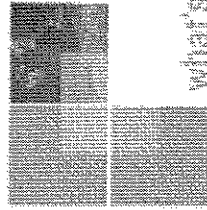




NEXTE[★]ENERGY

————— Economic Security through Energy Diversity



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NextEnergy Overview

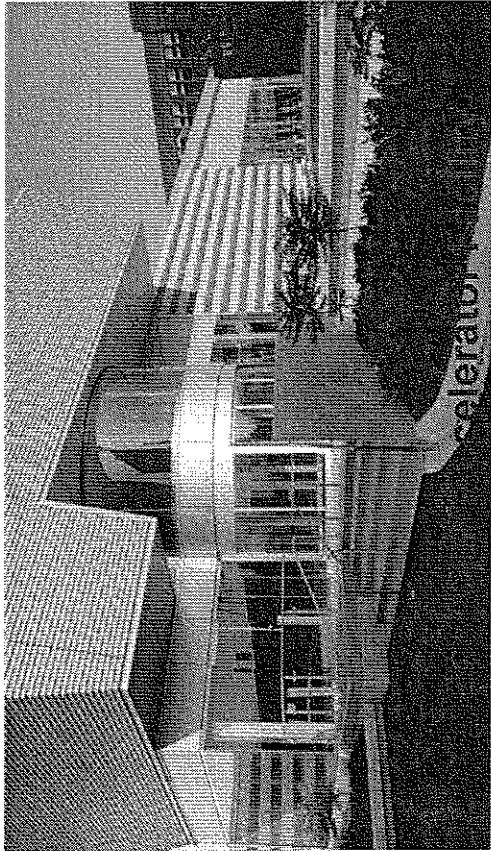
Who we are:

- Non-profit corporation dedicated to the advancement of the alternative energy industry in Michigan.

Mission:

- To enable the commercialization of energy technologies that positively contribute to economic competitiveness, energy security, and the environment.

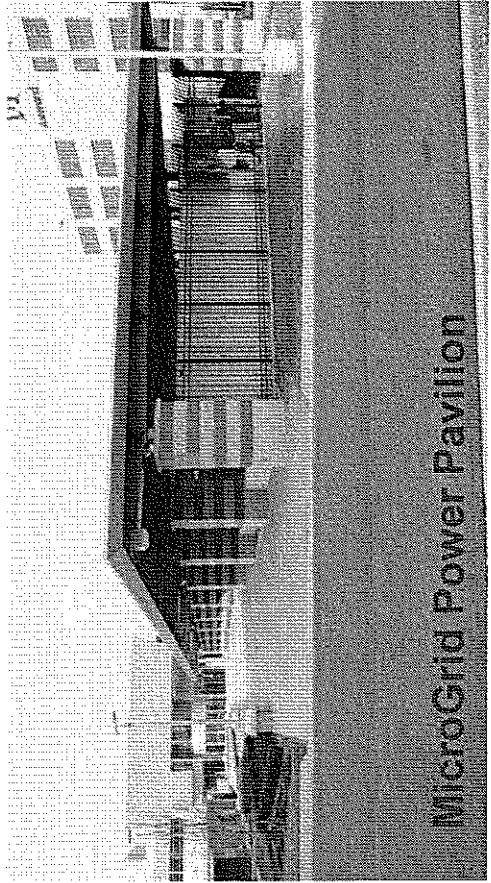
NextEnergy Physical Infrastructure



MicroGrid Power Pavilion



Alternative Fuels Platform

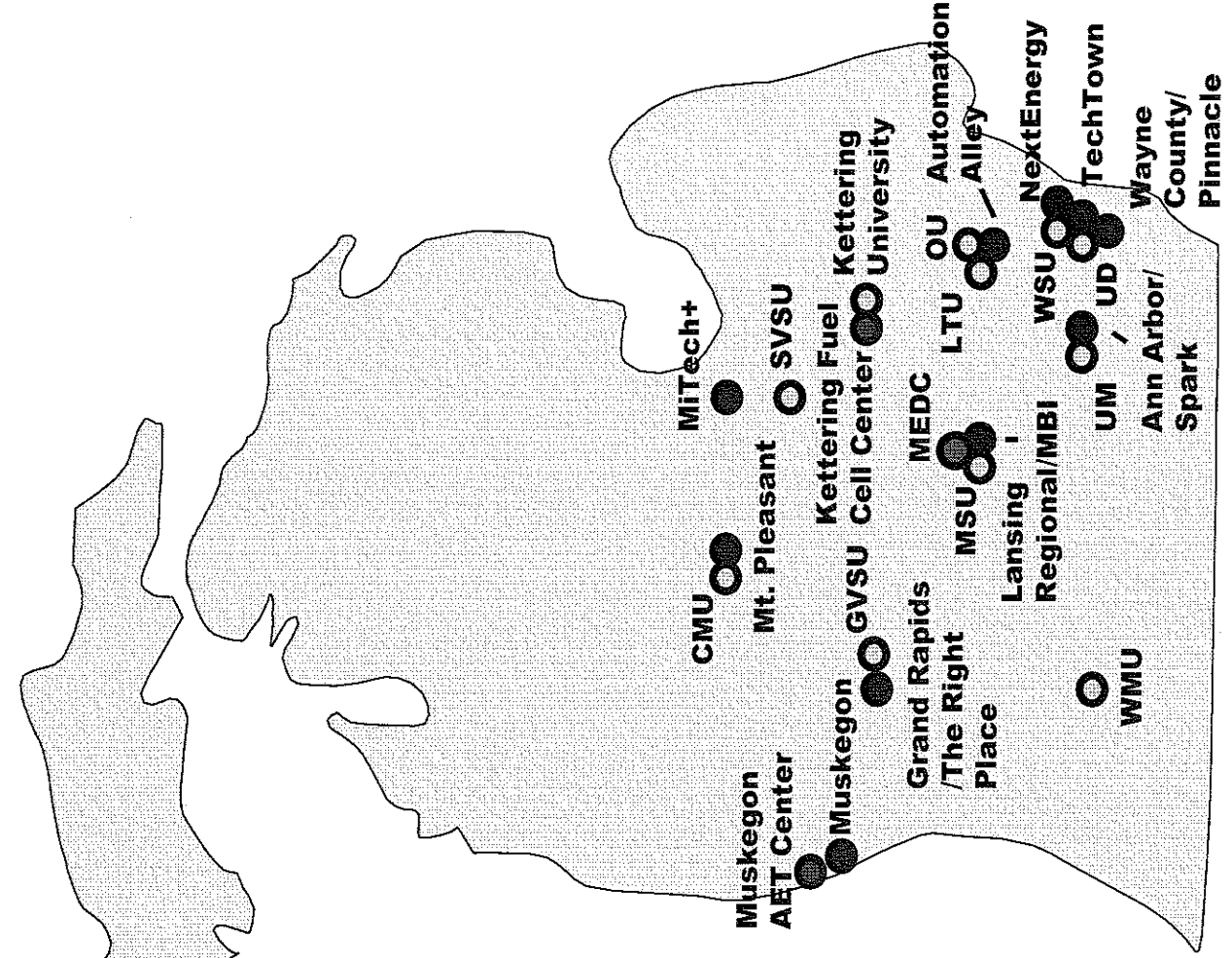


Research Labs

NEXTENERGY

Enabling Security through Energy Diversity

NextEnergy AET Support Network: Collaborators



Program Collaborators

- Dedicated AET Research Centers
- Smartzones and Other Economic Development Organizations
- Universities
- MEDC

* Enabled through Michigan's 21st Century Jobs Fund initiative

Michigan's Alternative Energy Destiny: Challenges and Opportunities

MEDA Conference

August 6, 2008

Dan Radomski
VP Industry Services
NextEnergy

NEXTENERGY
Economic Security through Energy Diversity

Contents

- The Focus Areas (for Michigan)
- The Potential
- The Constraints
- The Collaborators
- Summary and Conclusions

AET Market Focus

- **4 Strong Emerging Market Segments**

- Biomass to Energy
- Solar Thermal and Photovoltaic
- Advanced Batteries for Hybrid Electric Vehicles
- Large (Utility Scale) Wind Turbines

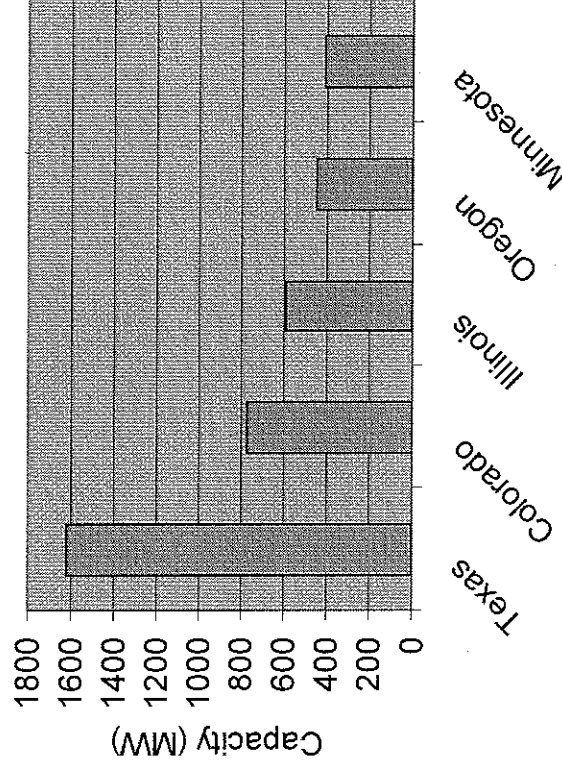
- All growing rapidly
- All have “anchor” companies to build off of
- Exploit Michigan’s manufacturing supply chain
- Exploit Michigan’s natural resource advantages

