SOLID POWER
The Leading Developer of All Solid-State Batteries (ASSB) for Mobile Power Markets

NASA EPFD Battery Day – November 30, 2020
Dean Frankel, Supply Chain – dean.frankel@solidpowerbattery.com
MARKET OPPORTUNITY

Li-ion Energy Density Projections

Total market projections
Energy storage annual revenue ($ billions)

Lithium Anode & Solid-State Solution

Strong market demand for high energy batteries (Wh/kg & Wh/L) at cost competitive prices

“This growth will be driven by the commercialization of several key innovative technologies, including solid-state.”

Lux Research
Global Energy Storage Market Forecast 2019
SOLID POWER OVERVIEW

Leading developer of sulfide-based all solid-state batteries (ASSB):

- Higher energy vs. Li-ion
- Inherently safer vs. Li-ion
- Compatible with existing Li-ion manufacturing
- Lower pack-level costs due to design simplicity

“Clients should consider Solid Power as a global leader in the innovation race to develop solid-state batteries with metallic lithium anodes”

Lux Research
2019’s Hottest Innovation Topics & Best Tech Start-Ups

“Solid Power is clearly one of the most advanced solid-state players, with a 10MWh manufacturing facility recently launched to provide prototypes to partners for testing.”

[Images and logos of Ford, Samsung, BMW, and Hyundai]
# SOLID POWER AT A GLANCE

## Overview

Industry-leading developer of sulfide-based **all solid-state batteries (ASSB)** for mobile power applications.

## MWh-Scale Production

Operating MWh-scale roll-to-roll all solid-state battery prototype pilot production line with validation by multiple OEMs.

## OEM JDAs

Ongoing, non-exclusive, joint development agreements (JDAs) with **BMW** & **FORD** among others.

## Backed By Prominent Investors

- **Ford**
- **Hyundai**
- **Samsung**
- **Volta Energy Technologies**
- **Sando**
- **A123 Systems**
- **Solvay**

## Two Product Groups

- **Energy-dense solid-state cells**
- **Sulfide solid electrolytes**
ADVANTAGES AT EVERY STAGE OF ASSB PRODUCTION

**Li₂S precursor**

Li₂S precursor developed in-house and via partners for low cost and optimized for mass production of electrolyte and cells.

**Electrolyte**

Best all-around solid electrolyte materials produced using low-cost scalable processes.

**Production**

Pilot scale production using the same equipment as conventional Li-ion to quickly enable low-cost GWh-scale production.

**Pouch cells**

Multi-Ah pouch cells deliver >50% energy advantage over Li-ion while also being inherently safer.
SOLID POWER’S ASSB PLATFORM: MULTIPLE ASSB VARIANTS

Core Technology: Solid Electrolyte

- Unique variants tuned as electrolyte, catholyte and anolyte products

Intercalation-Type Cathodes

- Industry-standard & commercially mature

Conversion-Type Cathodes

- Ultra low cost & high specific energy

Si-Based Anodes

- High charge rates

Lithium Metal Anode

- Ultra high energy

Flexible platform allows use of alternative anode + cathode materials to suit specific performance requirements

1 Solid Power’s v1 Cell Product
2 Solid Power’s v2 Cell Product
3 Solid Power’s v3 Cell Product
SOLID POWER’S FLEXIBLE ASSB PLATFORM

NMC + Li-Metal ASSB
V1 cell product
(Production scale today)

NMC + Silicon Anode ASSB
V2 cell product
(Production in late 2020)

Conversion Reaction Cathode + Li Metal ASSB
V3 cell product
(Production TBD)

- 350 Wh/kg demonstrated on production-line cells
- Core focus for mobility applications

- 340 Wh/kg demonstrated in hand-built pouch cells with quick-charge capability and excellent low temperature performance
- Promising for consumer electronics as well as mobility

- FeS2-based cathodes show significant advantages in cost, energy density and safety over NMC
- Mobility-relevant cycle is a longer-term challenge, but attractive for niche applications in near-term

Nearly **any future material** developed for Li-ion can be integrated using the same equipment and processes as Solid Power’s core materials
SOLID POWER’S TECHNOLOGY ROADMAP

Improvements in cell-level energy achieved through cell design optimization

Today’s Li-ion, 2019
260 Wh/kg, 500 Wh/L

Current Collector
Cathode
Separator
Graphite anode
Current Collector

Solid Power
ASSB, 2020
320 Wh/kg, 660 Wh/L

Current Collector
NMC composite cathode
Electrolyte / Separator Layer
Lithium Anode
Pre A- Sample

Solid Power
ASSB, 2021
340 Wh/kg, 720 Wh/L

Current Collector
NMC composite cathode
Electrolyte / Separator Layer
Lithium Anode
A- Sample

Solid Power
ASSB, 2022-2023
435 Wh/kg, 960 Wh/L

Current Collector
NMC composite cathode
Electrolyte / Separator Layer
Lithium Anode
B- Sample
ENERGY TARGETS ONLY REQUIRE CELL DESIGN OPTIMIZATION

Path to Li-NMC cell with 470 Wh/kg & 1000 Wh/L

**Reduced Electrolyte - Separator Thickness**

**Increased NMC % in Cathode**

**Increased Cathode Specific Capacity**

**Increased Cathode Loading**
COST BENEFITS OF SOLID-STATE

**Higher Energy Density vs. Li-ion**
- Higher energy density allows for decreased cost or increased range

**Inherently Safer vs. Li-ion**

**Solid Power Cost Advantages**
- Higher energy density allows for decreased cost or increased range
- Improved safety allows for pack simplification and use of larger cells / higher energy chemistries
- **Compatible with well-established and emerging Li-ion production equipment and processes**
- Elimination of expensive production steps such as cell formation
SOLID POWER’S MWh-SCALE PROTOTYPE PRODUCTION LINE

- Solid Power’s cell manufacturing processes are almost identical to current Lithium-ion
  - Electrolyte filling removed
  - Complicated formation steps replaced

- Dry room environment is compatible with existing Lithium-ion battery production infrastructure
  - Dew point spec of -40 °C

- Solid Power leverages current Li-ion manufacturing infrastructure to ensure minimal CAPEX investment to launch an all solid-state cell

Value proposition:
Ability to quickly deploy solid-state technology for early adaptor platforms
COMPARISON TO LI-ION PRODUCTION

Electrode manufacturing is identical

Electrolyte fill eliminated

Almost entire formation process eliminated!
## 2020 Q2-Q4 Achievements

### Manufacturing

- MWh-scale roll-to-roll production line fully operational
- 2020 production rate targets met for both cell and electrolyte

**Series A thesis validated:**

- Solid Power’s ASSBs can be manufactured using Li-ion industry-standard processes and equipment
- Cell performance improvements can be achieved via process improvements (e.g., slurry, coating, calendaring, etc.)

Production trials on 20Ah pre A-Sample initiated – first 20Ah cells built in November

### Performance

- Cell and electrolyte material performance validated via external parties.
- Further external party validation ongoing

- Near room-temp. and high rate (up to 5C discharge at 70°C) performance demonstrated on production-line cells

- Superior calendar life data vs. Li-ion indicates pack-cooling unnecessary

### Customer Deliverables

As of end of November, >450 cells delivered to partners with several having already validating in-house data.

**Recipient breakdown:**

- Seven auto OEMs
- 4 Tier 1 cell suppliers
- An additional 3 auto OEMs are planned for delivery to in Q3 & Q4
THANK YOU