

The impact of Clean Disruption in the world as we know it

Presentation to the



February 15, 2016 – Dick Lee, CEO,
Value innovations, Inc.



Easter Day Parade 5th Ave, NYC, 1900



Easter Day Parade 5th Ave, NYC, 1913



Questions

- Is the growth of photons²electrons²electricity disrupting big oil & gas, coal and nuclear?
- Chevron Value Innovation case study – Has CVX lost sight of the future?
- Is Tesla Motors leading the EV/AV charge & disrupting the automotive industry?
- Does big oil believe they have a problem?



CLEAN DISRUPTION

OF ENERGY AND TRANSPORTATION

Tony Seba

How Silicon Valley
Will Make Oil, Nuclear,
Natural Gas, Coal,
Electric Utilities and
Conventional Cars
Obsolete by 2030.



Published June, 2014



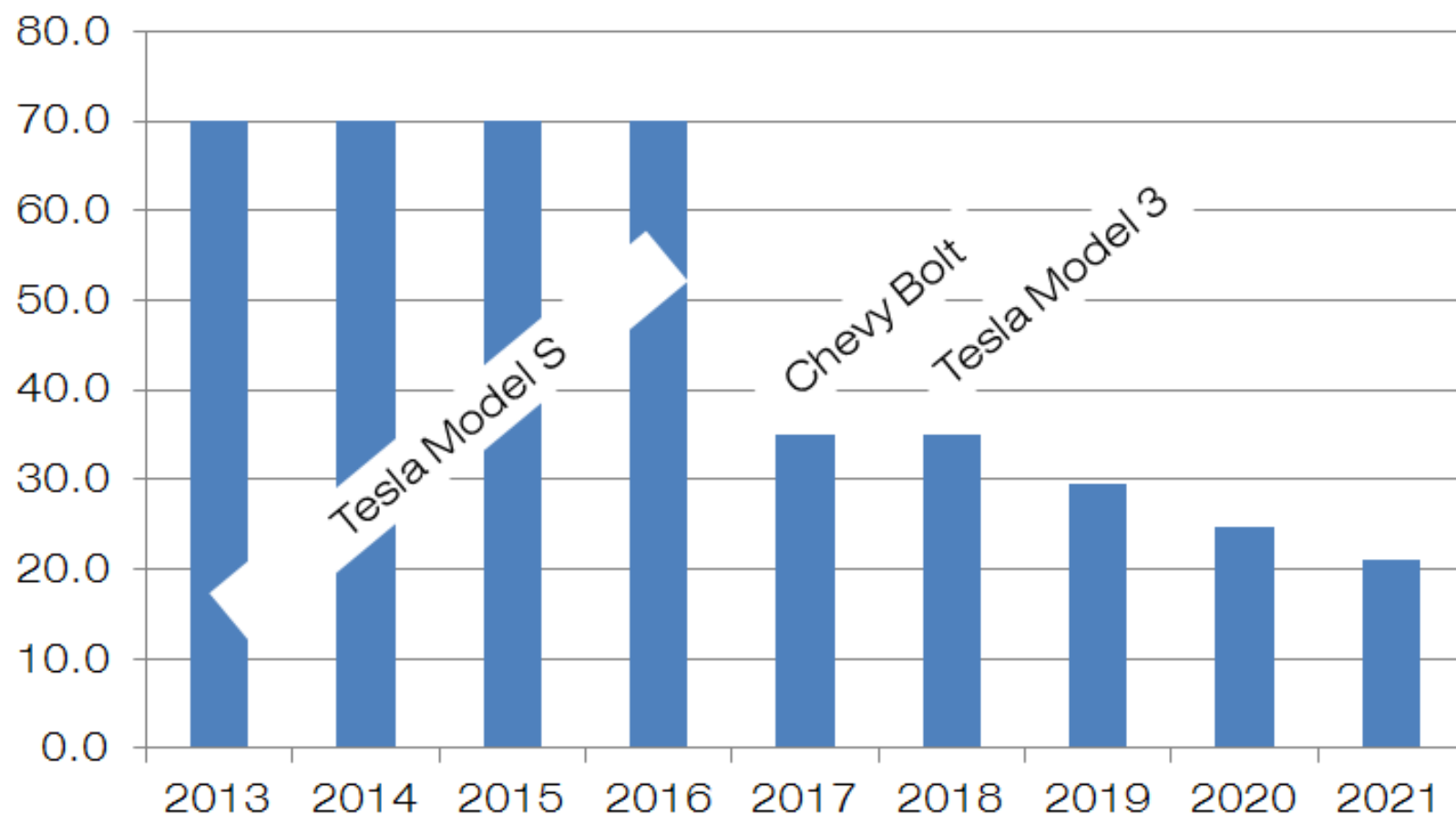
100y Later Tony Seba Predicts



The Internal
Combustion Engine
Obsolete by 2030



EV Price (\$K) projection by year in the US



Assumptions:

1. Costs reduced at the rate of 16%/annum starting in 2013
2. EV range is 200 miles
3. Performance matches a Porsche 911

Note: The average price of a low end car in the US is \$21,000



In 2005, CVX played 2nd fiddle to ExxonMobil

- Did not meet production forecasts (CVX stock was undervalued as a result)
- Return on upstream capital was lower
- Net income/barrel of oil equivalent was lower





The Start

- March, 2005 – Value Innovations invited by Don Paul (CTO) to deliver a 1-Day Workshop to the Technology Leadership Team
- The Team was asked if they thought the Value Innovation Process could bring value to CVX
- ETC president, Mark Puckett, agreed to pilot the Process





Pilot Project Goal:
Use work process and work flow to
increase oil extraction efficiencies





Work Process and Workflow Project

Step 2 of the Value Innovation Process

- Looked at
 - The CVX organization chart
 - Generated an .xlsm file with potential decision makers and influencers
- Concluded Asset Managers (have P&L responsibility) were the Most Important Customers





Work Process and Workflow Project

Contextually interviewed 24 Asset Managers over 5 months

- Generated 120 Elements of Performance (EoP) in the 1st Rd (Step 4)
- Reduced to 12 EoPs in the 2nd Rd (Steps 6-7)
- Agreed on 4 EoPs in the 3rd Rd (Step 10)





Work Process and Workflow Project

Output from these three rounds of interviews led to a 5y strategic technology roadmap





The Value Curve Process adopted by ITC

- Value Curve Process has been used on approx. 100 projects
