Building on the Battery Initiative in Michigan

The National Academy of Sciences
February 25, 2010
Targeted Industry Clusters: Background

- 3 year research program (initiated in 2007) identifying industry diversification opportunities leveraging MI competitive advantages
  - International/Federal/State trends
  - Market Analysis (size, trajectory, etc.)
  - Partner input
- Worldwide best practice review in industry acceleration programs (Swedish Triple Helix, Cluster Approach)
- Advanced Energy sectors identified and included in MEDC 2008 Strategic Plan (Emerging Sector – Initial Target Clusters)
- Implementation of Cluster teams (biofuels, wind, solar, advanced energy storage, defense)
- Inclusion in Governor Granholm’s 2008 “State of the State”
Targeted Industry Clusters: Strategy

• Focus on industry clusters which promote diversification but also;
  – Leverage MI core industry strengths
  – Leverage MI core assets/resources

• Develop collaborative teams which include partners, industry, appropriate State agencies, University specialists, associations, MEDC research/marketing/attraction etc.
  – Create ‘roadmap’ recommendation including potential deliverables (includes cluster gap analysis, policy & incentive analysis specific to sector, etc.)

• Create, as required, unique incentive tools designed to catalyze new industry clusters

• Identify associated industry value chain and key areas for initial investment (catalyze industry cluster)

• Continually monitor (MEDC research) viability of target cluster for efficacy (sunset, evolve, continue)

• Continuously monitor industry and economic trends to ID emerging opportunities for new cluster formation.
Targeted Industry Clusters: Current Industry Strengths

**TRADITIONAL MANUFACTURING**
- Tool & Die
- Cereal
- Furniture
  - Office
  - Home

**OTHER ADVANCED MANUFACTURING**
- Chemical
- Computer
- Robotics
- Power Generation
- Nano
- Plastics (New)

**AUTOMOTIVE**
- Manufacturing
  - OEM’s
  - 1st & 2nd Tier
- R & D
  - Applied Research
  - Product R&D

**AGRICULTURE**
- Commodity
  - Forestry
  - Crops
  - Animal
  - Biomass
- Value Add
  - Processing
  - Ag-Tourism

**TOURISM**
- Quality of Life
- Economic Impact
Targeted Industry Clusters:
New Michigan Incentive Tools

- Centers of Energy Excellence
- Anchor Credits
- Advanced Battery Credits
- Photovoltaic Credits
- Technology Collaboration Credits
Michigan Incentives:
Centers of Energy Excellence

• PA 175 was signed into law July 8, 2008.
• Authorized $45 Million grant program, awards made by the Michigan Strategic Fund.
• Objective was to partner private sector, universities, and government to commercialize innovative energy technologies - where Michigan has competitive advantages in such areas as:
  – Workforce
  – Intellectual Property
  – Natural Resources
• Assigned to areas where there are technical or supply chain issues that prevent commercialization.
• Focused on areas which have impact on Michigan’s:
  – Energy security
  – Environmental profile
• Potential for significant economic impact.
• Potential to leverage significant federal dollars.
• PA 144 was signed into law November 13, 2009. Authorizes an additional $30 Million grant program to promote the development, acceleration, and sustainability of “energy excellence sectors” in Michigan.

• Grants awarded only to for profit companies.
• Requires inclusion of institution of higher learning or National Lab
• Grants only awarded for all of the following purposes:
  – Providing up to a 1-for-1 match for federal funding of up to 50% of the total project costs.
  – Supplementing in-kind contributions provided by a person or entity other than this state.
  – Accelerating the commercialization of an innovative energy technology or process that will be ready to market within 3 years of the effective date of the agreement.
  – Activities of the center, including, but not limited to, workforce development and technology demonstration.
Michigan Incentives: Centers of Energy Excellence Model

- Goal is to rapidly grow an industry cluster
- Includes high profile anchor company at the center
- Geographically located in area with strong business infrastructure
- Surrounded by private sector companies, academic institutions, and government entities
Center of Energy Excellence Partners: Government, Industries, Universities

End Users
- MISTRA
- Energimyndigheten
- Länsstyrelsen i Norrbottens Län
- EU
- SVEASKOG
- VATTENFALL

Authoritie
- SCA
- Smurfit Kappa
- SÖDRA

Pulp & Paper Industry
Michigan Incentives:
Centers of Energy Excellence

• Bold initiative to help develop, grow and sustain alternative energy clusters
• Matches private sector with universities, national labs, and the state to accelerate the commercialization of innovative energy technologies
• $43 Million awarded to Six Centers of Energy Excellence in 2008:

  Advanced Batteries: $13 Million
  BioEconomy: $30 Million
Michigan Incentives: Anchor Credits

• Encourages the development of high-technology supply chains in Michigan
• Provides a refundable tax credit to high-technology businesses ("Anchor Companies") that attract investment to Michigan from their customers or suppliers
• Types of Anchor Credits:
  – **Anchor Jobs Credit**: (2008 SB 1115 (Allen) / PA 92; amended by HB 4674 (Mayes))
    • Refunds a portion of the Personal Income Tax generated by attracted employees to the Anchor Company
  – **Anchor District Credit**: 2008 HB 5858 (Clemente) / PA 88; amended by SB 493 (Allen)
    • Refunds a portion of the attracted investment to the Anchor Company (investment must occur within 10 miles of Anchor Company or at an existing industrial site nearby)
Michigan Incentives: Advanced Battery Credits

- PA 580 was signed into law January 14, 2009.
- Total value of credits: $1 Billion.
- Provides **refundable credits** on the Michigan Business Tax for battery cell manufacturing, vehicle battery pack assembly, and advanced battery engineering, designed to make Michigan the battery capitol of North America.
- The **Michigan Economic Growth Authority** is responsible for entering into agreements for tax credits available through this program.
- Potential to leverage **significant federal dollars**.
Michigan Incentives: Photovoltaic Tax Credit

- The Photovoltaic MBT credit provides a tax credit to qualified companies that construct and operate a manufacturing facility related to photovoltaic technology, systems or energy.
- The credit provides qualified companies with a refundable credit equal to 25% of their capital investment.
- The statute makes $75 million in total credit available until December 31, 2011. The credit is taken in equal installments over two years, once the qualified company has completed at least $25 million in capital investment. However, the statute does allow for one credit of $15 million or less to be provided in a single tax year.
- Two types of eligibility
  - Qualified Taxpayer: A business that has entered into an agreement with MEGA to create at least 500 qualified full-time new jobs and invest at least $50 million in capital investment. At least $25 million must be invested before a credit may be issued. The maximum credit available under this classification is $15 million.
  - Eligible Taxpayer: A business that has entered into an agreement with MEGA to create at least 250 qualified full-time new jobs and invest at least $100 million in capital investment. At least $25 million must be invested before a credit may be issued. The maximum credit available under this classification is $25 million, and only one credit may be issued under this definition.
Michigan Incentives:
Technology Collaboration Tax Credits

- Technology Collaboration Tax Credits (TTC) provides the opportunity to develop strategic partnerships between emerging technology companies and larger established businesses by providing an incentive for the larger companies to invest in the smaller companies.
- The investment occurs through funding, support and collaboration in the research and development and technology innovations for emerging markets.
  - The larger company assumes the role of qualified taxpayer proposing to fund the R&D and technology innovation.
  - The smaller company is the eligible business engaged in R&D. The company must employ 50 or fewer employees and have gross receipts of less than $10 million.
- An eligible contribution is the transfer of cash of not less than $350,000 for the purpose of R&D and technology innovation, excluding contract research. The credit must be used for new strategic relationships and not as an additional investment in a relationship that already exists.
- The TCC credit is available for a three-year period from 2008 to 2010. Thirty percent of the value of the contribution from the qualified taxpayer to the eligible business is eligible with a maximum up to $300,000.
Strategy:
Targeted Industry Clusters

- Targeted industries
- Potential for significant growth
- Leverage state strengths
- Generally not mature
- Gap exists – requires economic assistance

1. Advanced Energy Storage
2. Solar/Photovoltaic
3. Wind Turbine Mfg.
4. Bioenergy
5. Advanced Materials & Manufacturing
6. Defense
Advanced Energy Storage: Michigan Overview

- **Michigan Strengths** – Automotive R&D and advanced manufacturing
- **Michigan Tools** – Michigan Advanced Battery Credits and Centers of Energy Excellence
- **Results**
  - Committed Federal investment of $1.3 Billion
  - Total new business investment of $5.2 Billion
  - Direct employment creation of ~8,000
Advanced Energy Storage: Strategy

- Seed MI marketplace with key battery technology players (Centers of Energy Excellence) – be first to market in projected $20 Billion North American marketplace by 2020.
  - Completed July, 2008
- Develop incentives to attract key anchor/magnet companies to spur value chain growth (Battery Cell/Pack/R&D Credits)
  - Completed
- Develop tools to provide incentives for anchor companies to assist in growing the entire value chain in MI (Anchor Credits)
  - Completed
- Develop incentives that would provide companies cost share in Federal funding opportunities
  - Completed
- Assist OEMs in offsetting the incremental cost of vehicle electrification to minimize consumer impact and ‘dovetail’ IRC 30D credits
  - Completed
- Expose battery companies to market opportunities in grid stability, defense and renewable energy sectors (Alliance Model)
  - Ongoing
Advanced Energy Storage: Li-Ion Battery Components, Assembly, and Application

