

# Michigan Farm Energy Program

## *Renewable Energy Assessment Overview*

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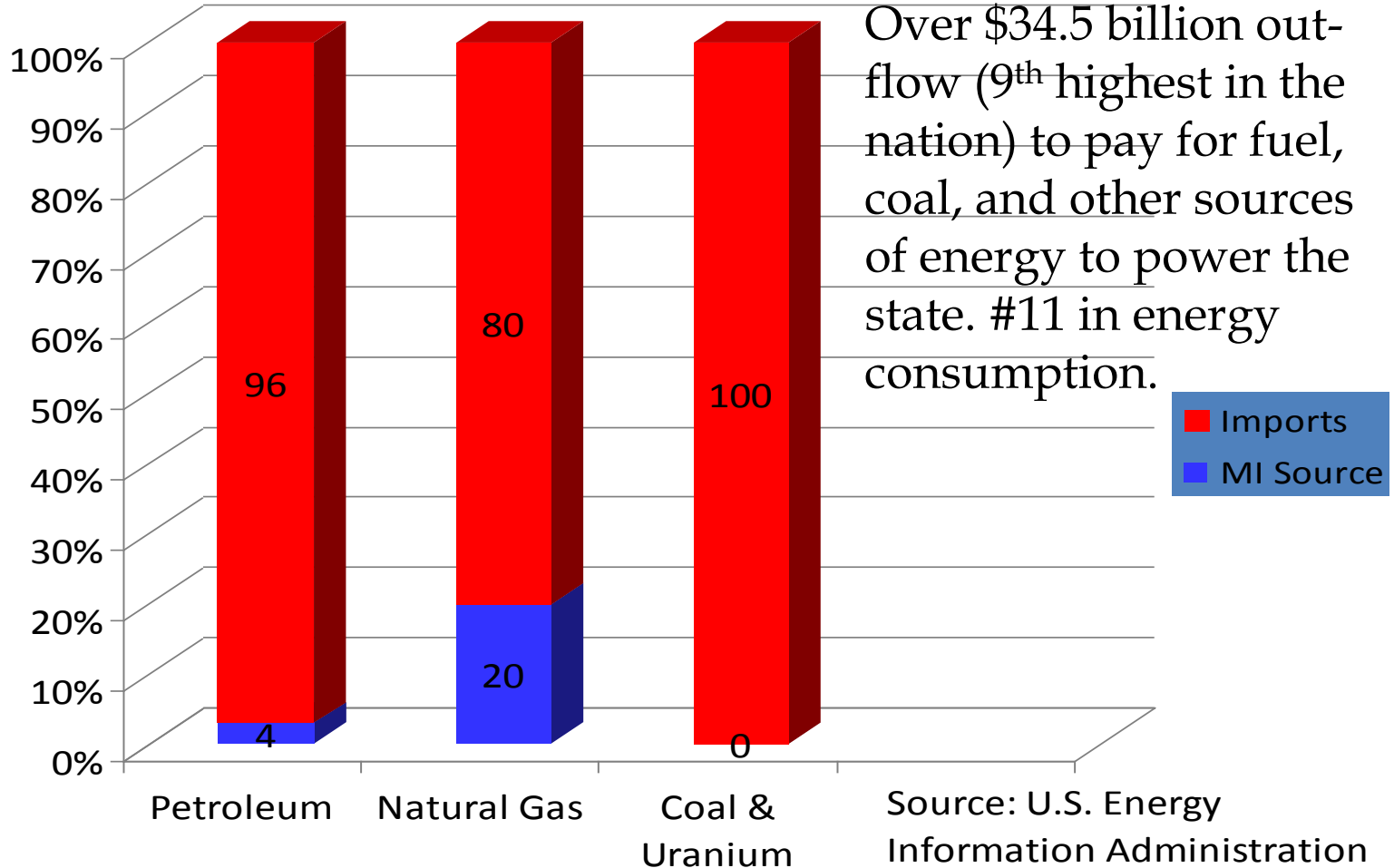


