Battery Technology & Products for Commercial Vehicles & Fleets

08-27-2020

ROMEO
POWER TECHNOLOGY

Continuous cross-pollination for accelerating battery innovation

Strong team with relevant combined experience across key engineering disciplines

Romeo Engineering Overview

- 7 GWh-capable, fully functional manufacturing and R&D center located in Los Angeles, California
- 60+ battery-specific engineers
- Deep knowledge experts team across all core engineering disciplines including electrical, thermal, chemical, mechanical, electrochemistry.
- Team members experienced with multiple prolific vehicle launches
- Combining automotive, space, and aviation tech to create the most advanced battery systems for electric vehicles.

Select Professional Experience

TESLA, SPACEX, BOSCH, BOMBARDIER, SIEMENS, Qualcomm, LOCKHEED MARTIN, United Technologies, ROLLS ROYCE, Ford

Representative Product Launch Experience of Romeo Engineering Team

Tesla Roadster

Tesla Model S

Tesla Model X

Faraday Future FF91

Fiat 500e

Porsche Cayenne Hybrid

Apache Helicopter

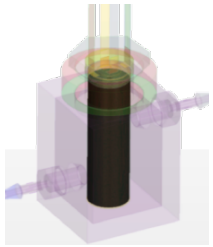
SpaceX Dragon Rocket

Advancing cell chemistry to system integration

Recipe for modular design and best-in-class components

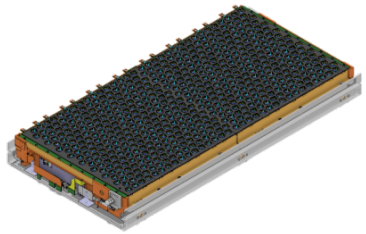
1 Cell Science

- Cell procurement is a carefully guided process with rigorous testing and validation processes to ensure only the best cells are selected
- Romeo's packs and modules are cell-agnostic, allowing the company to use only the best for each application, and adapt and change as new cells come to market



2 Module Technology

- Flexible and customizable design acts as a building block which allow for custom packs without needing months / years of additional R&D for each prototype
- Modules are designed to meet the highest safety standards and have undergone deep testing and validation, both at the individual pack and module level



3 Pack Technology

- Mechanical pack design addresses key requirements – from durability and crashworthiness to manufacturability, serviceability, and recyclability
- Flexible design allows the company to reach significant scale and a broad range of customer needs without incurring significant additional costs and overhead