Large Wind: 2007 US Market Demand

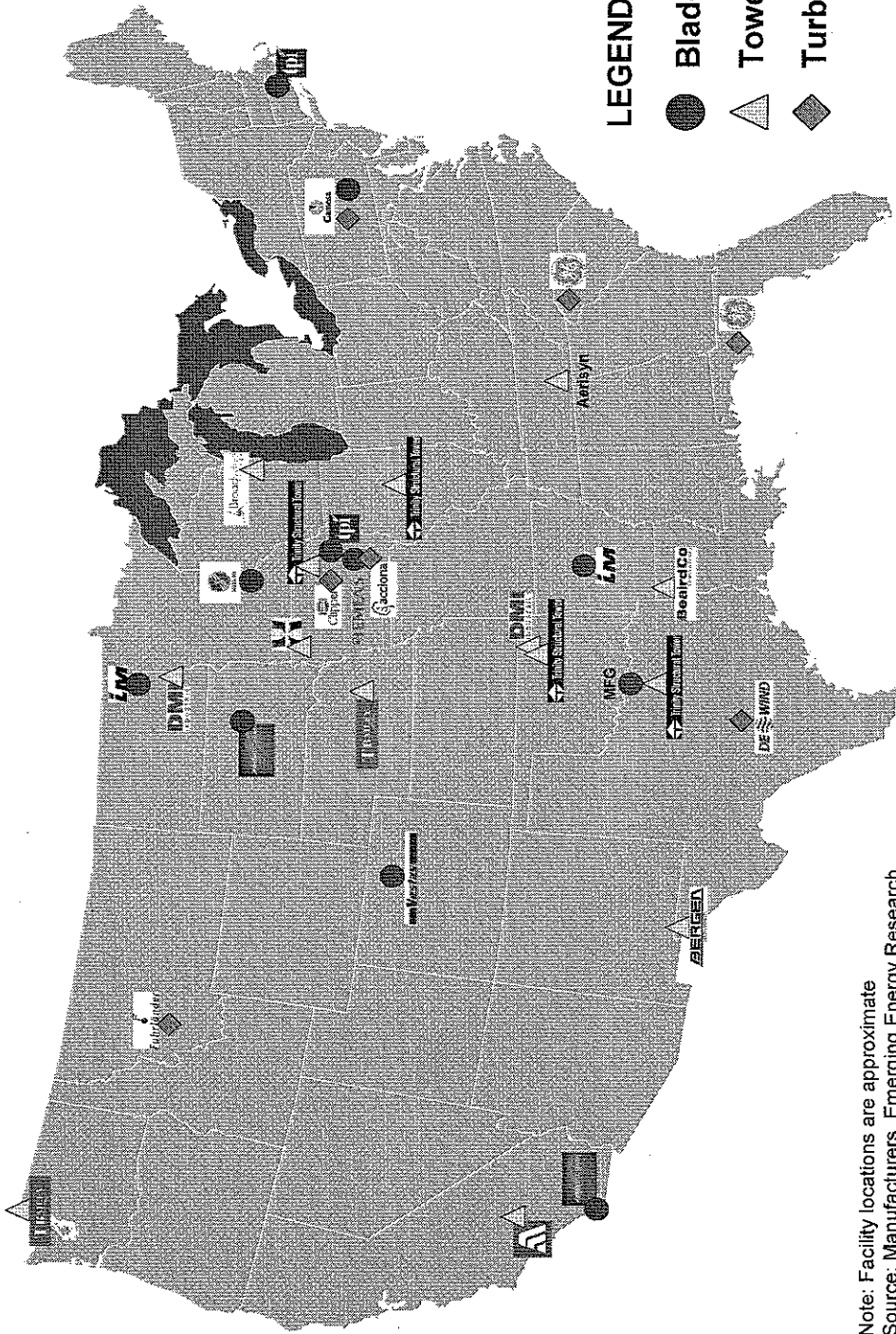
US Demand

- US is fastest global market (5,244 new MW of wind)
- 45% growth in 2007
- In 2007, Texas was state with most capacity (4,356 MW) and most growth (1618 MW)
- 6 states account for nearly 70% total US capacity (TX, CA, MN, IA, WA, CO)
- US DOE targeting 20% load by 2030
 - 350,000MW of new wind power (approx 175,000 turbines)

Top Five States in Terms of New Capacity in 2007



US Wind Turbine Supply Chain Large-Scale US Wind Turbine Supply Chain Investments as of Q1 2008



LEGEND:

- Blade Manufacturing
- △ Tower Fabrication
- ◆ Turbine Assembly

Note: Facility locations are approximate
Source: Manufacturers, Emerging Energy Research

Recent investments in US supply chain have created wind turbine manufacturing "corridor" running from Texas through upper Midwest, with Iowa as hub

US Wind Turbine Supply Chain
 US Wind Turbine Component Investment Potential through 2020 (est.)

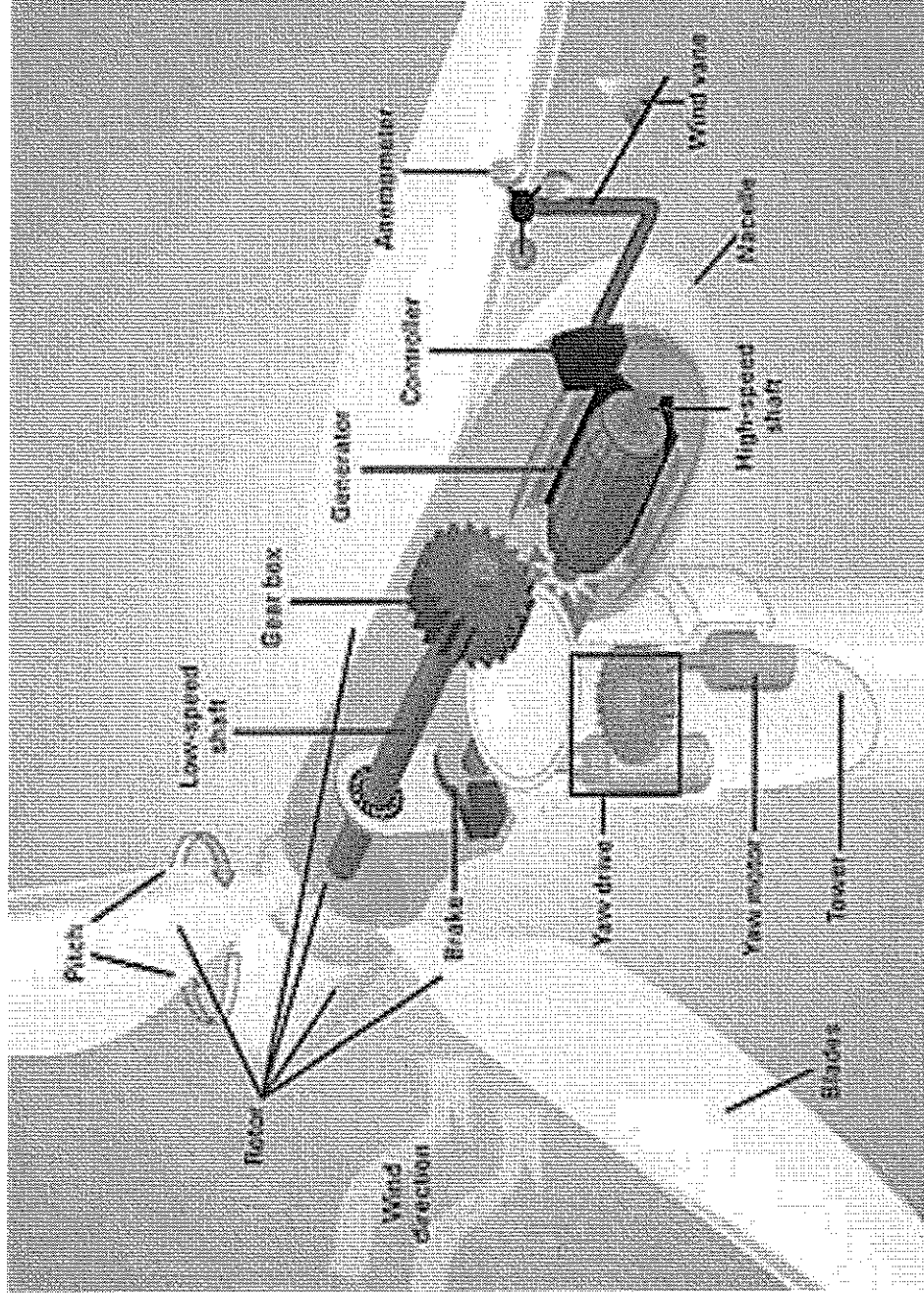
Wind Turbine Component	Investment Potential Through 2020, US (US\$ billion)*	Investment Potential Through 2020, Global (US\$ billion)*
Rotor Blades	\$23-\$27	\$121-\$139
Gearbox	\$13-\$16	\$66-\$85
Generator	\$3.5-\$6.0	\$18-\$30
Bearings (Pitch, Yaw)	\$2.5-\$5.0	\$12-\$24
Tower	\$29-\$33	\$151-\$169
Power Converter	\$4.5-\$7.0	\$24-\$36

Note: *Calculations include key assumptions regarding future trends in turbine pricing; vertical integration through the supply chain; and future trends in average wind turbine model size
 Source: Suppliers, Emerging Energy Research

