Electric Vehicle Infrastructure

Market History and Observations

9/23/09

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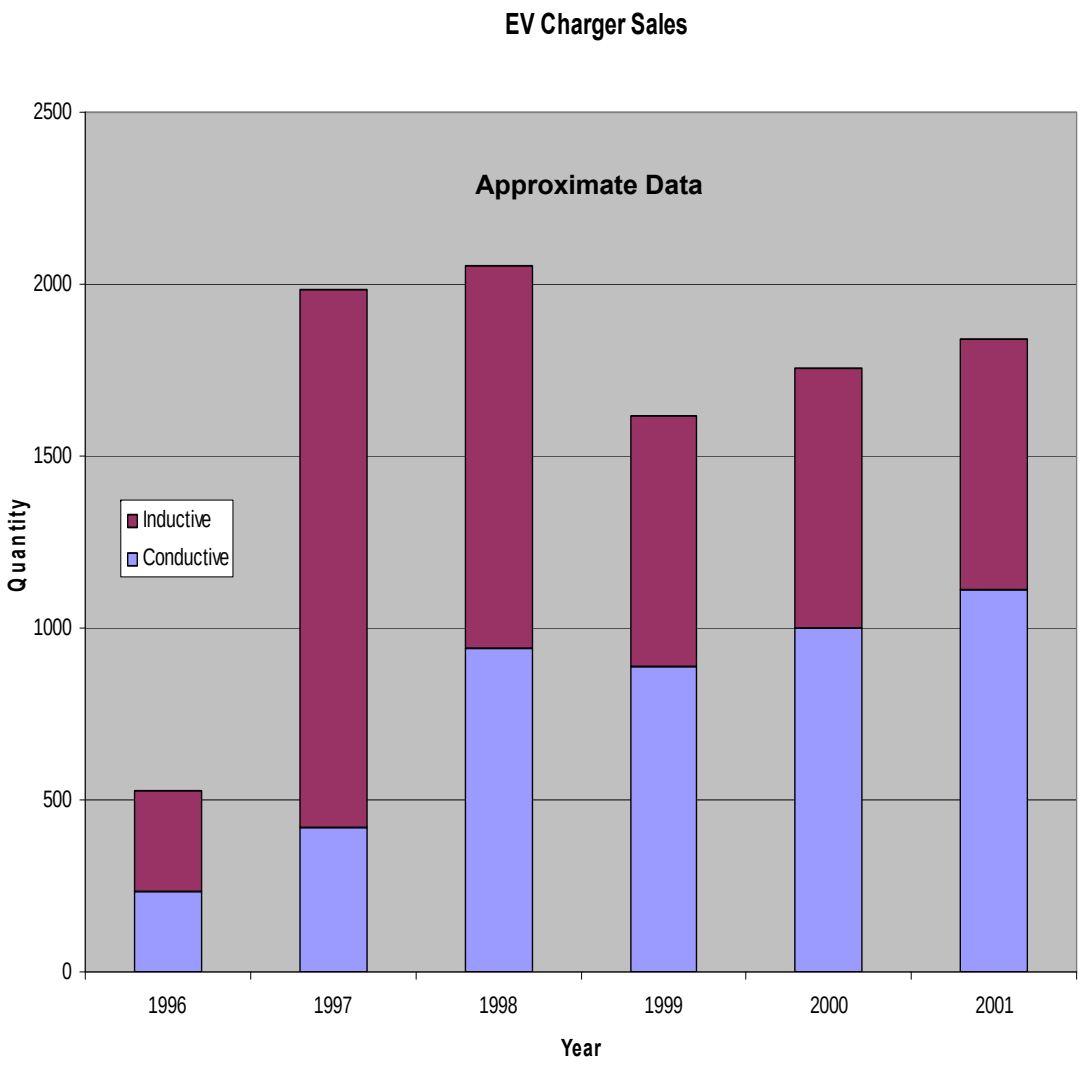
EV Infrastructure Market Circa 2001



- Charger market primarily tied to automaker vehicle placements
- Inductive Technology had early lead with GM EV-1 placements
- Conductive Technology shows steady growth as Ford products entered the market
- Approximately equal quantities of each technology sold to-date

California was about 50% of the market

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SMUD's EV Charger Program Summary

- SMUD has been actively installing EV Chargers Since 1991
  - Began Working With Electrical Vehicle Infrastructure Inc. in 1992 on Conductive Chargers
  - Market Studies Conducted On Public Acceptance in 1994
  - Began installing inductive chargers in 1995
  - Acquired Magne Charge / General Motors Charger Contract in December of 1999 from Edison EV
    - Installation contractor network in California and Arizona
    - Responsible for approximately 1900 charger installations
    - Clean Fuel Connections Inc. primary contractor

- SMUD still active regarding public infrastructure
  - Coordinated activities with local EV Driver's Association
  - 42 EV Charging sites still active (Total of 119 Chargers)
    - 61 conductive chargers
    - 33 small paddle inductive
    - 25 large paddle inductive

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Average Infrastructure Installation Cost Breakdown

•Level 2 Residential installations averaged	$4000 per charger
•Charger (Inductive with $500 incentive)	$1900
•Installation labor	$1177
•Permits	$ 150
•Other Mat'ls and freight	$ 572
•Tax	$ 193
•Level 2 Commercial installations averaged	$6300 per charger
•Charger (Inductive w/o incentive)	$2480
•Installation labor	$2287
•Permits	$ 77
•Other Mat'ls and freight	$1497

Inductive charging hardware shown for reference
- 88 residential installations
- 62 commercial installations

Conductive EVSE was approximately $1000 per unit less

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Historical EV Charging Business Model

- **Most EV charging was home based with Local Utility**
  - Special TOU incentive rates for off-peak charging
  - Typically required special dual meter adapter installation
  - Cost analysis to determine dual meter pay-off

- **Work Place and Public Charging were free to drivers**
  - Workplace related charging significantly more prevalent than public
  - Cost usually picked up by the facility owner
  - Other incentives, parking location, and fees sometimes waived etc.

