

Which Michigan Coal Units Are Ripe for Retirement?

UCS identified a range of 16 to 32 coal-fired generating units in Michigan as ripe for retirement in our core analysis (Table 1). These uneconomic coal units represent between 1,190 MW and 3,532 MW of coal generation capacity, or 10 to 29 percent of Michigan's total. The high estimate includes the coal capacity already scheduled to stop running (but not yet scheduled to be retired) in 2015. All ripe-for-retirement coal generators are good candidates for closure because they are old and economically uncompetitive compared with cleaner, more affordable energy sources. The *average* age of the coal units under the high estimate is 51 years, weighted by the size of the generator. Seventeen generators came online prior to 1960. Table 2 (pp. 8–9) lists generator-level information for each coal plant in Michigan, including age, ownership, and whether it has been designated as ripe for retirement in our analysis.

DTE and CMS, Michigan's two largest power companies, own the greatest share of the state's economically uncompetitive coal capacity under the high estimate: two-thirds of ripe-for-retirement coal units combined. DTE owns 1,364 MW of ripe-or-retirement units, or 38.6 percent, including two units at the Trenton Channel plant, five at the St. Clair plant, and one at the Harbor Beach facility. CMS owns 971 MW, or 27.5 percent, including the Whiting, Weadock, and Cobb plants where CMS has already decided to suspend operations. Lansing Board of Water & Light, the largest municipal utility in Michigan, ranks third with 530 MW of ripe-for-retirement coal capacity. Other power providers in Michigan that own and operate ripe-for-retirement coal generators include Wisconsin Energy, the Michigan South Central Power Agency, and municipal power authorities in Wyandotte, Holland, and Grand Haven.

Alternative scenarios. This analysis is sensitive to the price of natural gas. Under a higher natural gas price

Table 1. Ripe for Retirement Summary Results

Scenario		Capacity (MW) (% of Michigan coal fleet)	Number of Units	Generation (million MWh) (% of Michigan coal fleet)
Core cases	High estimate (existing NGCC)	3,532 (29%)	32	15.9 (24%)
	Low estimate (new NGCC)	1,190 (10%)	16	3.9 (6%)
Alternative Scenarios				
High gas prices	Existing NGCC	1,930 (16%)	21	7.3 (11%)
	New NGCC	832 (7%)	12	1.9 (3%)
Low gas prices	Existing NGCC	9,047 (74%)	44	46.3 (70%)
	New NGCC	3,099 (26%)	30	14.2 (21%)
Carbon price	Existing NGCC	6,491 (53%)	41	30.6 (46%)
	New NGCC	3,099 (26%)	30	14.2 (21%)
Wind	Without tax credits	887 (7%)	13	2.1 (3%)
	With tax credits	4,451 (37%)	35	19.7 (30%)

Under the two core scenarios—comparing upgraded coal units with existing and new NGCC plants—UCS identified a range of 16 to 32 coal-fired generating units in Michigan as ripe for retirement. These uneconomic coal units represent 1,190 MW to 3,532 MW of coal generation capacity, or 10 to 29 percent of Michigan's total. All are good candidates for closure because they are economically uncompetitive compared with cleaner, more affordable energy sources.

forecast, the amount of economically uncompetitive coal generating capacity decreases to a range of 832 to 1,930 MW (7 to 16 percent of the state's total coal capacity). Conversely, under lower natural gas prices, significantly more coal generating capacity meets our ripe-for-retirement threshold: 3,099 to 9,047 MW (26 to 74 percent).

Under our scenario with a conservatively low price on carbon, 26 percent of Michigan's coal generating capacity is economically uncompetitive compared with new NGCC plants. The amount increases to 53 percent when compared with existing NGCC plants. Of course, because natural gas is itself a fossil fuel and burning it still emits about half the CO_2 of a coal-fired plant, any price on carbon will also raise the cost of natural gas generation.

As Table 1 shows, wind power is cheaper than 13 of the upgraded coal units (887 MW) even if the federal PTC expires at the end of 2012. The amount of ripe-for-retirement coal capacity increases by five times (4,451 MW), however, if the PTC is extended.

