ELECTRIC VEHICLES & THE SMART GRID

Final Presentation

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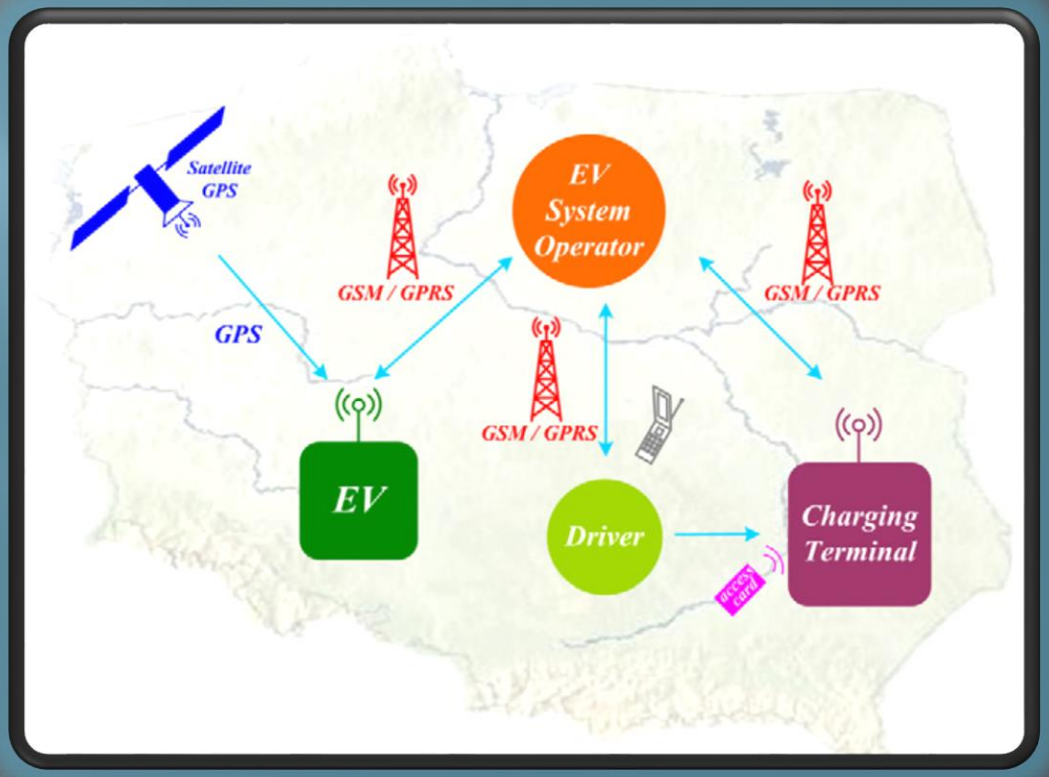
Who We Are?

- ***Electric Vehicle System Operator*** (EVSO) – manage communication with drivers, EVs, and charging terminals to help improve distribution and health of the smart grid
- ***Goal***: improve communication between participants with EVs in a "***CITY***" and manage smart grid at the same time

All pictures on this page are from the same source (Benysek & Jarnut, 2011)

Bi-directional Flow of Data and Electricity

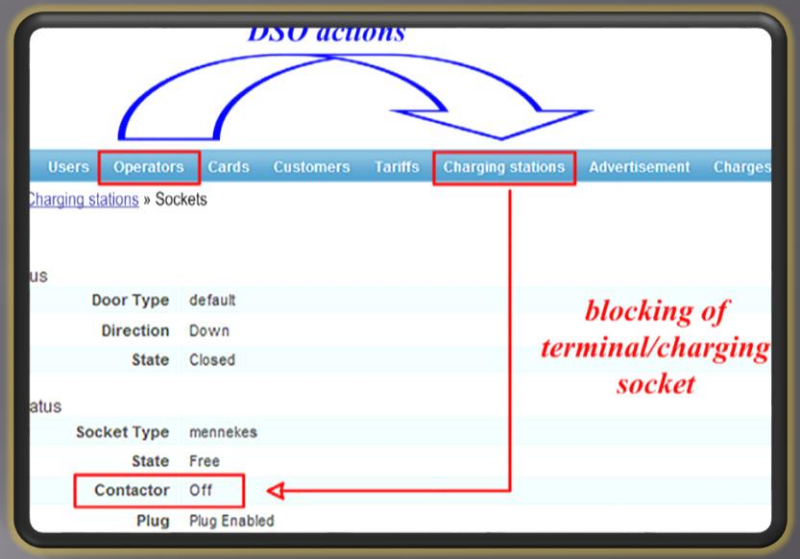
- EVSO collects data and compute the necessary requirements to maintain quality of EVs integration into the smart grid
- Data collected:
  - Battery Management System information
    - State of Charge (SOC)
    - State of Health (SOH)
  - Radio Frequency ID
  - Drivers input
  - Charging data
- Communication can be through General Packet Radio Service, or mesh wireless network



