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Farm-to-Factory:
Automotive Applications of Bio-based Materials in Michigan & Beyond

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GreenUp Conference

Ann Arbor, MI

4 November 2015

What Are Bio-Based Materials?

What Are Bio-Based Materials?

bio-based material

noun

1. Products made of substances derived from living organisms (renewable feedstocks) used to replace conventional (petroleum-based, mineral) materials.

2. Could include many common materials (e.g., wood and leather), but typically refers to other materials that have undergone extensive processing.

synonyms: biomaterial, bioplastic, biocomposite, biofoam, natural fibers

Photos from www.autoblog.com

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What Are Bio-Based Materials?

Natural Fibers:

- Flax
- Hemp
- Sissal
- Kenaf
- Wheat straw

Replace:

- Fiberglass
- Talc

Become Fillers and Reinforcements in:

- Interior door panels & storage bins
- Trim
- Package trays
- Seatbacks
- Engine covers

Bio-based Polymers:

- Soybeans
- Corn
- Castor beans
- Sweet potatoes

Replace:

- Petroleum-Based Polymers

Become Foams and Composites:

- Foam seating
- Headliners
- Seat frames
- Floor mats

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In the News and on Store Shelves

Toys

Food & Drink Containers

Kitchen Products

Packaging

Photos from LEGO, Coke, Heinz, Architec, GreenCell Foam, and Landaal Packaging

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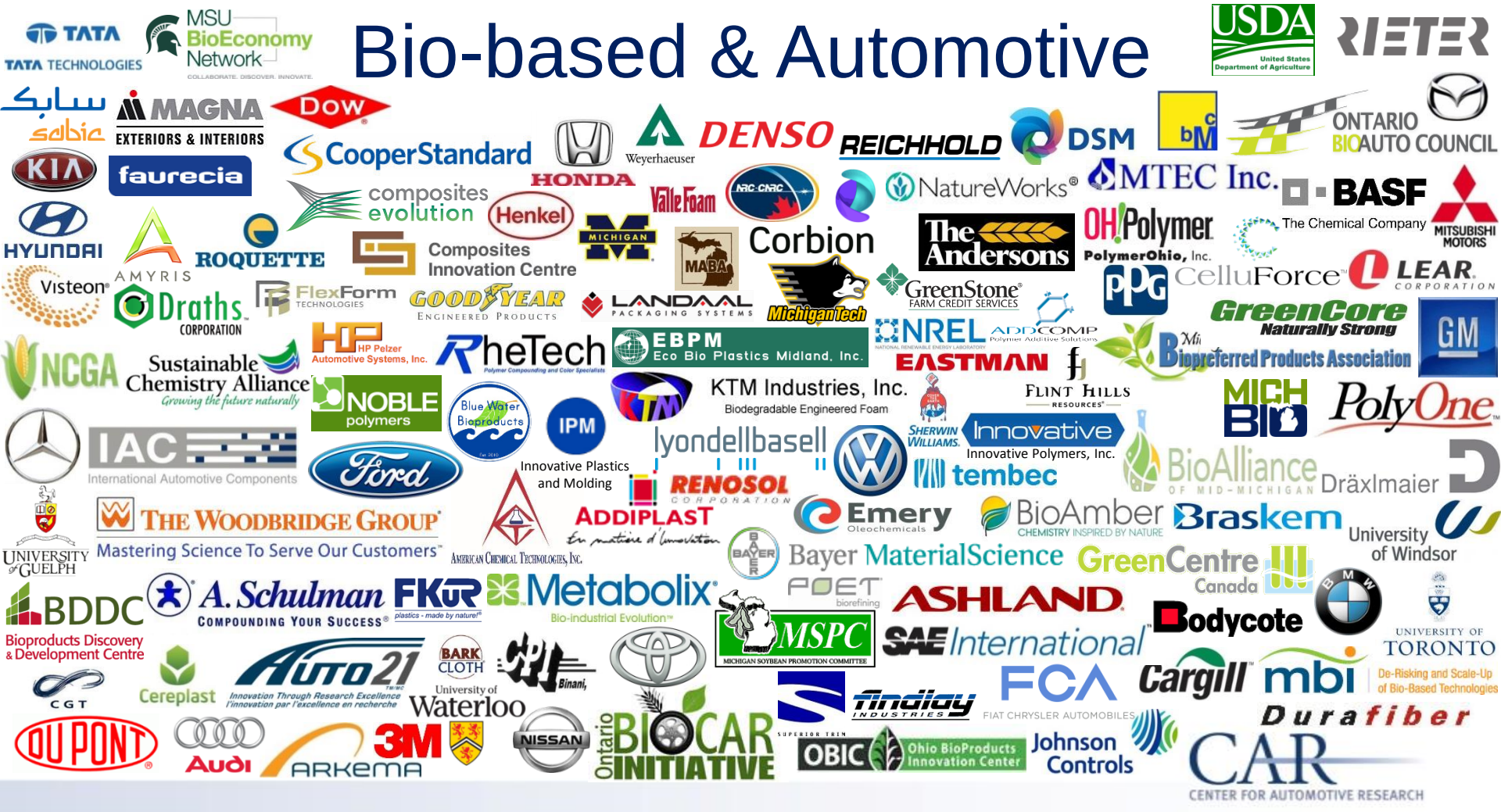
Bio-based & Automotive