Michigan State University



# Michigan Energy Sources

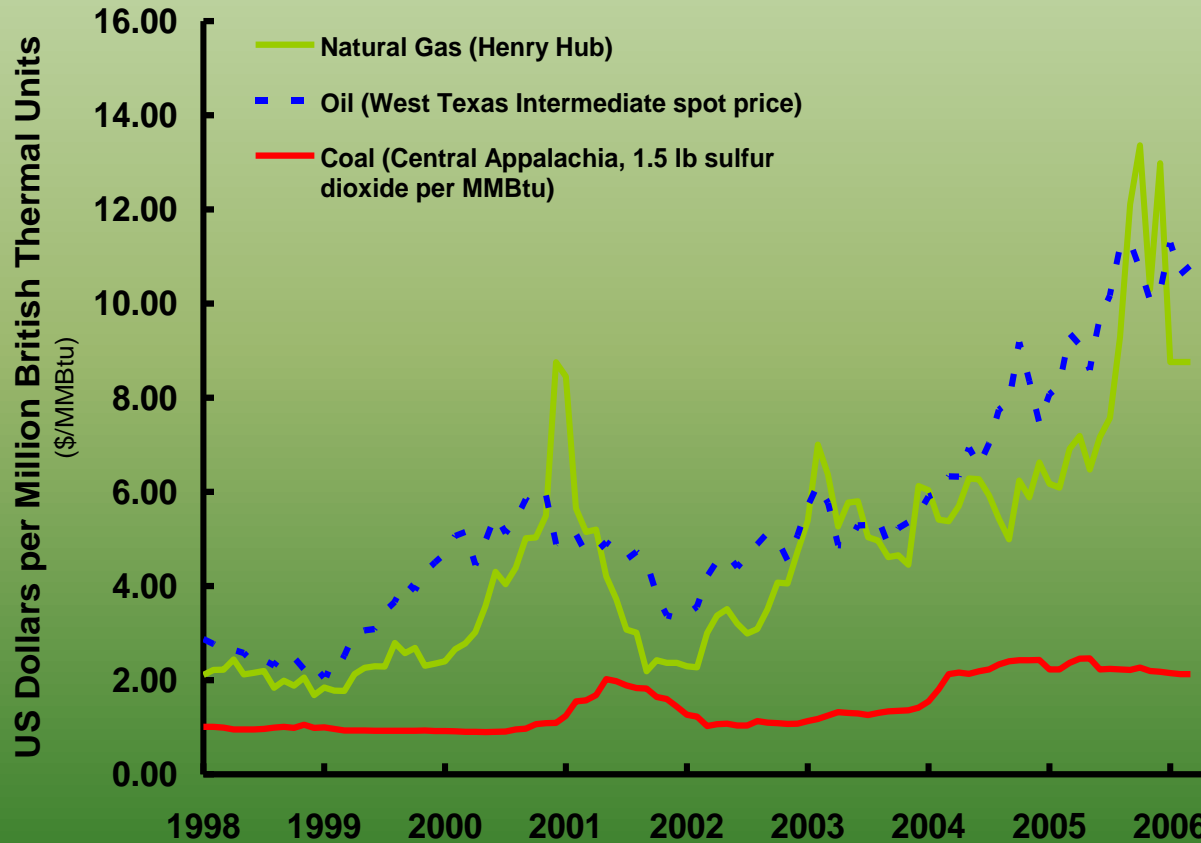
## Major Net Energy Importer



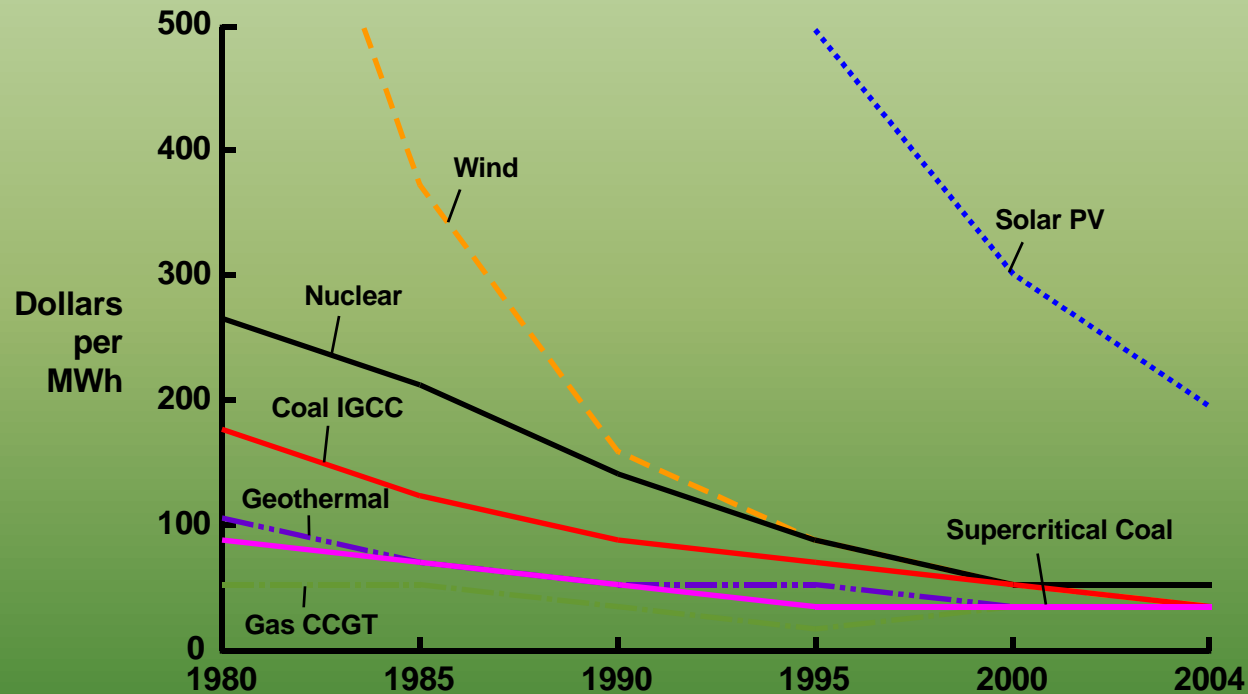
# Midwest Energy Imports

State	Consumption (trillion Btus)	Production (trillion Btus)	Import Gap	% Imported	Energy Expenditures (\$M)	Est. Energy Expenditures Lost to Imports (\$M)	Gross State Product (\$M)	Expenditure s Lost as % of GSP
Ohio	3833.70	1,036.0	2,797.7	73%	45,081	32,898	\$466,930	7.0%
Illinois	3936.70	2,085.2	1,851.5	47%	44,989	21,160	\$646,794	3.3%
<b>Michigan</b>	<b>2798.10</b>	<b>657.4</b>	<b>2,140.7</b>	<b>77%</b>	<b>34,540</b>	<b>26,425</b>	<b>\$368,371</b>	<b>7.2%</b>
Indiana	2871.10	991.2	1,879.9	65%	27,374	17,924	\$267,277	6.7%
Missouri	1928.40	193.7	1,734.7	90%	22,885	20,587	\$243,386	8.5%
Wisconsin	1800.10	340.7	1,459.4	81%	21,483	17,417	\$245,720	7.1%
Minnesota	1867.30	429.2	1,438.1	77%	20,869	16,072	\$270,792	5.9%
Iowa	1492.30	677.0	815.3	55%	14,766	8,067	\$140,945	5.7%
Regional Average				69%				
Sources: Update April 24, 2013								
Energy consumption, energy production, and energy expenditures – U.S. Energy Information Administration, State Rankings, <a href="http://www.eia.gov/beta/state/rankings/?sid=US">http://www.eia.gov/beta/state/rankings/?sid=US</a>								
Gross State Product – Bureau of Economic Analysis, U.S. Department of Commerce, <a href="http://www.bea.gov">www.bea.gov</a>								

