EV OPPORTUNITY GROUP

Facilitated by DCMME Team:
Ananth Iyer
Steve Dunlop
Angus McLeod
Roy Vasher

PURDUE UNIVERSITY®

EV Opportunity Group
Agenda

May 18, 2022

12:00-1:30

- Welcome & Review of Agenda – Steve Dunlop, Purdue
- EV Opportunity Group – Overview – Ananth Iyer, Purdue
- Individual Attendees Introductions – Facilitated by Roy Vasher, Purdue
- EV Battery Supply Chain - Subhash Dhar, American Battery Solutions
- EV Battery Components – Roy Vasher, Purdue
- Questions, feedback, next meeting - Facilitated by Angus McLeod, Purdue
- Closing – Ananth Iyer, Purdue

EV Opportunity Group

Mission

Competing effectively and successfully in the **EV ECO-System**
New Profit Opportunity

Goals & Objectives

- Assist current Indiana manufacturers with diversifying into EV suppliers and/or EV Infrastructure businesses
- Assist current ICE (Internal Combustion Engine) suppliers with diversifying by identifying reshoring opportunities
- Attract new EV startups to locate in Indiana

Membership Expectation

- Facilitated by Purdue DCMME
- Open to all Indiana Manufactures at no cost
- Open to LEDOs and other Economic Development Organizations.
- Government financial incentives in the form of grants and direct business investment awards to businesses

Individual Introductions

- Name & Position
- Company Name
- If already participating in EV Business, please describe
- If not, please describe your interest in EV opportunities

List of Confirmed Attendees

Company	First	Last
Acuity Capital Group	Robert	Bierwagen
Alliance LLC	Dan	Vukovich
American Electronic	Tony	Downer
Charleston Metal Products	Chris	Rowe
Dayton-Phoenix Group	Gabe	Widmer
Decatur Mold	Louie	Fields
EMCO Gears Inc	Bruce	Williams
General Stamping &	John	Axelberg
Genesis Molding, Inc.	James	Deren
Grant County Economic	Charity	Bailey
Huston Electric, Inc.	Matthew	Huston

Company	First	Last
Kirby Risk Corporation	Doug	Mansfield
Koester Metals, Inc.	Gary	Koester
Nucor	Kyle	Smith
Overton Industries	Scott	Buie
Phoenix America	Scott	Mentzer
PTS Automation Inc.	Jeffrey	Hardwick
Rochester Metal Products	Rick	Bean
Small Parts Inc	Doug	Azbell
Triton Metal Products	Brevin	Bennett
Tube Form Solutions	Jeff	Jacobs
UAW	Danny	Ernstes
UAW	Lisa	Mayberry-Raymond

Established Manufacturing Capacity with Footprint Ready to Scale

60,000
Battery pack systems delivered through existing facilities

200[1]
Team Members across all locations

300k sq. ft.
of innovation and manufacturing facilities

Ex-Bosch Facility
Acquired ready-to-scale facility

120[1]
Battery engineers across all locations

Zero PPM
quality performance for FCA, BMW, Daimler and GM

Key Competencies

- Experience with Multiple Chemistries
- Battery Pack Design
- Thermal Management System
- Battery Management System
- Testing and Validation
- Battery Manufacturing