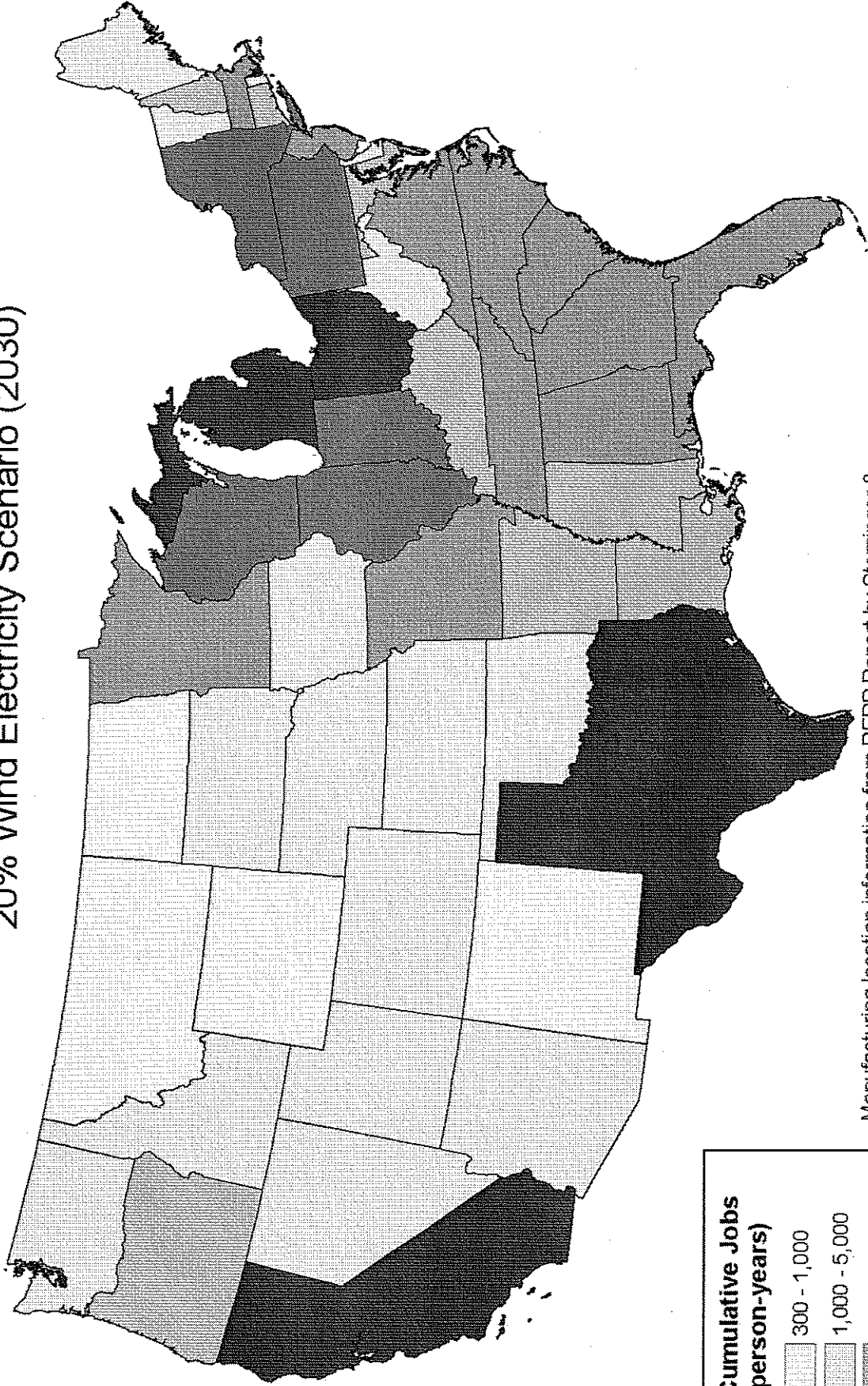
With hundreds of billions expected to be spent on wind turbines globally through 2020, significant investment potential exists throughout component supply chain

Wind Components

There are approximately 8,000 components in a wind turbine design!



New Manufacturing Employment Resulting From 20% Wind Electricity Scenario (2030)



**Cumulative Jobs
(person-years)**

- 300 - 1,000
- 1,000 - 5,000
- 5,000 - 10,000
- 10,000 - 20,000
- 20,000 - 30,000
- > 30,000

Manufacturing location information from REPP Report by Sterzinger & Svroek (2004)

Major component assumptions: 50% of blades are manufactured in U.S. in 2007 increasing to 80% by 2030, 26% of towers are from the U.S. in 2007 increasing to 50% by 2030 and 20% of turbines are

Manufacturing Potential to Serve U.S. Growth in Renewables (Michigan)*

Michigan	# U. S. MW	Number of Firms	Millions \$ Investment	New FTE Jobs
Wind	124,900	967	\$3,453	24,350
Solar	23,150	360	\$1,256	6,644
Geothermal	15,190	129	\$272	1,502
Biomass	21,760	594	\$349	2,281
Total:	185,000	2,050	\$5,328	34,777

* Assumes 18,500 installed per year for 10 years in U.S.
("Climate Stabilization Case", REPP, 11/06)

Incremental Investment and Job Potential by County – Top 10 (1)

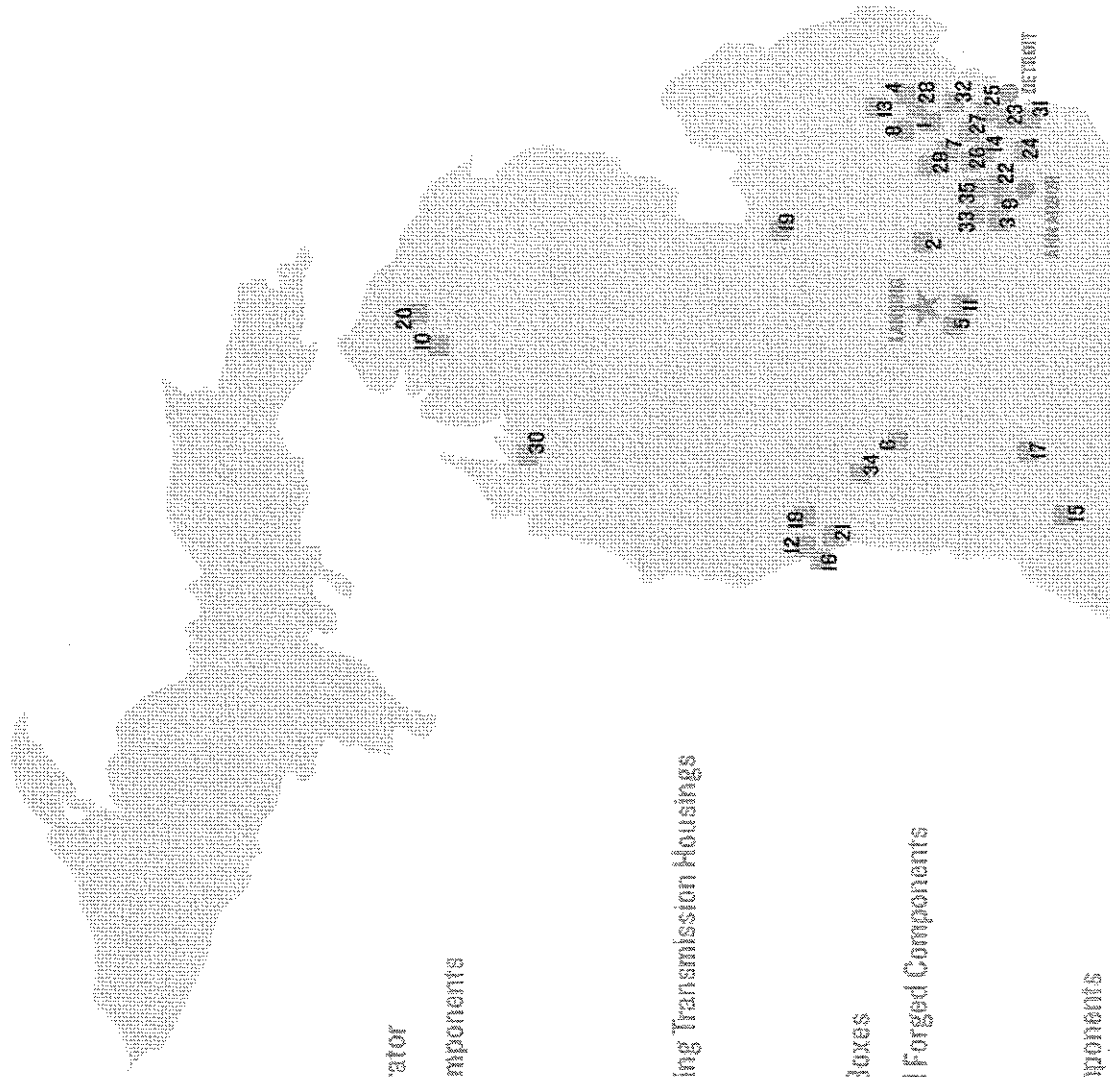
	<u>New Investment</u> (millions)	<u>Jobs</u>
Wayne	\$557	3,431
Kent	\$514	3,575
Oakland	\$480	3,063
Macomb	\$465	3,227
Grand	\$439	2,999
Monroe	\$396	1,693
Saginaw	\$180	1,197
Muskegon	\$176	1,195
Berrien	\$139	923
Ottawa	<u>\$130</u>	<u>966</u>
Subtotal (10 counties)	\$3,476	22,269

