



VOTE SOLAR

Union of
Concerned
Scientists



Vote Solar

MEMORANDUM REPORT

[bw] RESEARCH
PARTNERSHIP



Executive Summary

DTE Energy, a large investor-owned utility based in Detroit, Michigan, has asked state regulators to approve the construction of an 1100 megawatt (MW) natural gas-fired power plant to be constructed in St. Clair County, Michigan, where the company is retiring older coal units. DTE Energy's filing before the Michigan Public Service Commission estimates that this plant will result in 520 construction jobs and will employ 35 people on an ongoing basis.

Vote Solar and the Union of Concerned Scientists commissioned BW Research to conduct an analysis of the economic development and job benefits that would occur if DTE Energy invested in solar, wind and energy efficiency resources, rather than building the fossil fuel plant. According to a witness for a coalition of clean energy intervenors¹, DTE Energy could produce the same electric generating capacity as the plant by through roughly 1100 MW of solar, 1100 MW of wind, and 87 MW of energy efficiency savings. Vote Solar and the Union of Concerned Scientists asked BW Research to determine the economic development and job benefits of this portfolio of resources. This memo describes both the conclusions of that research and the methodology we used to derive those conclusions.

Overall, the solar, wind and efficiency portfolio would create 16,360 direct, indirect and induced jobs in Michigan. This number includes jobs designing, siting, engineering, installing, and operating these energy measures, as well as those in the supply chain and those in the broader economy that result from the wage spending expected from these developments.

Making an apples-to-apples comparison between the direct (construction and ongoing operating/maintenance) job creation of the solar, wind and efficiency portfolio and the gas plant as estimated by DTE in its testimony before the Michigan Public Service Commission, **we would expect that the clean energy portfolio would create just over 10 times the number of construction jobs and just under 4 times the number of ongoing jobs.**

¹ The Clean Energy Intervenors included the Environmental Law and Policy Center, the Union of Concerned Scientists, the Solar Energy Industries Association and Vote Solar.

	Construction Jobs	Ongoing Operating/Maintenance Jobs
DTE Proposed Plant	520	35
Clean Portfolio Total	5,642	137
Wind	2,649	119
Solar	2,335	18
Energy Efficiency	658	

BW Research also assessed the number of indirect jobs that would be created by the clean energy portfolio. Indirect jobs are those that are created in the supply chain to serve the initial (direct) job creation. We estimate that there would be another 2582 indirect jobs created in Michigan if DTE were to build the wind, solar and efficiency portfolio suggested by the Clean Energy Intervenors.

Finally, BW Research estimated the number of induced jobs that would be created as a result of this clean energy investment by DTE at 7721 jobs. Induced jobs are those created in the economy as a result of wage spending from the direct and indirect jobs resulting from the project.

	Direct	Indirect	Induced	Total
Wind Construction Jobs	2,649	1,517	5,009	9,175
Wind O&M Jobs	119	66	237	422
Solar Construction Jobs	2,335	824	2,282	5,441
Solar O&M Jobs	18	4	22	44
Energy Efficiency Jobs	658	171	448	1,277

The study also found that in addition to significant jobs potential from solar, wind, and energy efficiency capacity additions, the economic impact of this work would also generate significant tax revenue. In total, the proposed renewable production and efficiency savings would generate \$213.5 million in local and state taxes and \$41.1 million in federal taxes.

A complete explanation of our sources of data, assumptions and methodology, and the implications of our findings follows below.

Introduction

BW Research was commissioned by Vote Solar and the Union of Concerned Scientists to produce an economic impact analysis of the direct, construction and operations jobs associated with approximately 2,500 megawatts (MW) of renewable power plant production and efficiency savings in the State of Michigan. BW Research applied proprietary labor efficiency data produced from years of studying clean economies in the region to calculate the direct impact of the added energy capacity and savings. Vote Solar and the Union of Concerned Scientists provided the total MW of proposed wind, distributed solar, and utility-scale solar energy capacity, and the total proposed MW associated with added energy efficiency capacity for the State of Michigan. BW Research used these proposed MW of added energy capacity and energy efficiency to calculate the following:

- Construction jobs associated with wind energy capacity addition
- Operations and maintenance jobs associated with wind energy capacity addition
- Construction jobs associated with solar energy capacity addition
- Operations & maintenance (O&M) jobs associated with solar energy capacity addition
- Industry jobs associated with the added energy efficiency capacity

BW Research applied Economic Modelling Specialists (EMS) multipliers to these inputs to determine the number of indirect and induced jobs and related fiscal impacts associated with the new capacity additions. This report provides the results of these analyses.