**Electrode Substrate**
- Substrates (foil, woven, porous, ...)
  - Surface Area
  - Stability
  - Conductivity
- Structure
  - Powder
  - “Nano” / “Vapor Growth”

**Cathodes**
- Chemistry
  - Ni-Co-Oxide
  - Mn-Spinel
  - Fe-Phosphate
  - Ni-Mg-Co
  - Ni-Co-Al-Oxide
  - Li-Vanadium-Phosphate
  - …

**Anodes**
- Material
  - Hard Carbon
  - Graphite
  - Li-Titanate

**Electrolytes**
- Chemistry
  - Li-PF6 (Lithium Hexafluorophosphate)
  - LiBF4
  - LiClO4
- Additives
- Solvents

**Separator**
- Structure
  - Co-Extruded (Exxon)
  - In-Organic Blended
- Requirements
  - Permeability
  - Stability
  - Thickness
  - Dendrite growth reduction

**Cell Structure / Manufacturer**
- Shape
  - Wound Cylindrical
  - Wound Trapezoidal
  - Layered Pouch
- Structure & Assembly
  - Termination
  - Housing
  - Formation
- Mfg. environmental requirements
- Operational Requirements
- Reliability
- Safety
- Thermal & Vibration Environment
- Thermal Management during failure
- Quality (PPM failure rate)

**Stack / Pack Integration**
- Thermal Management
  - Cooling
  - Heating
  - Over temperature control
- Interconnections
- Cell Charge / Discharge Balance
- Cell failure Detection & Isolation
- Thermal Event management

**Systems Integration**
- Impedance Matching with Load
- Power Density Requirements
- Energy Density Requirements
- Environmental Requirements
- Life Cycle Requirements
- End-of-Life Recycle Requirements
- Multiple Technology Energy Storage Device Integration (Li-Ion Battery & Ultra Capacitor "Teaming" for peak load shaving)
- Cost

**Other Energy Storage Concepts**
- Flooded and AGM Lead Acid Batteries
- Ultra Capacitors
- Flywheel Concepts
- Compressed Gas

Similar value chains for additional energy storage technologies need also to be developed.
Michigan Advanced Battery Credits: Over $1 Billion in Refundable Credits

<table>
<thead>
<tr>
<th>Credit Type</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Pack Manufacturing Credit</td>
<td>$255 Million</td>
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<tr>
<td>for manufacture of plug-in traction &amp; Hybrid battery packs</td>
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<tr>
<td>Vehicle Engineering Credit</td>
<td>$135 Million</td>
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<tr>
<td>to support battery integration, prototyping, launch expenses</td>
<td></td>
</tr>
<tr>
<td>Advanced Battery Technologies Engineering Credit</td>
<td>$30 Million</td>
</tr>
<tr>
<td>to support engineering activities</td>
<td></td>
</tr>
<tr>
<td>Cell Manufacturing Credit</td>
<td>$600 Million</td>
</tr>
<tr>
<td>up to 50% capital investment for cell manufacturing facility</td>
<td></td>
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**Status**

- $115M GM
- $78M Ford
- $20M JCS
- $42M Available

- $45M GM
- $45M Ford
- $45M Chrysler

- $30M Ford

- $100M JCS
- $100M Dow Kokam
- $100M A123 Systems
- $100M LG Chem
- $100M Xtreme Power
- $100M Fortu Power
Michigan’s Stimulus for Advanced Batteries

$1 Billion Program

<table>
<thead>
<tr>
<th>Cell Manufacturing</th>
<th>Pack Manufacturing</th>
<th>Battery &amp; Vehicle Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>$100 Million</td>
<td>$115 Million</td>
<td>$45 Million</td>
</tr>
<tr>
<td>Johnson Controls</td>
<td>$100 Million</td>
<td>$78 Million</td>
</tr>
<tr>
<td>SAFT</td>
<td>$100 Million</td>
<td>$75 Million</td>
</tr>
<tr>
<td>LG Chem</td>
<td>$100 Million</td>
<td>$20 Million</td>
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<tr>
<td>CPI compact power</td>
<td></td>
<td>Chrysler</td>
</tr>
<tr>
<td>$45 Million</td>
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Federal Stimulus for Advanced Batteries
$1.3 Billion Awarded to Michigan! (August 5, 2009)