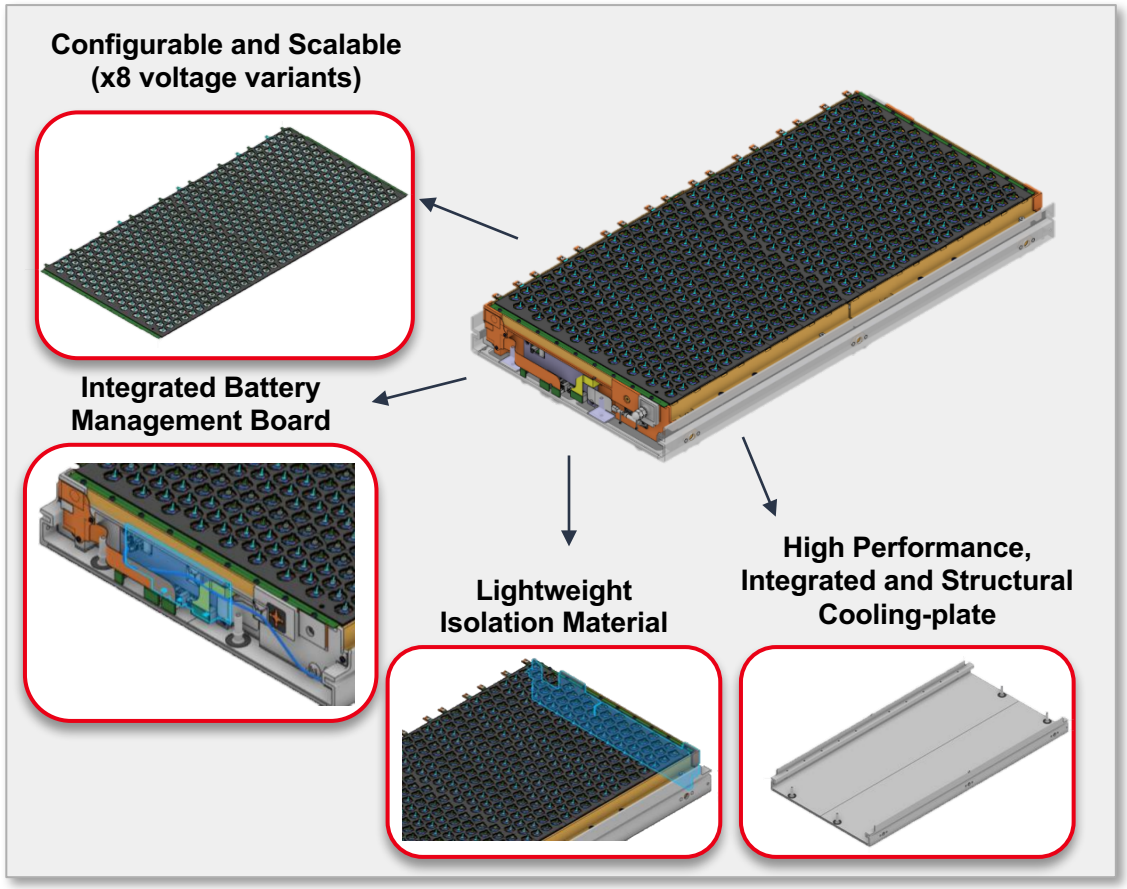
4 BMS & Algorithms

- Battery management system serves as complete solution for monitoring and control
- Romeo's BMS are built on a highly configurable platform, allowing it to support a wide variety of architectures, and driving lower cost and a faster time to market when compared to peers

2 Module Technology

Flexible and efficient building block for configurable, scalable energy storage

Hermes Module



Key Attributes

- ***Market-leading automotive building block*** with active high cooling performance
- ***20-30% more energy density*** than same-size competitor packs
- High stability and ***superior thermal management*** (<4 deg C Temp delta)
- Patented cold-plate technology allows for ***quick integration into Class 1 to Class 8 electric motors***
- ***Electrical isolation protection achieved without compromising*** energy density or thermal performance
- Liquid active cooling within ***slimmest volume factor*** (7% of volume)
- ***No fire propagation*** during single or multiple cell failures
- ***2hr baseline charge time*** for optimal life (20min, fast charge to 80%)
- ***Highest manufacturing rate***

3 Pack Technology

Common battery technology across multiple classes of vehicles

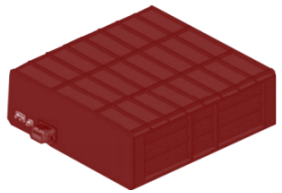
Massive Deployment Leverage at Every Level

