



MICHIGAN'S BIOENERGY SECTOR

Bioenergy plays a key role in increasing our state's energy independence and provides value added opportunities for existing Michigan businesses.

Bioenergy technologies transform renewable resources (biomass) into gaseous and liquid fuels, chemicals, electricity, and heat. Bioenergy has been produced at Michigan's paper mills, and wood-fired power plants for decades and corn ethanol production started in the early 2000s. In 2006, the state of Michigan and the Michigan Economic Development Corporation (MEDC) began to focus economic development efforts on diversification of the state's economy. These efforts were expected to leverage the state's competitive advantages—natural resources, workforce, rich engineering and manufacturing heritage—into new industries with the potential for significant growth. This led to a strategy to target four clean energy sectors: bioenergy, wind energy manufacturing, solar energy manufacturing, and advanced energy storage. Each of these sectors had potential for significant growth, could leverage state strengths, were generally not mature and had value chain gaps that could be strategically developed with economic assistance.

Over the last four years, our bioenergy sector development efforts have focused on actively developing the bioenergy value chain, enabling and accelerating production of second generation, non-food based biofuels, improving efficiencies of thermochemical and biomass supply technologies, and value-added bioenergy waste-to-energy solutions for existing Michigan businesses. These efforts are promoting the sustainable production of bioenergy from renewable sources that will reduce our dependence on and consumption of oil and coal.

ASSETS, OPPORTUNITIES AND MARKET FACTORS

Our state's biomass assets are the foundation for the sustainable development of Michigan's bioenergy sector.

Biomass assets include agricultural residues, municipal waste streams, and sustainable unutilized forest growth and logging residues, with forest growth-to-removal ratios exceeding other regions in the country including the U.S. South. Michigan's bioenergy development is also supported by our state's world class universities, an urgency to diversify our economy, and opportunities to implement bioenergy technologies that add value to existing Michigan businesses by reducing operational costs, adding new revenue sources, and making existing businesses more cost effective and competitive.

The financial and economic crisis resulted in global energy demand falling significantly in 2009 for the first time since 1981. Global energy demand is however forecasted to resume a long-term upward trend once the economic recovery gains momentum, increasing 40 percent over 2007 by 2030 (World Energy Outlook—IEA 2009). Crude oil prices in 2008 dropped from over \$90/barrel in 2008 to under \$45/barrel in 2009 (IOGA 2009). Resulting petroleum price volatility, global recession and over capacity of production have tempered biofuel investment excitement, but the combined biodiesel and ethanol markets are expected to reach \$247 billion in sales in 2020, up from \$76 billion in 2010 (Pike Research 2009). Biofuel investments will lean towards second and third generation biofuel production from non-food biomass feedstock. It is expected that government policies and grant opportunities will support and foster this forecasted trend.

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BIOENERGY VALUE CHAIN

Multiple bioenergy production chains result from the wide range of biomass feedstocks (e.g. wood, grass, oil, starch, fat, waste water, solid waste, etc.), variety of conversion processes, and range of possible end-uses.

In general the bioenergy value chain converts biomass feedstock supplies via biochemical or thermochemical pathways into products that are distributed to market (See Figure 1).

Biomass supply, the combustion portion of the thermochemical pathway, and distribution to market utilize already commercialized technologies. Along the biochemical pathway, corn ethanol and biodiesel production are examples of commercialized first

generation biofuel technologies, while value chain gaps exist in commercial scale second and third generation biofuel production. Significant opportunities also exist to improve efficiencies throughout the bioenergy value chain, especially in the biomass-to-facility gate portion of the value chain that can also benefit existing agriculture and forest biomass based businesses.

Michigan's Bioenergy Facilities

Bioenergy facilities are located throughout the state and can be categorized into several facility types: combined heat and power, wood-fired power plants, cellulosic ethanol, biochemicals, corn ethanol, anaerobic digesters, gasification systems, and pellet producers (See next page.)