About Vote Solar

Since 2002, Vote Solar has been working to lower solar costs and expand solar access. A 501(c)3 non-profit organization, Vote Solar advocates for state policies and programs needed to repower our electric grid with clean energy.

Learn more at votesolar.org.



About BW Research

BW Research Partnership is a full-service applied research firm that is focused on supporting clients with economic & workforce research, customer & community research, as well as strategic planning and evaluation services. BW Research has extensive qualifications in energy-related research.

Learn more at bwresearch.com.



About the Union of Concerned Scientists

The Union of Concerned Scientists puts rigorous, independent science to work to solve our planet's most pressing problems. Joining with people across the country, we combine technical analysis and effective advocacy to create innovative, practical solutions for a healthy, safe, and sustainable future.



Energy Jobs - Methodology

This research study calculates the economic impact of potential energy capacity added to the State of Michigan. It includes a hypothetical addition of 1,100MW of wind energy, 1,100 MW of solar energy (200MW of distributed generation and 900MW of utility-scale solar energy), and 87MW of savings from energy efficiency. BW Research applied proprietary labor efficiency data produced from years of studying renewable energy and energy efficiency employment in the region to calculate jobs per MW of energy capacity.



WIND ENERGY JOBS

Wind energy construction and operations jobs were calculated using research conducted by BW Research for a variety of clients over the past several years, including labor market analyses for the National Renewable Energy Laboratory (<https://www.nrel.gov/docs/fy13osti/57512.pdf>; <https://www.nrel.gov/docs/fy14osti/61251.pdf>) and the Natural Resources Defense Council (<https://www.nrdc.org/sites/default/files/american-wind-farms-IP.pdf>). These findings were used to develop a custom model for the number of jobs associated with each MW of added wind energy capacity, including the number of construction and operations & maintenance jobs associated with a MW of wind energy generation. The total employment impact for 1,100 MW of wind energy generation is 2,649 jobs². This phase includes site identification and assessment, project development, project permitting, and on-site civil workers, mechanical assembly, and electrical work. Operations and maintenance of these 1,100 MW requires an additional 119 workers on an annual basis.

² In this study a job is any position in which a worker provides labor in exchange for monetary compensation, including those who work as employees for businesses (i.e. “wage and salary” employees) and proprietors who work for themselves. Jobs are shown as annual job averages and include both full- and part-time jobs, which are counted equally (job counts are not adjusted to full-time equivalents). Geographically, payroll jobs are always reported by the place of work rather than the worker’s place of residence and self-employed and proprietors jobs are always reported by their place of residence.



SOLAR ENERGY JOBS

Distributed generation installation workers per MW installed was generated from primary data collected from Michigan firms regarding typical installations (using 1,850 hours as a full-time worker equivalent) and large installation firm (multiple locations), total installation workforce divided by total annual MW installed. Both methodologies returned estimates of over 5 workers per MW; the 5.19 jobs per MW represents an average of the two figures.

Utility generation installation (construction) workers per MW installed was generated from secondary data sources for total man hours at Michigan solar utility projects. The largest project currently in operation in Michigan, the 60 MW DTE Energy Solar Farm in Lapeer, used 160,000 total man hours, or approximately 86.49 full-time equivalent installation workers (using 1,850 hours as a full-time worker equivalent), or 1.44 installation workers per MW.

Utility-scale installed capacity solar is currently approximately 80 MW in Michigan. The Bureau of Labor Statistics (BLS) Quarterly Census of Employment and Wages (QCEW) currently estimates <10 workers at solar electric power generation establishments (operations and maintenance positions). Secondary data sources report up to five full-time O&M workers at solar farms ranging from 60 (60 MW DTE Energy Solar Farm in Lapeer, MI) – 250 MW in the United States (various utility-scale arrays). We estimate that 18 O&M workers would be employed at a 900 MW combined utility-scale project using a straight curve from 250 MW $((900/250)*5)$.



ENERGY EFFICIENCY JOBS

BW Research used secondary data sources to determine the number of jobs associated with 87 MW of energy efficiency measures in the State of Michigan. The American Council for an Energy-Efficient Economy's (ACEEE) findings (provided in the report "*What Will It Cost? Exploring Energy Efficiency Measure Costs over Time*") show a \$1 cost associated with 1 Watt of energy reduced by energy saving-measures. Thus, to achieve a goal of 87 MW of energy savings, a total of approximately \$87 million would have to be spent on energy efficiency measures.

BW Research created four models for the following energy efficiency-related industries: residential remodelers, electrical contractors, plumbing and HVAC contractors, and commercial and Institutional Building Construction. The average results for those four models show that 87 MW of energy savings are associated with 658 direct jobs in the State of Michigan.



