Evaluation of factory infrastructure for Advanced Battery Manufacturing
International Battery Seminar, FL

March 21, 2017 I Ankush Halbe
Advanced Technology Facilities
Global Leading Engineering and Construction Company

100+
years of continuous operation

Leading
technology-driven global engineering and construction company

$3.05B
annual order intake and sales

in 30+
countries

Semiconductor

Renewable Energy

Science & Research

Displays / Flat Panel
Scope of Services

- Site Analysis
- Concept Design
- Preconstruction Planning
- Issued-for-Construction
- Construction Management
- Tool Installation
- Feasibility Studies
- Concept Design
- Operations
- Site Analysis
- New Construction
- Renovation
M+W International Battery Projects

Americas  Europe  Asia

Representative Clients

- Tesla
- A123 Systems
- European Batteries
- Renault Nissan
- Alevo
- Kodak
- ii-Tec
- Karlsruhe Institute of Technology
- P&G Duracell
- Galaxy
Progressive Reduction in Battery Manufacturing Cost is Expected

- Economies of scale
- Improvements in process equipment
- Improvements in materials technology
- Supply chain maturity

Source: “Strategische Planung der Fertigungstiefe bei Unsicherheit und Dynamik”; Chr.Huth & M+W Research
The function, operation and shape of any battery facility are primarily driven by process & manufacturing requirements.
Battery Cell Manufacturing
Production Environment: Li-Ion Technology

- Temperature and humidity requirements are driven by cell manufacturer's process technology
- Temperature control in Formation and Aging areas differs on manufacturer needs
# Battery Cell Manufacturing

Sample Tool Utility Matrix

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- Utility consumption data from process tools determines the type and capacity of facility systems for the battery fab (e.g. for exhaust, air handling, abatement, water, bulk-gases, power, etc.)
Pilot Cell Manufacturing Facility
Generic Production Layout

- Sizing and location of functional areas determine efficiency of materials and personnel flow
- Electrode preparation, assembly, and electrolyte filling typically > 60% fab area
- A central corridor allows easy access to functional areas
Pilot Cell Manufacturing Facility
Dryroom Concept

• Process steps such as oven-drying, case assembly, and electrolyte filling conducted inside a dryroom to eliminate moisture

• An ‘isolator’ dryroom design provides more cost-effective controlled environment compared to ‘conventional’-ballroom dryroom design
  - Reduced dryroom footprint
  - Reduced energy consumption
  - Tighter temperature & humidity control
  - Reduced contamination
High Volume Cell Manufacturing Facility
Production Fab Concept

- Multi-GWh/year
- ‘Smart’ scale-up of pilot line layout
- Islanding of manufacturing process clusters for logistical efficiency
High Volume Cell Manufacturing Facility
Site Master Plan for a Giga-Fab
Battery Cell Manufacturing Facility
Cost Reduction

Cost/ kWh (a.u.)

1.0
0.5
0.0

Technology Improvement
High Throughput Process Tools
Material Supply Chain
Diluted Overhead Costs
Higher Area Utilization
Optimized Building & Facilities
Cost effective Dryroom

Process Equipment & Technology
Purchasing
Scaling
Benchmarking Value & Industrial Engineering
Smart Engineering

M+W and Manufacturer Focus

M+W Focus
Summary

• Design specifications for battery manufacturing facilities are primarily driven by process and manufacturing requirements

• Layout and sizing of fab areas requires deep understanding of underlying manufacturing process steps and flow

• Certain cell technologies require tight temperature and humidity control in the fab
  – Ability to design a dryroom with minimal footprint is crucial to manage facilities-related capex

• Cost of battery packs are dropping dramatically & demand is rising
  – Traditional battery manufacturing space disrupted by novel manufacturing and materials technologies. This requires rapid construction of lean and green manufacturing facilities
Contact

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THANK YOU
Visit us at Booth 321