# Fossil Price Increasing

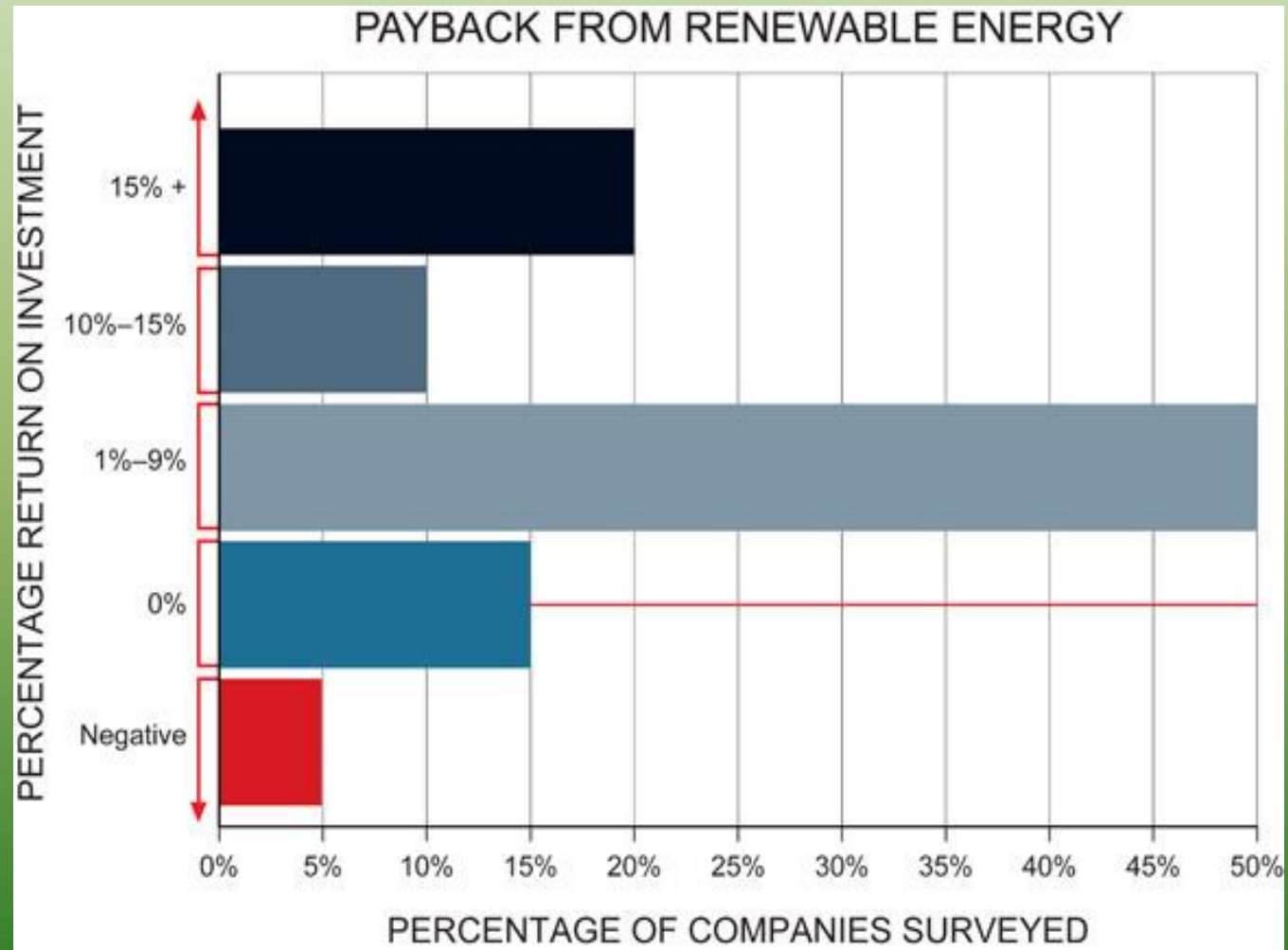


# Renewable Costs Decreasing



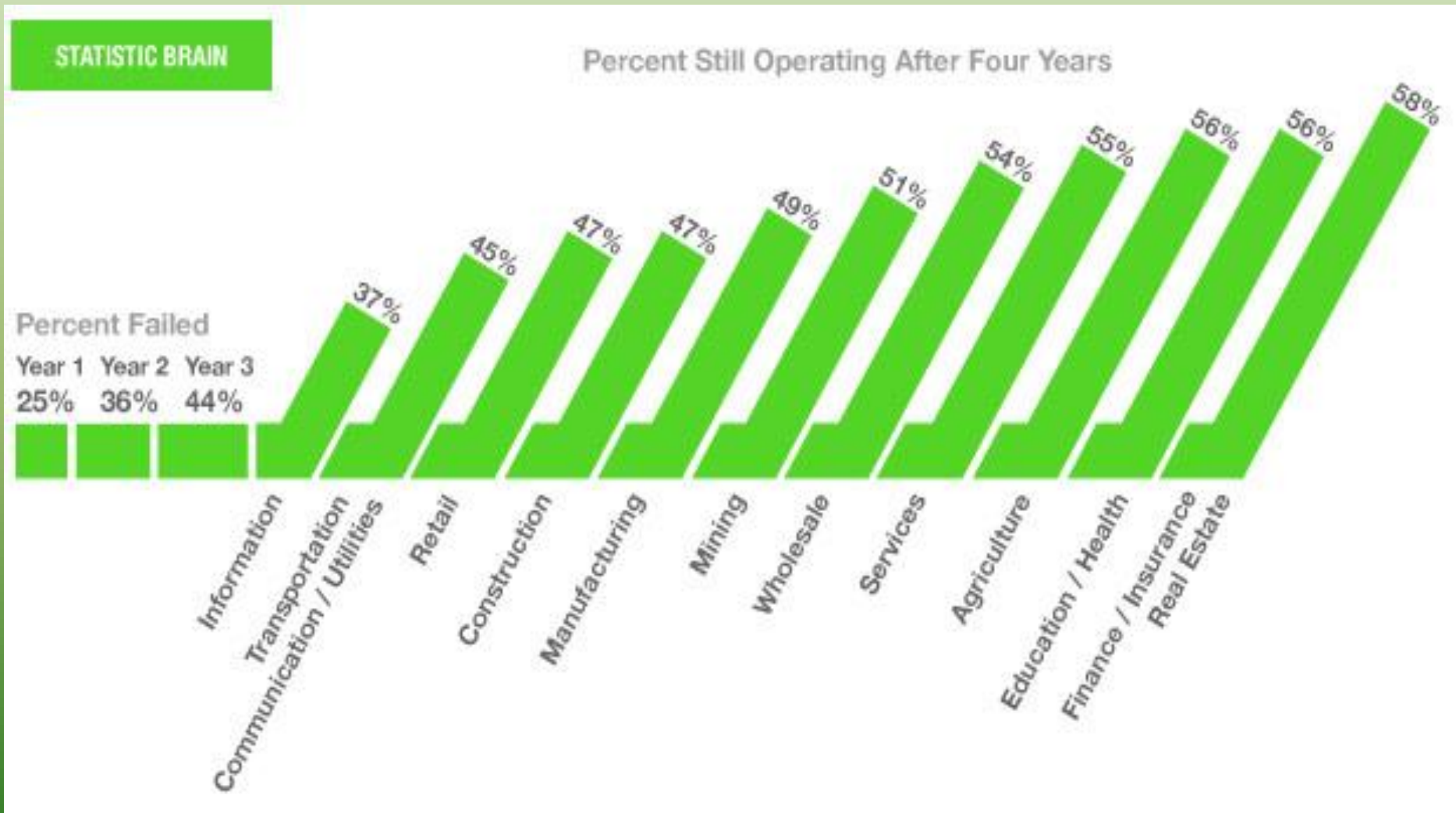
# Renewable Energy – Worthy Investment?