Reducing Dangerous Air Emissions from Coal Plants

In Michigan, as in the nation as a whole, coal plants are a dominant source of many dangerous air pollutants. By retiring its dirtiest coal generators, Michigan could greatly reduce emissions of some of the pollutants that take the heaviest toll on public health. It could also reduce these emissions by adding pollution controls to those generators, but as this analysis shows, retrofits would cost more (and yield fewer benefits) for much of the state's coal fleet than replacing these plants with newer, cleaner options.

Eighty-three percent of Michigan's ripe-for-retirement coal generators lack all vital modern pollution controls. Retiring Michigan's dirtiest coal generators could greatly reduce dangerous air pollutants that take the heaviest toll on public health.

Sulfur dioxide (SO_2). Coal plants are the largest source of SO_2 emissions in the country and the state. Michigan coal plants emitted 254,000 tons of SO_2 in 2010—the sixth highest among all states (EIA 2012c). SO_2 causes acid rain that can directly harm the lungs, and it can also be converted into dangerous small particulates that, when inhaled, are a major cause of the hundreds of annual deaths from heart and lung disease linked to Michigan's coal plants (CATF 2010). Scrubbers—a pollution control technology available for decades and used by 6 in 10 coal plants nationwide—can cut SO_2 emissions by 95 to 99 percent (NESCAUM 2011).

Nitrogen oxides (NO_x). Coal plants in Michigan emitted 89,000 tons of NO_x in 2010—also the sixth highest among all states (EIA 2012c). NO_x contributes to the formation of smog, which exacerbates asthma, bronchitis, and other chronic lung conditions (Perera and Sanford 2011). Like SO_2, NO_x contributes to the formation of deadly particulates. The best technology to reduce NO_x is selective catalytic reduction (SCR), which can cut NO_x emissions by 90 percent, and is used by 4 in 10 coal plants nationwide (NESCAUM 2011).

Particulates. Coal plant smokestacks also emit particulates directly. Tightly woven baghouses, which can capture more than 99 percent of particulates, are used at about one-third of coal plants nationally (NESCAUM 2011).

Mercury. According to the U.S. Environmental Protection Agency's (EPA's) Toxic Release Inventory database, Michigan's coal plants are the source of 80 percent of the state's airborne mercury emissions (EPA 2011). Mercury is a potent neurotoxin that threatens the brain development of infants and children; it collects in bodies of water and builds up in the tissues of fish and the people who eat them. Nationally, hundreds of thousands of infants born each year may be exposed *in utero* to enough mercury to reduce their IQs (Trasande et al. 2005). For many coal plants, activated carbon injection (ACI) combined with other pollution controls can reduce mercury emissions by 90 percent or more (NESCAUM 2011).

Injuring public health. The Michigan coal generators designated as ripe for retirement lack modern pollution controls: of the 32 generators identified under the high estimate, 83 percent lack *all four* of the vital control technologies discussed above. Almost all the ripe-for-retirement generators—96 percent—lack scrubbers, and have taken no evident steps to install these life- and health-saving pollution controls. Table 2 shows the control status of each

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Table 2. Which Michigan Coal Units Are Ripe for Retirement?[a]

