

Charging ahead

GE EV Solutions

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Daniel Ciarcia
Product Manager, EV
daniel.ciarcia@ge.com



GE imagination at work



Electric Vehicle Marketplace



Motivation To Embrace Electric Vehicles



Domestic Policy Goals

- Reduce dependence on foreign oil
- Job creation
- Economic Growth (energy sources local)

Global Impact

- Europe to mitigate climate change
- China to balance growth with pollution
- Governments around the world have allocated funding for clean technology



Energy Independence

- Local energy sources reduce price volatility
- Reduce export of dollars, particularly to unstable regions of the world
- Reduce dependence on few key regions – roughly half of the EU's gas consumption comes from only three countries (Russia, Norway, Algeria)



Developing Nations

- Lower-cost conventional vehicles support economic development goals.
- Urban air pollution and rising oil imports to be the main driver of electrification
- China has stated its goal of reducing the carbon intensity of its economy.
- Lack of Infrastructure (grids) is a huge factor.



Climate Change

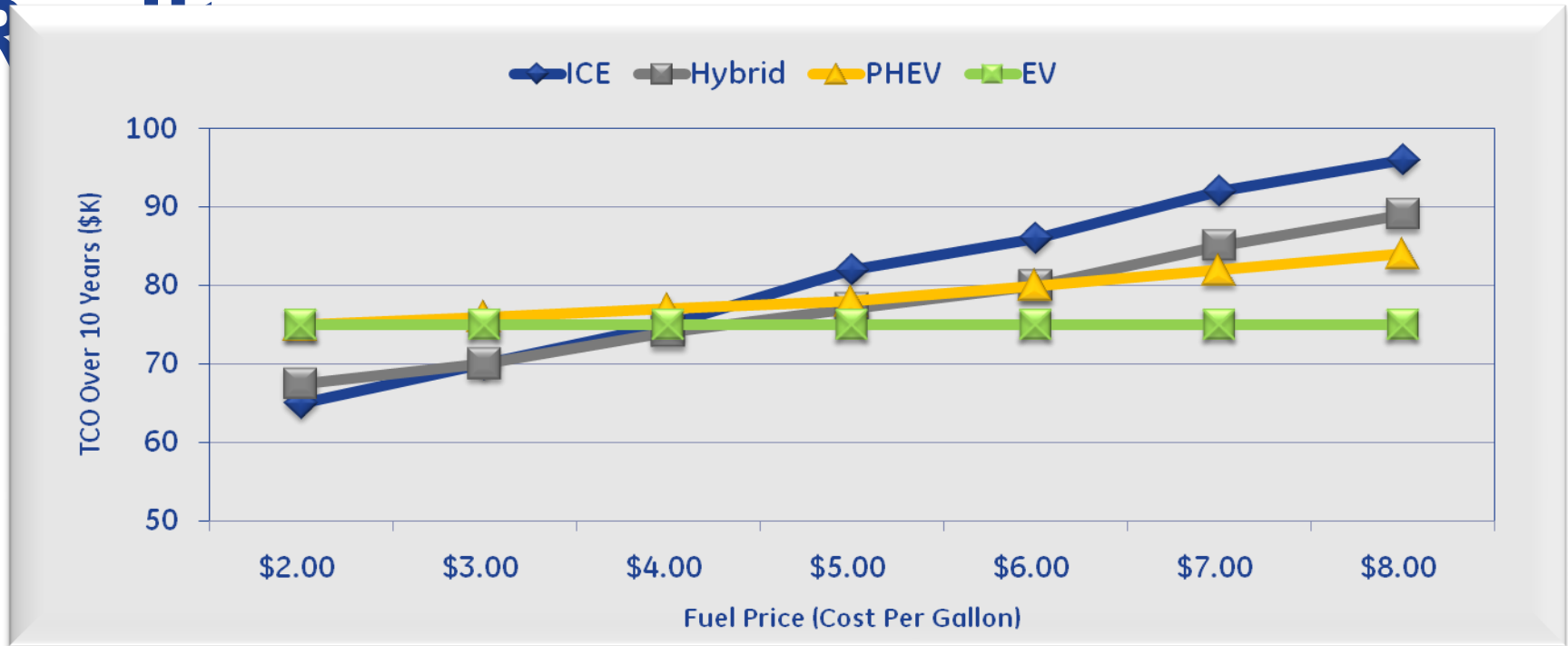
- Global support for climate change has gained momentum with Europe leading the way.
- Transportation accounts for roughly 15% of energy related CO2 emissions globally.
- In 1992, the United States ratified the United Nations' Framework Convention on Climate Change (UNFCCC), which called on industrialized countries to make voluntary efforts to reduce greenhouse gases.