“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<sup>nd</sup> most diverse agriculture state in the nation while ranking 19<sup>th</sup> 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.

# 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.

# Michigan's Agriculture Sector

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"

# Renewable Energy Assessments

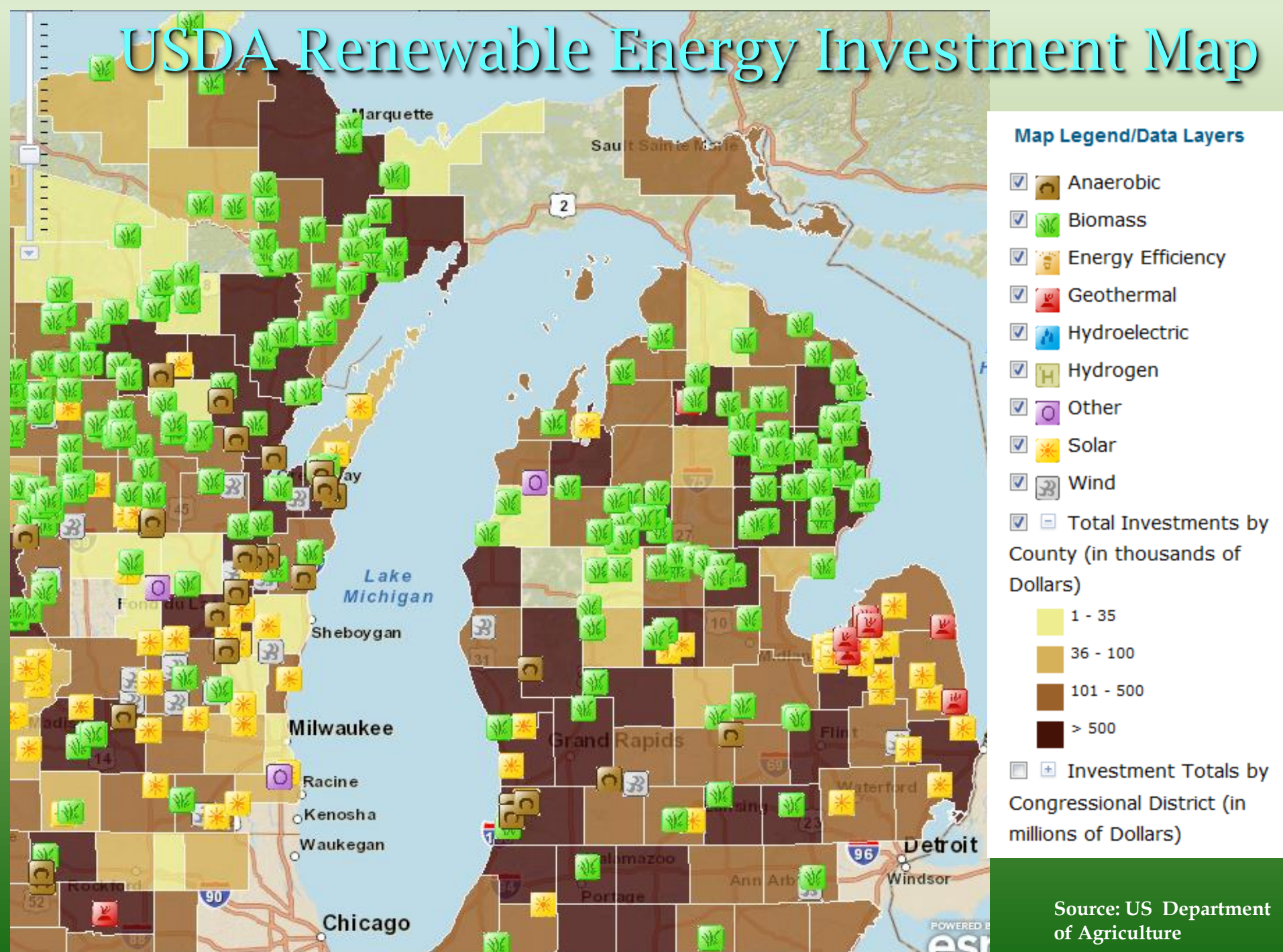
These are reports that assess the technical, economic and implementation aspects of a renewable energy project.

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

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

Desired for Utility renewable energy funding applications.

# USDA Renewable Energy Investment Map

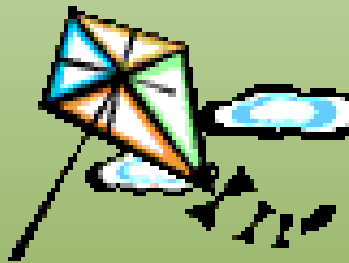




# Summary of Renewable Energy Reports

## 99 Reports from 2010 - 2013

Type	# of Audits	Electricity Used (kWh/yr)	Electricity Saved (kWh/yr)	% Savings	Cash Savings (\$/yr)	Implementation Cost (\$)	Payback (years)	Fuel Used (MMBTU)	Fuel Saved (MMBTU)	% Savings
Renewable Assessments	99	26,265,249	23,369,516	89%	\$1,622,309	\$12,879,385	7.9	193,377	65,932	34%
Includes only Federal Tax Credit IRS Sec 1122 for 30% of system cost for cost reductions.										

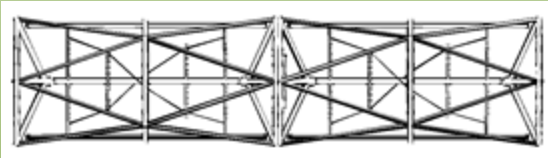


small wind

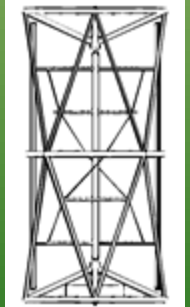
Wind energy systems for homeowners and  
small businesses



# WIND GENERATORS COME IN MANY SHAPES AND SIZES!



Aerotecture International Inc.