- **High Fixed Costs hard for Business Case**
  - Money primarily made on Hardware Sales
  - Installation activities broke even
  - Maintenance and repairs lost money
  - 3 Employee Business Office Typical
    - Office/Business manager
    - Electrical Design / Field Supervisor
    - Call Center / Records Keeper

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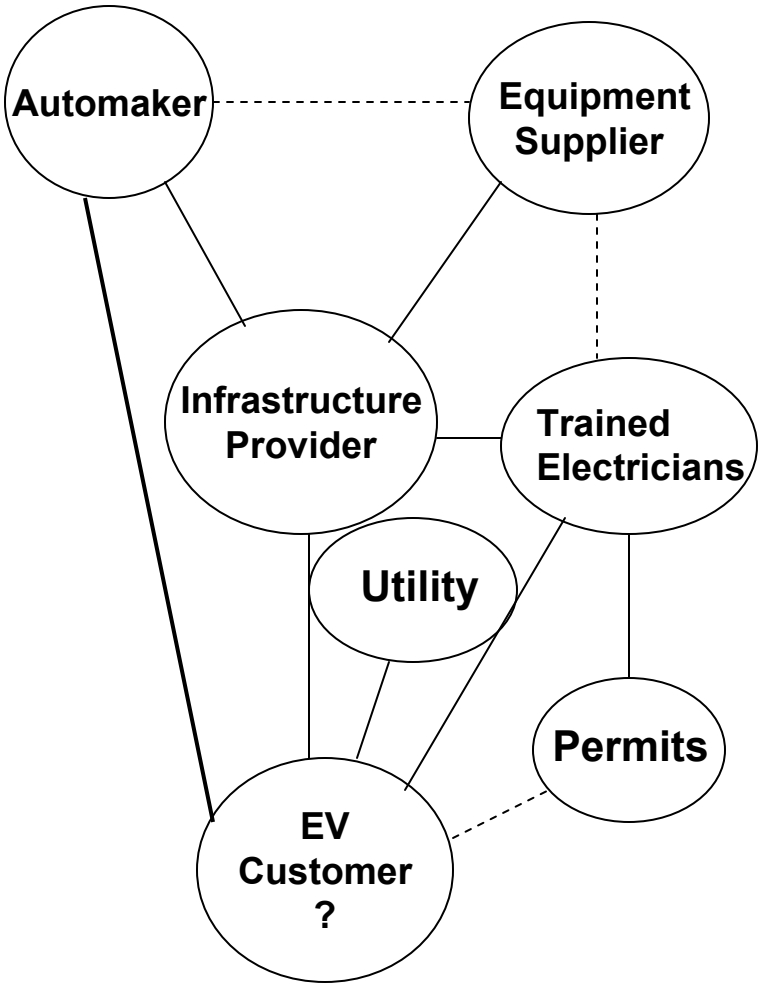
EV Infrastructure Market Drives Dilemma



Customer Wants

- #1 Immediate home installation and service
- #2 System Reliability and Wide Network
- #3 Low Cost Charging Equipment and Service
- #4 Low Cost Electric Power

Automaker Wants

- #1 Happy Customers (Immediate Service and System Reliability, Low Cost)
- #2 Low Cost

Infrastructure Provider's Dilemma:

Provide Immediate Reliable Service at Low Cost to A Wide Network of Charging Stations

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Reflections on Historical Business Problems

- Market never developed to sustain the business
  - Fixed cost coverage could not be met
  - No economy of scale to reduce hardware cost

- Lack of charging standards doubled public infrastructure costs
  Inductive versus conductive charger issue

- Unique equipment and warranty requirements required specialized contractor training

- Repair cost coverage needs to be factored into business model

- Free public charging eliminated any ongoing cost recovery from that sector which happened to require the most maintenance

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Other Tough Issues Never Addressed

- Multi-family Dwellings / Apartments
  - Typically require facility service upgrade
- Residential Street / Parking
  - Service upgrades for new service
  - Parking permits / regulations to prevent ICE-ing
- Integration with Advanced Metering and Smart Grid
  - Communication protocols standards
  - New EVSE Technology

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Lessons Learned from EV Infrastructure Market

- Invent Plug-in Hybrids √
  - Originally envisioned with 110V charging
  - No need for workplace or public charging
  - No range anxiety for drivers
- Need single standard interface √
  - Reduces public and work place infrastructure costs
- Need "Contractor" grade hardware that does not require special training
  - Common electrical contractor installation
  - More competition and widespread coverage
- Need to establish a mechanism to cover service cost
  - Warranty repair will not last forever

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New Business Models are cropping up

- Utility Bundled Services
  - Use of existing contractor networks
  - Bundled with other electrical service to spread cost

- Turnkey Infrastructure Service Providers
  - Hardware, Installation, O&M, Billing

- Centralized / “Gas Station” Operations
  - Fast Charging
  - Battery swap outs

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Final Thoughts

- Historical business model was not effective but may not have had time to fully develop
- New business models addressing some barriers
- New Communication Technology will eventually revolutionize plug-in vehicle charging
- Market likely to shift with time as technology matures
  - Network coverage cost versus gas station model
- Advanced Technologies will take time to materialize

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