Coal Generator Age and Performance			Pollution Control Status (IP: in process of being added)[b]				Air Emissions (2009)[c]				Ripe-for-Retirement (R4R) Status by Scenario		
Units/Size in Megawatts (MW)	First Year Online	Capacity Factor (%)	SO_2 (scrubber)	NO_x (SCR)	Particulates (baghouse)	Mercury (ACI)	CO_2 (tons)	NO_x (tons)	SO_2 (tons)	Mercury (plant-wide) (lb)	Low Estimate	High Estimate	Carbon Price
Trenton Channel (Detroit Edison)													
7/120	1949	60	No	No	No	No	521,914	1,192	3,447	185	Operational	R4R	R4R
8/120	1950	20	No	No	No	No	315,110	683	2,086		R4R	R4R	R4R
9/536	1968	68	No	No	No	No	3,319,146	3,286	19,910		Operational	Operational	R4R
St. Clair (Detroit Edison)													
1/169	1953	52	No	No	No	No	823,040	1,474	2,382	280	Operational	R4R	R4R
2/156	1953	51	No	No	No	No	870,338	1,626	2,608		Operational	R4R	R4R
3/156	1954	52	No	No	No	No	909,502	1,772	2,630		Operational	R4R	R4R
4/169	1954	53	No	No	No	No	847,629	1,318	2,509		Operational	R4R	R4R
6/353	1961	51	No	No	No	No	1,482,251	1,193	7,457		Operational	R4R	R4R
7/545	1969	56	No	No	No	No	2,282,730	1,997	11,346		Operational	Operational	R4R
River Rouge (Detroit Edison)													
2/293	1957	78	No	No	No	No	1,741,140	1,462	7,481	153	Operational	Operational	R4R
3/358	1958	68	No	No	No	No	1,776,422	2,878	7,464		Operational	Operational	R4R
Harbor Beach (Detroit Edison)													
1/121	1968	14	No	No	No	No	172,034	460	1,044	N/A	R4R	R4R	R4R
Monroe (Detroit Edison)													
1/817	1971	66	IP	Yes	No	No	4,448,266	6,668	24,947	848	Operational	Operational	Operational
2/823	1973	70	IP	IP	No	No	4,852,354	8,205	27,230		Operational	Operational	Operational
3/823	1973	68	Yes	Yes	No	No	4,792,840	2,515	22,959		Operational	Operational	Operational
4/817	1974	74	Yes	Yes	No	No	5,282,599	2,987	10,762		Operational	Operational	Operational
Belle River (Detroit Edison)													
1/698	1984	85	No	No	No	No	4,929,799	5,324	13,595	328	Operational	Operational	Operational
2/698	1985	86	No	No	No	No	5,147,528	5,111	14,475		Operational	Operational	Operational
J.R. Whiting (Consumers Energy) [Suspension of operations by 2015 announced]													
1/106	1952	73	No	No	No	No	782,173	839	2,568	85	R4R	R4R	R4R
2/106	1952	72	No	No	No	No	790,438	892	2,540		R4R	R4R	R4R
3/133	1953	38	No	No	No	No	485,640	538	1,562		R4R	R4R	R4R
J.C. Weadock (Consumers Energy) [Suspension of operations by 2015 announced]													
7/156	1955	73	No	No	No	No	966,659	1,585	4,439	N/A[d]	Operational	R4R	R4R
8/156	1958	64	No	No	No	No	876,739	1,428	3,997		Operational	R4R	R4R
B.C. Cobb (Consumers Energy) [Suspension of operations by 2015 announced]													
4/156	1956	63	No	No	No	No	941,156	1,699	4,825	79	Operational	R4R	R4R
5/156	1957	60	No	No	No	No	943,695	886	4,805		Operational	R4R	R4R
Dan E. Karn (Consumers Energy)													
1/255	1959	43	IP	Yes	IP	IP	1,117,492	543	4,165	197[d]	Operational	Operational	R4R
2/260	1961	62	IP	Yes	Yes	IP	1,794,719	676	7,138		Operational	Operational	R4R