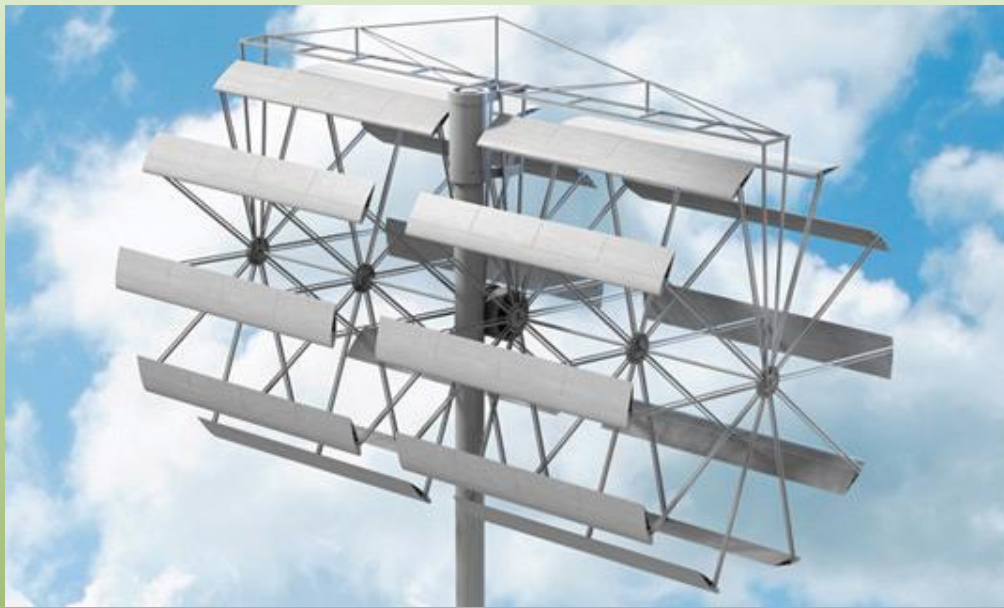




# Architectural Wind™

## Renewable Energy That You Can See!

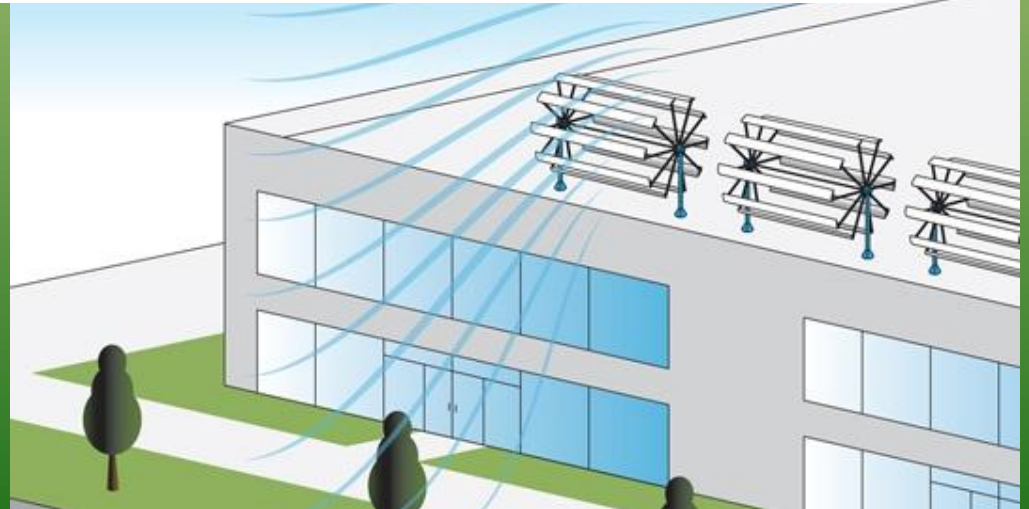




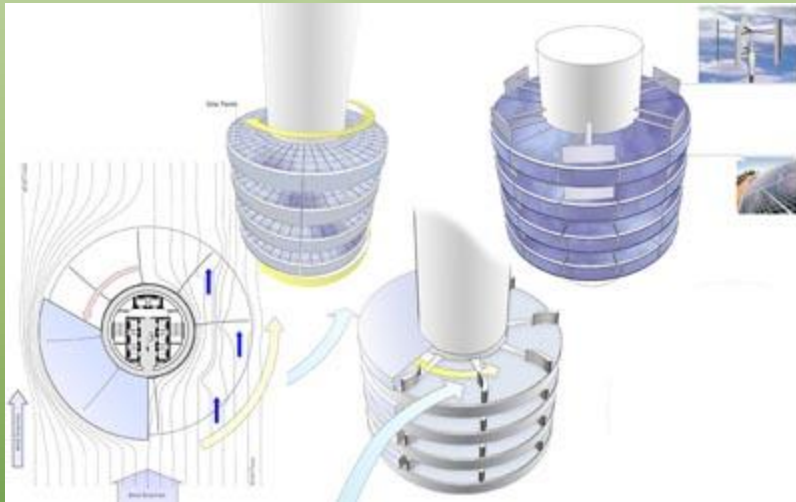
# AeroCam Wind Turbines



**BROADSTAR™**  
WIND SYSTEMS

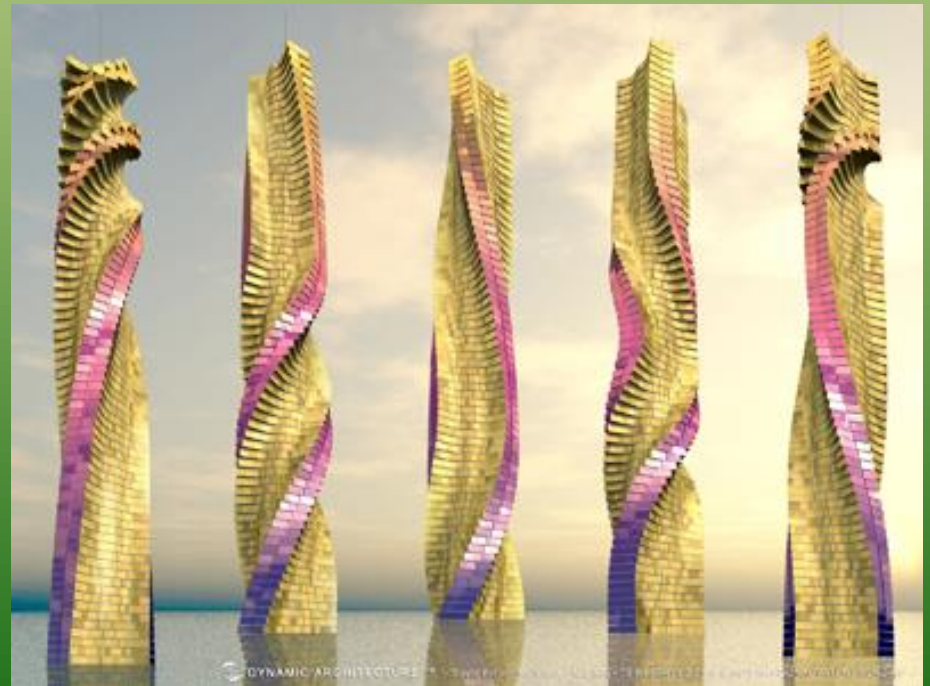


An 80-story building will have up to 79 wind turbines, making it a true green power plant.