Bio-based Materials Research at CAR

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Bio-Based Materials Project Details

- Make it in America Challenge
- Project Partners
  - National Center for Manufacturing Sciences
  - Michigan Manufacturing Technology Center
  - Macomb/St. Clair Workforce Development Board
  - Macomb Community College
- Three year program
  - October 2013 - September 2016

NCMS
NATIONAL CENTER FOR MANUFACTURING SCIENCES

Macomb Community College
Education • Enrichment • Economic Development
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MMTC
A NIST MEP NETWORK AFFILIATE

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Bio-Based Materials Project Goals

- Build employment and facilitate new investment in bio-based materials manufacturing
- Identify and meet with stakeholders involved in the bio-based materials space
- Create a roadmap report describing gaps and opportunities to make products commercialization-ready

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Automotive Usage

Bio-based Automotive History

- Early 1900s: Bakelite distributor caps, straw-reinforced Model-T steering wheel
- 1930s: Parts using soybeans, hemp, wood pulp, cotton, flax, and ramie fiber
- 1940s: Soybean car
- 1990s: Bio-based materials gain traction

Ford's 1941 Soybean Car

Photos from www.thehenryford.org

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Selected Vehicles Made in Michigan

	Company	Model	Feedstock	Application	Plant
	FCA	Dodge Viper	Natural fibers	Door panels, center console	Conner Ave
	FCA	Jeep Grand Cherokee	Natural fibers	Door panels	Jefferson North
	Ford	Ford F-150	Soy, rice hulls	Foam seating, wire harness bracket	Dearborn Truck
	Ford	Ford Focus	Soy, castor, kenaf, coconut fiber	Foam seating, instrument panel, interior door panel, loadfloor	Michigan
	Ford	Ford Fusion	Soy	Seating headrests	Flat Rock
	Ford	Ford Mustang	Soy	Foam seating	Flat Rock
	GM	Chevrolet Impala	Flax	Trim, rear shelf	Hamtramck
	GM	Chevrolet Volt	Soy	Foam seating	Hamtramck

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Why Michigan?