Energy Jobs - Results

The economic impact analyses were developed using EMSI's input-output model, a model that traces spending and infrastructural developments through the economy. The cumulative effects of the initial spending and jobs created are measured monetarily and the results are categorized into direct, indirect, and induced effects. Direct effects show the change in the economy associated with the initial spending, or how the industry experiences the change (e.g. jobs created by the added energy capacity). Indirect effects include all the backward linkages, or the supply chain responses and local employment as a result of the initial jobs created or spending. Lastly, induced effects refer to household spending and are the consequence of workers who are responsible for the direct and indirect effects spending their wages in the region. Jobs in this analysis include full- and part-time wage and salaried jobs and self-employed jobs. Full- and part-time jobs are counted equally, i.e. job counts are not adjusted to full-time equivalents.

The input-output model also calculates the fiscal impact of the initial change in the economy (e.g. jobs created) by estimating the taxes on production and imports (TPI). These taxes consist of tax liabilities, such as general sales and property taxes, that are chargeable to business expenses. TPI is comprised of state and local taxes—primarily non-personal property taxes, licenses, and sales and gross receipts taxes—and Federal excise taxes on goods and services. The results of the economic analyses are presented below.

THE IMPACT OF WIND JOBS

BW Research calculated the impact of adding 2,649 construction jobs and 119 O&M jobs associated with 1,100 MW of wind energy generation. The jobs associated with the construction phase include site identification and assessment, project development, project permitting, and on-site civil workers, mechanical assembly, and electrical work. The operations jobs include the typical positions necessary to operate and maintain a wind energy plant such as technicians, engineers, and professional staff. The industries included in these two phases are engineering services and wind electric power generation. The results are provided below.

Wind Construction Jobs

A total of 9,175 direct, indirect, and induced jobs are created in the State of Michigan from adding 1,100 MW of wind energy generation. 1,517 indirect jobs are created in the supply chain (i.e. other industries required for the wind energy generation to occur, such as construction, manufacturing, and wholesale trade) as a result of the initial 2,649 wind jobs created and a significant 5,009 induced jobs are created as a result of the wages that were generated by the direct and indirect jobs and that are spent in the region's economy. The multipliers presented in Table 1 refer to the ripple effect in the economy of the initial, i.e. direct, jobs created. This means that for every direct job created, 0.57 indirect (supply chain) and 1.89 induced jobs (jobs created as a result of wage spending from the direct and indirect jobs) are

created in the economy. Lastly, all this job creation and spending results in a fiscal impact of over \$181 million in local and state taxes and nearly \$33 million in federal taxes (Table 2).

Table 1: Construction Jobs associated with adding 1,100MW of Wind Energy to the State of Michigan

	Direct	Indirect	Induced
Jobs	2,649	1,517	5,009
Multipliers		0.57	1.89

Table 2: Effect on Taxes on Production and Imports

Local Taxes	State Taxes	Federal Taxes
\$100,274,155	\$80,927,395	\$32,994,757

Wind O&M Jobs

A total of **422 O&M direct, indirect, and induced jobs** are created in the State of Michigan from adding 1,100 MW of wind energy generation. 66 indirect jobs are created in the supply chain as a result of the initial 119 wind jobs created and 237 induced jobs are created as a result of the wages that are spent in the region’s economy. To note that the induced jobs are nearly twice the direct jobs, meaning that salary spending as a result of the direct and indirect jobs has a significant impact in the region’s economy. Lastly, fiscal impact is a little over \$9 million in local and state taxes and \$1.67 million in federal taxes.

Table 3: Operations & Maintenance Jobs associated with adding 1,100MW of Wind Energy to the State of Michigan

	Direct	Indirect	Induced
Jobs	119	66	237
Multipliers		0.55	1.99

Table 4: Effect on Taxes on Production and Imports

Local Taxes	State Taxes	Federal Taxes
\$5,098,804	\$4,113,968	\$1,672,932

THE IMPACT OF SOLAR ENERGY JOBS

The proposed added capacity for the state is 1,100 MW of solar energy, of which 200 MW are distributed generation and 900 MW are utility-scale energy generation. The impacts of this added capacity are presented below.

Impacts of 200 MW of distributed generation

Construction

The industry included in the model to determine the construction jobs for distributed generation was electrical contractors and other wiring installation contractors. Results show that a total of 2,237 direct, indirect, and induced jobs are created in the State of Michigan as a result of the 200 MW added capacity (Table 5). The fiscal impacts include \$7.3 million in local and state taxes and \$2 million in federal taxes (Table 6).