Coal Generator Age and Performance			Pollution Control Status (IP: in process of being added)[b]				Air Emissions (2009)[c]				Ripe-for-Retirement (R4R) Status by Scenario		
Units/Size in Megawatts (MW)	First Year Online	Capacity Factor (%)	SO_2 (scrubber)	NO_x (SCR)	Particulates (baghouse)	Mercury (ACI)	CO_2 (tons)	NO_x (tons)	SO_2 (tons)	Mercury (plant-wide) (lb)	Low Estimate	High Estimate	Carbon Price
J.H. Campbell (Consumers Energy)													
1/265	1962	81	No	No	IP	No	1,988,354	1,520	6,790	431	Operational	Operational	R4R
2/404	1967	46	IP	IP	IP	No	1,538,092	2,405	6,637		Operational	Operational	R4R
3/917	1980	87	IP	Yes	IP	No	7,198,924	4,571	18,370		Operational	Operational	Operational
Eckert Station (Lansing Board of Water and Light)													
1/44	1954	9	No	No	No	No	60,703	68	163	71	R4R	R4R	R4R
2/44	1958	15	No	No	No	No	72,074	101	198		R4R	R4R	R4R
3/47	1960	19	No	No	No	No	102,832	87	263		R4R	R4R	R4R
4/80	1964	41	No	No	No	No	331,548	328	846		R4R	R4R	R4R
5/80	1968	41	No	No	No	No	361,597	358	926		R4R	R4R	R4R
6/80	1970	38	No	No	No	No	330,784	325	831		R4R	R4R	R4R
Erickson (Lansing Board of Water and Light)													
1/155	1973	80	No	No	No	No	1,323,259	1,231	3,543	58	Operational	R4R	R4R
Wyandotte (Wyandotte Municipal Service Commission)													
5/22	1958	20	No	No	No	No	208,073	380	985	8	R4R	R4R	R4R
7/32	1986	47	No	No	No	No	173,574	168	284		R4R	R4R	R4R
James De Young (City of Holland)													
5/29	1969	30	No	No	No	No	115,646	227	654	3	R4R	R4R	R4R
Presque Isle (Wisconsin Electric)													
5/90	1974	55	No	No	Yes	No	481,778	887	1,966	30	Operational	R4R	R4R
6/90	1975	60	No	No	Yes	No	545,762	1,007	2,214		R4R	R4R	R4R
7/90	1978	71	No	No	Yes	Yes	653,175	1,203	1,549		Operational	R4R	R4R
8/90	1978	71	No	No	Yes	Yes	711,891	1,305	1,682		Operational	R4R	R4R
9/90	1979	77	No	No	Yes	Yes	750,525	1,375	1,773		Operational	R4R	R4R
Endicott Generating Station (Michigan South Central Power Agency)													
1/55	1982	56	Yes	No	No	No	478,052	424	1,242	14	R4R	R4R	R4R
J.B. Sims (City of Grand Haven)													
3/80	1983	43	Yes	No[e]	No	No	341,096	379	334	2	Operational	R4R	R4R
Shiras (City of Marquette)													
3/44	1983	74	Yes	No	Yes	No	345,696	247	63	18	Operational	Operational	R4R
TES Filer City Station (TES Filer City Station LP)													
1/70	1990	95	Yes	No	Yes	No	585,239	1,255	582	1	Operational	Operational	Operational

NOTES:

[a] Certain small Michigan coal units are not included in this table or in the aggregate values presented in the text because of a lack of complete data. These include two Escanaba units (totaling 23 MW), two units at James De Young (totaling 33.5 MW), one unit at Shiras (21 MW), and three units at White Pine (totaling 60 MW). Coal units that are nonoperational or operated by industrial facilities or educational facilities rather than by a public utility are also excluded.

[b] Pollution controls are considered in process of being added based on announcements by plant owners, regulatory filings, and communications with state regulators.

[c] Capacity factors and emissions of SO_2, NO_x, and CO_2 are from EIA 2009. Mercury emissions are for 2009 (EPA 2011).

[d] Mercury emissions from both Karn and Weadock are reported together (under Karn). For additional discussion of data sources and limitations, see *Ripe for Retirement* text and appendices.

[e] UCS did not add SCR costs to J.B. Sims because it already uses selective noncatalytic reduction (SNCR) for NO_x control.

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generating unit, and presents the unit's annual emissions of SO_2, NO_x, and CO_2. Mercury emissions are presented for the entire power plant.

The Added Benefits of Retiring Coal Plants

Carbon dioxide. While retrofitting old coal plants with the pollution controls discussed above can greatly reduce SO_2, NO_x, particulates, and mercury, no commercially available pollution control can reduce coal plants' enormous emissions of climate-changing CO_2. However, by retiring its old generators, Michigan can achieve even greater health benefits than retrofits alone could deliver, and realize deep cuts in CO_2 emissions.