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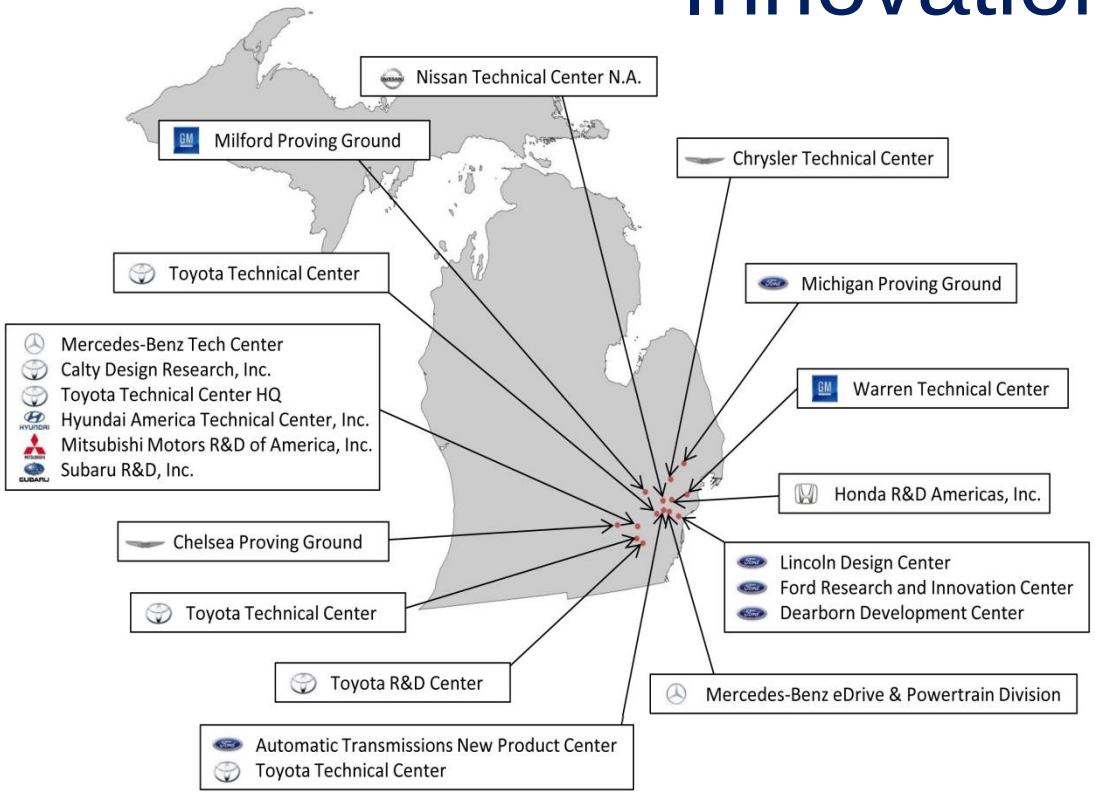
Michigan as the Hub of Automotive Innovation



- More than 350 automotive research and development (R&D) facilities
- Responsible for ≈75% of U.S. automotive R&D spending

Sources: CAR Research 2015, NSF 2014

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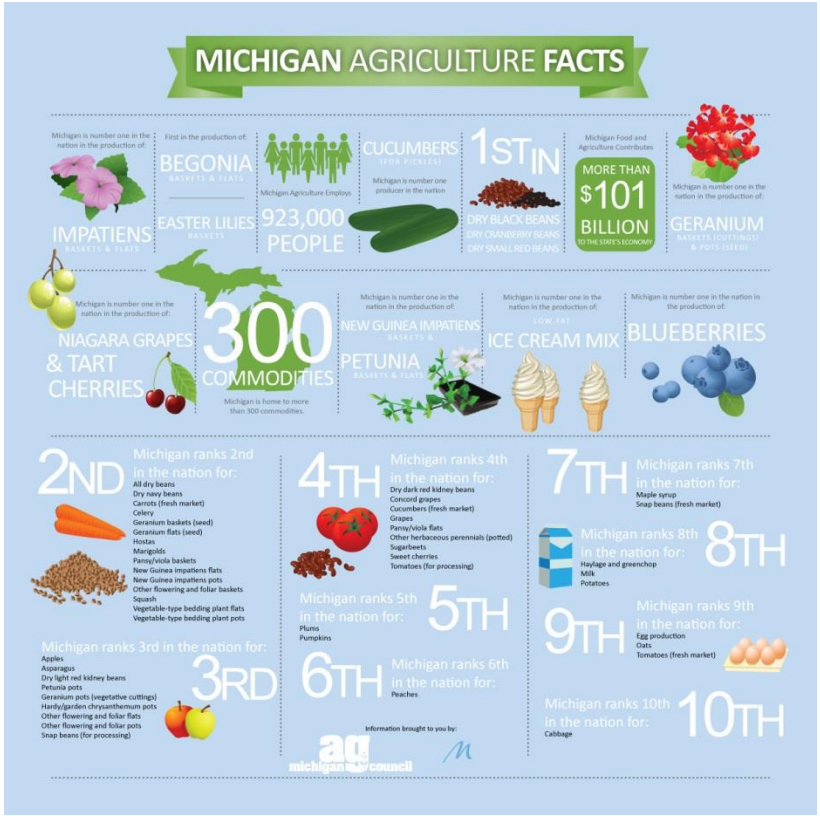
Michigan Agriculture by the Numbers