- >75 people trained





Don Paul (CTO) shared these words in 2007

“The CVX project team sees many benefits to using VI methodology, ranging from winning the support and buy-in of the BU asset managers to defining a technology roadmap that could potentially yield significant enhancements to oil & gas production from these assets over the next several years.”





In 2012, Don Paul's words came true

- Chevron's ROI on upstream capital, 25% (ExxonMobil, 20%)
- Chevron's net income/barrel of oil equivalent, \$18 (Exxon, \$15) [CVX has beaten Exxon the last 5y]
- Chevron regularly exceeds production forecasts





2005 to 2016

- 2005: Don Paul had 3 groups re[orting to him: ETC, ITC & CTV
- From 2005 to 2009: CTV was investing in renewables – effort championed and funded by DP
- In March 2009, DP retired and CVX's attention on CTV diminished
- There have been two CTO's since Don Paul



Where is CVX today?

BP PLC, Chevron and Royal Dutch Shell PLC — have since 2000 taken on ventures in wind, biofuels and geothermal. All took big positions in solar, sometimes more than once. They were positioned to compete or even dominate. Now, as solar is gaining market momentum like never before, the oil majors are nowhere to be found. Analysts who cover the industry say it isn't that oil and gas companies want to kill their brood of adopted low-carbon children, or that they even perceive them as a threat. They have a straightforward answer: The oil business is changing, and times are tough.



Where is CVX today?

Projects that made sky-high profits are a little lower in the sky. “It’s not their strong suit to be spending a lot of money and time on renewables when they are definitely challenged in their core industry,” said Lysle Brinker, an oil and gas equity analyst at IHS. Even those depressed profits tower over the margins earned in renewables, where projects are slow, bureaucratic and hard-won. If there are any profits to be had, they are too meager to impress an oil executive. But there is yet another explanation.



Where is CVX today?

An executive who has worked with both Chevron and the solar industry says that although the oil company was happy to nurture solar power with seed money, it lost interest when the investment began to require real money — real money for a business that, at its heart, it didn't understand

Excerpted from article published by David Ferris and Nathaniel Gronewold, October 3, 2014, EE Publishing



Is Big Oil in denial?