A BUILDING IN MOTION

DYNAMIC ARCHITECTURE



# Michigan made Small Wind Turbines



Windspire  
Manistee, MI



Earthtronics/Honeywell  
Muskegon, MI



Swift

Cascade Engineering  
Grand Rapids, MI



# WEPOWER



# SOLAR ENERGY

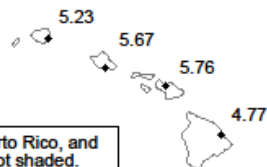


The amount of sunlight that hits the Earth's surface in one hour is enough to power the entire world for a year.

### Alaska

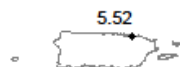


### Hawaii

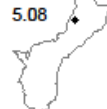


Hawaii, Puerto Rico, and Guam are not shaded.

### San Juan, PR

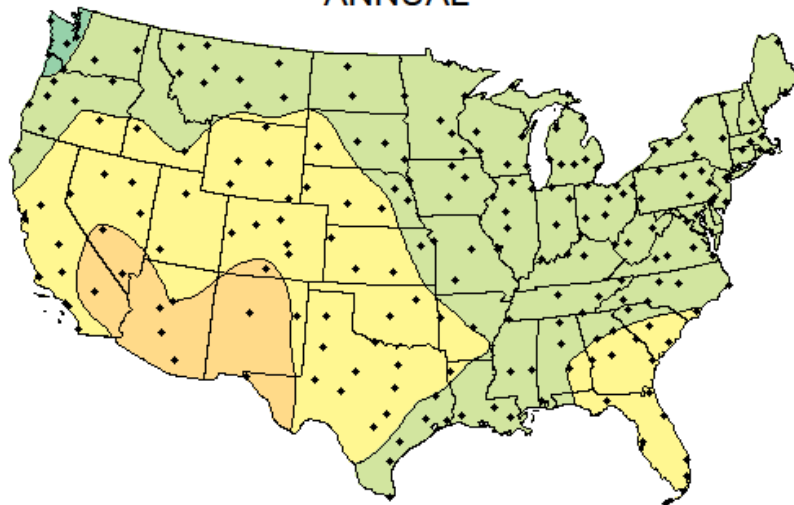


### Guam, PI



## Average Daily Solar Radiation Per Month

### ANNUAL



### Flat Plate Tilted South at Latitude

### Collector Orientation

Flat-plate collector facing south at 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 239 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.

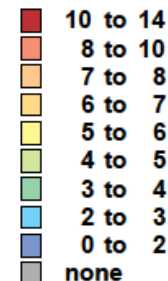
Though useful for identifying general trends, this map should be used with caution for site-specific resource evaluations because variations in solar radiation not reflected in the maps can exist, introducing uncertainty into resource estimates.

Maps are not drawn to scale.



National Renewable Energy Laboratory  
Resource Assessment Program

### kWh/m<sup>2</sup>/day



FLATA13-208

# Poly and Mono Crystalline Solar

Dow Corning HQ



MSU Recycling Center



# Schneider Pole Mount



# Northville Collision



Ballast Roof Mount

# Jonesville High School



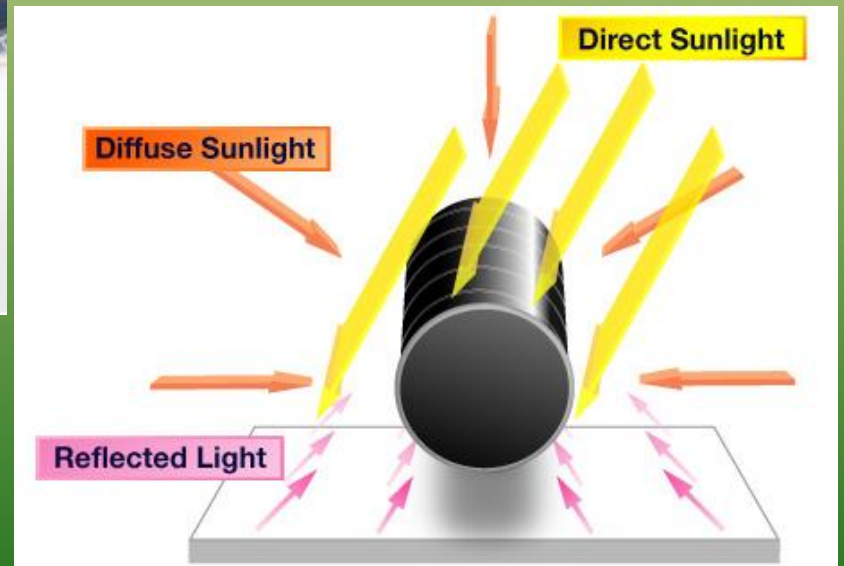
Wall Mount (Awning)