Table 5: Construction Jobs associated with 200MW of distributed generation

	Direct	Indirect	Induced
Jobs	1,038	331	868
Multipliers		0.32	0.84

Table 6: Effect on Taxes on Production and Imports

Local Taxes	State Taxes	Federal Taxes
\$32,983,036	\$26,654,490	\$11,009,304

Impacts of 900 MW of utility-scale solar energy

The added 900 MW of utility-scale solar energy is responsible for 1,297 direct, construction jobs and 18 direct, O&M jobs. The impacts of these jobs are presented below.

Construction

The industry included in the model to determine the construction jobs for utility-scale energy generation was power and communication line and related structures construction. Results show that a total of **3,203 direct, indirect, and induced jobs** are created in the State of Michigan as a result of the 900 MW of utility-scale energy capacity (Table 7). The fiscal impacts include \$11.57 million in local and state taxes and \$3.24 million in federal taxes (Table 8).

Table 7: Construction Jobs associated with 900MW of utility-scale solar energy

	Direct	Indirect	Induced
Jobs	1,297	493	1,414
Multipliers		0.38	1.09

Table 8: Effect on Taxes on Production and Imports

Local Taxes	State Taxes	Federal Taxes
\$6,254,596	\$5,314,380	\$3,243,671

Operations and Maintenance

The industry included in the model to determine the O&M jobs for utility-scale energy generation was solar electric power generation. Results show that a total of **44 direct, indirect, and induced O&M jobs** are created in the State of Michigan as a result of the 900 MW of utility-scale energy capacity (Table 9). The fiscal impacts include \$827,660 in local and state taxes and \$152,789 in federal taxes (Table 10).

Table 9: O&M Jobs associated with 900MW of utility-scale solar energy

	Direct	Indirect	Induced
Jobs	18	4	22
Multipliers		0.24	1.21

Table 10: Effect on Taxes on Production and Imports

Local Taxes	State Taxes	Federal Taxes
\$457,745	\$369,916	\$152,789

IMPACTS OF 87MW OF ENERGY EFFICIENCY IN MICHIGAN

The industries included in the model to determine the jobs associated with energy efficiency measures were residential remodelers, electrical contractors, plumbing and HVAC contractors, and commercial and institutional building construction. Based on averaged results for these four industries, a total of 1,277 direct, indirect, and induced jobs are created in the State of Michigan as a result of the 87 MW of energy savings (Table 11). The fiscal impacts include \$3.77 million in local and state taxes and \$1.04 million in federal taxes (Table 12).

Table 11: Jobs associated with 87MW of energy efficiency measures

	Direct	Indirect	Induced
Jobs	658	171	448
Multipliers		0.26	0.68

Table 12: Effect on taxes on production and imports

Local Taxes	State Taxes	Federal Taxes
\$2,039,400	\$1,728,029	\$1,036,291

Conclusions

BW Research conducted an economic impact analysis of the direct, construction and O&M jobs associated with nearly 2,500 megawatts (MW) of renewable power plant production and efficiency savings in the State of Michigan (1,100 MW of wind energy, 1,100 MW of solar energy, and 87 MW of energy efficiency measures).

Results show that a total of **9,597 wind jobs** (9,175 construction and 422 O&M jobs), **5,485 solar jobs** (5,441 construction jobs and 44 O&M jobs), and **1,277 energy efficiency-related jobs** are created in the State of Michigan from adding 2,200 MW of renewable power plant production and 87 MW of energy savings in the state (Table 13).

Table 13: Total Job Creation of Added Energy Capacity

	Direct	Indirect	Induced	Total
Wind Construction Jobs	2,649	1,517	5,009	9,175
Wind O&M Jobs	119	66	237	422
Solar Construction Jobs	2,335	824	2,282	5,441
Solar O&M Jobs	18	4	22	44
Energy Efficiency Jobs	658	171	448	1,277

Regarding the ripple effects of job creation across the state, wind O&M jobs have the highest multiplier (i.e., for every direct wind O&M job created, additional 2.55 jobs are created in the economy), followed by wind construction jobs (2.46), solar O&M jobs, and solar construction jobs (Table 14). This may be driven by a multitude of factors, including the wages of the direct jobs created, the availability of resources and suppliers in the region, and the size and cost of the required energy infrastructures and technologies.

Table 14: Jobs multipliers per job type

	Indirect Jobs	Induced Jobs	Total
Wind Construction Jobs	0.57	1.89	2.46
Wind O&M Jobs	0.55	1.99	2.55
Solar Construction Jobs	0.35	0.98	1.33
Solar O&M Jobs	0.22	1.22	1.44
Energy Efficiency Jobs	0.26	0.68	0.94