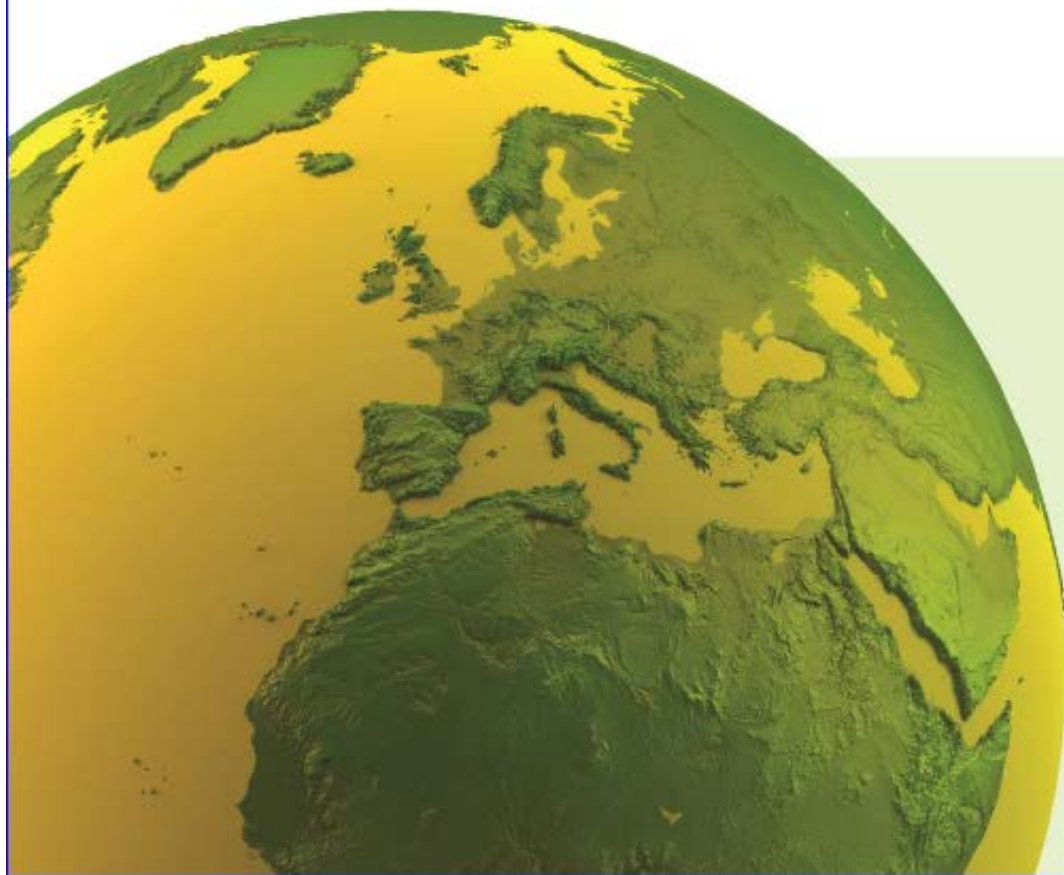


BP Energy Outlook 2035

February 2015



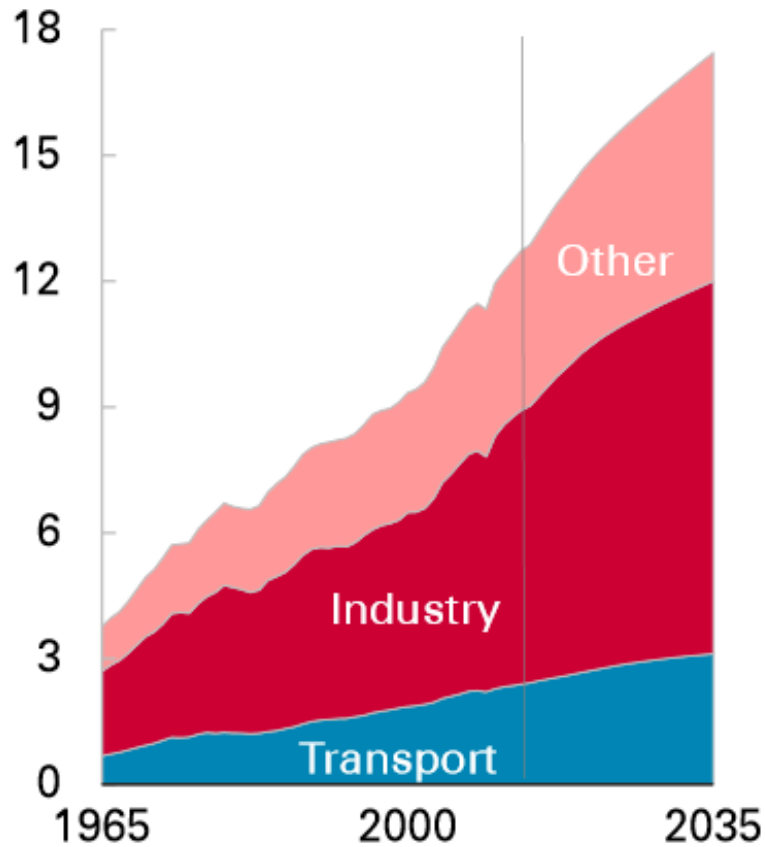
*bp.com/energyoutlook
#BPstats*



Bp forecast consumption by sector & fuel

Consumption by final sector¹

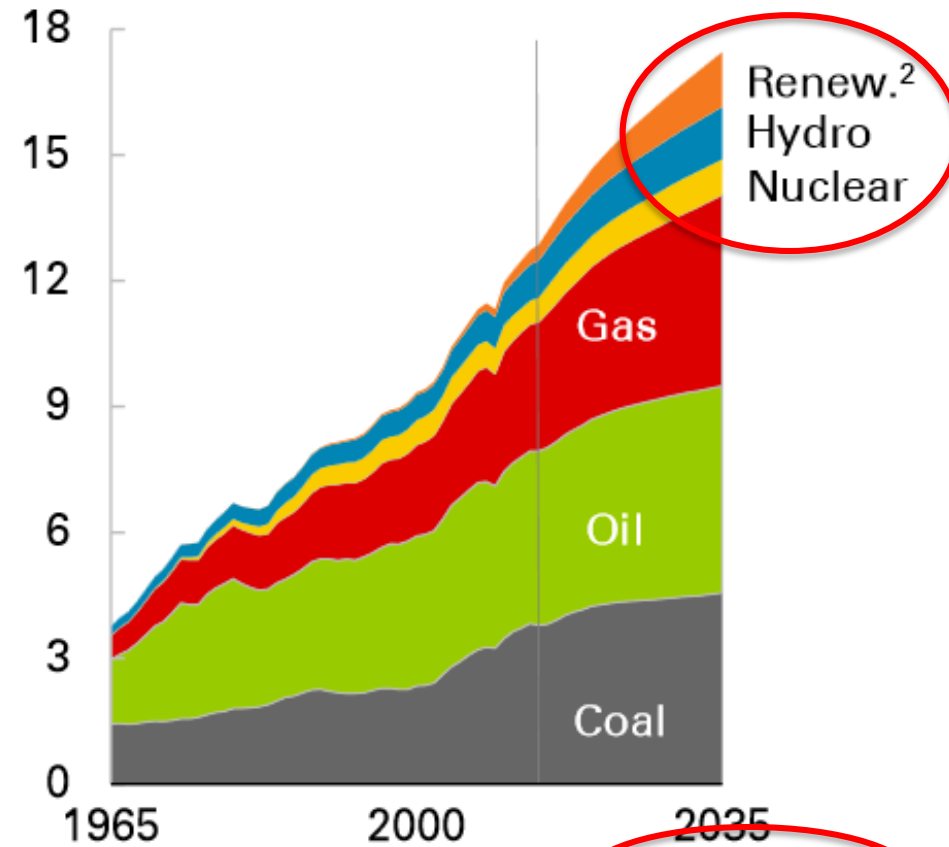
Billion toe (Tonne of Oil Equivalent)



¹Primary fuels in power allocated according to final sector electricity consumption

Consumption by fuel

Billion toe (Tonne of Oil Equivalent)



²Includes biofuels

It looks like it



Tesla Motors - Roadster



A white Tesla Roadster is shown driving on a road, with a blurred background of green trees. The car is positioned in the center of the frame. Above the car, there is a red Tesla logo. To the right of the car, there is a table with performance metrics. Below the car, the text "TEST DRIVE THE TESLA ROADSTER" is displayed.

