BATTERY SYSTEMS IN POWERTRAIN DURING ELECTRIFICATION TRANSITION: FOCUS ON SAFETY

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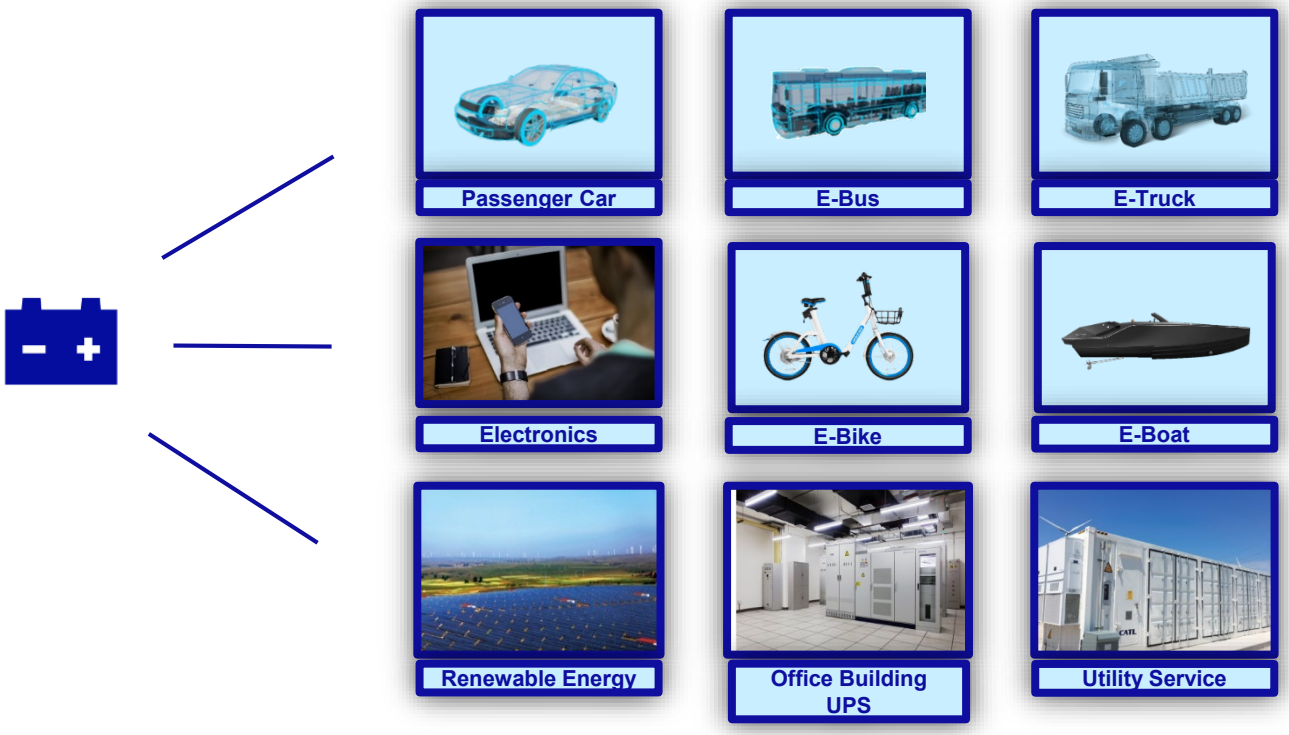
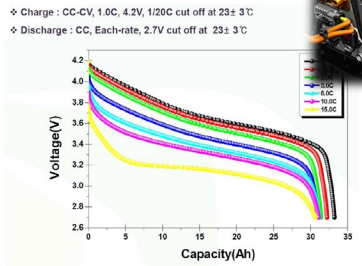
PROTERRA
BATTERY ELECTRIC
ZERO EMISSIONS
E-FAN X
AIRBUS
SIEMENS
Rolls-Royce
CalTrain
HYBRID
KYOKUTO
TOYOTA

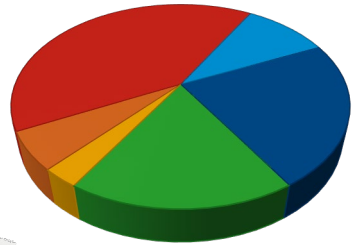
EXAMPLE BATTERY APPLICATIONS:
Each application has its own set of safety and environmental characteristics