- 54,900 farms in Michigan
- 10 million acres of farmland
- >$100 billion in annual economic activity
- >300 commercially produced agricultural commodities
  - Top Producer of 18 commodities
  - Ranks in top 10 for 56 other commodities

Sources: MI Ag Council 2013, MDARD 2012, and MSU Product Center 2014

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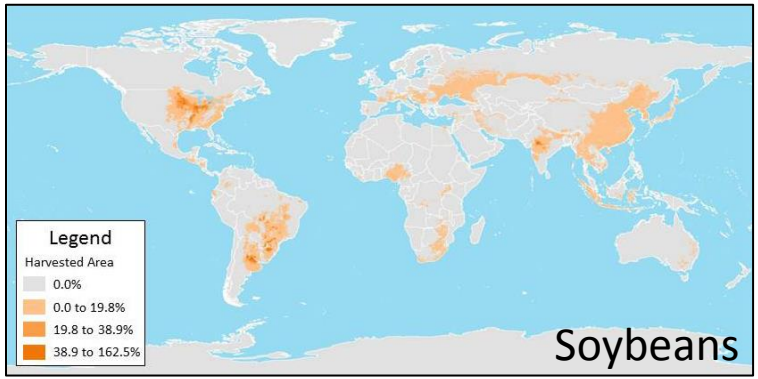
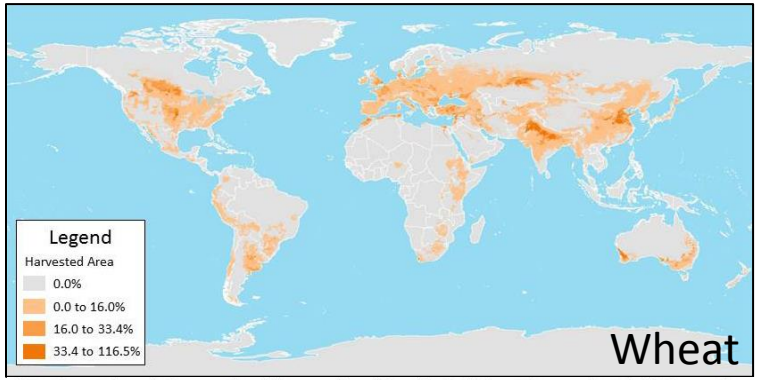
Feedstock Geography





Note, harvested area is the proportion of the proportion of the grid cell which contains areas planted with the crop; the harvested area may be greater than 100% because of multiple cropping.

North America

- Soybeans, corn, wheat, cotton, wood
- United States is the largest oil crop producer

Other Regions

- Castor beans, sugar cane, bast fibers, leaf fibers

Developing Local Crops

- Testing of fiber crops in North America
- Properties change with geography, climate
- Sustainability aspect related to distance traveled

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Commercialization

Case Studies

1. Ford Flex Wheat Straw-Reinforced Storage Bin
2. Toyota Camry Castor-Based Radiator End Tank
3. Ontario BioAuto Council Commercialization Fund

