Fuji Electric Corp. of America

DC Fast Charging: The Need To Remain Flexible
December 2011
About Us: *Fuji Electric Corporation of America*

- Fuji Electric Corporation, Ltd. (based in Tokyo, Japan)
  - Established in 1923
  - leader in industrial manufacturing
  - $8 billion in annual revenue
  - 25,000 employees worldwide
  - 300 DC Quick Chargers deployed to date
  - Global businesses in Asia, China, Europe, and Americas

Fuji Electric Corporation of America (based in Edison, NJ)
- Wholly owned subsidiary of Fuji Electric Co, Ltd.
- Established 1970
- responsible for the sales, marketing and distribution throughout the Americas
- 16 business units with products ranging from Semiconductors and Drives to Radiation Detection Equipment and Power Supply products.
- All products with a focus on energy and the environment
About the Speaker: Larry Butkovich

- Larry joined Fuji Electric Corp. of America in September as the General Manager for EV Systems

- **Primary Responsibilities at Fuji Electric:**
  - New product launch in US market
  - Development of short and long-term strategies for Fuji Electric’s EV business

- **Past Experience:**
  - History of successful plant development and startups at General Motors, Cobasys and International Battery.
  - Direct involvement with the design, manufacture and testing of Lithium Ion cells and battery systems for motive and stationary applications.
Market Similarities
EV: Common Concerns Around the Globe

- Range Anxiety
- Price Sensitivity
- Charging Infrastructure
- Standards & Regulations
- Long-Term Viability of EV Industry
- Charging Time / Harming the Battery
Range Anxiety

• Availability of public charging infrastructure is a major concern in all markets; Majority of charging will be done at home but in order to generate widespread acceptance of Electric Vehicles, range anxiety needs to be addressed

• Global vs. Domestic Consumer Behavior
  – On average, about 70%-80% of consumers around the world travel fifty miles or less per day (that figure rises to as high as 94% in Japan). The lowest percentage is about 60%, in India.
  – To ease range anxiety, people want to be able to drive 200-300 miles on a single charge (this is three times the range that is currently available)
  – In reality, most users around the world could be satisfied with the current technology for their daily commute.

• DC Quick Charging offers the best solution to this issue—there is currently no short-term EV manufacturer claiming to have a product with significantly longer range in the next 3-5 years.
  – Public charging stations and placement along highway corridors may help reassure consumers that charging infrastructure is in place

Current EV technology might offer what people **NEED**, but it **does not give them what they WANT**.
Charging Infrastructure

- **Residential Chargers**
  - Although the majority of consumers will utilize Level I AC Charging to charge their vehicles at home overnight (8 hours for a full charge), they want a quicker alternative.

- **Workplace Charging**
  - Level I and Level II chargers may be available in non-residential locations (i.e. work) for EV owners to use.
  - Potential market for DC Quick Charging.

- **DC Quick Chargers**
  - Most convenient charging option, offering EV owners an 80% charge in 30 minutes.
  - Ideal for public parking, retail locations, fleets, rental cars, etc.
Price Sensitivity

Electric Vehicle Costs

• Why the Higher Cost?
  – Electric cars are generally more expensive than gasoline cars due to the high cost of car batteries.

• What are Consumers Willing to Pay?
  – A report by J.D. Power and Associates stated that, despite the growing emphasis on “green” living and environment concerns, 50% of U.S. car buyers are not willing to pay more than a $5,000 premium for a “green vehicle”
  – When polled, the majority of consumers want to pay $20,000 or less for an EV.
    • In a few developed countries, such as US, Canada and Japan, consumers may be willing to pay up to $30,000—still a tall order for EV manufacturers.
Price Sensitivity

Charging Station Costs

- Development of public charging infrastructure is challenged by the cost of charging stations
- DC Quick Chargers range from $10,000 (Nissan’s new low-cost model) to $65,000; Average price of a DC Quick Charger is $30-40k
- Billing models have not yet been fully developed
- Many businesses are offering EV Charging Stations as a value-add service to their customers
- Cost reduction must be accomplished by improved technology, and design/manufacturing practices.

  *Production volume alone will not bring prices to the level consumers want to pay.--Consumers always want more for less.

Government Funding

- Government subsidies or incentives are vital for the long-term success of the EV industry market
- Extreme price sensitivity by consumers and business professionals will delay mass adoption, unless government programs are available to help defray EV costs
- Several national and local governments have established tax credits, subsidies, and other incentives to reduce the net purchase price of electric cars and other plug-ins.
DC Quick Charging Standard: CHAdeMO

- CHAdeMO was formed by The Tokyo Electric Power Company, Nissan, Mitsubishi and Fuji Heavy Industries in early 2010. Toyota later joined as its fifth executive member.

- **Fun Trivia:** CHAdeMO is an abbreviation of “CHArge de MOve”, equivalent to “charge for moving”, and is a pun for O cha demo ikaga desuka in Japanese,[1] meaning “How about some tea” (while charging) in English.[2]
DC Quick Chargers: The Need to Remain Flexible

- Fuji Electric has over 300 DC Quick Charging Stations deployed in the Japanese market
- Growing importance for EVSE Professionals to understand the differences and similarities between the global EV market and the domestic US market
  - Fuji Electric to offer insight into Japanese EV Market, and its impact on our US strategy for DC Quick Charging
  - Understanding of global market can help shape domestic strategies

- Flexibility is key for all EVSE professionals:
  - Adapting to local market regulations (i.e. UL) is necessary for penetration
  - Legislation