5 GOLDEN RULES OF ELECTRIFICATION

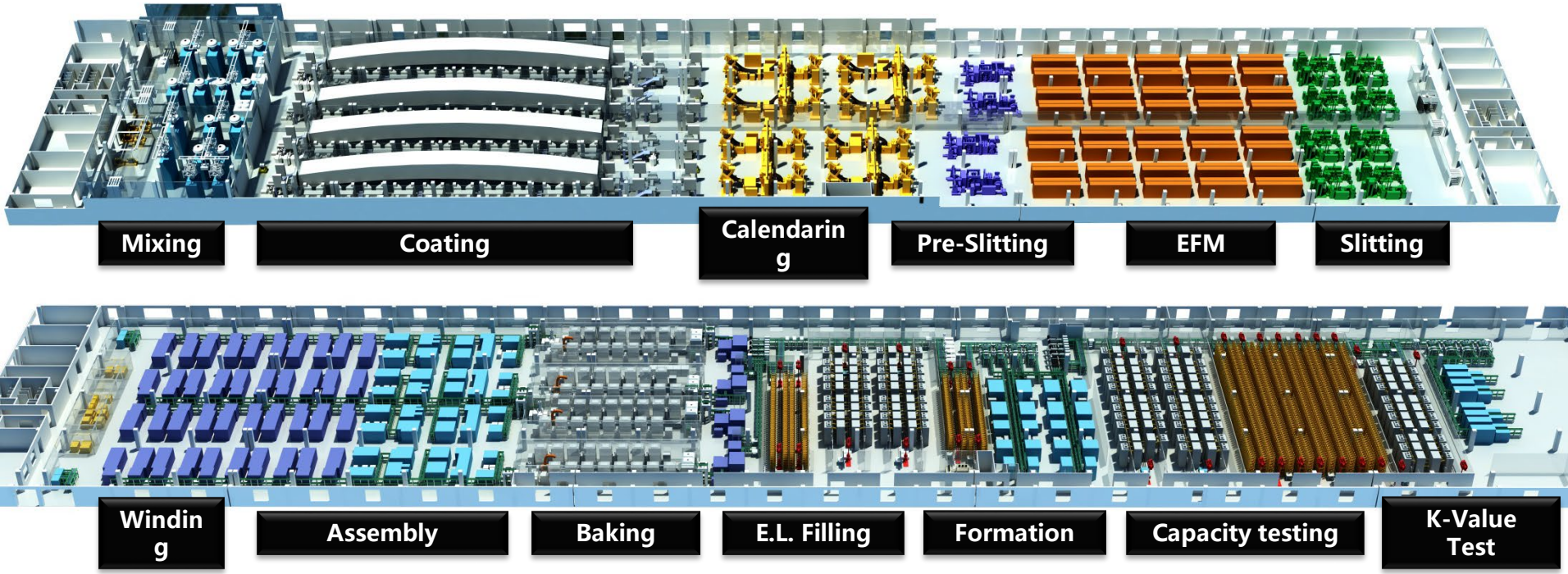
- Safety
- Performance
- Life
- Cost
- Environmental





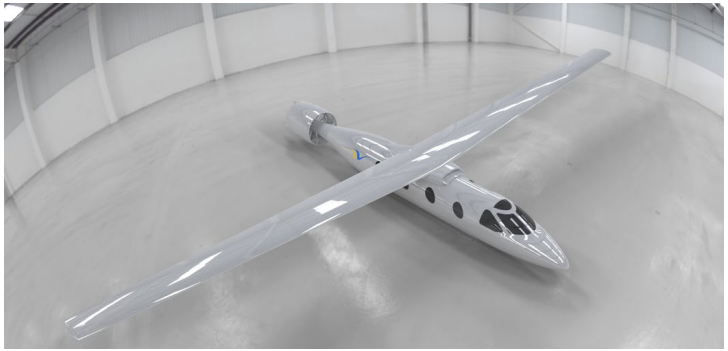
BATTERY TESTING FACILITIES VALIDATE SAFETY