(1) REPP/Detroit Economic Growth Corporation analysis, 11/06

Potential Michigan Suppliers to the Wind Industry

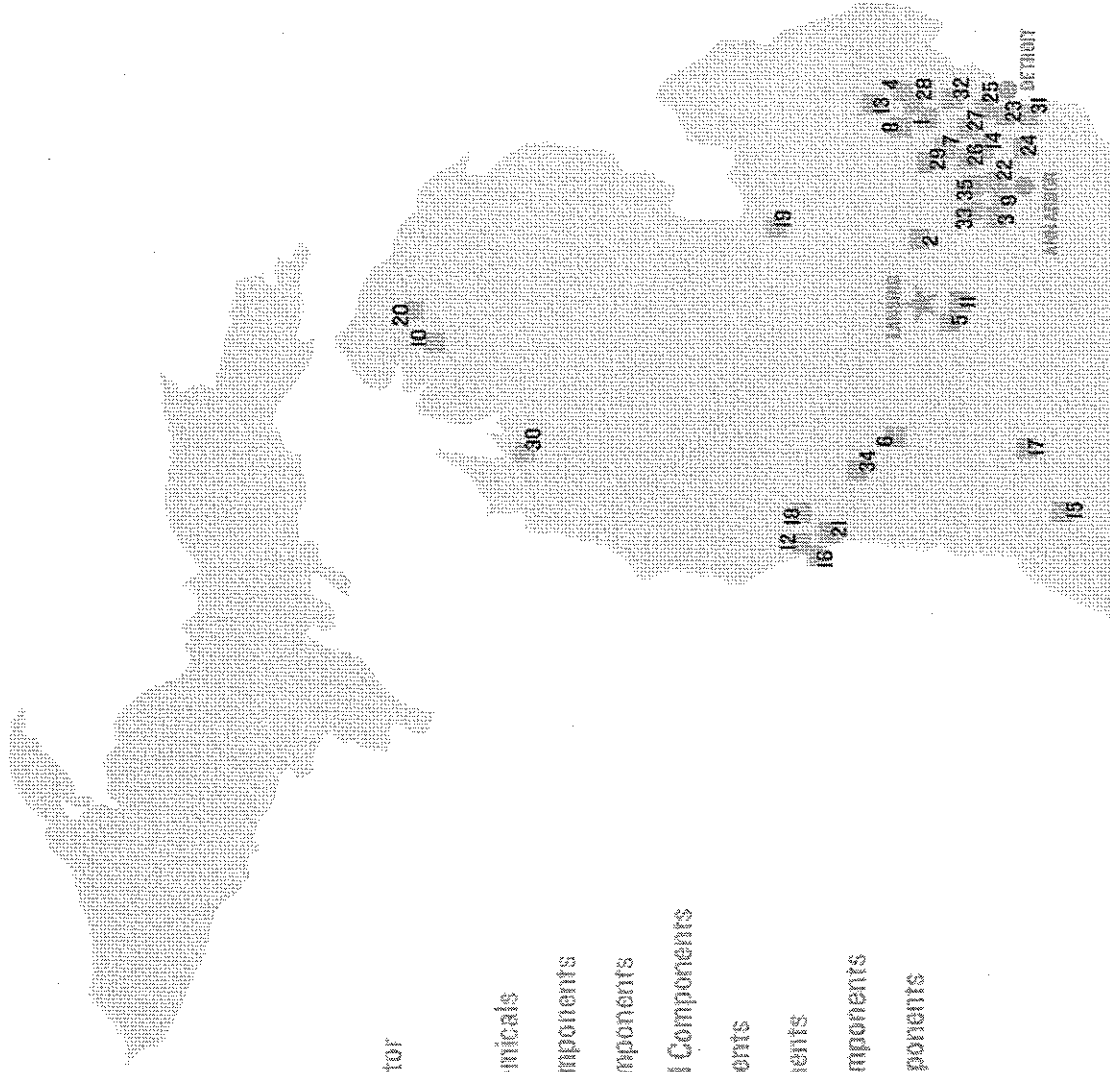


Wind Industry Suppliers in Michigan



1. ADCO Circuits - Controls
2. American Chemical Technologies
3. Ann Arbor Machine Company - Gear and Gear Boxes
4. Arcurus Energy Systems - System Integrators
5. Axson North America - Lubricants/Chemicals
6. Cascade Engineering - Engineering and System Integrator
7. Citation Corporation - Machined, Cast, and Forged Components
8. Cobasys - Batteries
9. Danotek Motion Technology - Generators
10. Diversified Sales and Service, Inc. - Installers
11. Dowding Industries - Tower Construction and Machining Transmission Housings
12. Freedom Power - Installers
13. Goertz - Schiele - Gear and Gear Boxes
14. Great Lakes Gear Technologies, Inc. - Gear and Gear Boxes
15. K&M Machine Fabricating, Inc. - Machined, Cast, and Forged Components
16. Kaydon Corporation - Bearings
17. Hov-Aire - Rotor and Blade Fabrication
18. Kurtziel Industries - Machined, Cast, and Forged Components

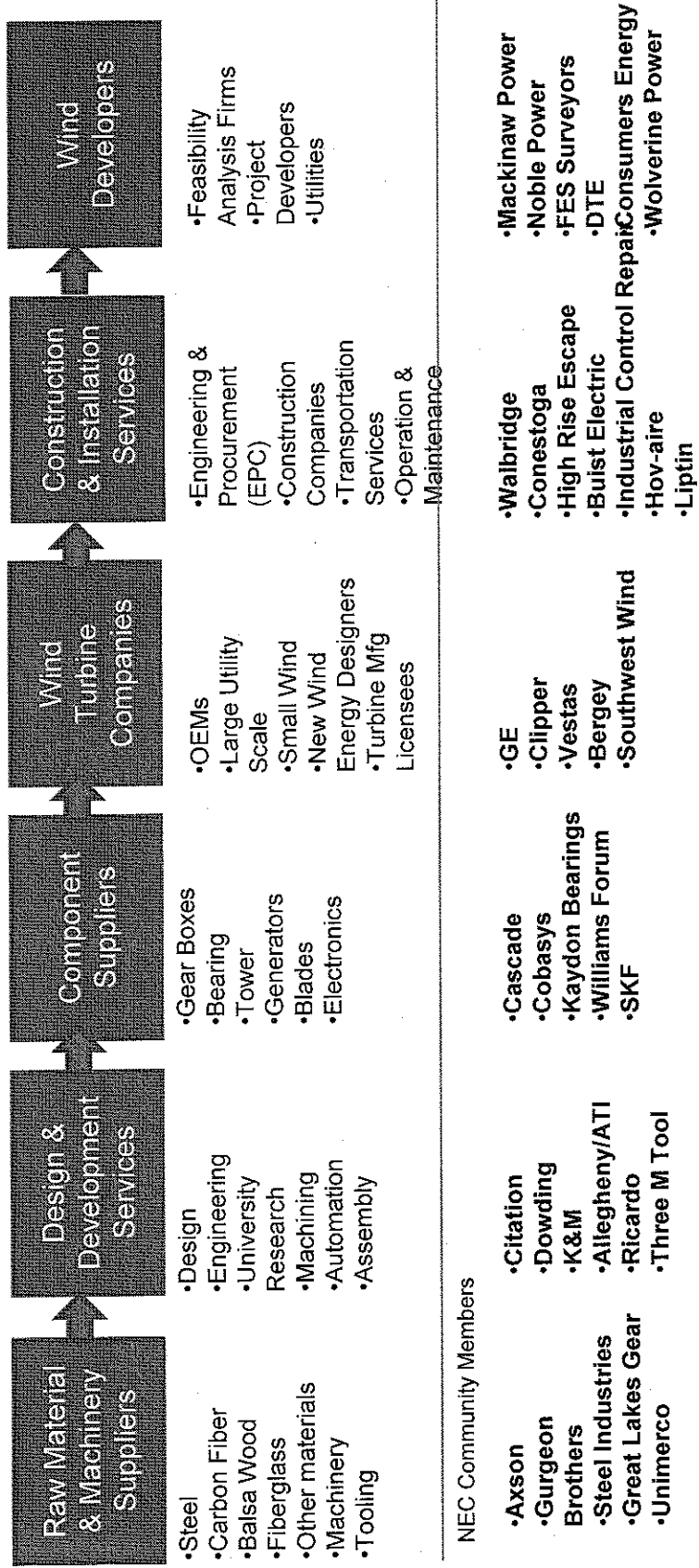
Wind Industry Suppliers in Michigan



19. Merrill Fabricators – Generators
20. Moran Iron Works – Tower Construction
21. Nord-Lock – Fasteners
22. NSK Corporation – Gear and Gear Boxes
23. Pernatic Generator Group – Technology Developers
24. Ricardo Engineering – Engineering and System Integrator
25. Siemens VDO Electric Drives – Controls
26. Simit, Division of Freudenberg-NOK – Lubricants/Chemicals
27. Steel Industries, Inc. – Machined, Cast, and Forged Components
28. Su-Dan Corporation – Machined, Cast, and Forged Components
29. Three M Tool & Machinery – Gear Boxes and Machined Components
30. Tool North, Inc. – Machined, Cast, and Forged Components
31. Trenton Forging – Machined, Cast, and Forged Components
32. Triad Services Group – Machined, Cast, and Forged Components
33. Wahco Composites – Machined, Cast, and Forged Components
34. Williams Form Engineering Corporation – Fasteners
35. Wind to Energy – Technology Developers

Industry Value Chain Map: WIND

From Raw Material-to-Installation



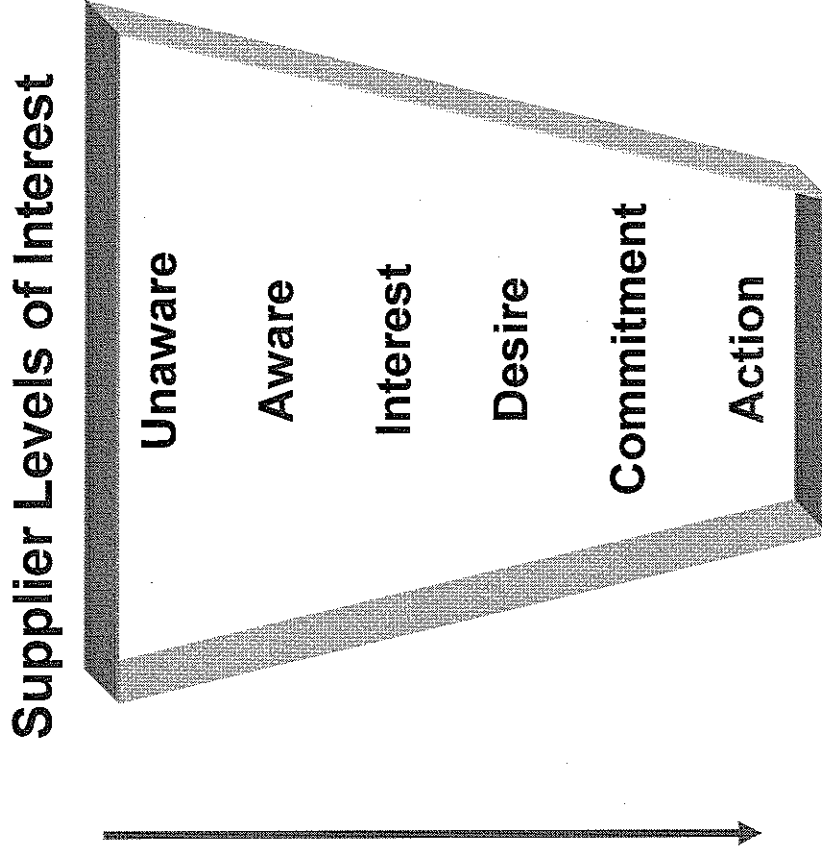
- Paragon Die
- 3G Services
- Great Lakes Carbon Fiber
- FlexSys*
- Danotek*
- ADSC*
- Aerofecture*
- Franklin Energy*
- Heron Wind
- Tool North
- Watts*

*NEC New Venture Clients

So what does an action plan look like?