295	245	3.7	0
LB-FT OF TORQUE	MILES PER CHARGE	SECONDS 0 TO 60 MPH	TAILPIPE EMISSIONS

TEST DRIVE THE TESLA ROADSTER

- Build the brand
- Show electric vehicles are exciting
- Production stopped Dec. 31, 2011
- 2,100 produced (in 30 countries)



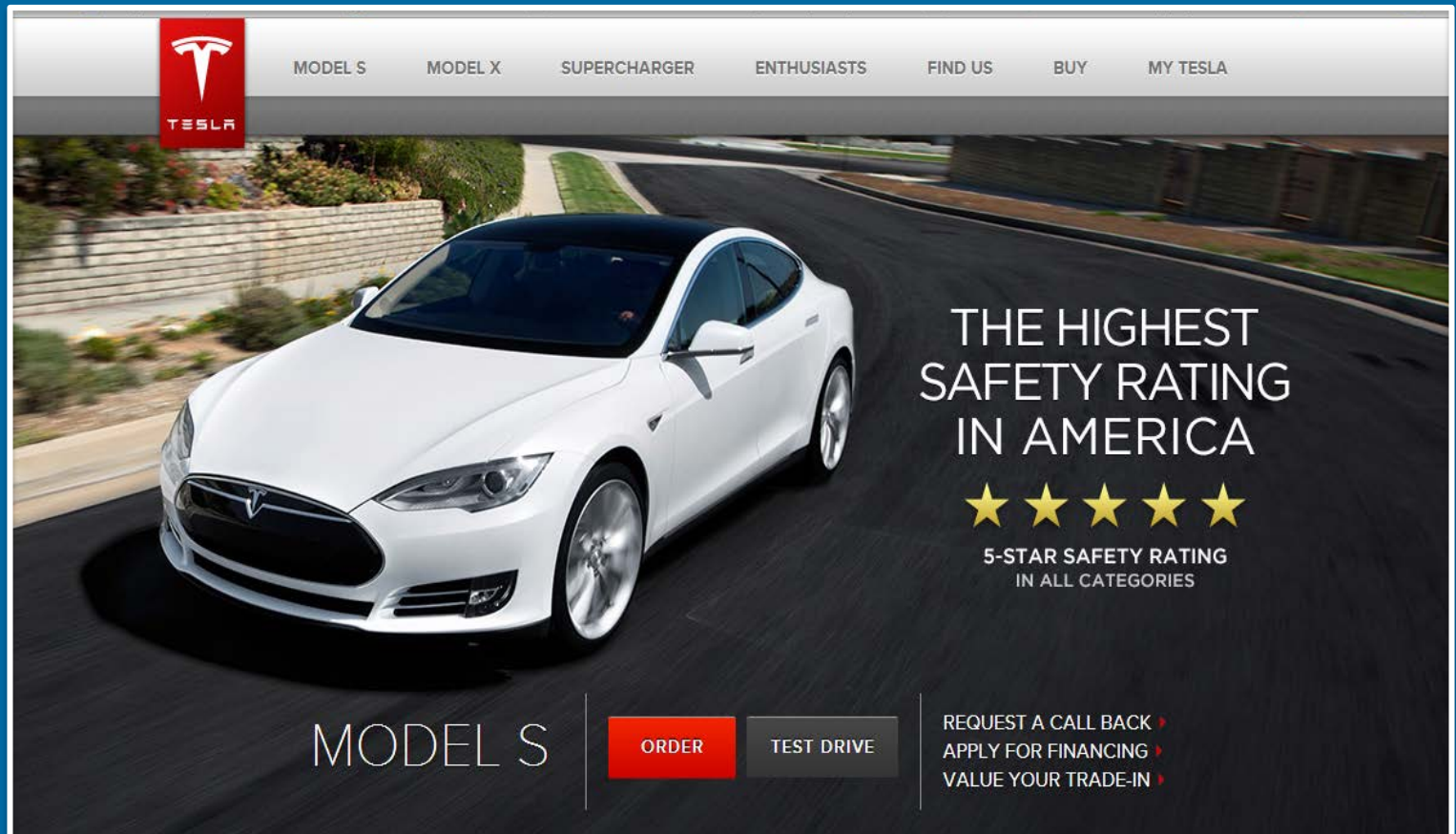
Tesla Motors – S Sedan



- Seats 5 to 7, one trunk, one frunk, 4,600 lbs
- P90D: 0-60mph, 2.8 seconds
- Consumer Reports:
“Best car we’ve ever tested”
- NHTSA: “Safest car we have ever tested”



