Michigan Farm Energy Program

Renewable Energy Assessment

Overview

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Michigan Energy Sources
Major Net Energy Importer

Over $34.5 billion outflow (9th highest in the nation) to pay for fuel, coal, and other sources of energy to power the state. #11 in energy consumption.

Source: U.S. Energy Information Administration
# Midwest Energy Imports

<table>
<thead>
<tr>
<th>State</th>
<th>Consumption (trillion Btus)</th>
<th>Production (trillion Btus)</th>
<th>Import Gap</th>
<th>% Imported</th>
<th>Energy Expenditures ($M)</th>
<th>Est. Energy Expenditures Lost to Imports ($M)</th>
<th>Gross State Product ($M)</th>
<th>Expenditure Lost as % of GSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ohio</td>
<td>3833.70</td>
<td>1,036.0</td>
<td>2,797.7</td>
<td>73%</td>
<td>45,081</td>
<td>32,898</td>
<td>$466,930</td>
<td>7.0%</td>
</tr>
<tr>
<td>Illinois</td>
<td>3936.70</td>
<td>2,085.2</td>
<td>1,851.5</td>
<td>47%</td>
<td>44,989</td>
<td>21,160</td>
<td>$646,794</td>
<td>3.3%</td>
</tr>
<tr>
<td>Michigan</td>
<td>2798.10</td>
<td>657.4</td>
<td>2,140.7</td>
<td>77%</td>
<td>34,540</td>
<td>26,425</td>
<td>$368,371</td>
<td>7.2%</td>
</tr>
<tr>
<td>Indiana</td>
<td>2871.10</td>
<td>991.2</td>
<td>1,879.9</td>
<td>65%</td>
<td>27,374</td>
<td>17,924</td>
<td>$267,277</td>
<td>6.7%</td>
</tr>
<tr>
<td>Missouri</td>
<td>1928.40</td>
<td>193.7</td>
<td>1,734.7</td>
<td>90%</td>
<td>22,885</td>
<td>20,587</td>
<td>$243,386</td>
<td>8.5%</td>
</tr>
<tr>
<td>Wisconsin</td>
<td>1800.10</td>
<td>340.7</td>
<td>1,459.4</td>
<td>81%</td>
<td>21,483</td>
<td>17,417</td>
<td>$245,720</td>
<td>7.1%</td>
</tr>
<tr>
<td>Minnesota</td>
<td>1867.30</td>
<td>429.2</td>
<td>1,438.1</td>
<td>77%</td>
<td>20,869</td>
<td>16,072</td>
<td>$270,792</td>
<td>5.9%</td>
</tr>
<tr>
<td>Iowa</td>
<td>1492.30</td>
<td>677.0</td>
<td>815.3</td>
<td>55%</td>
<td>14,766</td>
<td>8,067</td>
<td>$140,945</td>
<td>5.7%</td>
</tr>
</tbody>
</table>

Regional Average: 69%

Sources: Update April 24, 2013


Fossil Price Increasing

- Natural Gas (Henry Hub)
- Oil (West Texas Intermediate spot price)
- Coal (Central Appalachia, 1.5 lb sulfur dioxide per MMBtu)

Source: CERA
Renewable Costs Decreasing

Source: CERA
“Happy returns? Few companies lose money embracing renewable energy, but they don’t make much either, according to an Environmental Leader survey of nearly 400 companies that have adopted solar, wind, and other renewable power sources. Credit: Mark McKie”

Source: MIT Technology Review, 2011
Business Investment Statistics

Source: University of Tennessee, July 26, 2012
MICHIGAN’S LEADING INDUSTRIES

- Manufacturing
- Food & Agriculture ($91.4B)
  - Tourism
  - Services
  - Forestry & Lumber
Michigan Food & Agriculture

No Small Potatoes

$91.4 billion industry. 2\textsuperscript{nd} most diverse agriculture state in the nation while ranking 19\textsuperscript{th} in food manufacturing.

Employs 923,000 residents - accounts for about 22 percent of the state's employment.

Sustained growth at a rate of more than 5 times faster than the rate of the general economy over the last decade. Only industry in Michigan to grow during the recent recession.

Michigan farms accounts for $13 billion of the industry's overall total, making the Agriculture Sector necessary for Michigan's economic recovery and reinvention. Michigan has 54,900 farms averaging 182 acres each. There is 10 million acres of farmland.

Source: Michigan Department of Agriculture
Agriculture Sector

Renewable Energy’s Home Field

It has the land base, open spaces, biomass, natural resources and desire to be good stewards of the land, water and environment. Renewable technologies that are commercially available today can all be economically implemented in farms, ranches and rural communities/businesses that make-up this sector. No other sector or industry can make that claim. In short, the Agricultural Sector is renewable energy’s home field.
Renewable technologies that are commercially available today can all be economically implemented in farms, ranches and rural communities/businesses that make-up this sector. No other sector or industry can make that claim.

- Biofuels
- Biopower
- Bioproducts
- Geothermal heat pumps
- Geothermal direct use
- Hydroelectric power
- Passive solar heating
- Photovoltaic (solar cell) systems
- Solar hot water systems
- Wind energy
These are reports that assess the technical, economic and implementation aspects of a renewable energy project.

These reports do not include detailed engineering designs/drawings or simulations.

Required for USDA-REAP applications of $200,000 of less, Michigan Energy Office’s Agri-Energy, Michigan Saves other funding programs.