- Build off of what is already developed (MEDC, NextEnergy, others)
- Asset inventory for your region
- Develop value chain (existing players vs. companies with capabilities to enter market)
- Assess needs, opportunities and challenges of value chain partners
- Identify strengths and weak links in value chain

Stages of Supplier Interest in New Markets





What are the Supplier Learning Curves?

- Understanding the Markets
 - What is the projected growth and sustainability of the market
 - Demand Drivers
 - How does policy effect demand (e.g., RPS, PTC, Carbon Trade)
 - Industry terminology

What are the Supplier Learning Curves?

- Understanding supply chain dynamics
 - What are the Components, equipment and sub assemblies (e.g., what goes into a wind turbine)
 - Size, weight, materials used for components
 - What are the Supplier sourcing dynamics affecting the industry (vertical integration, mergers)
 - Specifications unique to the industry
 - What components does the OEM mfg vs. outsource

What are the Supplier Learning Curves?

- Mapping your capabilities/competencies to the needs of the market
 - How do my assets match up with industry needs (Work force, equipment, facilities, partnerships)?
 - What supply partners do I need to break into market
 - What are my business model options
 - What are the customer contract options (licensing agreement, JV, work in exchange for equity)
 - What investment will be required (equipment, facility, talent)
 - Does my investment allow entry into multiple AE markets (wind, solar, HEV's, biomass systems)
 - A detailed market structure and penetration analysis is helpful (SWOT, competitive analysis/threats)

NEXTENERGY

Renewable Safety Through Energy Diversity

What NextEnergy is Doing to Assist?

- **Focusing on Supporting Both...**
 - Michigan suppliers who want to diversify
 - AET product producers who need mfg help
- **Defined the Manufacturing Value Chain**
 - Michigan suppliers who want to diversify
 - AET product producers who need mfg help
- **Education and Intelligence Sharing**
 - Held several educational seminars for Suppliers on Mfg Opportunities in the Renewable Energy industry
 - Developed market briefings and manufacturing/component resource guides for wind, PV, advanced batteries and biomass systems
- **Brokering Relationships**
 - Reached out to OEM's, tier 1's to identify mfg bottle necks
 - Hosting supplier match making events

Results

- 500+ manufacturers who are in our Michigan supplier network groups
- 20+ supplier match making events/activities
 - Wind Turbine OEM's: Clipper, GE, Vestas, Siemens, Acciona, Nordic Wind Power
 - Wind Energy Tier 1 Suppliers: Moventas - Gear Boxes, SKF – Bearings, Danotek - PM Generators
 - Solar/PV OEM's: Uni-Solar, Prime Star Solar, Infinia, Soliant
 - Fuel Cells: Nuvera, Adaptive Materials
 - Biomass Systems: Greenville Mfg
 - Automotive EV/HEV OEM's: Tesla Motors, Chrysler
- 120+ organized private meetings and several more personal introductions between Michigan suppliers and AE product developers
 - 75+ quoting on new business
 - Helped current AE suppliers take on additional business (\$100MM+)
 - Helped suppliers receive their first order in the AE market

Biofuels:

Market Analysis

- **Biofuel Markets varies widely for different biofuels and in geographic regions**
 - **Biogas** (from landfills) and especially **digester gas** (primarily from animal wastes) production in Asia
 - **Corn Ethanol**
 - US Capacity of 8.5 billion gallons per year
 - Major manufacturing equipment user and there is therefore a well-established 'design, build and equip' supply chain
 - **Cellulosic Ethanol** – market still emerging. Expect plants by 2012 ...

Biofuels: Market Analysis

- **Biodiesel Market Growth but Challenged**
 - US market faces overcapacity:
 - Demand: 250-300 million gallons annually
 - Capacity: 450 million gallons in 2007;
 - 2017 Capacity Targets: 7+ billion gallons
 - Feedstock challenges
 - EU is major biodiesel market
 - Projected 2007 Demand: 3.2 billion gallons
 - Nation leaders: Germany is largest in EU
 - Producers in EU facing capacity and cost issues

NEXTENERGY

Energy. Security. Through Energy Diversity.

BioEnergy – How do you prepare your region to be “Investment Ready”

- **Start with an Asset Inventory**

- What crops have a solid market vs. those prime for diversification
- Identify low value or stranded biomass (wood chips, residuals)
- Map the entire agricultural value chain (harvesting, collection, transportation, pre-processing, processing, added value or after-market use of byproducts)
- Who is already producing Biofuels in the region. Where is their waste or efficiency needs.
- Consider small and commercial/large scale biomass systems
- Define market, key players, market share by segment, market drivers/trends, need for end product, units in field by segment
- Land Use: feedstock, acres needed, logistics
- Economics: feedstock value, processing energy content of feedstock, energy use comparison by system

NEXTENERGY
..... Enhancing Security Through Energy Diversity

Make it Easy for AE Developers

- Identify and secure waste streams that can be used in biomass operations
 - Biodiesel:
 - Animal fats (food processing or rendering plants)
 - Waste oils/greases (waste water treatment and industrial plants, used restaurant grease)
 - Ethanol:
 - Cellulosic materials that already have value chain but limited value
 - Residuals from timber industry, pulp and paper facilities
 - Waste to Energy:
 - MSW - who collects, transports, stores, where is the value proposition
 - Tires - who collects, transports, stores, where is the value proposition

Consider all Biomass Energy Options

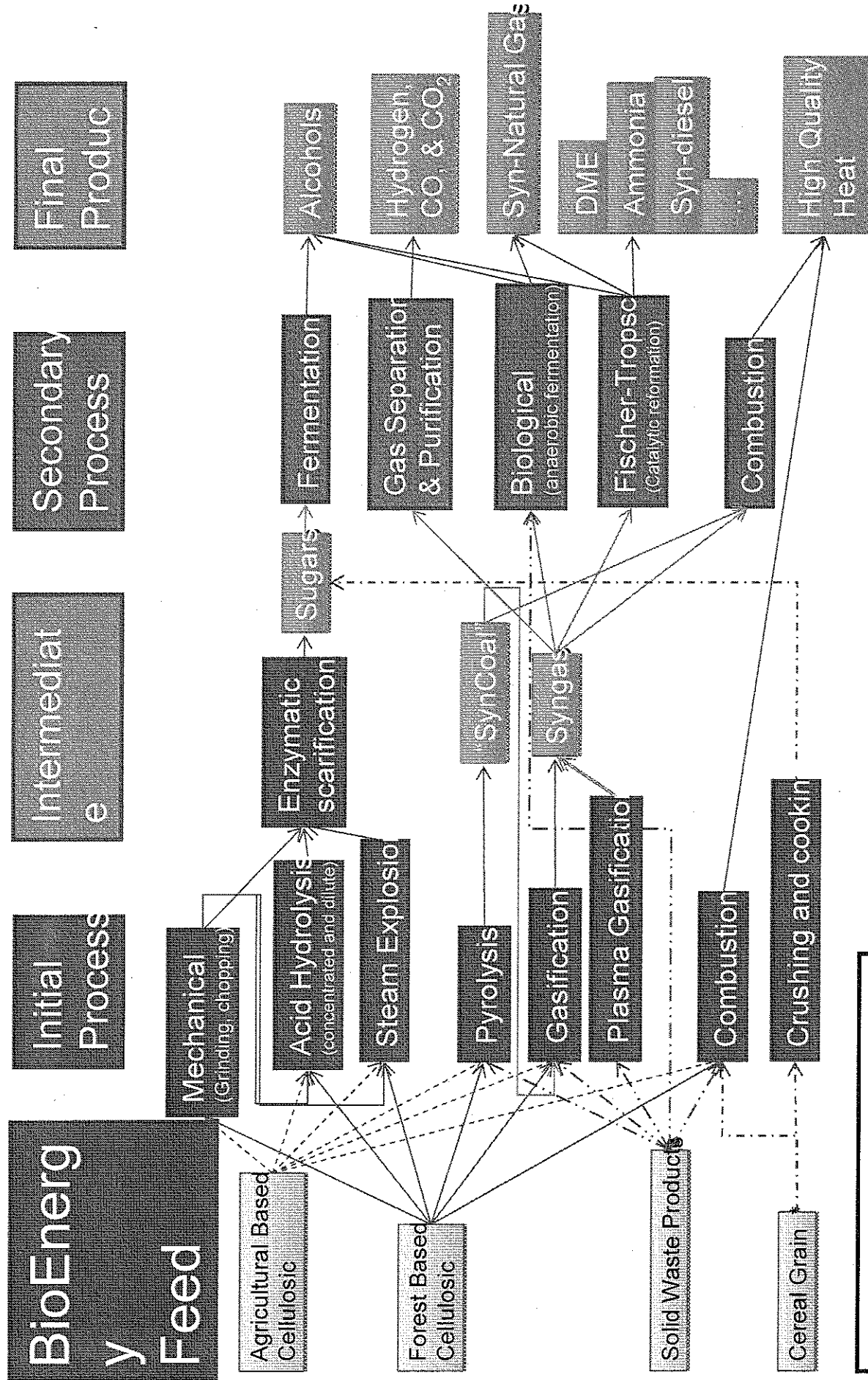
- Biomass to Heat or Electricity
 - Methane Recovery (anaerobic digesters, large digesters)
 - Combustion units
 - Gasification units
- Biomass to Biofuels
 - Ethanol and Biodiesel from food crops
 - Butanol, Methanol, and Mixed Alcohols
 - DME and Synthetic Diesel
- Cellulosic Biomass to Biofuels
 - Thermochemical
 - Hydrolysis
 - Fermentation