(Benysek & Jarnut, 2011)

EV System Operator Tasks

- After data is collected and stored in the database EVSO operate base on the information available from the data
- EVSO communicate with electric energy Distribution System Operator (DSO) to manage electricity demand issues:
  - Peak issues
  - Blackout
  - Brownout
  - Frequency, Voltage, and Phasor
- Action is relay back to the charging terminals to either:
  - Add tariffs (bottom image)
  - Block/limit charging (top image)
  - Discharging of battery
  - Incentives (lower/higher prices)



Both images are from: (Benysek & Jarnut, 2011)

Smartphone App

- Smart Phone App enable the consumers to monitor their car and set up schedule for their EVs charging time
- Data managing includes information such as pricing rates, charging time, bills, and charging records.
- Smartphone apps enable consumers to monitor or input max and min price they are willing to pay for electricity consumption
- Charging records enable smart grid (or in this case EVSO) to intelligently create best schedule for costumers while avoiding peak hours and other technical issues

http://www.comparance.com/articles/power-up-your-own-smart-grid

Bottom Picture: http://tommytoy.typepad.com/tommy-toy-pbt-consultin/2011/10/the-first-electric-car-that-runs-on-more-than-electricity-volt-is-unique-among-electric-vehicles-because-you-have-two.html

Convenience/Time

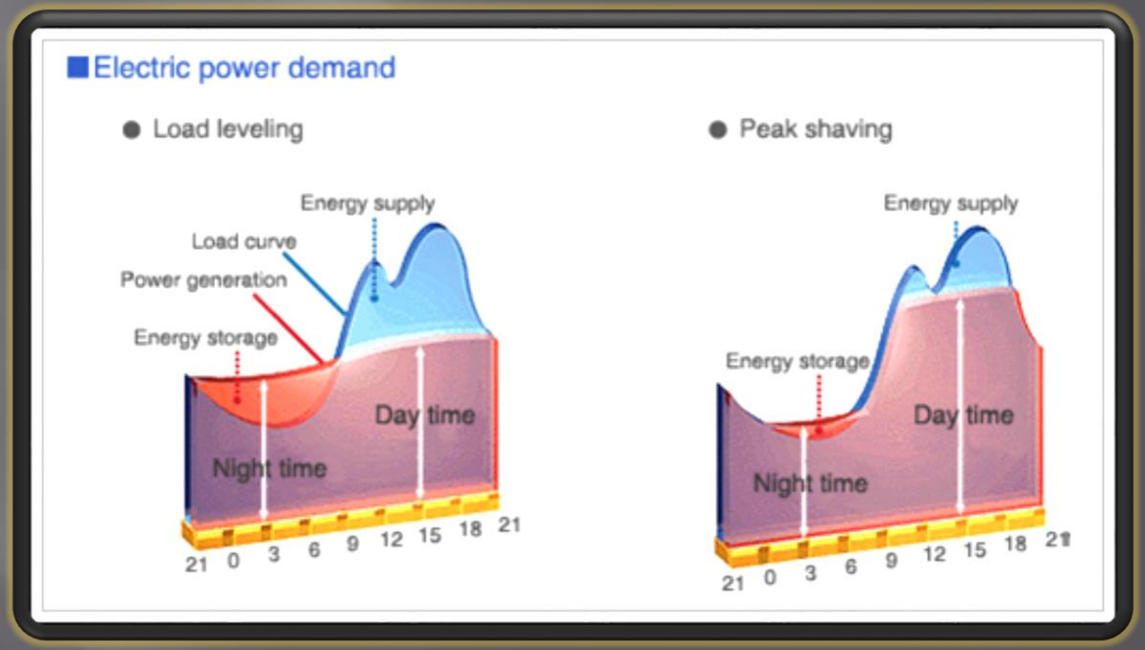
- Currently - 116,855 gas stations in the U.S. (1 station for every 2,500)
- 5,000 electric charging in the U.S. (California leads the way with 1,400)
- We must provide more charging station (public/home)