By replacing 3,532 MW of coal generators with increased generation from wind power, other zero-emissions sources, and reduced power demand due to greater energy efficiency, CO_2 emissions would be cut by 18.7 million tons annually—equal to 26 percent of the CO_2 emissions from Michigan's total coal fleet. If the coal power is replaced with power from NGCC plants, the net CO_2 benefit would be significantly smaller, but would still be important because NGCC plants emit about 40 percent as much CO_2 as inefficient old coal plants. Adding a $15 per ton carbon price would alter the economics of both NGCC facilities and coal-fired generators, but would affect the coal units far more, providing greater incentive to retire them. Under this case, if all ripe-for-retirement coal generators were shut down, CO_2 emissions would be cut by up to 34.7 million tons annually, depending on the mix of technologies that replaced them.

Nothing in this analysis, however, should be construed as advocating a wholesale conversion to natural gas power generation. Natural gas (methane or CH_4) is still a fossil fuel, and burning it emits vast quantities of CO_2. Moreover, there are many unresolved questions about the amount of methane that leaks into the air that could reduce the climate benefit of natural gas, because methane is a far more potent heat-trapping gas than CO_2. In particular, the extraction of natural gas using "hydrofracking" technology and the transport of natural gas in pipelines create the potential for significant additional global warming emissions.

Cooling water. Retiring coal generators would also remove a major strain on local water bodies. A coal plant can withdraw hundreds of millions of gallons of water daily from adjacent lakes and rivers for cooling purposes. While most of that water is eventually returned, the simple act of removal kills fish and their larvae. Moreover, the waste heat in the returned water can also harm aquatic ecosystems (Averyt et al. 2011). Cooling towers can cut the total water a power plant withdraws by more than 90 percent. While about half of U.S. coal plants have cooling towers, only three of Michigan's coal plants do (EIA 2011e; Shuster 2010).

Ash. Burning coal creates vast quantities of ash that contains arsenic, selenium, cadmium, lead, mercury, and other hazardous chemicals that can leak into ground or surface water when disposed. Studies have found that the landfills at Michigan's Karn and Weadock plants have already leaked arsenic into Saginaw Bay (EIP and Earthjustice 2010). Retiring old coal generators reduces the costs and risks associated with this waste, including the risk that the facility could be required to switch to safer dry-ash handling systems.

Retiring coal generators would cut many harmful pollutants that damage public health and contribute to global warming. Replacing all 3,432 MW of ripe-for-retirement coal generators in Michigan with wind power and other zero-emissions sources would cut 18.7 million tons of CO_2 emissions annually—equal to 26 percent of the CO_2 emissions from Michigan's total coal fleet.

Ideally, an analysis of whether a coal generator is ripe for retirement would consider the costs of lower-impact cooling systems and ash handling. However, because of a lack of consistent data at the generator level, we did not include these costs in our analysis.

Maximizing the Benefits of Retiring Coal

Strengthening energy standards. Michigan is well poised to shift away from coal toward cleaner, more sustainable energy sources such as wind, solar, and biomass. Michigan also has a wealth of untapped potential for replacing coal-fired power by relying more strongly on energy-saving technologies that can reduce overall demand for electric power.

Michigan took an important first step in moving toward clean electricity in 2008 when it passed a law requiring utilities to use renewables to meet 10 percent of their electricity sales by 2015. State regulators have found not only that utilities are on track to meet this renewable electricity standard (RES) but that it has also spurred more than $100 million in new investments in Michigan. State regulators also reported that the cost of renewable power has been lower than expected, declining over time, and less than the cost of building new coal plants (Quackenbush, Isiogu, and White 2012).