Tesla Motors – S Sedan



EV Maintenance Costs 10x less



2000 moving parts compared to 18



The Tesla S Power Train



Supercharging Stations

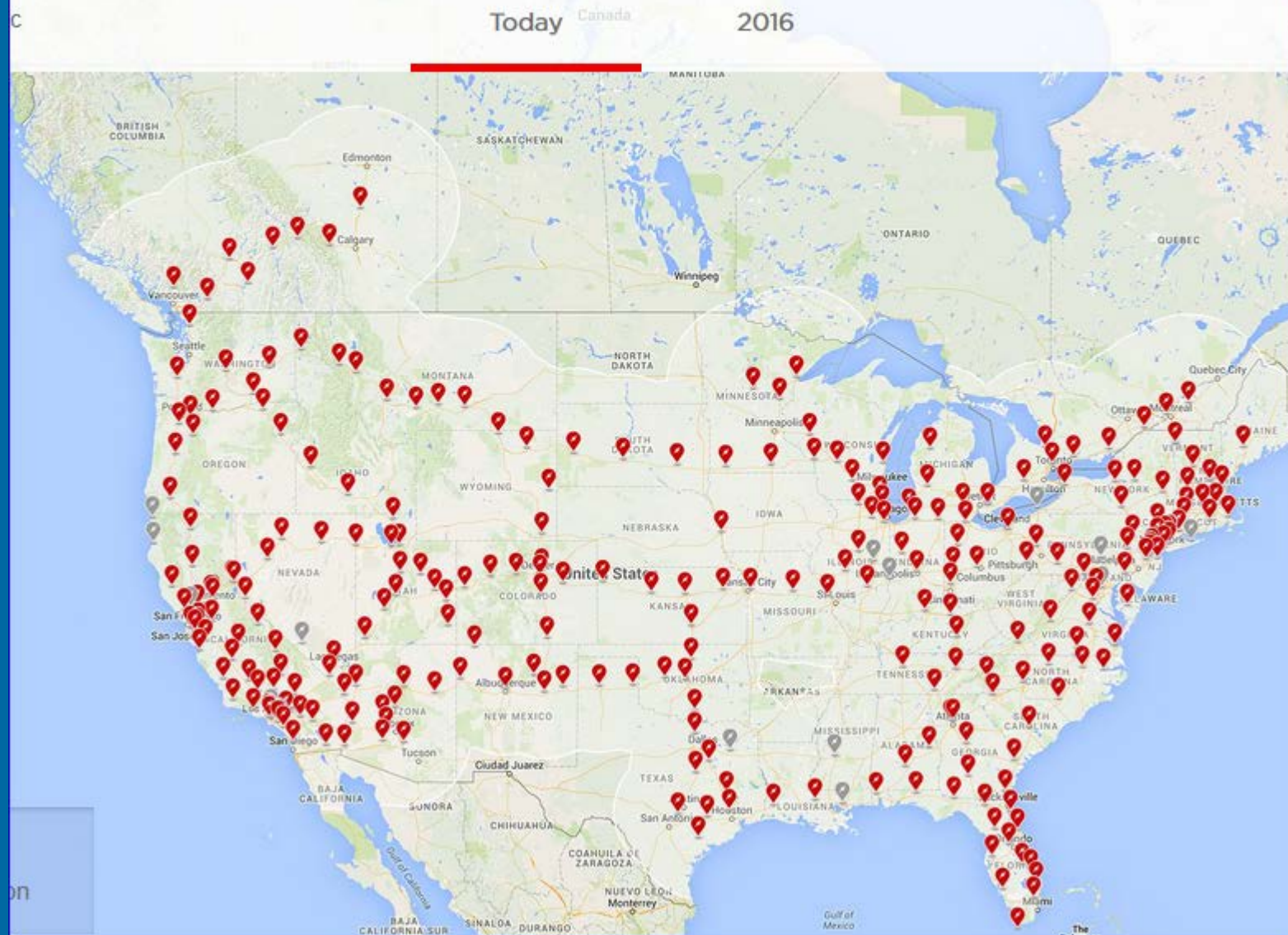


- >200 in operation in the US today (4 stalls)
- 30 minute charge – 200 miles - free
- Free fuel