Manufacturing Facility – Springboro, OH

170k sq. ft.
Expandable to 213k

2 GWh
2022 installed capacity

8 GWh
Current building capacity

Innovation Centers

Lake Orion, MI

120k sq. ft.
Engineering, test and validation facility

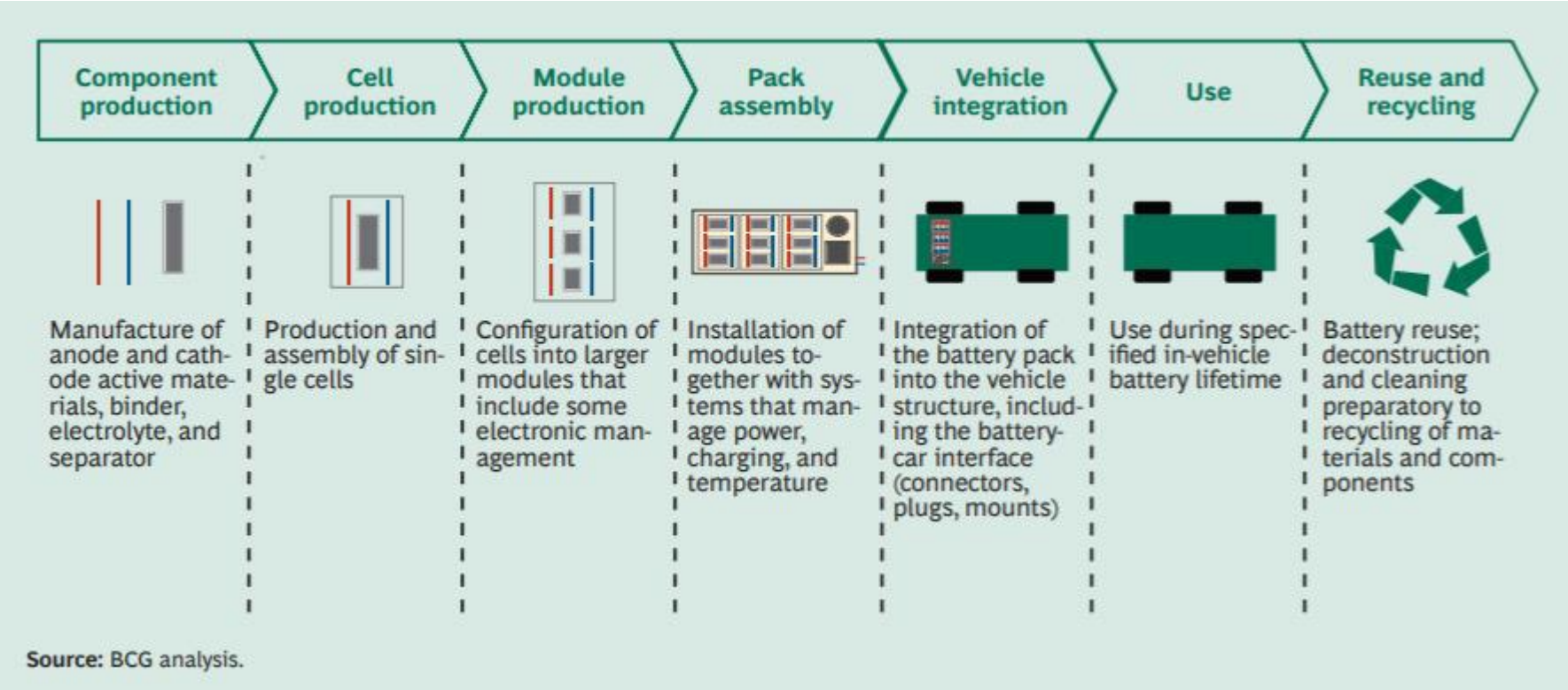
Pilot line
Flexible semi-automatic prototype build facility

Boston, MA

~16k sq. ft.
ESS design center in MA

EV Battery Supply Chain

Value chain of EV battery consists of 7 steps:



https://www.bcg.com/publications/2018/future-battery-production-electric-vehicles.aspx

- 1 module (of 12 cells) generates 2-3kWh energy, 1kWh gives 3.5-4.5 miles of range
- VW gives 250miles of range and has 36 modules ie. 36*2 (or 3)kWh = 72 (or 108)kWh

Battery Pack Configuration

Subsystem	Function	Components
Lithium-ion cells	Power Source	Cathode
		Anode
		Substrate
		Enclosure
		Electrolyte
		Chemicals
Battery Module	Mechanical structure	Battery enclosures may be made of a combination of stamped steel or aluminum, cast aluminum, fiber glass, composite, or plastic
		Bolts/Nuts
		Fasteners
		Dust protection sealant
		Water protection sealant
		Bus Bars / Current Collectors (Copper, nickel plated copper, aluminum stampings)
Battery Management System (BMS)	Master Control System	Master Controller - Printed Circuit Board (PCB)
		Series of “slave” control boards
		Sensors
		Software

Source: The Handbook of Lithium-ion Battery Pack Design by John Warner

Battery Pack Configuration - Continued

Subsystem	Function	Components
Thermal management system	Climate Control	Cooling plate
		Liquid cooling channels
		Thermal Interface Materials (TIM)
		Insulation
		Thermal Propogation Protection Pads or Foam
Controls	System Control Electronics	Switches
		Fuses
		High-voltage front end
		High-voltage interlock loop
		Voltage Temperature Monitor (VTM) board (These are the "slave" boards shown above)
		Battery Disconnect Unit
		Contactors/Relays
		Connectors
		Charging connectors

Source: The Handbook of Lithium-ion Battery Pack Design by John Warner

Open Discussion

- Questions
- Feedback on meeting
- Next Meeting Potential Topics
  - Presentations from EV OEM’s
  - Presentations from EV Suppliers from this group
  - Timing: Mid July

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