Value Chain Development

Analysis of Industry Capability Gaps

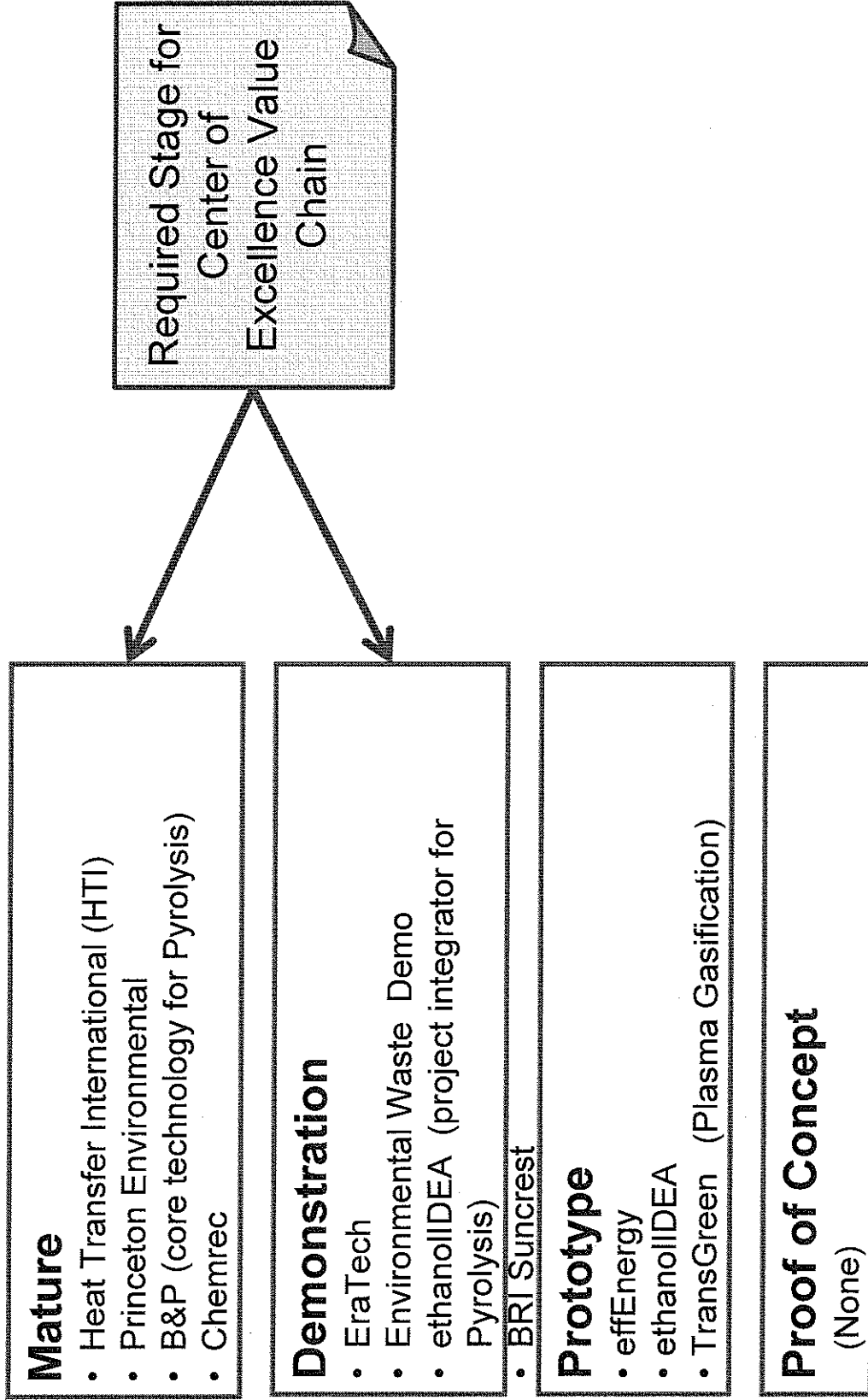
- Develop value chain map
 - Processes for each industry
 - Upstream/Downstream needs and dependencies
- Identify existing players
- Identify weak links and capability gaps
- Identify potential and prospective players, and transition needs
- Identify attraction targets that need **value ENERGY**