MANUFACTURING SAFETY IMPROVEMENTS



EARLY ADOPTERS IN CONSTRUCTION ELECTRIFICATION

EARLY ADOPTERS OF ELECTRIC REGIONAL AIRCRAFT



Source clockwise from top left: 1. https://en.wikipedia.org/wiki/NASA_X-57_Maxwell, 2. http://ampaire.com, 3. https://www.eviation.co/, 4. http://zunum.aero,

MARINE MARKET

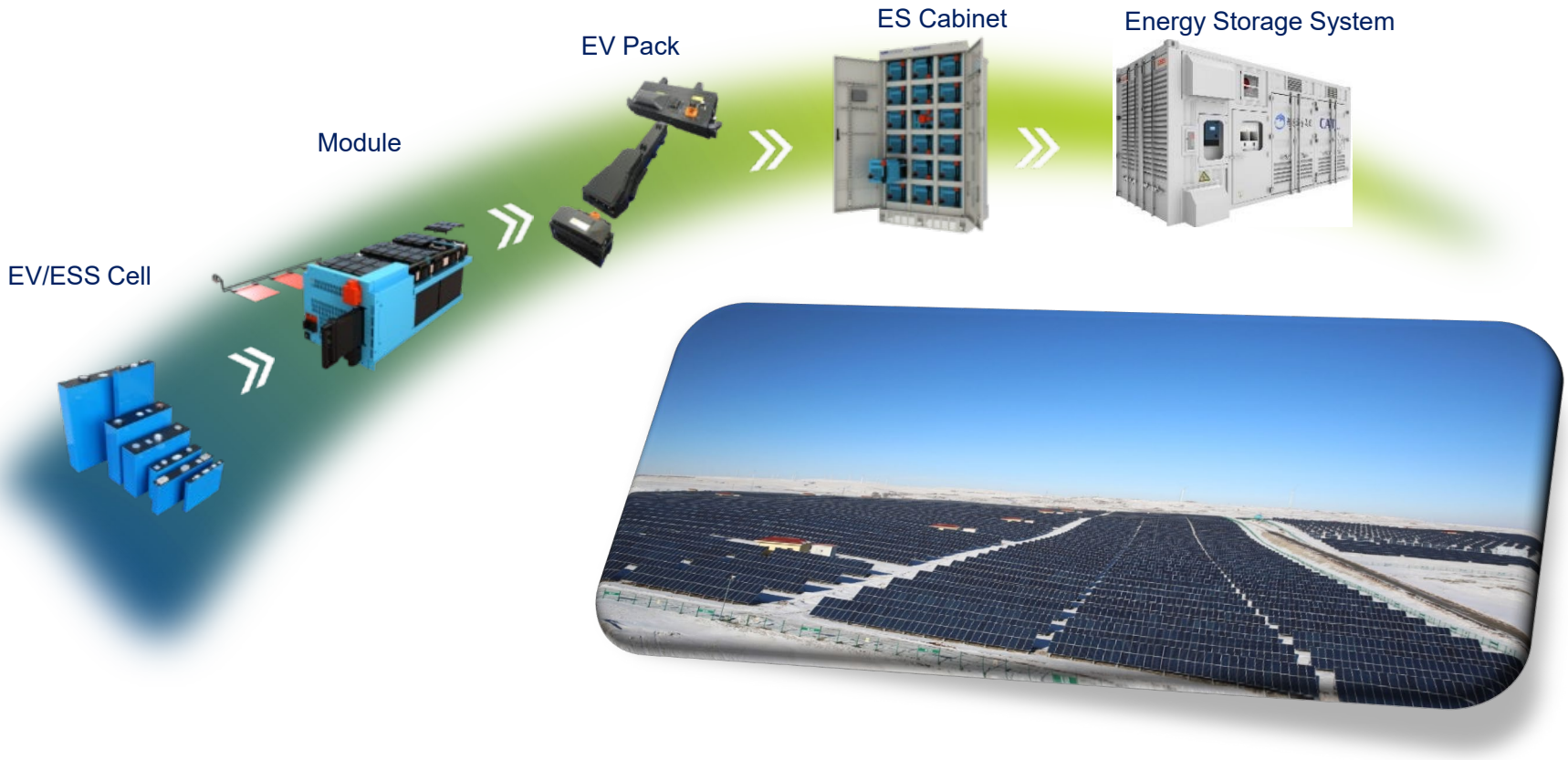
Range from 100’s of kWh to multi-MWh

- “Ellen” Largest electric ferry = 4.3 MWh
- “Yara Birkeland” – autonomous, container vessel launches in 2020 with 9 MWh battery