The 2008 legislation also requires utilities to achieve 1 percent annual energy savings by 2012 through energy efficiency investments that cut energy usage and consumers' utility bills. Investing in energy-saving technologies is one of the quickest and most cost-effective ways to transition to a clean energy economy. Michigan regulators estimate that investing in energy savings will cost only 1.6 cents per kilowatt-hour (kWh) for the next few years based on utility filings (Quackenbush, Isiogu, and White 2012). By comparison, the cost of generating and delivering power is far higher (the average retail price of power in Michigan is 9.9 cents per kWh) (EIA 2012c).

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Since 2008, clean energy investments in Michigan have exceeded $100 million, creating more than 10,000 jobs across the state. State regulators reported that the cost of renewable power in Michigan is declining over time and less than the cost of building new coal plants.

To ensure a successful transition to sustainable energy, Michigan should also boost state clean energy incentives, adopt stronger energy efficiency codes for buildings, and implement better processes for planning, siting, and approving clean energy projects. In addition, elected officials should support expanded federal clean energy tax credits and other financial incentives, as well as more research and development funding.

Creating clean energy jobs. Michigan has already become a hot spot for the clean energy sector. With the state's strong manufacturing base and highly trained workforce, it is well positioned to create even more jobs in fast-growing clean energy industries. Already, Hemlock Semiconductor and Dow Chemical are investing heavily in major new solar manufacturing facilities in the state, and many businesses are part of the growing renewable energy supply chain. For example, a recent analysis found that Michigan is home to 121 companies in the solar supply chain and 120 companies in the wind supply chain, providing more than 10,000 jobs in the state (Craig, Learner, and Gray 2011).

Accelerating the replacement of coal generators by investing in renewable power and energy efficiency would also let Michigan keep more of its energy dollars in the state. In 2010, Michigan imported all its coal, sending

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A new solar power manufacturing facility under construction in Midland, MI. Dow Chemical expects this facility will begin producing solar shingles in 2012 and will directly create 1,275 jobs (Dow 2011).

nearly $1.3 billion to other states (UCS 2012). From 2002 to 2010, its cumulative purchases of imported coal reached nearly $10.4 billion. Reducing Michigan's reliance on coal could put those dollars to work at home.

Public planning for coal retirements is needed. In many states, utilities must prepare detailed resource plans projecting long-range energy demand and analyzing alternatives for meeting it. The plan's choices and underlying cost/benefit assumptions are then reviewed in public hearings. Michigan utilities are not required to conduct such detailed, long-range public planning, but given the high-stakes decisions on coal plants that lie ahead, such a thorough, public process is needed. The state legislature should enact laws requiring its utilities to routinely undertake such planning.

Meanwhile, each utility that owns or operates a coal plant should prepare a coal retirement/retrofit strategy, clearly showing the long-term cost assumptions of each path and inviting public comment. These strategies should be prepared not only by investor-owned utilities such as DTE, but also by the municipal utilities (such as Lansing) that own some of the oldest, most economically marginal coal generators in Michigan. For retiring coal generators, utilities should develop an economic transition plan for both the affected workers and the broader community to help minimize any dislocation that may result from a plant closure.

Certainly, any utility expecting to charge ratepayers for the costs of retrofitting a plant should make an explicit case that retrofits make more economic and environmental sense than retirement. This case should consider the many financial risks associated with investing in coal (as detailed in both *Ripe for Retirement* and another recent report by UCS, *A Risky Proposition: The Financial Hazards of New Investments in Coal Plants* (Freese et al. 2011).

Regulators and citizens should demand a particularly rigorous demonstration of economic competitiveness and environmental benefit before any utility makes major new investments in any coal generator listed as ripe for retirement in this fact sheet.

Making the transition to a modern and sustainable energy system involves more than just adding new clean power sources to the grid—it also requires getting the dirtiest old power sources off the grid. Stronger clean energy policies and a long-term planning perspective will help Michigan maximize the environmental and economic benefits of a cleaner energy future, while maintaining reliable and affordable power for Michigan's families and businesses.

The fully referenced report and technical appendices are available online (in PDF format) at *www.ucsusa.org/ripeforretirement*.

The Union of Concerned Scientists is the leading science-based nonprofit working for a healthy environment and a safer world.

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