BioEnergy Value Chain

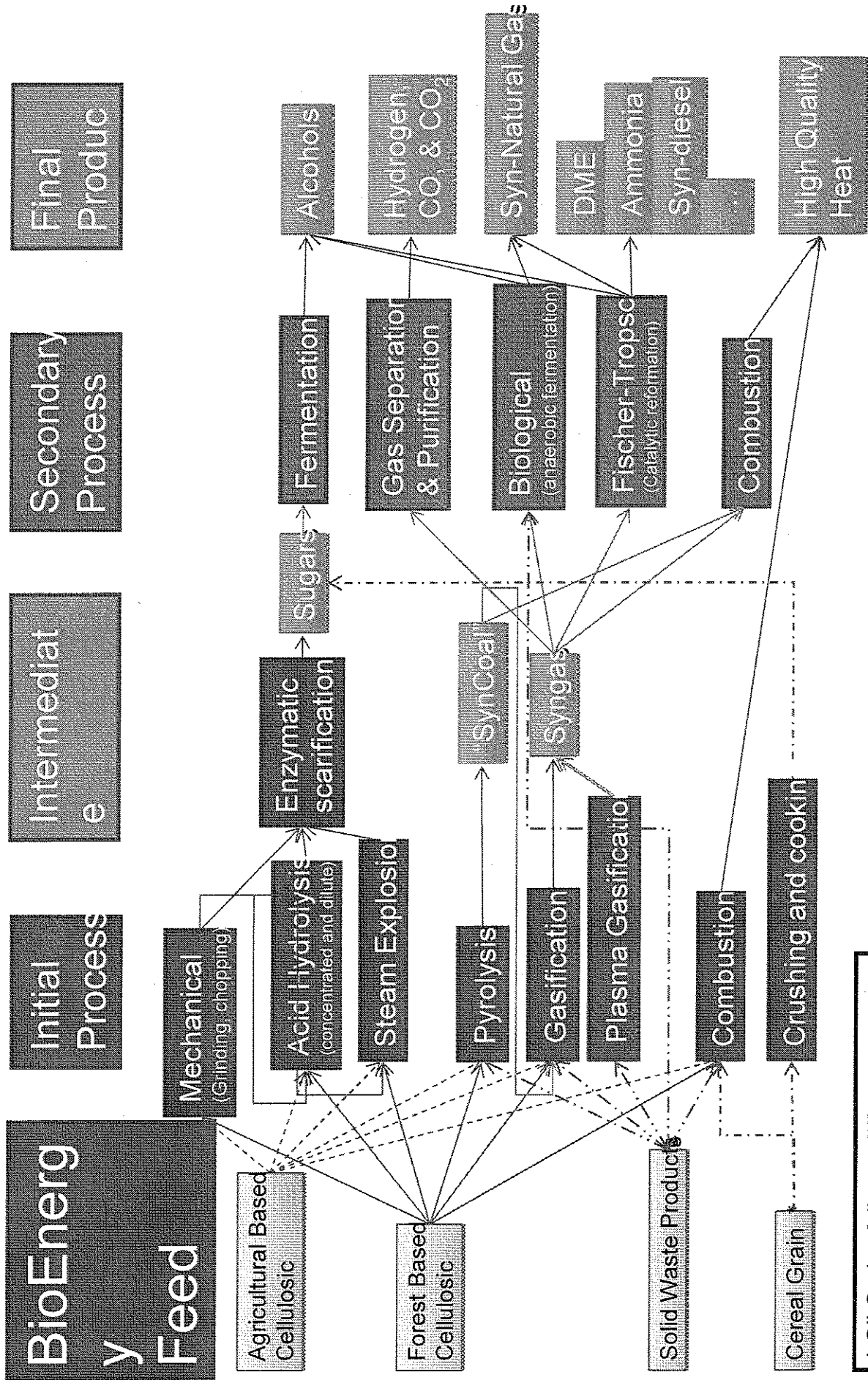


* Oil Grains follow a different Value Chain

Pyrolysis & Gasification Value Chain Partners

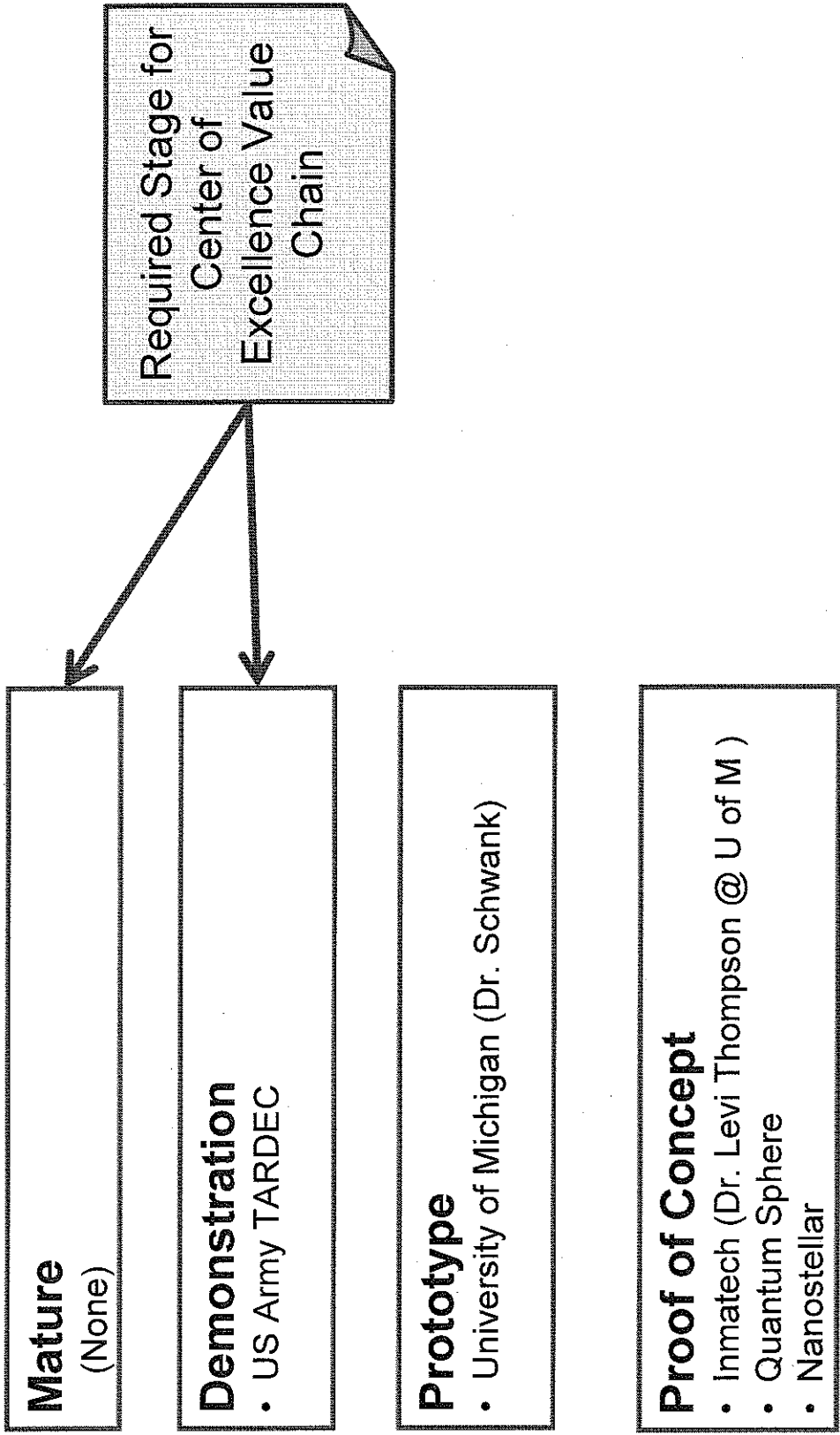


BioEnergy Value Chain



* Oil Grains follow a different Value Chain

Fischer-Tropsch Value Chain Partners



Develop an Action Plan for the Region

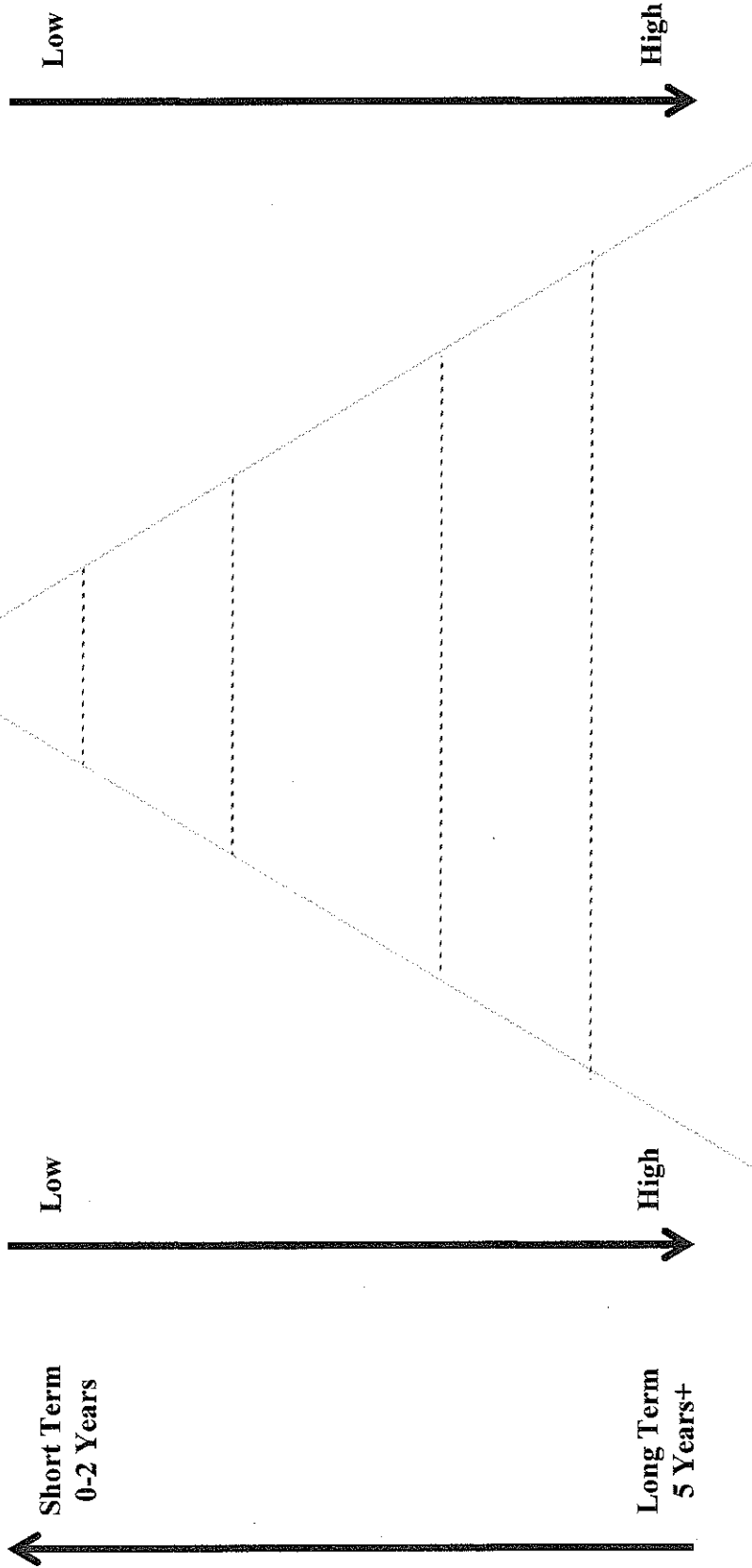
- Who will take the lead?
- Who do you need at the table that brings value, connections, expertise?
- Start by making contact with most prominent players
- Develop a mission
- Convene groups
- Assign task teams
- Draft an action plan for the region
- Get going and move with confidence!

Entrepreneurial Growth Pyramid

Jobs Realized

Risk of Failure

of Potential Jobs Makers



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Energy Security Through Energy Diversity

Entrepreneurial Growth Pyramid

Example Companies

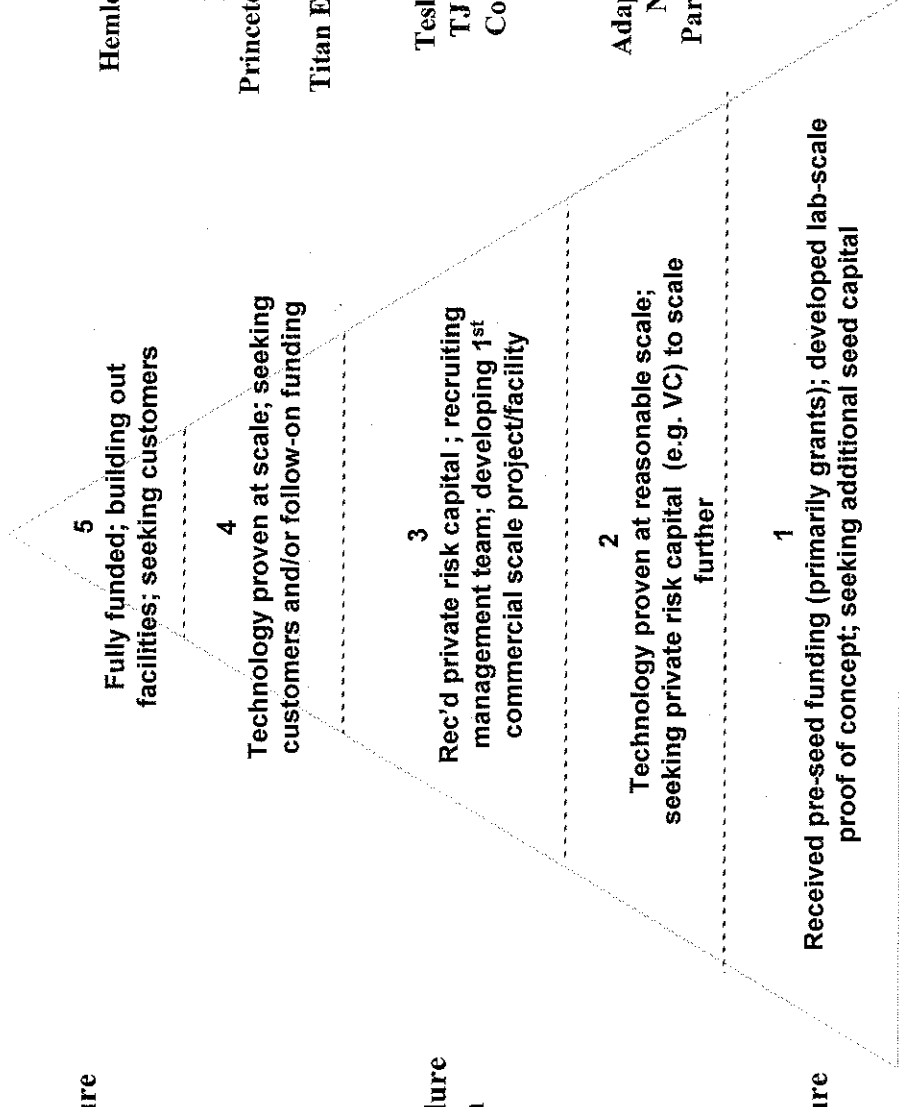
- Broin (Ethanol)
- United Solar Ovonix
- Hemlock Semiconductor (Solar)
- John Deere Wind

- Biodiesel Industries
- Princeton Environmental (Syngas)
- Cobasys (Battery)
- Titan Energy (Emergency Power)

- Mascoma (Ethanol)
- Tesla Motors (Hybrid Auto)
- TJ Technologies (Battery)
- Compact Power (Battery)

- Danotek (Wind)
- Adaptive Materials (Fuel Cells)
- NEXTEK Power (Solar)
- Parking Carma (Automotive)

- Ra Energy (Ethanol)
- EcoV (Elec. Vehicle)
- Beholtech (Fuel Cell)
- ATOM (Alt. Fuels)