“Ellen” (2019)

“Yara Birkeland” (2020)

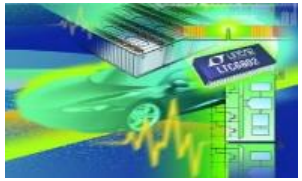
SAFETY IN RENEWABLE ENERGY STORAGE



SAE Standards in Advanced Technology Focus Areas

Wireless Charging

Driver-Vehicle Interface



Electronics System Reliability

Driving Automation Systems

Active Safety

Functional Safety

Connected Vehicles

Shared Mobility

EV/Hybrid/FC Vehicle & Battery

Vehicle Electronics Cyber Security

Intelligent Transport Systems

Mobility for Elderly and Persons with Disabilities

BATTERY STANDARDS COMMITTEE DOCUMENTS

10 Active
15 Under Revision
2 Stabilized
7 New in Progress

Battery Life Assessment Testing:
J240, J2185, J2288, J2801

Sealing, Adhesives, Thermal Management:
J3073, JXXXX

Battery Testing Methodologies:
J537, J1495, J2758 , J930

Future Battery Systems:
JXXXX

Battery Materials Testing:
J2983, J3021, J3042, J3159

Functional Guidelines:
J2289

Vibration:
J2380, J3060

Battery Labeling:
J2936

Battery Recycling:
J3071, J2974, J2984

Battery Safety:
J2929, J2464, J2946

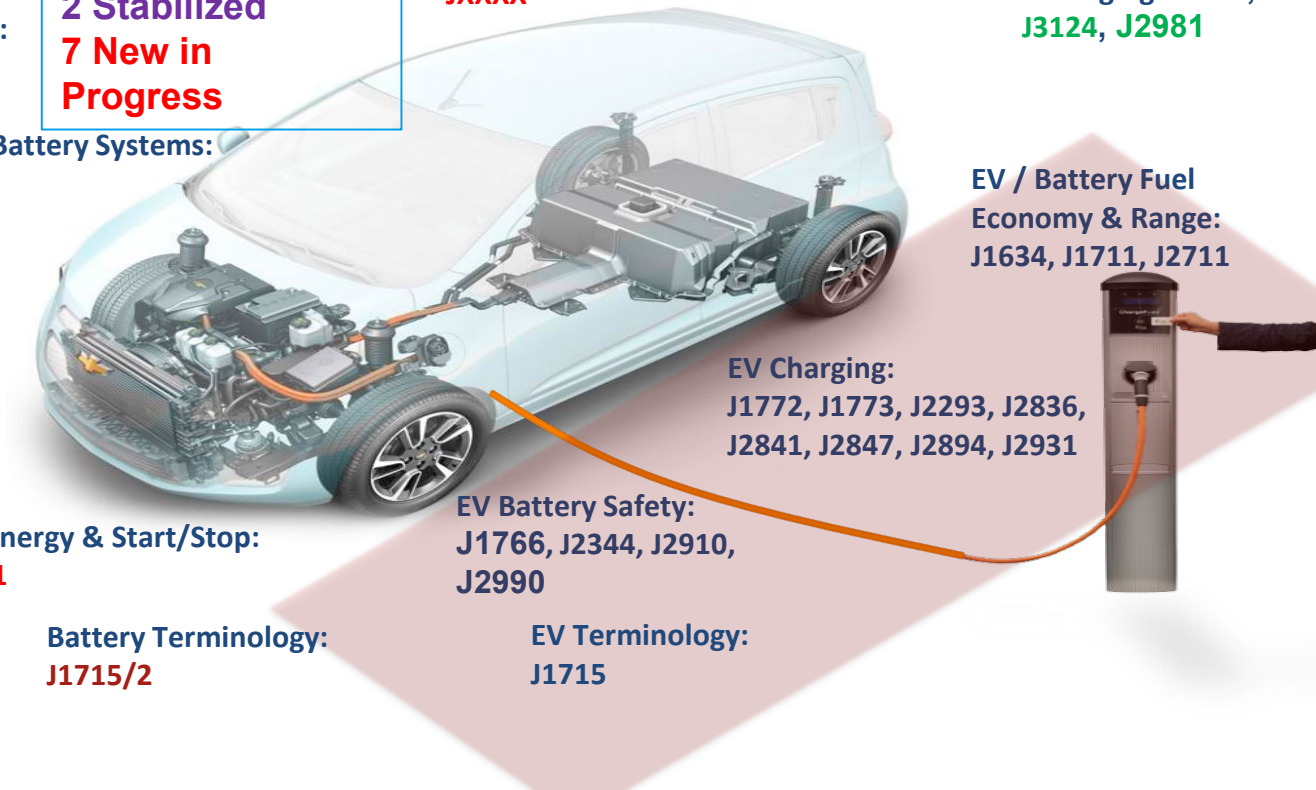
Battery Transport:
J2950

Capacitive Energy & Start/Stop:
J3012, J3051

Battery Testing Equipment:
JXXXX

Battery Performance Rating: J1798

Battery Size, Identification & Packaging: J1797, J3124, J2981



EV / Battery Fuel Economy & Range:
J1634, J1711, J2711

EV Charging:
J1772, J1773, J2293, J2836, J2841, J2847, J2894, J2931

EV Battery Safety:
J1766, J2344, J2910, J2990

Battery Terminology:
J1715/2

EV Terminology:
J1715

61 SAE EV, Hybrid, Fuel Cell Vehicle Standards:

Fuel Cell Fueling: J2600, J2601, J2601/1. J2601/2, J2601/3,J2601/4, J2719, J2719/1, J2799, J1766, J2578, J2579

Fuel Cell Testing: J2615, J2616, J2617

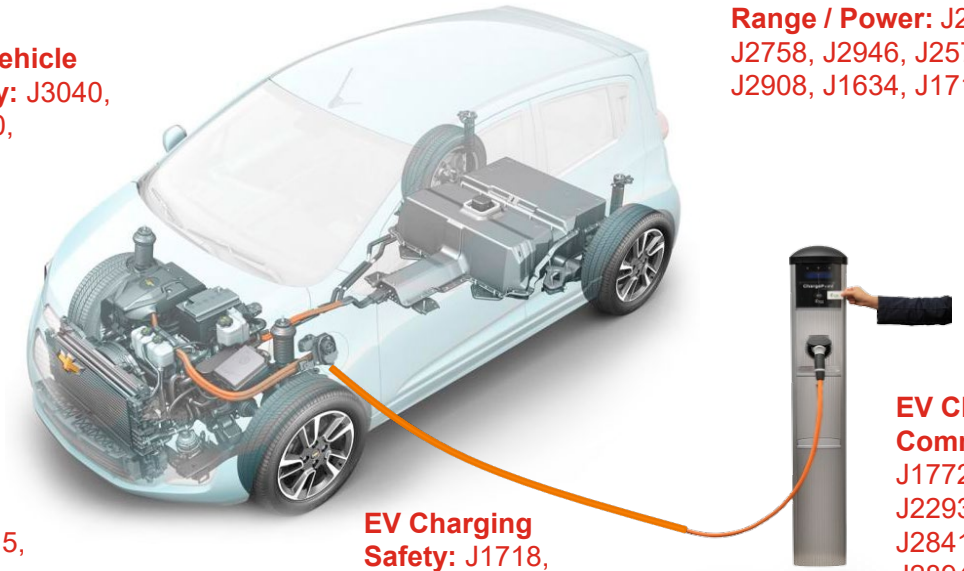
Fuel Cell Systems: J2579, J2594, J3089

Energy Transfer Systems: J2293, J2293/1, J3072

EV / Fuel Cell Terminology: J1715, J2574, J2760

EV Hybrid Vehicle Crash Safety: J3040, J1766, J2990, J2990/2

EV / Fuel Cell - Safety: J1766, J2344, J2910, J2990, J2990/1, J3108, J2578, 3108



EV Charging Safety: J1718, J2953/1, J2953/2, J2953/3

EV / Fuel Cell Economy, Range / Power: J2991, J1798, J2758, J2946, J2572, J2907, J2908, J1634, J1711, J2711

EV Charging & Grid Communications: J1772, J1773, J2293, J2836, J2841, J2847, J2894, J2931, J2954, J3068, J3105

* Blue Font Denotes WIP