# Shingle Roof Mount



# SOLYNDRA CIRCULAR SOLAR MODULES



# Amorphous Thin Film Solar



- 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



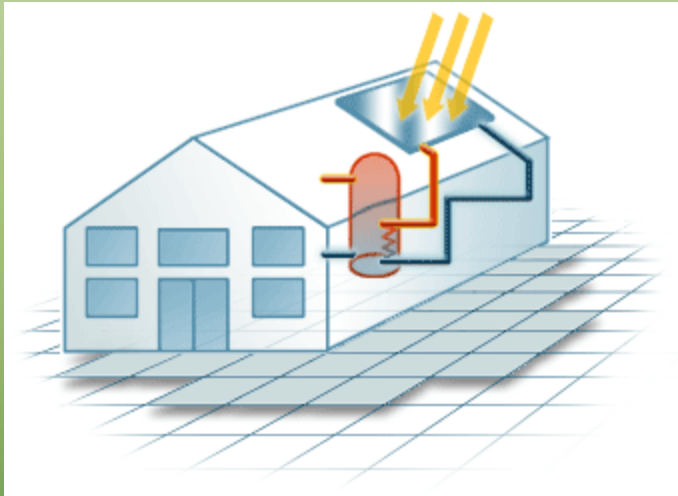
Luma Shingles



Transparent Solar

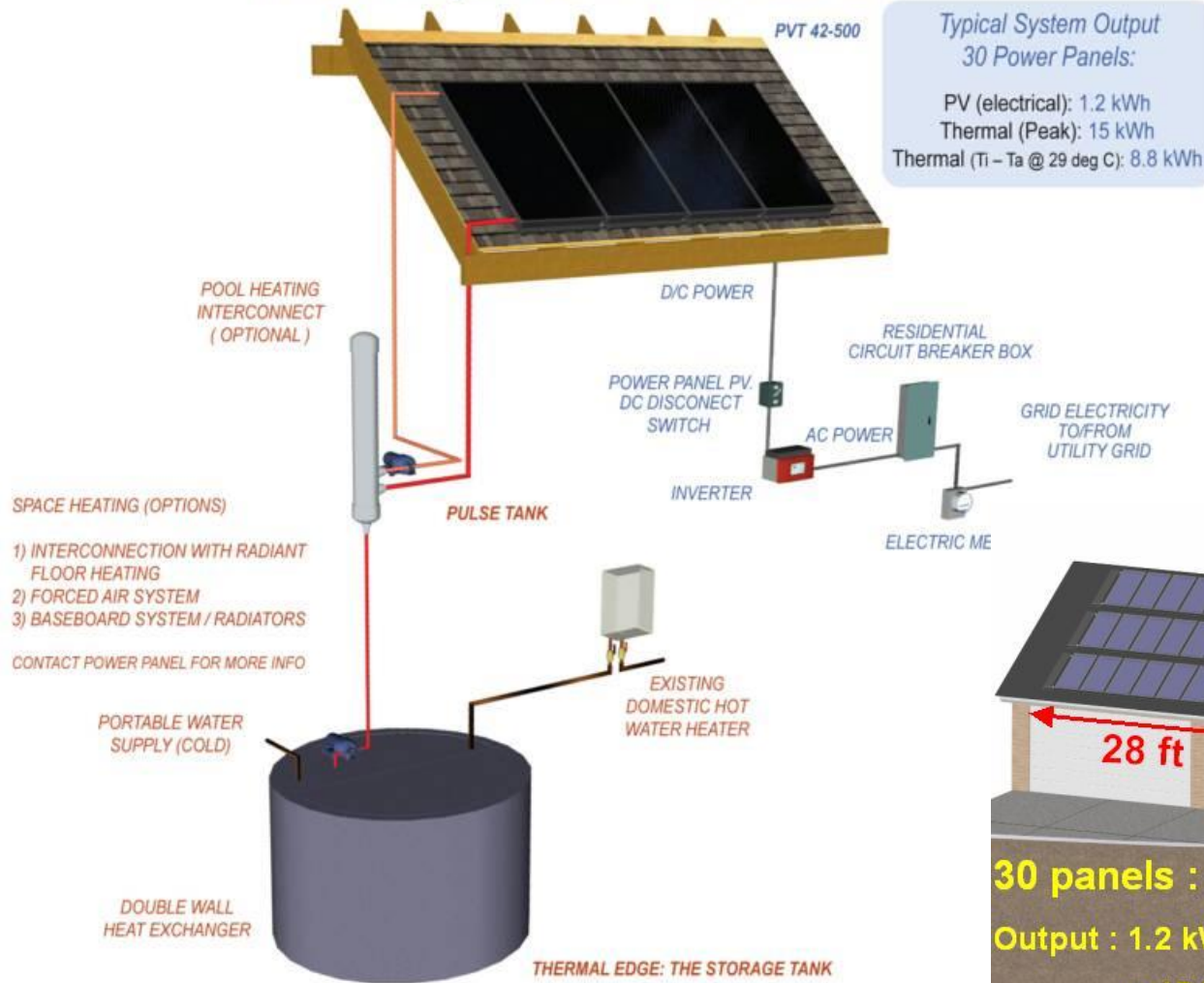


# Solar Thermal





## General Plumbing Schematic with Tankless Hot Water Heater

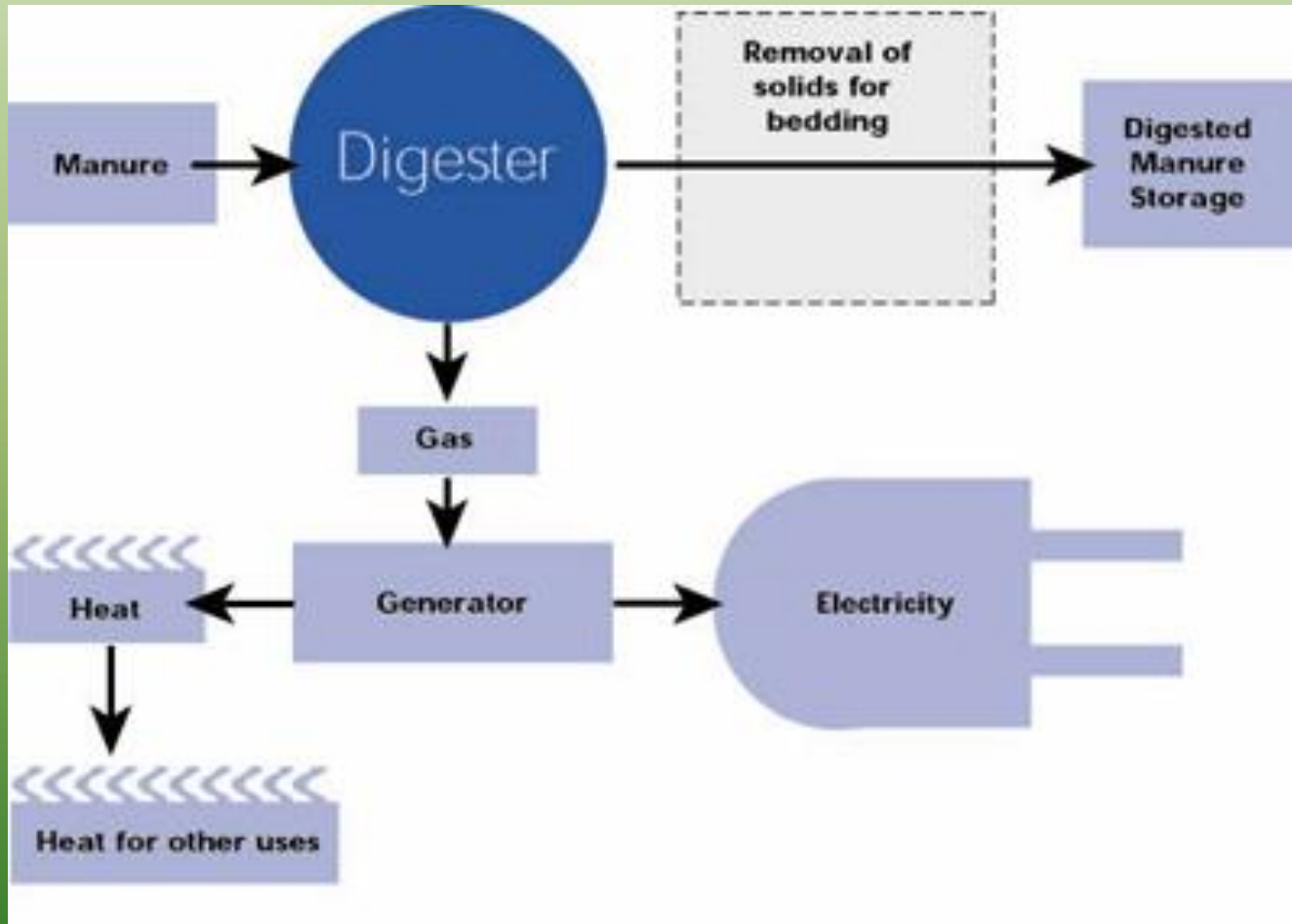


**POWER PANEL**

# 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



# 100 Degrees F to keep the bugs alive

Gas builds on top of the slurry





# Power to the grid – Natural Gas or Electricity



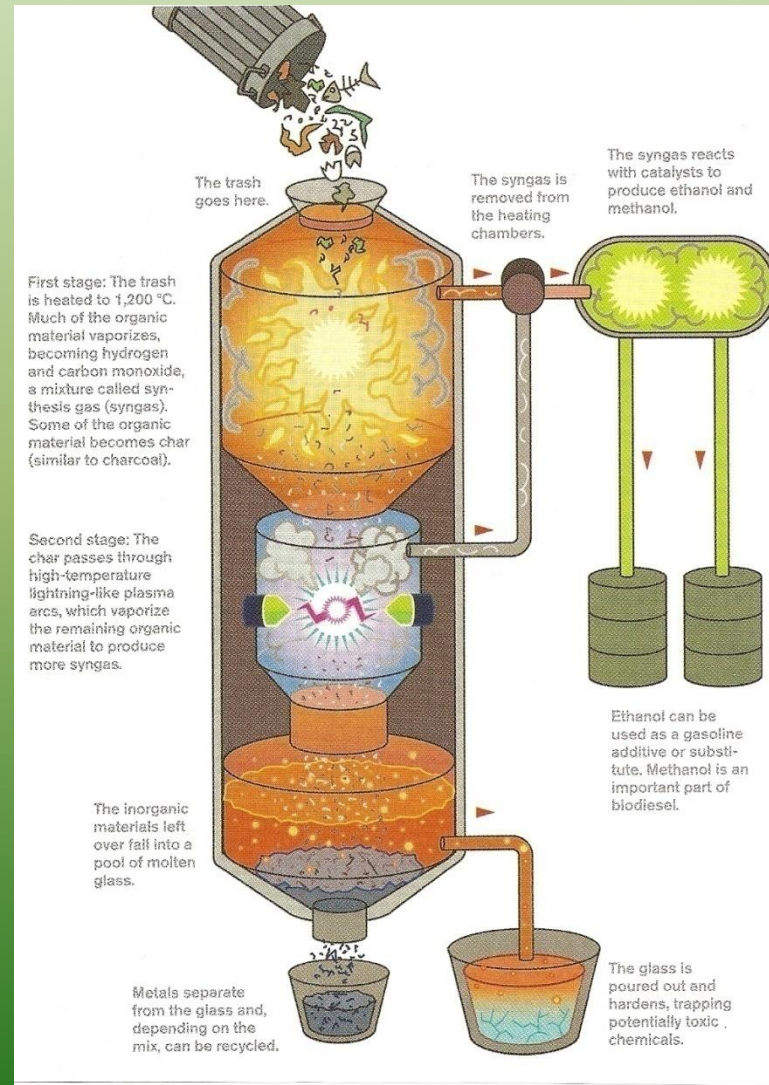
Gas Purification



Generator



# Garbage Power – Plasma Vaporization



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# **GEO THERMAL ENERGY**

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# SINGLE STRUCTURE GEOTHERMAL

