

Energy, Environment and Battery

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U.S. Energy Flows 2005 US consumes about 100 Quads of Energy Annually



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US consumes about 100 Quads Energy Annually

- The 40 quads of income energy is OIL.
 <u>– Net imports is 60% of the 40 quads.</u>
- Light-Duty Vehicle consumes <u>17</u> quads of total energy.
- Freight/Others consume <u>7.60</u> quads of total energy.
- The lost energy is <u>55.1</u> quads.
 - The loss from electricity generation, transmission and distribution is <u>25.54</u> quads of total energy.

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Needed Technology to Save Energy and Environment

- Electrical energy storage technology to reduce loss
 - Battery technology
- High efficient transportation technology (Improve mileage per gallon)
 Battery Technology for EV, PHEV and HEV

Advanced Battery Technology is Critically Important!

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Issues of Battery Technology

- Light Weight (Wh/kg) Requirement leads to Li-ion Technology.
 - Issues
 - 1. Safety issue
 - 2. Performance issue
 - 3. Cost issue

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Safety Issue: Manageable Fully Charge Crush Test



Quallion Helicopter Battery

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Advanced Safety Quallion HAM Technology







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Quallion Matrix Module 48V, 9.5Ah, 0.456Kwh*, 78x115x260mm

Small Cells for Better Thermal Management





* Standard Module (Whr and W capability varies in energy module and power module)

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Design of Matrix Module

Sealed Container

- prevents mildew and particle contamination Small cells in Matrix 2D connection
- Cooling Plate and Thermo-Conductive Plastic
- Battery Monitor Circuit
- SMBUS Data Output



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BMC in the Matrix Module

Block Diagram for Each Battery pack



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Central Controller

Block Diagram for All system



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SOA COTS Cells: Optimum 18650 Will be Chosen

Cell Type	Capacity(mAh)	Weight(g)	Remark	Wh/kg	W/kg
18650 F3	2500	47	High energy application - 2005 Version	197	390
18650 F1	2100	47	High energy application - 2001 Version	165	330
18650 Y	1900	43.3	Energy/Power combination application	162	970
18650 W	1500	44.3	High power application	125	1600
18650 SA	1200	41	Ultra high power application	108	2200

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Performance is not an Issue

Quallion Long Life and Scalable Chemistry

Both 170mAh and 72Ah Cells Shows Consistent Cycle Life Prediction (>70% capacity retention after 60,000 Cycles at DOD 60% cycle)







72Ah Cell Test Data

170mAh Cell Test Data

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Cost Issue

New Business Case

The Vehicle-to-Grid Concept - V2G

Connected vehicles serve as distributed energy resource (DER)



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Real Issue Going Forward Japan used to be Battery Technology Leader



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Real issue going forward

- Lack of Vision
- Lack of Business Mind/Talent
- Needs US patents and US Attorneys
- A New Vertically Integrated Industry/Technology Leader
 - Material in-house production
 - Cell/Battery Production capability
 - Control Electronics/System Technology Capability
 - Battery Lease Business

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