597 Supercharger stations with 3,481 Superchargers

February 8, 2016



EU Supercharging Stations – 6/15



Tesla Motors



- First 5 units, June 22, 2012
- 35,000 units in 2014
- 50,000 units in 2015



Tesla Motors – S Sedan



- Fuel cost, 10x less
- Motor life, 1 MM miles
- Maintenance cost, 10x less
- ALL owners love their S
- Matches the Porsche 911 Turbo



Tesla Motors



X SUV – November, 2015 - 200 units sold



Tesla Motors –

The Future Lowering costs and price

- Model 3 – The affordable EV
 - Price, \$35,000
 - 20% smaller than the S Sedan
 - Range, 200 miles
 - Available, 2017?
- Battery Plant groundbreaking, 2014
 - Cost, \$5B
 - Panasonic putting up \$1.4 to 1.6B
 - Panasonic will manufacture the cells
 - Tesla will assemble the batteries
 - Brings battery cost down by 30%



Li-on Producer relationships with auto mfrs

Li ion Battery Manufacturers &
the Auto/Truck companies they have Agreements with

Battery Mfr	Alignment with Auto Companies	Battery Mfr	Alignment with Auto Companies
A123 Systems	<u>Fisker</u> , Daimler Buses, Navistar, & BMW	GS Yuasa	Mitsubishi
<u>Axeon</u>	Rolls Royce Motors, Jaguar, & Land Rover	LG <u>Chem</u>	GM, Renault, Hyundai, Ford, & Volvo
Bosch Samsung	Fiat	NEC	Nissan
Boston Power	Saab	Panasonic	Tesla Motors
<u>Electrovaya</u>	Tata Motors	Sanyo	Ford & Honda
Johnson Controls	Daimler, Ford		

Prepared by Value Innovations, Inc. January 17, 2016
Source, Wikipedia




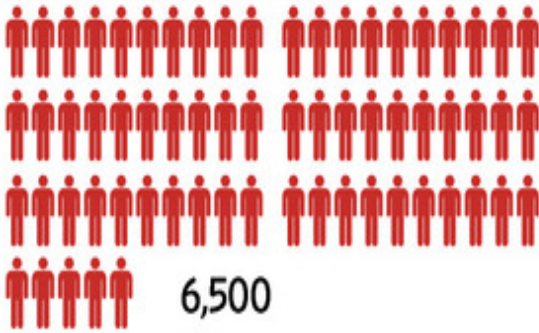










Tesla Motors – Li ion Gigafactory



Tesla's Gigafactory will more than double global Li-on production capacity

Tesla's Titan | Gigafactory to dwarf other U.S. battery plants in scale

Experts say Tesla's plan carries big risks, but it may have no choice if it is to meet high sales goals.