Jobs Realized
0-2 Years

Risk of Failure
Low

Jobs Realized
3-4 Years

Risk of Failure
Medium

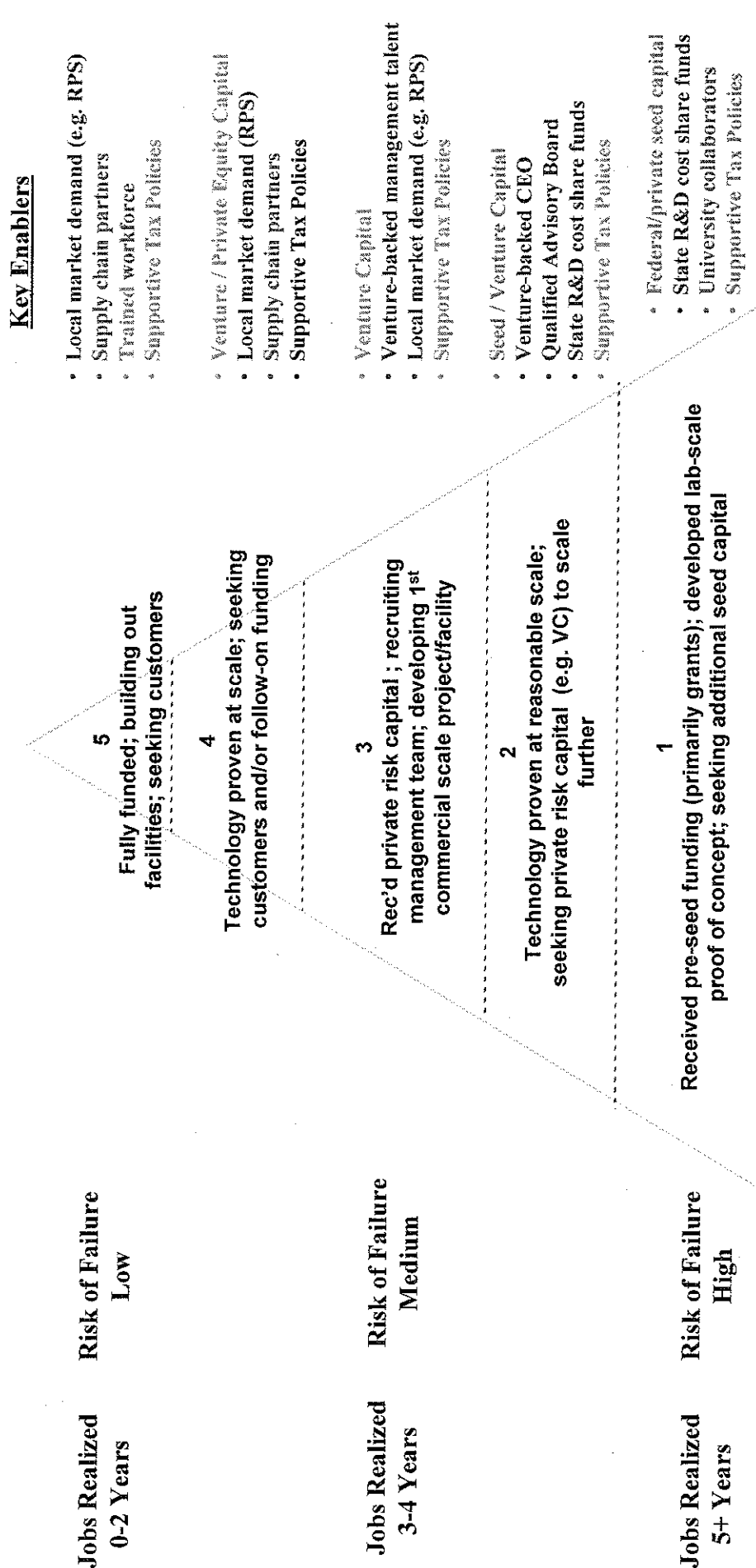
Jobs Realized
5+ Years

Risk of Failure
High

NEXTENERGY

Energy Security through Energy Diversity

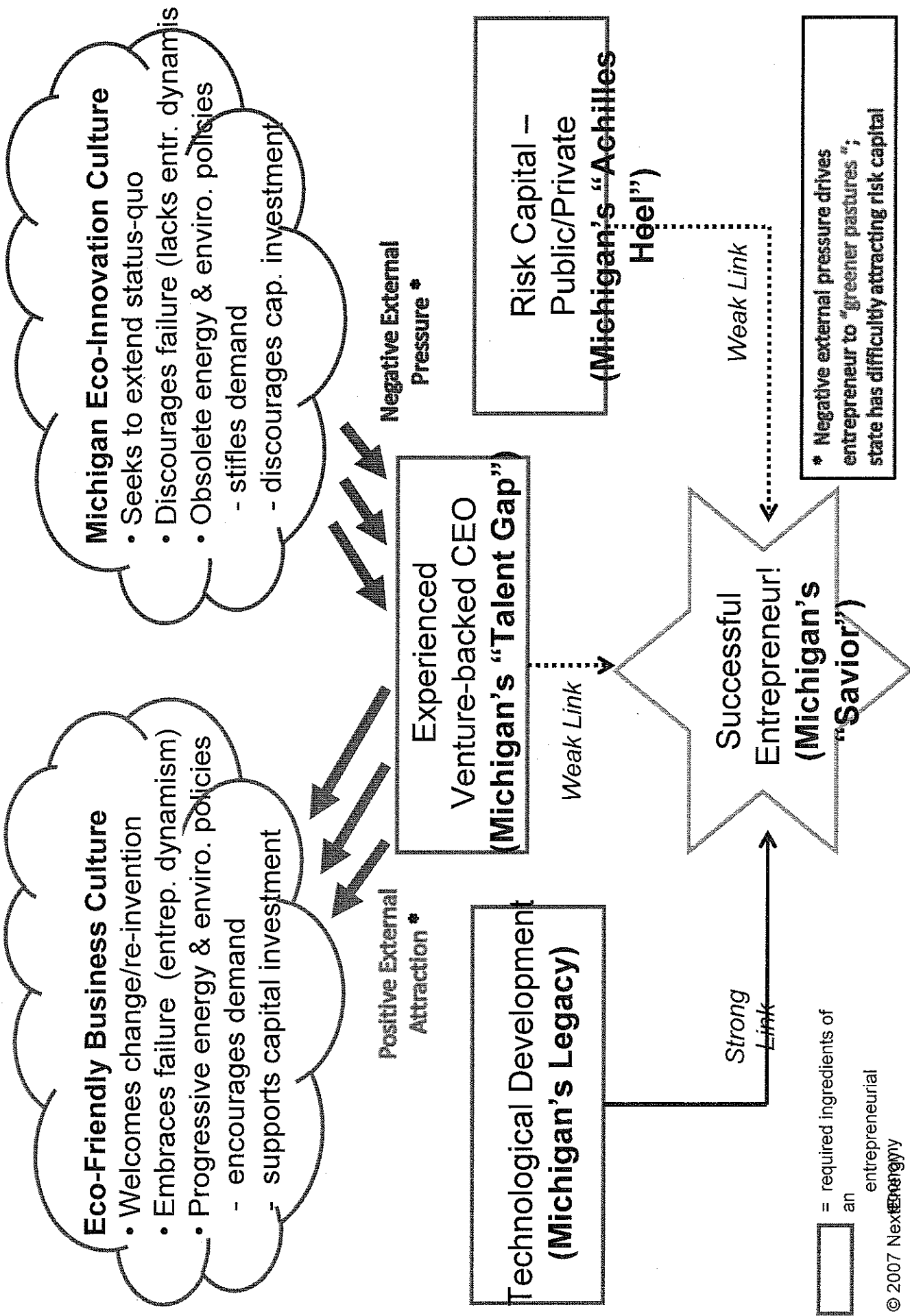
Key Enablers to Entrepreneurial Growth



Color Key:
 Red – Severe constraint in Michigan
 Orange – Improving in Michigan
 Green – Largely available in Michigan



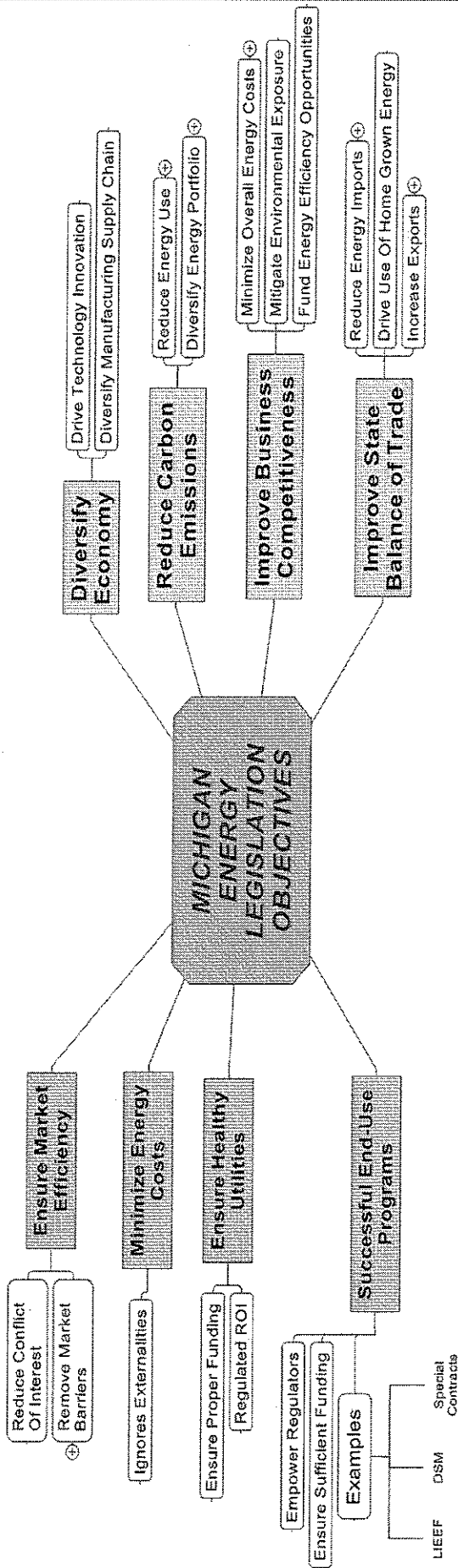
Energy Innovation Culture in Michigan



New Energy Policy Imperative

Existing Regulatory Framework

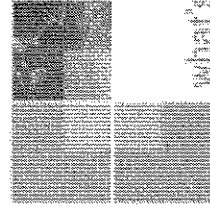
21st Century Regulatory Imperative





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