With Just One Highly Configurable Module…

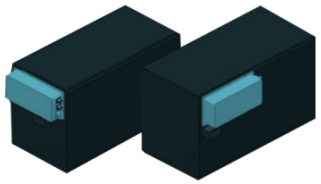
Hermes Module

… Romeo Can Create a Variety of Unique Packs…

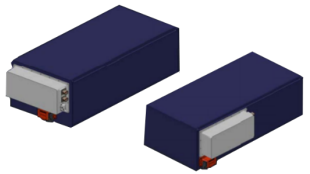
Orion V4



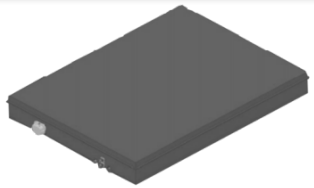
Orion V3



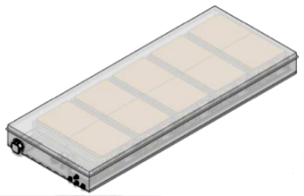
Orion V2



Orion V1



Flat V2



Flat 1

… Serving a Wide Range of Growing End Markets

Freight

Bus / Shuttle

Fire Truck

Refuse Truck

Yard Truck

Delivery Truck

Step-Van

Passenger Truck

High Performance EV

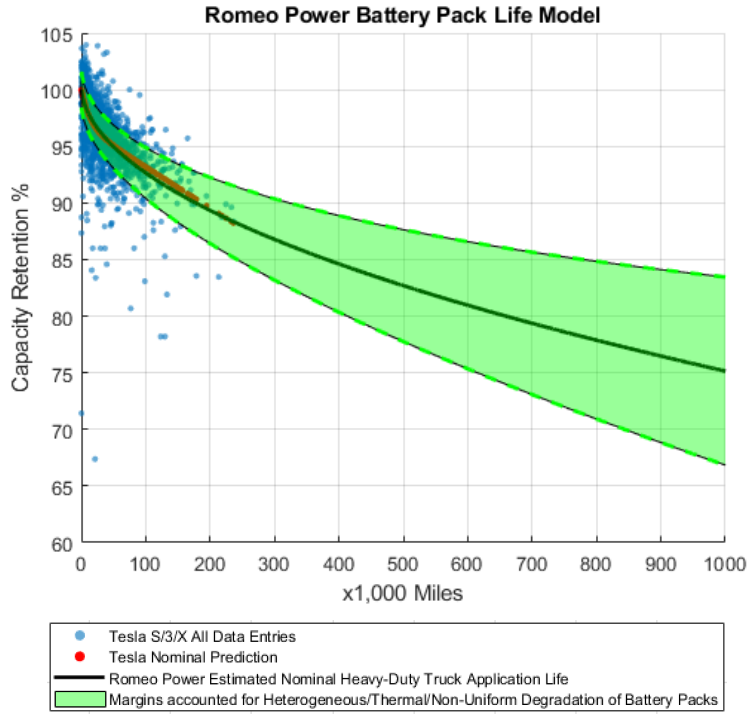
Using 4 major cells, with 8 voltage variants and 6 different packs, Romeo is able to create *192 products* utilizing the same module, manufacturing line, process and test sequence, allowing for high customizability and product expansion with ease

[1]Representative only, non-exhaustive list of potential end markets

Battery Lifecycle Management

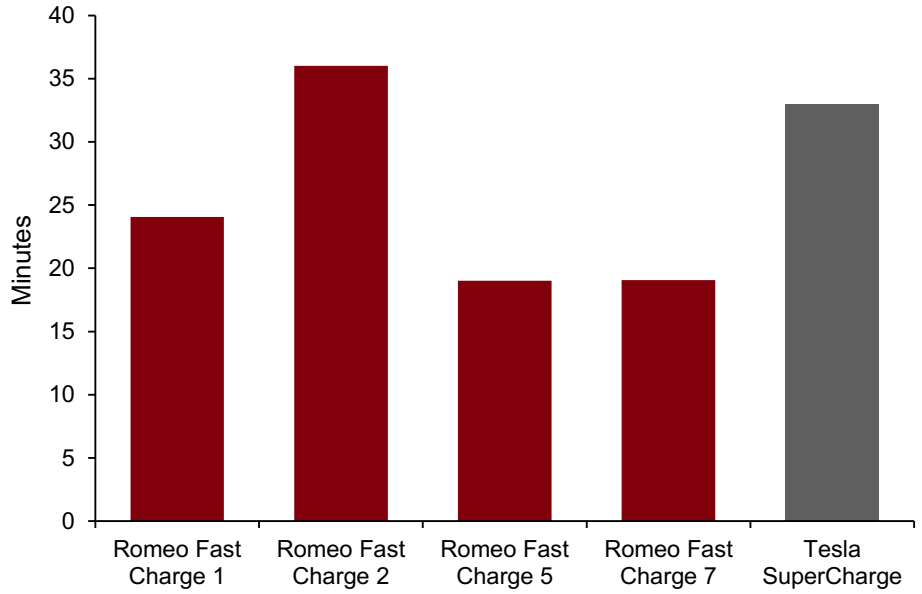
One Million miles battery, and balancing for fast charge needs