▪ EU energy policy provides affordable energy while contributing to the EU's wider social and climate goals



EV Is Becoming An Economic

R

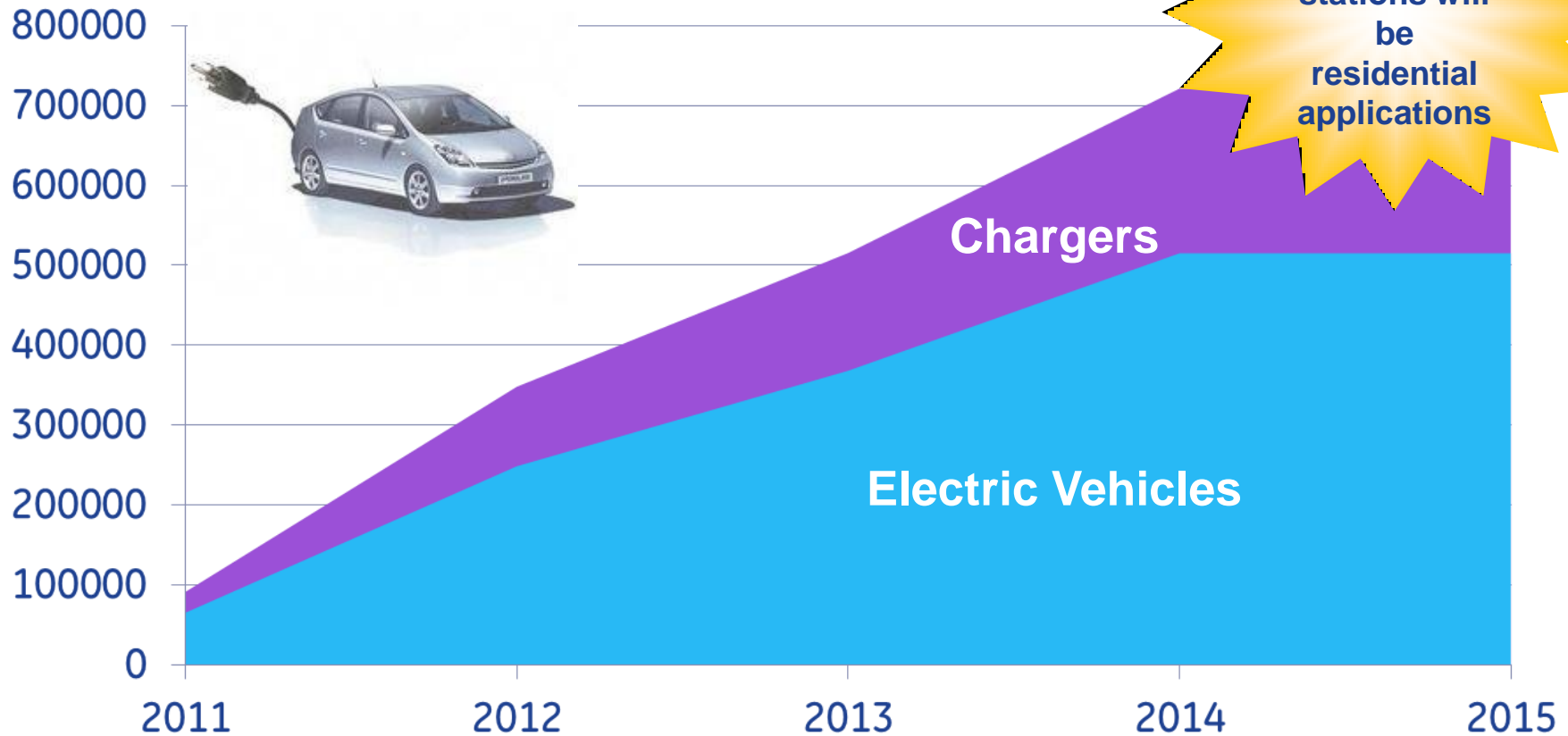


Economics Will Favor Electrification

- Electric vehicles emit zero tailpipe emissions at the point of use. The carbon footprint of electric vehicles is approximately 30% better than that of conventional vehicles, even when the electricity used is produced by a coal-fired power station.
- Total Cost of Ownership (TCO) will become increasingly favorable as the price of fuel rises in the future. Current global economic conditions will drive how quickly fuel prices begin to appreciably rise and influence the TCO of various models (ICE, Hybrid, PHEV, EV)..