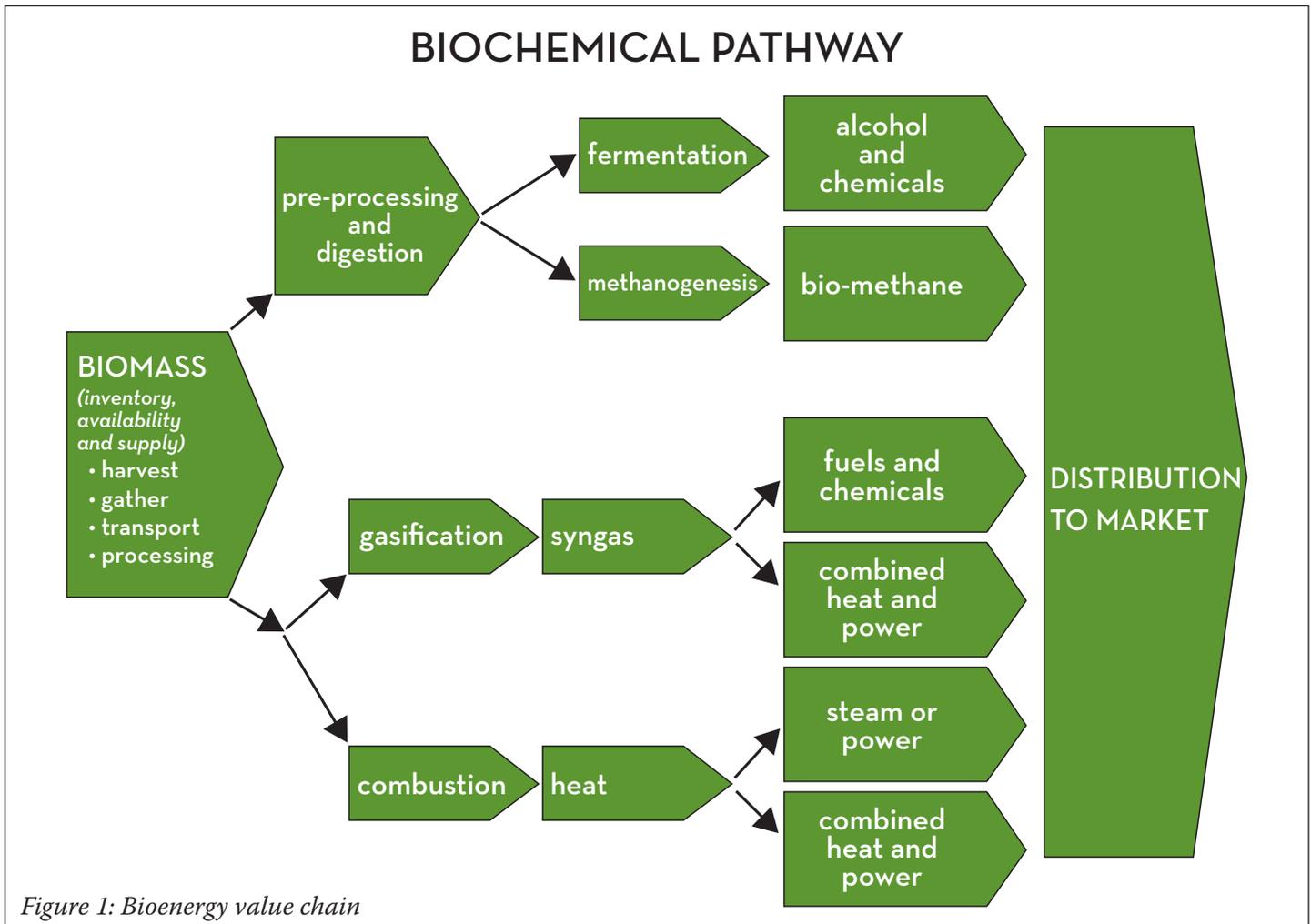
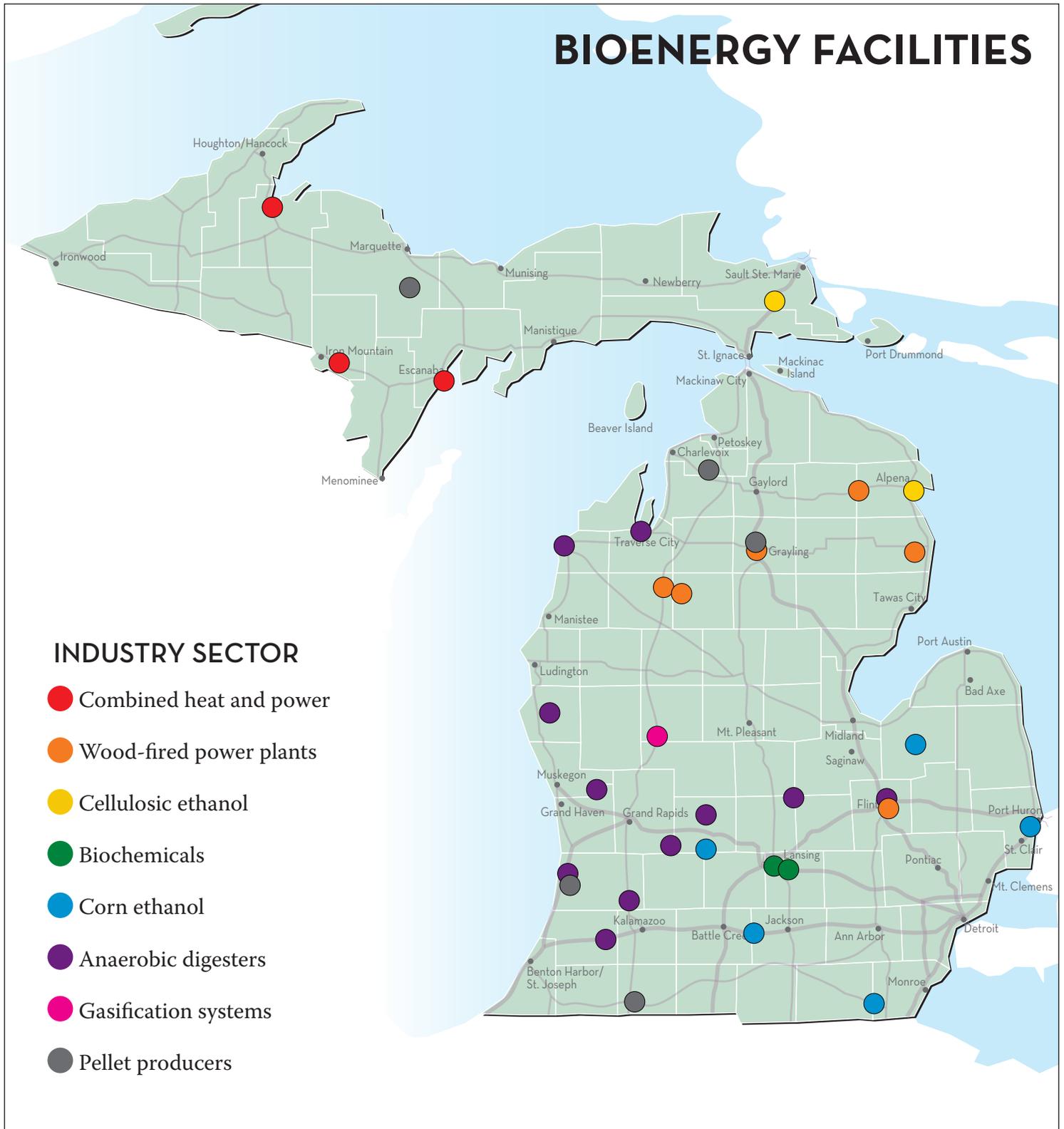