One Million Mile Battery Life[1]



- Cell chemistry selection and design based on commercial vehicle needs
- New generation of low cobalt NCA cells with extra long life
- Uniform thermal management and BMS controls

Collection of the Quickest Fast Charge Protocols for Different Applications



- By developing multiple leading edge fast charging protocols, Romeo is able to balance charging needs with battery life
- Preheating and thermal modulation ensure cells receptive to fast charge
- Rigorous laboratory experimentation and battery modeling identifies fast charge methods with least damage factors

[1]Source: Tesla Open Source Data Project

Designing for Recycling and Second-life

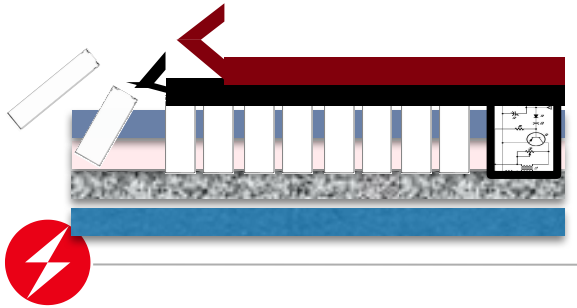
Romeo keeps sustainability at the forefront from the beginning

Battery Recycling will be a Key Focus for Many Peers

- Recycling rates for li-ion batteries in the U.S. and Europe are less than 5% today
- Large-scale, global adoption of li-ion batteries will require cost-effective recycling processes
- Ease of battery recovery cannot be at expense of safety and durability
- Reducing recycling cost through ease of access to aged battery cells:
  - Reduced work hours for pack/module disassembly
  - Reduced tooling required for disassembly

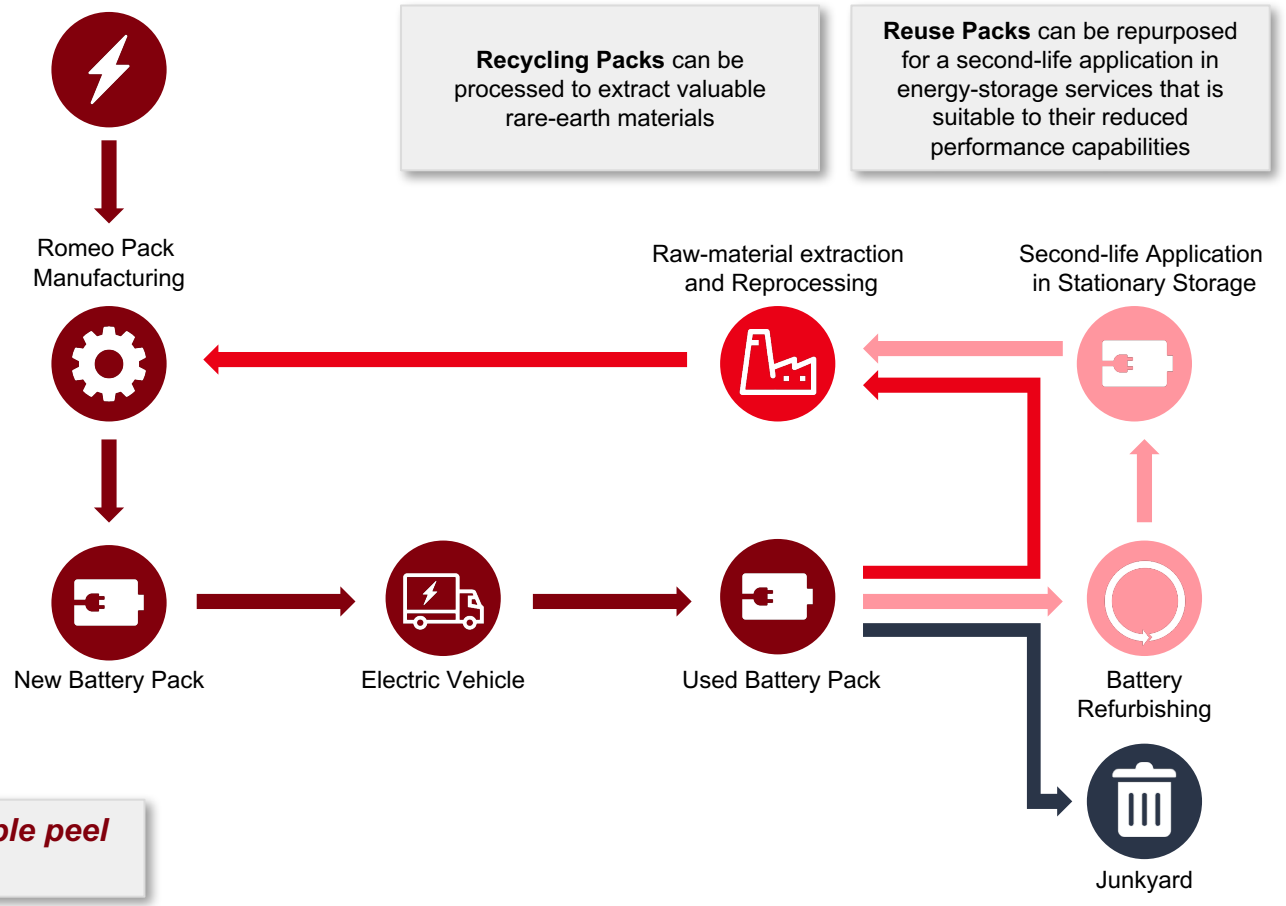
Designed for Cell & Material Recovery at End of Life