Cells, Batteries, & Materials Manufacturing

- Johnson Controls: $299 Million
- SAFT: $151 Million
- LG Chem: $249 Million
- A123 Systems: $161 Million
- Dow Kokam: $106 Million

Electric Drive Component Manufacturing

- GM: $105 Million
- Ford: $63 Million

Transportation Electrification

- Chrysler: $70 Million

Awards also to Magna, South Coast Air Quality Management District, University of Michigan, Michigan Tech, Wayne State University
From COEE to Center of the Battery World

Cell Manufacturers
- Johnson Controls
- SAFT
- LG Chem
- CPI Compact Power
- A123 Systems
- Sakti3
- Dow Kokam
- Extreme Power
- Fortu Holding AG

Value Chain
- TODA America
- Techno Semichem Co., Ltd.
- Azure Dynamics
- Magna

Vehicle Builds
- EV3
- Ford

Announced Investment Since 11/2008
- $13M
- $5.2B
Battery Value Chain Demonstration: Deployment of incentives

- Centers of Energy Excellence
- Anchor Credits
- Contract Mfg
- Powertrain Integrators
- OEMs
- Technology Collaboration Credits
- Michigan Advanced Battery Credits
- Anchor Credits
- Materials
- Cell Mfg
- Pack Mfg
Battery Value Chain Demonstration:

**Companies**

- JCS
- A123
- Dow Kokam
- LG Chem
- Sakti 3
- Xtreme Power
- fortu PowerCell
- GM Pack Mfg
- JCS Pack Mfg
- Ford HEV Pack Mfg
- Dow Kokam Pack Mfg

**Materials**
- $117.7M
- Toda America
- Techno Semichem

**Cell Mfg**
- $2.91B

**Pack Mfg**

**Contract Mfg**

**OEMs**
- $2.65B
- Ford
- Chrysler Component Mfg
- GM

**Powertrain Integrators**
- $72.7M
- Eaton
- Magna Electronics
- Azure Dynamics
Battery Value Chain: Location of Companies

- A123
- Johnson Controls
- Saft
- Dow Kokam
- Sakti-3
- Fortu PowerCell
- LG Chem
- Eaton
- Toda
- Magna
- Xtreme Power
- Azure Dynamics
- Techno Semichem
- A123

Cell manufacturer
Value chain company
Advanced Energy Storage: Status Summary

- **Cell manufacturers ramp up**
  - A123 to occupy Livonia facility by April 1; just announced acceleration of hiring 500+ to support business with Fisker
  - JCS to occupy Holland facility late spring 2010
  - Dow Kokam plans groundbreaking by May 2010
  - LG Chem plans groundbreaking by June 2010
  - All are targeting 2012 ramp up to full production
  - Hiring begins to ramp up in second half of 2010

- **Value Chain pipeline**
  - $200M+ in projects to close over next 3 months
  - Represents materials, component/system mfg, testing
Advanced Energy Storage: Status Summary (cont.)

• Federal opportunities
  – ~$900M in outstanding federal loan program applications
    • DOE Advanced Technology Vehicles Manufacturing (ATVM)
    • DOE 1703/1705 loan/loan guarantee program
  – ARPA-E grants
    • DOE grants for advanced battery technologies
    • Award size is $3M to $5M
    • Multiple MI companies are applying
    • Early application review period ends in March
Advanced Energy Storage: Next Steps

- Continue to recruit value chain
- Expose companies to multiple market opportunities via the Alliance (TARDEC and Oak Ridge National Labs)
- Serve as facilitator to newly-formed battery manufacturers workgroup
- Coordinate resources to assist projects contingent on Federal Awards
Emerging Energy Clusters

Consortium Core Members
- State of Michigan
- Department of Energy / ORNL & other National Labs
- Department of Defense/TARDEC
- Sweden/ VINNOVA/STEM
- Dow Chemical

Advanced Energy Storage
- A123Systems
- Dow-Kokam
- Johnson Control Saft
- LG Chem
- Sakti3
- Fortu Power

Bio Products
- Working Bugs
- Mascoma
- American Process Inc.
- Swedish Biogas Inc.

Light Weight Materials
- Dow
- MAG
- Astraeus
- Merrill

Solar/Photovoltaic
- Hemlock Semiconductor
- Evergreen Solar
- Dow Solar
- Global Watt
- Unisolar-Ovonics
- Suniva

Wind
- Astraeus
- Merrill
- Energetrix
- Loc

Other
Thank You

Michigan Economic Development Corporation

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