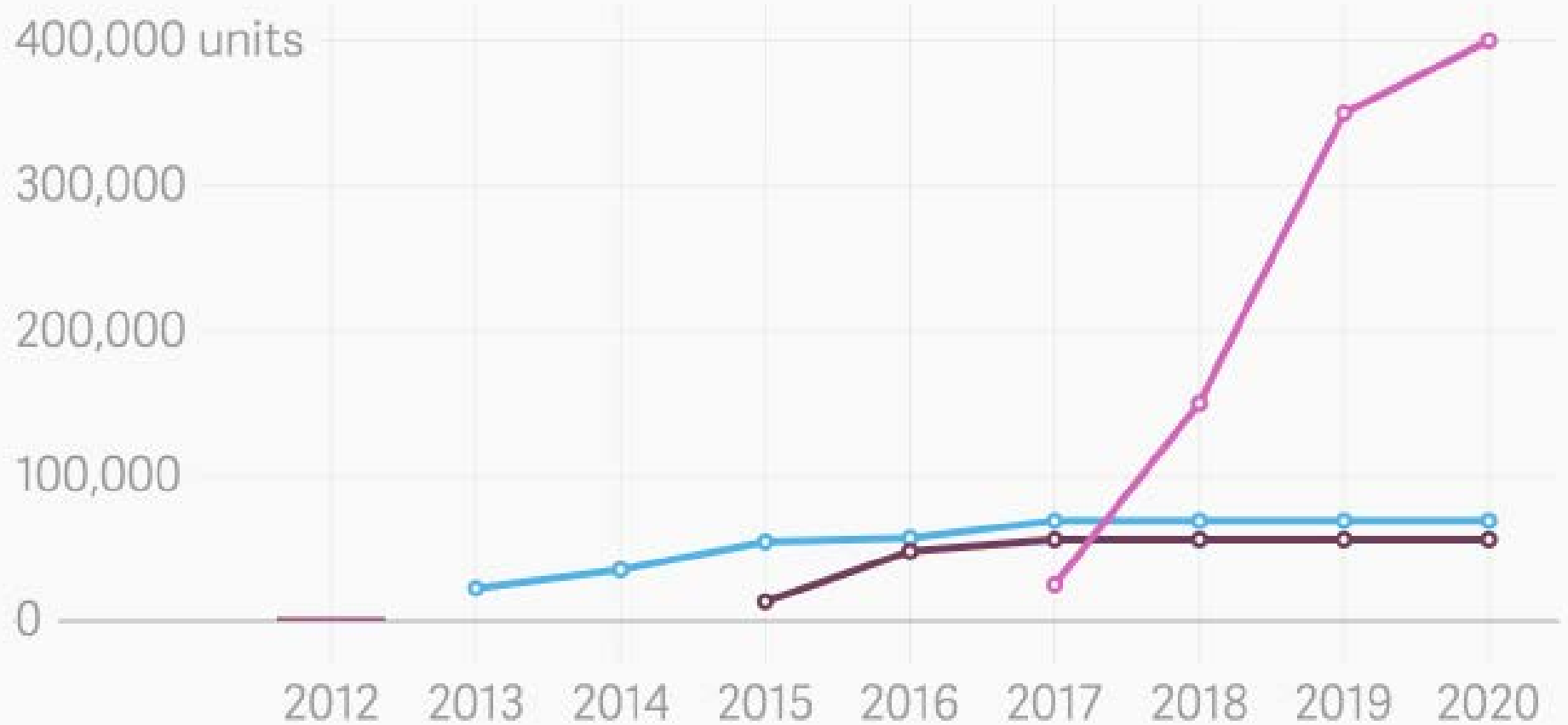
Select U.S. battery factories	Size	Employees	Capacity in gigawatt hours of battery produced in a year
Proposed Tesla factory Site yet to be determined	 10 million square feet	 6,500	 35.0
LG Chem factory Holland, Mich.	 600,000	 125	 1.0
Nissan Battery Factory Smyrna, Tenn.	 475,000	 300	 4.8
A123 Battery Factory Livonia, Mich.	 291,000	 400	 0.6

Sources: the companies

The Wall Street Journal

Tesla historical and forecast production volumes

■ Roadster ■ Model S ■ Model X ■ Model 3



Battery Cost vs Range Requirements 2016, 2020, & 2025

Assumptions:

- Current Li-on cost, \$400/Kwh
- 1Kwh delivers 3.5 miles
- Battery costs will decrease by 15%/y

Year	2016	2020	2025
Battery Cost \$/Kwh	400	208	108



Battery Cost vs. Range Requirements 2016, 2020, & 2025

Range Required (miles)	Battery Capacity (Kwh)		Battery Cost (\$K)	
		2016	2020	2025
200	57	22.8	11.9	6.2
250	71	28.4	14.8	7.7
300	86	34.4	17.9	9.3

Larger capacity reduces acceleration times

In 2025, the Model 3 in 2025 with a 86Kwh battery will probably accelerate from 0-60 mph in 2.5 seconds



Is Tesla leading the way?



Global Auto Manufacturers are investing in EVs



Next

- “Summons” function available now
- Autonomous S available by 2018