- Romeo's batteries are designed with recycling ease in mind:
  - Layered design approach for ease of disassembly drives more cost effective recycling
  - Low content of adhesives and putties that would make separation processes complex and expensive



Layered design allows for simple peel style disassembly

Battery Life Cycle



Recycling Packs can be processed to extract valuable rare-earth materials

Reuse Packs can be repurposed for a second-life application in energy-storage services that is suitable to their reduced performance capabilities

Source: Chemical & Engineering News

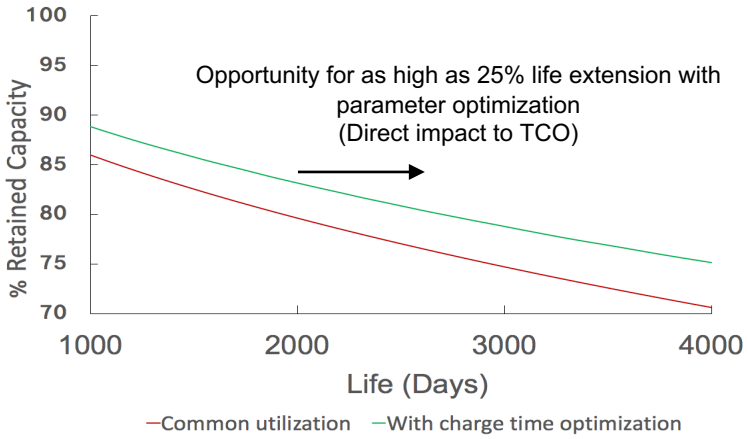
Machine Learning to Optimize Battery Life and Warranty Coverage

Romeo's machine learning provides incremental life extension, and TCO improvements for fleets