Desired for Utility renewable energy funding applications.
## Summary of Renewable Energy Reports
99 Reports from 2010 - 2013

<table>
<thead>
<tr>
<th>Type</th>
<th># of Audits</th>
<th>Electricity Used (kWh/yr)</th>
<th>Electricity Saved (kWh/yr)</th>
<th>% Savings</th>
<th>Cash Savings ($/yr)</th>
<th>Implementation Cost ($)</th>
<th>Payback (years)</th>
<th>Fuel Used (MMBTU)</th>
<th>Fuel Saved (MMBTU)</th>
<th>% Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable Assessments</td>
<td>99</td>
<td>26,265,249</td>
<td>23,369,516</td>
<td>89%</td>
<td>$1,622,309</td>
<td>$12,879,385</td>
<td>7.9</td>
<td>193,377</td>
<td>65,932</td>
<td>34%</td>
</tr>
</tbody>
</table>

Includes only Federal Tax Credit IRS Sec 1122 for 30% of system cost for cost reductions.
Wind energy systems for homeowners and small businesses
WIND GENERATORS COME IN MANY SHAPES AND SIZES!

Aerotecture International Inc.
Architectural Wind™
Renewable Energy That You Can See!
AeroCam Wind Turbines
An 80-story building will have up to 79 wind turbines, making it a true green power plant.
Michigan made Small Wind Turbines

Windspire
Manistee, MI

Swift
Cascade Engineering
Grand Rapids, MI

Earthtronics/Honeywell
Muskegon, MI
WEPOWER
The amount of sunlight that hits the Earth's surface in one hour is enough to power the entire world for a year.
Average Daily Solar Radiation Per Month

ANNUAL

Flat Plate Tilted South at Latitude

Collector Orientation

Flat-plate collector facing south at a fixed tilt equal to the latitude of the site. Capturing the maximum amount of solar radiation throughout the year can be achieved using a tilt angle approximately equal to the site’s latitude.

This map shows the general trends in the amount of solar radiation received in the United States and its territories. It is a spatial interpolation of solar radiation values derived from the 1961-1990 National Solar Radiation Data Base (NSRDB). The dots on the map represent the 230 sites of the NSRDB.

Maps of average values are produced by averaging all 30 years of data for each site. Maps of maximum and minimum values are composites of specific months and years for which each site achieved its maximum or minimum amounts of solar radiation.

Though useful for identifying general trends, this map should be used with caution for site-specific resource evaluations because variations in solar radiation not reflected in the maps can exist, introducing uncertainty into resource estimates.

Maps are not drawn to scale.

* NREL

National Renewable Energy Laboratory
Resource Assessment Program

kWh/m²/day

- 10 to 14
- 8 to 10
- 7 to 8
- 6 to 7
- 5 to 6
- 4 to 5
- 3 to 4
- 2 to 3
- 0 to 2
- none

FLATA13-208
Poly and Mono Crystalline Solar

Dow Corning HQ

MSU Recycling Center
Northville Collision

Ballast Roof Mount
Jonesville High School

Wall Mount (Awning)
Shingle Roof Mount
SOLYNDRA CIRCULAR SOLAR MODULES
• Use much less material—the cell's active area is usually only 1 to 10 micrometers thick.
• Continuous production process.
• Can be deposited on flexible substrate materials.
Building Integrated PV (BIPV)

Dow Powerhouse Shingles
Luma Shingles

Transparent Solar
Solar Thermal
SOLAR INCENTIVES/FINANCING

• 30% Federal Tax Credit (uncapped)
• Utility Rebates & Incentives (in their service area)
• Accelerated Depreciation – 85% in 5 Years. 50% in First Year
• USDA 25% Grant
• Michigan Energy Office, Michigan Saves, GreenStone Farm Credit Services & others
• Outside financing, including PPAs
• Open Market REC sales
AGRICULTURAL DIGESTERS

Diagram:
- Manure → Digester
  → Removal of solids for bedding → Digested Manure Storage
- Digester → Gas
  → Generator → Electricity
  → Heat
  → Heat for other uses
100 Degrees F to keep the bugs alive

Gas builds on top of the slurry
Power to the grid – Natural Gas or Electricity
Garbage Power – Plasma Vaporization

First stage: The trash is heated to 1,200 °C. Much of the organic material vaporizes, becoming hydrogen and carbon monoxide, a mixture called synthesis gas (syngas). Some of the organic material becomes char (similar to charcoal).

Second stage: The char passes through high-temperature lightning-like plasma arcs, which vaporize the remaining organic material to produce more syngas.

The inorganic materials left over fall into a pool of molten glass.

Metals separate from the glass and, depending on the mix, can be recycled.

The glass is poured out and hardens, trapping potentially toxic chemicals.

Ethanol can be used as a gasoline additive or substitute. Methanol is an important part of biodiesel.

The syngas reacts with catalysts to produce ethanol and methanol.

The trash goes here.

The syngas is removed from the heating chambers.
Geothermal heat pumps can be used almost everywhere in the world, without a geothermal reservoir. The insulating properties of the earth, just below our feet, can keep us warm or cool.
Geothermal Options
HYDRO
Any moving water has the potential to make power.
Conventional Hydropower: Harnessing Rivers’ Waterpower

- Reservoirs
- Run-of-River
- Pumped Storage
There are still about 100,000 megawatts of run-of-river resources available in this country.

That's not even considering the tens of thousands of megawatts available in our oceans and tidal estuaries.
MICHIANA HYDRO ELECTRIC
(The Stockhausens)

Bellevue, MI

Elk Rapids Hydroelectric Power
Kinetic hydropower is dam-less hydropower that is converted from energy found in the flowing water currents...

This is a pre-production model of the turbines that Verdant Power installed under New York's East River.
Be Part of THE 4TH GREAT HUMAN REVOLUTION

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GO GREEN
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