Energy Storage, EV’s and the Grid

Tesla Motors
JB Straubel – CTO, co-founder

2015 EIA Conference
June 15, 2015
Washington, D.C.
Tesla History & Corporate Overview

- Founded 2003
- IPO in 2010
- Model S sales begin in 2012
- Tesla Energy launched 2015
- HQ in Palo Alto, CA
- 13,000 employees

Headquarters Palo Alto, CA
Tesla Factory Fremont, CA
Design Studio Hawthorne, CA
EU Assembly Tilburg, NL
Electric Vehicle History – Battery History

- Lead-acid technology was still status quo in 1995
- Performance had stagnated
  - Short lifespan
  - Very heavy
  - Short range
Lithium-Ion Batteries & Tesla Roadster

Lithium Ion Technology Enabled
- 4 X gravimetric energy density
- 6 X volumetric energy density
Battery Technology

• Highest energy density
• Longest range
• Lowest $/kWh
Tesla Model S

“Better than anything we’ve ever tested”
“99 out of 100 points”

Highest safety rating in America
Available All-Wheel Drive Dual Motor
Zero to 60 mph in as little as 3.2 seconds
Up to 270 miles range (EPA)
Roadmap – EVs for the Mass Market

Vehicle Affordability

Market Size / Timing

First Generation

Tesla Roadster

Second Generation Platform

Tesla Model S

Tesla Model X

Third Generation Platform

Tesla Gen III Sedan & Crossover

Mercedes-Benz

Toyota
• **Tesla Supercharger Network**
  - DC connection to vehicle
  - 135 kW power (300-415VDC)
  - 400 mph charging (30 minutes)

**SUPERCHARGER**

Find a charging location near you

The World’s Fastest Charging Station

Superchargers are free connectors that charge Model S in minutes instead of hours. Stations are strategically placed to minimize stops during long distance travel and are conveniently located near restaurants, shopping centers, and WiFi hot spots. Each station contains multiple Superchargers to help you get back on the road quickly.
Superchargers Today
Connected Vehicle Fleet

- Battery Management
- Motor Control
- Diagnostics
- Touchscreen
- Mobile App
- Traction and Stability Control

Complete Over the Air Updates

2015: 60,000+ cumulative Model S
5GWh of Batteries

2020: 1,000,000+ Tesla Vehicles
70GWh of Batteries
10GW Controllable Charge Load
Tesla Powerwall

- 10kWh for backup power, $3,500
- 7kWh for daily cycling, $3,000
- Can be paralleled and aggregated/dispatched
- 10 year warranty
Tesla Powerpack

- 100kWh building block
- Scales to 100MWh+
- 20+ year PPA, capacity guaranteed
- Focus on delivering lowest LCOE,
  flexible transaction structure
Grid-Scale Storage

Example:
25MW / 100 MWh
< 2 acres
Global Battery Manufacturing

500,000 vehicles/year

- Gigafactory
- Others
- Lishen
- BYD
- BAK
- ATL
- Maxell
- Sony
- Panasonic
- LG Chem
- SDI

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Gigafactory 1.0

- $4-5 Billion investment
- Under construction in Reno, NV
- 6,500 full-time jobs
- First battery packs mid-2016

50 GWh in annual battery production by 2020
Enough for 500,000 Tesla cars
Powered by renewable energy
Net zero energy factory
Solar Photovoltaics

- The cost of solar PV has dropped precipitously

$0.60 PER WATT MODULE COST IN 2014
Solar Photovoltaics

- The cost of solar PV has dropped precipitously.
- This cost decline has led to a doubling of annual capacity installation every two years.

44%
GLOBAL PV INSTALLATIONS GROWTH 2007-2014
Solar Photovoltaics

• The cost of solar PV has dropped precipitously
• This cost decline has led to a doubling of annual capacity installation every two years
• Current prices are at or near retail grid parity and rapidly approaching wholesale in many markets.
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Electric Vehicles

• Battery costs will improve much more rapidly

$350
PRICE PER KILOWATT HOUR
FOR 10KWH POWERWALL (2015)
WITH POWER ELECTRONICS INCLUDED

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Electric Vehicles

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- Price gap with ICE vehicles will shrink then disappear

$35K
200 MI-RANGE EV PLANNED FOR 2018
Electric Vehicles

- Battery costs will improve much more rapidly
- Price gap with ICE vehicles will shrink then disappear
- **Electric vehicles sales will grow quickly**

500,000 VEHICLES PER YEAR BY 2020

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Our View

• Electricity will replace petroleum as primary fuel for LDV transportation
  – BEVs better than ICE-based cars
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- The utility business model becomes very different than what it used to be
  - EVs provide source of electricity demand growth
  - Storage breaks instantaneous market balance requirement
Our View

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- The utility business model becomes very different than what it used to be
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- Solar + Storage becomes low-cost solution for developing countries where grid is nonexistent, expensive, or unreliable

1.2 B
PEOPLE WITHOUT ELECTRICITY
“The stone age came to an end not for lack of stones
And the oil age will come to an end not for lack of oil”
— Sheikh Yamani, former Saudi Oil Minister