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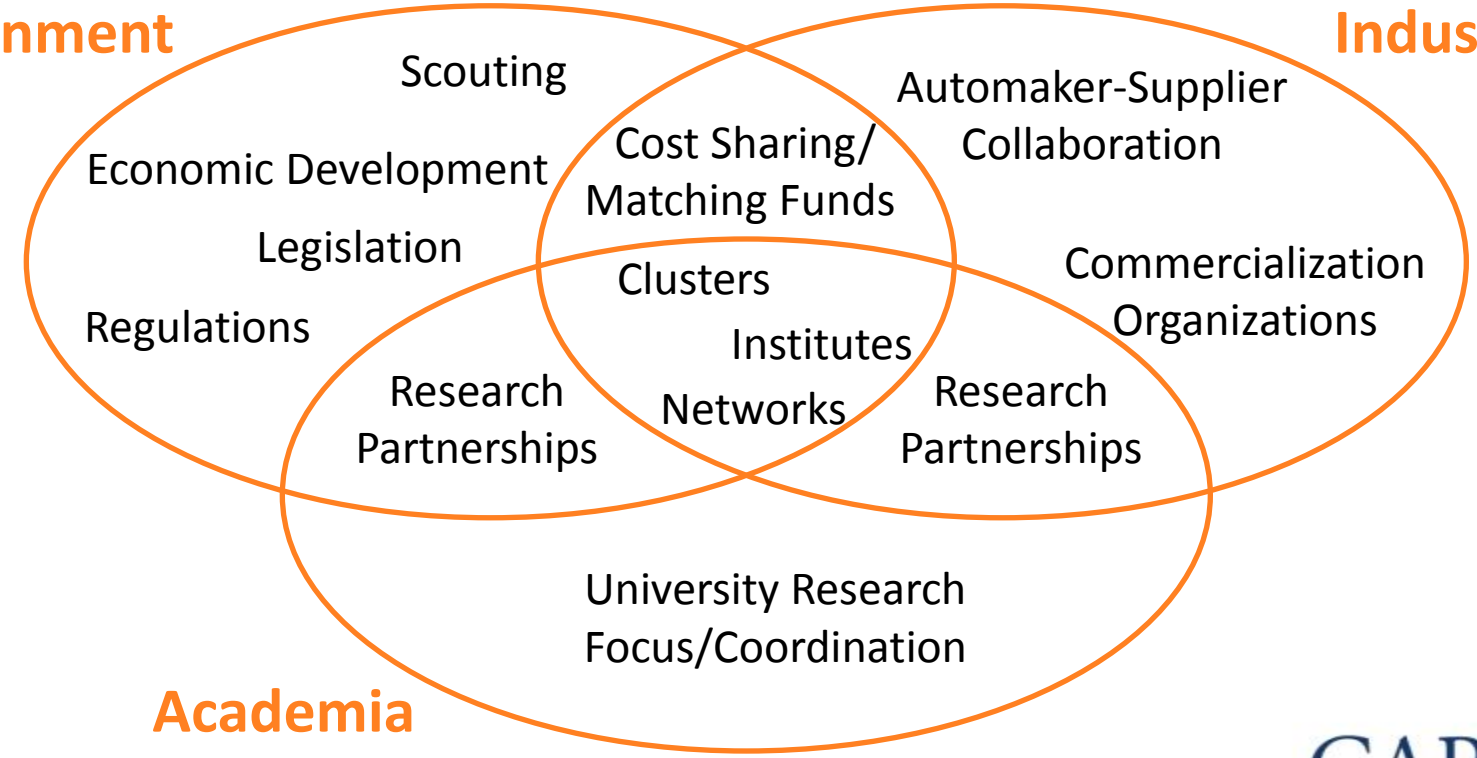
Commercialization Pathways



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Existing Efforts and Future Opportunities

Michigan Forest Biomaterials Initiative (MiFBI)

Center for Bioplastics and Biocomposites (CB^2)

USDA-led Manufacturing Innovation Institutes

Biomanufacturing

Nanocellulosics

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Commercialization Challenges

- Changes
  - Material Properties
  - Manufacturing Processes
- Approval Process
  - New Failure Modes
- Cost
  - Scale
  - Feedstock
- Supply Chain
  - Single Source

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Initial Conclusions

- Bio-based materials are not poised to take over auto industry
  - Low petroleum/natural gas prices
  - Barriers to entry in automotive
- **Yet these materials are not going away…**
  - New materials
  - New applications

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