Stabilizing the Energy Supply
Through the use of Decentralized Energy Storage in Consumer Electric Vehicles

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Background Information

Electrical Grid
- birth in Industrial Revolution
- Supply and Demand Equilibrium
- Net metering
- Smart Grid

- Electrical Storage Dilemma
  - lithium ion batteries
  - centralized batteries?
Possibilities

Decentralized storage
- power to the consumers
- store large amounts of energy in numerous batteries

Electric Vehicles
- rising in popularity
- relatively large storage

Renewable Energy
- grid parity
- dispatchability/efficiency
- encouraged baseline renewable consumption
Part 1: Vehicle-To-Grid

- Vehicle-to-grid (V2G): allows owners of plug-in electric vehicles to send power stored in their car batteries back into the grid during times of high demand.

http://greenlivingguy.com/2011/05/03/infographic-vehicle-to-grid-v2g-power-storage-why-electric-vehicles-matter/
Part 1: Vehicle-To-Grid

- Off-peak Charging/ On-peak discharging: Difference in price is the customer’s profit (potential of $4,000/year/car).

Part 1: Vehicle-To-Grid

- Stabilization of the grid through V2G

http://www.evwind.es/2012/09/30/u-s-development-of-vehicle-to-grid-v2g-technology/24049
Part 2: Smart Grid 2.0

In order for V2G technology to be most successful you need a grid that is digitally automated...

- Smart Grid 2.0 = Distribution automation
  - Real-time meter readings
  - Automated control
  - Smart home automation
  - Distributed storage
The Edison Project

- Original idea was a symbiosis of Smart Grid 2.0 infrastructure and V2G tech into what we called “Smart Grid 2.1”

- Instead we found The Edison Project
  - Pilot project in Denmark attempting to support an increase of wind capacity to 50% by 2020.
  - Project lacked an interface for consumers that creates a marketplace for energy trading between hydro companies and V2G customers.
PowerSwap

- A virtual market for power trading between electrical utilities and V2G customers.

- A simple app accessible by anyone with an EV
  - Provides an easy to use interface to simplify energy auctioning.
  - The app asks the users a series of questions, and produces a corresponding minimum energy price that the user is willing to sell their excess EV energy for.
PowerSwap: How it works

- If the transaction occurs, the energy sold will be credited to the user's account and paid to the user in the form of utility credit or rollover credit.

- During peak or intermediate demand hours, hydro companies can place a maximum bid for stored EV energy from their customers.

- If the bid meets or exceeds the customer's minimum sale price, the app will ask if the customer is willing to sell their excess energy.
PowerSwap: Features

- **AI interface**
  - Decides if it is more economical to utilize stored energy or to sell it.
  - Learns your travel habits and energy usage habits to optimize the trading of electricity.

- **Smart Home/Appliance Integration**
  - Real time measurements of energy usage data.
  - Appliance prioritization and scheduling.

- **Localized power generation integration**
  - Can store power generated from solar panels or other renewables and sell back to the grid only when the price for electricity is the highest.

- **Smart battery usage**
  - Calculates minimum energy sale price based on battery wear and tear.

- **Energy security**
  - Reserves a specified amount of energy in the EV for the sake of emergencies at all times.
Target Market
Demographic

- Location
  - Place where on-peak and off-peak electricity difference is high
  - Marketplace for electric vehicles is growing or has the potential to grow
  - Progressive cities with an infrastructure for vehicle to grid technology

- Consumers
  - Environmentally conscience individuals who own electrical vehicles.
    - Electrical vehicle ownership projected to rise exponentially with time.
Existing Governmental Policy

- Energy Policy Act of 2005
  - Promotional subsidies for producing renewable energy
  - Providing incentives for consumers as well as access to the technology needed for the implementation of our idea
Possible Governmental Policy

- Bridge the gap between the electric companies and the consumers
- Government funding for the app
- Smart meters
  - Installation
  - Development
Finances: Upfront costs for Consumer

- No upfront costs; no installation costs
- Costs allocated to homeowners utility bills instead
Finances: On-going Costs
Consumer

- Save money on household energy bills
- By using energy efficiently
- And hydro companies saving money
Finances: Supplier

- Smart meters will help suppliers save money
- Meter reads will no longer be needed
Pros

- Good way to promote electric cars
- Less CO2
- Promotes the upgrading of current outdated grid systems to new smart grid infrastructure.
- Stabilize the grid
- Future price of batteries expected to be lower while quality will increase
- Use battery as backup power for residential homes power outages
Cons

- Better to use partial discharge for the battery of the car
- Power loss through inefficiency of the transmission of electricity
- Power loss through inefficiency of the battery (heat)
- Electric Cars are currently expensive
Conclusion

- We were looking for an idea that promotes renewable energy and sustainability through a decentralized initiative.

- Our application, PowerSwap, will empower consumers to become more conscious of their energy usage and to contribute to their community’s grid infrastructure.

- Ultimately the ability to change our energy systems for the better lies in the hands of individuals.
References

- www.epa.gov