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e-Mobility Industry Update

Oregon Transportation Electrification Executive Council

November 10, 2010

by Charlie Allcock

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Topics

- EVS-25 Conference & Exhibition
- WEVA e-Visionary Award
- e-Mobility Overview
- Auto OEM
- Charging
- Batteries
- Supply Chain
- Other Observations

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EVS-25
Shenzhen, China

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E-Visionary Award
Presented by the World Electric Vehicle Association (WEVA)
at EVS-25 Conference & Exhibition
Shenzhen, China
November 9, 2010

2010 Award winners – Oregon, Shenzhen & Amsterdam

Oregon representatives Charlie Allcock, Tim McCabe & James Mast with EDTA President Brian Wynne

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e-Mobility

- Discussion shifting from Plug-in passenger vehicles to electrification of many forms of transportation
  - Truck, bus, taxi, rail, scooters, bikes
  - Integration among these many transportation forms
- More focus on reducing GHG emissions from transportation
  - 75% of world's population lives in 1% of the land area (in urban environments), and contribute to 75-80% of GHG emissions
- Regions and Metros are focus geographies, not nations

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Auto OEM

- All major global OEMs have announced PEV models
  - Some start-up OEMs are gaining traction
- Passenger cars first (2010/12), followed by trucks, busses and taxi fleets (2011/12)
- Simultaneous global deployment/sales, limited only by battery manufacturing capacity
- Partnering among OEMs
- Initial costs are still high, and must be offset by government subsidies. Can be cost-competitive to ICE vehicles on all-in, life-cycle basis

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Charging

- Global electrical equipment manufacturers have begun e-mobility product offerings
- Vehicle and charging infrastructure deployment beginning with minimal standards
  - Changing international standards & protocols
  - Little consistency among plug designs
- Europe, US, Japan and China
  - 200V vs 100V
  - Quick Charging: AC vs DC (CHAdeMO)
- Early research show most charging occurs at home and at work for private passenger cars
  - Limited use of public chargers except for “opportunistic” quick charging
- Fleet charging may involve combinations of charging protocols, ways to reduce impact of peak electrical loads, and battery swapping
- No clear business model for charger deployment and operations without government subsidies
- Many new designs for chargers; unit prices also expected to fall significantly.
  - Expect charger manufacturers to incorporate “value-added” features/services to enhance business model
- Clear trend to incorporating solar PV as part of EV charging

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Batteries

- Mostly based on Li-ion, with varying combinations of Ni, Co, Mg, and other metals
- Batteries are unique
  - Form factors vary (sizes vary considerably)
  - PHEV vs BEV (power vs energy)
  - Auto OEM specs vary
  - Battery Management Units (BMU) vary
- Considerable new Li-ion battery manufacturing capacity coming on-line globally 2011/13
- Prices of new batteries (per kWh) falling $1000 → $500→ ???
- Consolidation among battery manufacturers likely

Supply Chain Transformation

- Back-office systems integration and information flow is next “frontier”
  - Opportunity for Oregon’s software industry
  - Think lots of “apps”
  - PEV is first “smart appliance”
- Some BEV products will be sold through different distribution channels
- “Smart Grid” & “V2G” are popular discussion topics
  - Auto OEMs concern over vehicle/battery warranty
  - G2V is challenging enough
  - Charging infrastructure/standards not designed for bi-directional power flows

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Other Observations

- Leverage “Best Practices” learned from activities worldwide
  - Collaborate with other “pack leader” regions – local governments, universities, utilities, supply chain
  - University research collaboration, in particular, can be invaluable to information gathering/sharing
- Fleets (eg bus, delivery trucks, taxis, rental cars) may be best near-term approach to demonstrate benefits of transportation electrification for broader adoption
- Leadership in e-Mobility does lead to other clean-tech opportunities for additional job creation
- Formalize Oregon framework for e-mobility initiatives
- Think Global, Be Opportunistic. Act Quickly and Boldly.