Figure 1: Bioenergy value chain

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BIOENERGY FACILITIES

● Combined Heat and Power

L'Anse Warden Electric Company	L'Anse
NewPage Corporation	Escanaba
Verso Paper	Quinnesec

● Wood-Fired Power Plants

Cadillac Renewable Energy	Cadillac
Genesse Power Station	Flint
Grayling Generating Station	Grayling
Hillman Power Company	Hillman
Lincoln Power Station	Lincoln
McBain Power Station	McBain

● Cellulosic Ethanol

American Process, Inc.	Alpena
Frontier Renewable Resources	Kinross

● Biochemicals

Draths Corporation	Okemos
Working Bugs	East Lansing

● Corn Ethanol

Global Ethanol	Riga
Marysville Ethanol LLC	Marysville
POET Biorefining	Caro
The Andersons Ethanol LLC	Albion
U.S. Bio	Woodbury

● Anaerobic Digesters

Cherry Central Co-op	Traverse City
Coca-Cola/Minute Maid	Paw Paw
DenDulk's Willow Point Dairy	Ionia
DenDulk's Ravenna Dairy	Ravenna
Geerling Hillside Farms/Scenic View Dairy	Fennville
Geerling's Hillside Farms	Freeport
Graceland Fruit	Frankfort
Green Meadows Dairy	Elsie
Oceana Food	Shelby
Packerland Meat Packing Facility	Plainwell
Swedish Biogas International	Flint

● Gasification Systems

Sietsema Farm Feeds/Heat Transfer Intl.	Howard City
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● Pellet Producers

Fiber By-Products, Corp.	White Pigeon
Kirtland Products	Boyer City
Michigan Wood Pellet Fuel LLC	Grayling
Michigan Wood Pellet Fuel LLC	Holland
Renewafuel	Gwinn