http://nfpa.typepad.com/evsafetytraining/2011/07/index.html

- When asked if drivers would pay for a home charging station, 33.3%said no, while 33.3% said only up to $500
- Provide EVs buyers with level 1 charging station (Save time from going to charging station)
- Install level 3 chargers (quickest charging) in public charging stations (less wait time)

Extra Electricity Storage

- Storage of electricity enable consumers to participate in electricity selling market
- Battery can provide electricity to smart grid to prevent peak issues (this process can be managed by EVSO)
- Consider life span of battery and costs when participating in electricity storage (+ cycle of possible recharging and discharging
- The extra cost of grid tie inverter (GTI) unless included in newer EVs



http://comnetenergy.com/wp-content/uploads/2011/01/lithium-ion-storage-chart.png

Cost of our Operation

CHARGERS

Charging terminals prices for EVSO to manage:

- Level 1: $900 (home)
- Level 2: $3,000 (home/public)
- Level 3: $40,000 (public)
- This technology implementation does not consider installation cost so price will be much higher!

NETWORK

Base on Tropos mesh network technology :

- Pole mounting communication technologies: $230
- Network management software: $1000

Below here shows more costs for implementation of charging terminals

Location Type	Number of Stations	Total Installation Price	Unit Price
Street Side	1	$2300	$2300
Underground Garage	2	$4100	$2050
Street Side	2	$2800	$1400
Parking Garage	5	$4300	$860
Parking Lot	3	$3200	$1066
Parking Lot	1	$7400	$7400
	15	**$24100**	

http://projectgetready.com/resources/charging-station-installation-costs

Cost of Operation (cont')

- Table below shows the cost of deploying wireless network in Manhattan (size being deployed to is 34 square miles)
- Cost are already in the millions (NOT CHEAP!)

- Area of Los Angeles: 470 sq. mi.
- (L.A. AREA)*(Manhattan Cost/Manhattan Area) = 470*($2 mil/34) = $27.6 million
- Note: this only consider the network cost => ignoring the terminals, other devices, and installation type cost

	Cells	Cost	Performance
3G (1x EV-DO)	64	~$8M	⇩150-400 kbps ⇧ 10-50 kbps
Wi-Fi TROPOS networks	600	<$2M	500-2,000 kbps *symmetric*

http://www.tropos.com/pdf/whitepapers/tropos_whitepaper_price_performance.pdf

Pros & Cons

BENEFITS

- EVSO will be able to help manage peak issues that arise
- Better maintenance of the smart grid health
- EVSO communication can create better services:
  - BMS data to analyze for issues in EVs:
    - State of Charge (SOC)
    - State of Health (SOH)
- Real time demand and response market for electricity consumers and distributors to participate in

PROBLEMS

- New idea, new technology, new market – lots of risk
- Investing before results
- Price of installation costs are unfeasible
- Setup of wireless network for EVSO communication with
  - EVs
  - Drivers
  - Terminals
- Smart grid technology has not been implemented while this scenario assume smart grid technology is already implemented

Conclusion

- Electric vehicle system operator in the smart grid is still far from being realistic
- Lack of money and investments make network setup for communication impossible so EVSO will never be a third party communicator between the smart grid's DSO and electric vehicle drivers
- EVSO communication network to communicate with EVs, drivers, and charging terminals costs can be reduce if risks of network setup is distributed between different investor or technology investments (HAN & AMI may use same wireless network so investments can be split with these two technologies)
- For EVSO to be successful:
  - Smart grid must be operational
  - Cost of technologies must go down
  - Wireless network must be available or set up
  - Electric energy DSO must communicate with EVSO

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Questions