## Geothermal Heat Pumps (GeoExchange Systems)

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Residential and commercial heating and cooling  
. . . without a geothermal reservoir

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

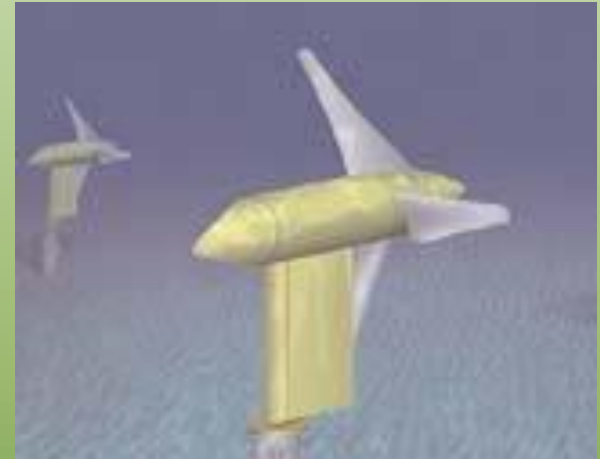


# Any moving water has the potential to make power



Wave Energy

Hydrokinetic  
Energy



Tidal Energy

Constructed  
Waterways





# Conventional Hydropower: Harnessing Rivers' Waterpower

**Reservoirs**



**Pumped  
Storage**



**Run-of-River**

# VAST HYDROPOWER POTENTIAL



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 4<sup>TH</sup> GREAT HUMAN REVOLUTION

1. AGRICULTURAL
2. INDUSTRIAL
3. INFORMATION
4. ENERGY AUTONOMY

**GO GREEN**



## MICHIGAN FARM ENERGY PROGRAM

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<http://maec.msu.edu/farmenergy>