“Keep up…or get left behind.”
Short-Term Approach for Long-Term Success

POWER
FLEXIBILITY
AGILITY
Developing vs. Developed Nations

Developed Nations

- As of October 2011, Japan and the United States are the “largest highway-capable electric car markets in the world”
  - Japan – As of July 2011, over 10,000 electric cars have been reported sold, including more than 6,000 Nissan Leaf and more than 4,000 Mitsubishi i MiEVs.
  - U.S. - As of October 2011, electric car sales are led by the Nissan Leaf with 8,066 units reported sold

Developing Nations

- Barriers to entry in Developing nations (i.e. India) exist, but are less about market’s willingness to change and more about price sensitivity; High fuel prices generate interest in EV, but the cost of ownership remains a challenge.
- Satisfied with existing EV technology in terms of distance.
EV Charging Stations: *Looks Matter*

- **Japan market observations:**
  - Vending machines are used as a basis for comparison in terms of size; this allows for use of readily available products (i.e. weather protection shelters, etc)

- **US Market Strategy**
  - Emphasis is placed on
    - Efficiency
    - Reduction in unit size
    - Cost reduction
    - Design flexibility
    - Reliability, MTB

*Price erosion is inevitable in all markets.*

- Technological improvements need to be explored now so that advancements can be identified ahead of time.
  - This will allow for cost reduction without sacrificing quality
- Design development is critical, and must continue—the EV industry is in its early stages, and needs to evolve to offer higher quality products with more features/benefits at a reduced cost.
A Surprising Connection: Vending Machines

• Fuji Electric is one of Japan’s largest manufacturers of vending machines, producing over 500 units per day.

• Synergies exist between vending machine design/construction and EV Charging Stations, bringing to light some key points for EVSE manufacturers:
  – Importance of design development is important—volume alone is not enough to ensure success.
  – Combination of design technology and manufacturing competencies.
EV Chargers vs. Vending Machines: Market Similarities

**Similarities**
- Complex product
- Importance of data
- Individual Point-of-Sale
- Size & Shape
- 3rd Party Supported Products
- High volume required
- Importance of manufacturing design
- Similar sales channels
- Low competitor differentiation
- New technology development is key
- Modular approach to offer custom solutions

**Impact on FEA EV Strategy**
- Modular 25kW unit for EV Chargers
- DFA, DFM
- Design components to limit size and weight
- Standardized manufacturing process
- Point-of-Sale capabilities
- Various transactional types
- Designed to allow for outdoor use
- Lower manufacturing cost
- Transaction value similar to vending

We know what you’re thinking...
What about GAS STATIONS?

- Similarities between EV Chargers and Gas Stations are not as significant as we originally assumed
- Important to keep an open mind with emerging technologies and markets… *the most obvious comparisons may not be the best ones.*

**Why Are Gas Stations DIFFERENT than EV Chargers?**
- Higher transaction cost (~$50)
- Locations require significant infrastructure
- Environmental issues and permit requirements
- Potential for odors and leaks
- Need large centralized install (not scaleable)

**What does this mean for EV Chargers?**
- Opens the realm of possibilities for location of EV Chargers
  - Small business
  - Parks
  - Chain Stores
  .......*similar to vending machines*
Vending Machine Production Process

Materials

- **Coil material**: Sheet material used for outer casing of vending machines. About 80 sheets can be obtained per coil.

- **Ammonia**:
  - Coil is cut into sections and transported, forming the inner of the vending machine.

Folding Process

- **Folding**: Cutter is used to cut and fold the coil, forming the shell of the vending machine.

Welding

- **Welding and penetration welding**: welded using a NCW welding machine.
- **Top and side surface welding**: using top welding robot to weld the outer frame of the vending machine.
- **Surface welding / surface finishing**: manually welded points to be reinforced, and finishing the appearance.

Applying coating

- **Applying coating**: Nontoxic water-based coating is used to protect the inner shell of the vending machine.

Assembly

- **Assembly**: Main body assembly line, using automatic welding for high-quality welding.
- **Door attachment**: Frame is produced at another factory, then attached.
- **Door adjustment**: Doors are attached to the main body and adjusted.

Finished products

- **Door adjustment**: Adjusting the inner frame after the door is attached.
- **Test**: Testing the finished product before shipping.
DC Quick Charging: *Target Markets in US*

- DC Quick Charging markets are similar in Japan and US
  - Range Anxiety can be overcome with publicly available DC Fast Chargers (~80% charge in 30 minutes)
  - High cost makes them less suitable for at-home installation
  - DCQC is an enabler opening EV market to consumers that would not consider EVs today due to range concerns

- Fleets – Primary Target for US
  - Route predictability
  - High utilization rates
  - Centralized charging.
  - Lower “total cost of ownership” than conventional fleet vehicles
  - Electrification Coalition estimates that by 2015, as much as 6-7% of fleet segment sales could be plug-in vehicles, equivalent to annual sales of approximately 130,000 units in 2015.
Summary

• EVSE Professionals must recognize the differences between the Global market and the domestic US market, including (but not limited to):
  – Regulations and Legislation
  – Consumer Willingness to Change
  – Development of charging infrastructure
  – Market requirements for product specifications
  – Price Sensitivity (what costs are consumers most sensitive about? EV costs? Fuel costs?)

• Flexibility is KEY – EVSE professionals with the willingness and ability to adapt to market changes

• Government funding is critical in all markets

• Universal standards for DC Quick Charging are critical--EVSE professionals are paying a high price for delays in standardization decisions

• Design development must continue to evolve and improve in order to ensure quality products with additional features/benefits at competitive prices
Thank You