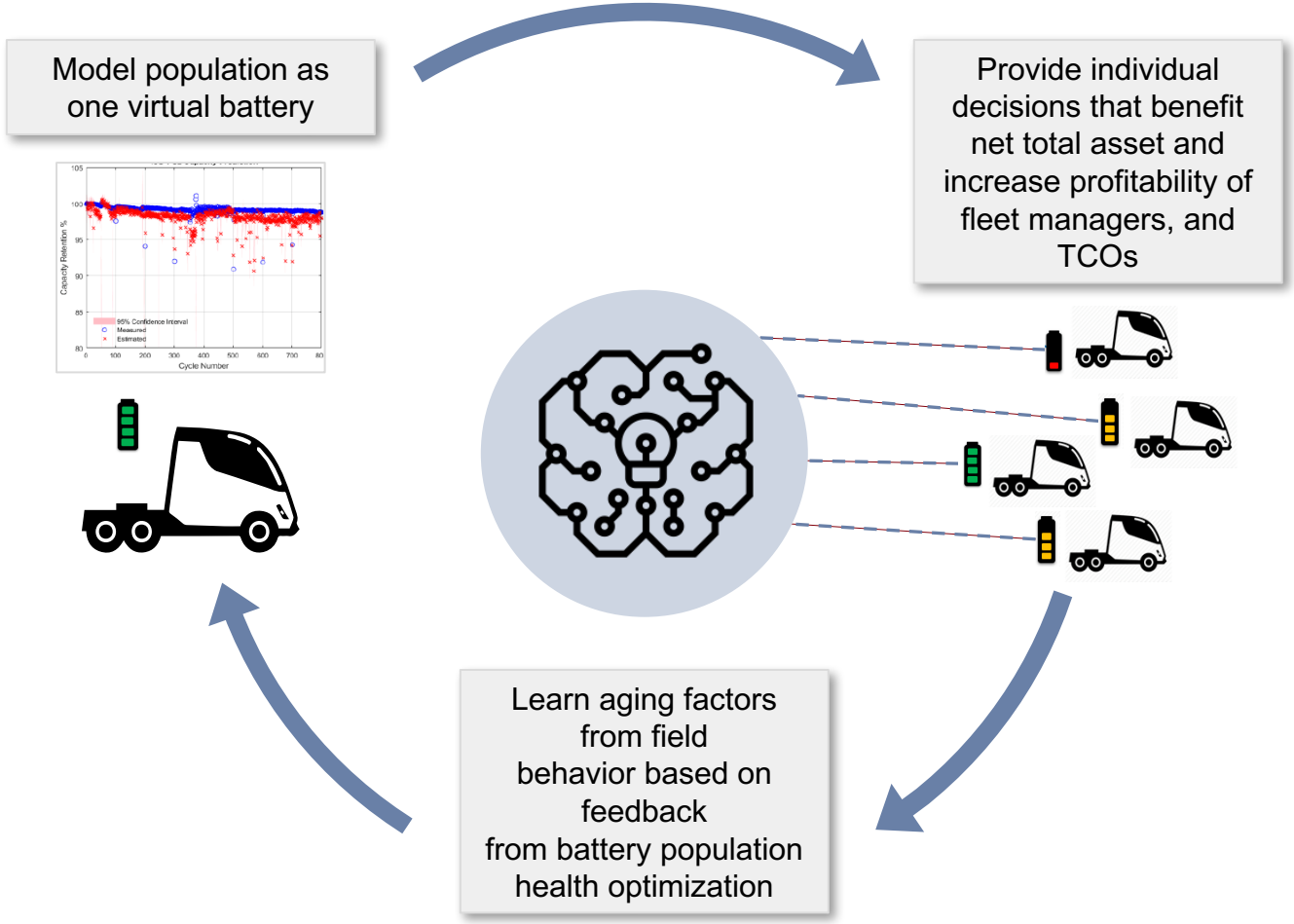
Machine Learning

- Romeo applies algorithms for life optimization of electric fleets based on field operation data
- Ride sharing or truck fleet companies can maximize total fleet battery health (effective total asset life) by leveraging machine learning to help make choices on the following:
  - Vehicles to deploy
  - Routes to take
  - Optimal charging schedule & rate

Aging as a Result of Charge Time Optimization



How it Works: Couples over existing vehicle telemetry solutions



Batteries will keep evolving after Diesel is completely displaced

Continuous advancement in multitude of fields will accelerate adoption rates, and price down.

1. Safer
2. Faster charging
3. Longer life
4. Lighter weight
5. More compact
6. 1 MWh systems at 1MW charging
7. Connected
8. Scaling

Pathway to Densification