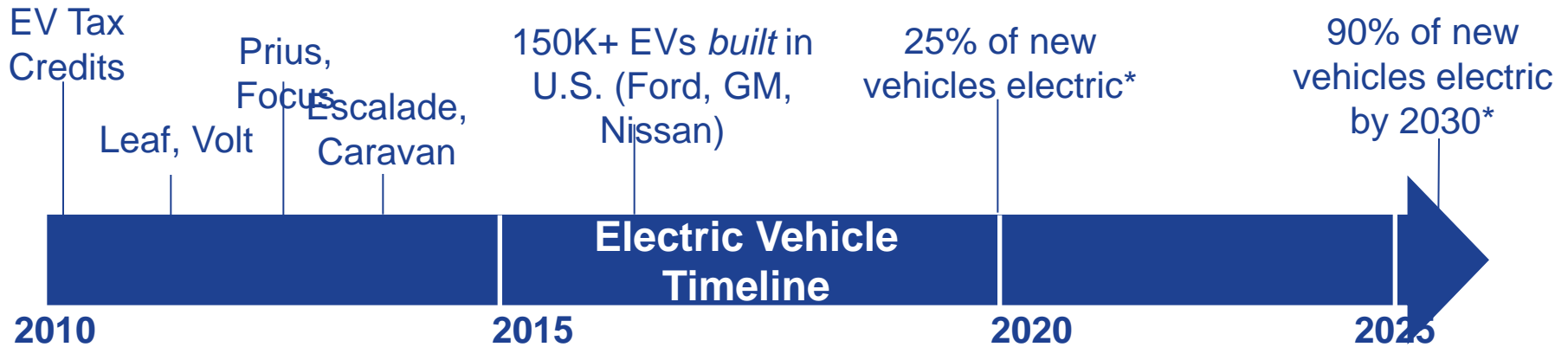
One Million Electric Vehicles



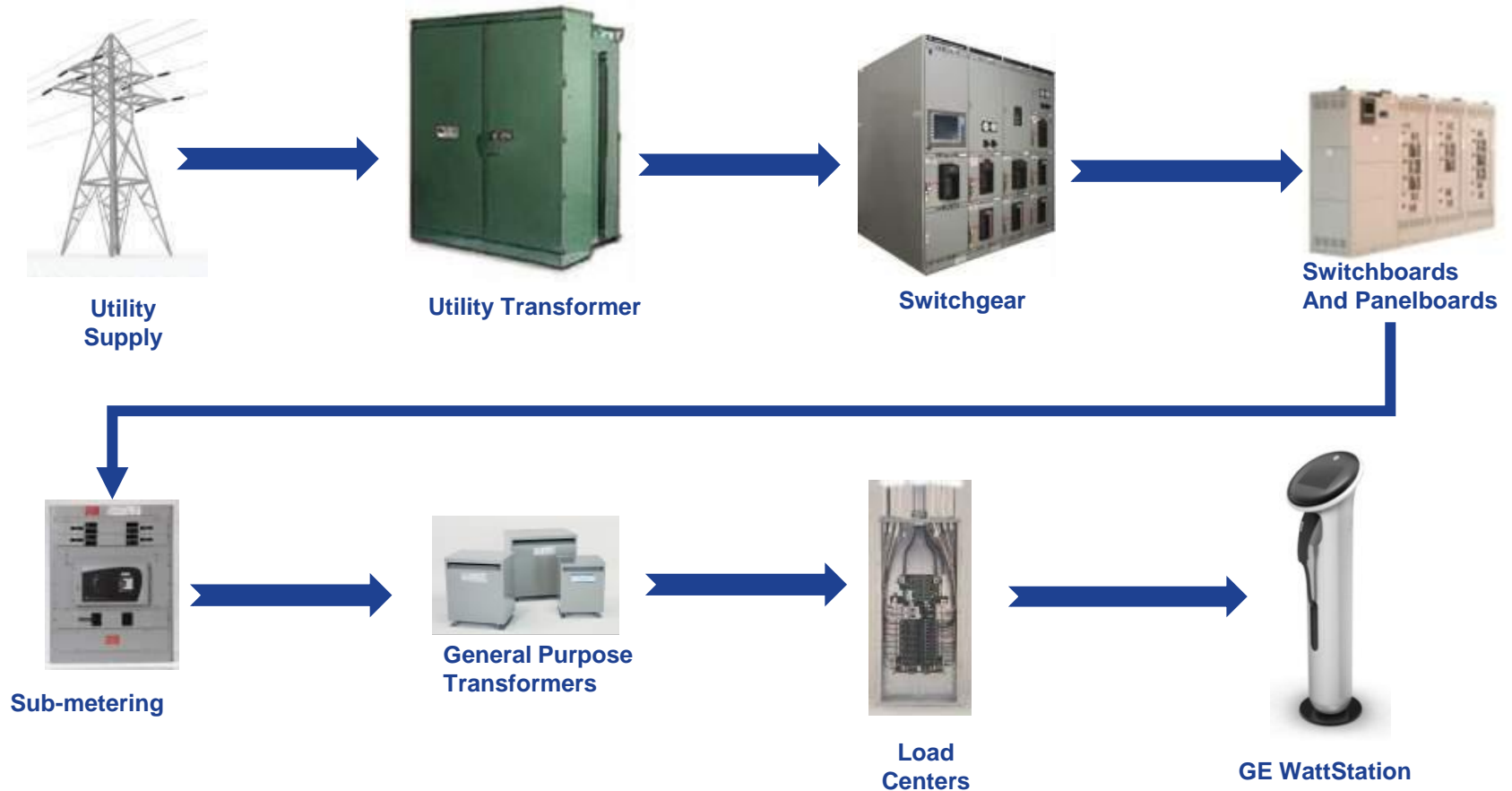
Source: Department of Energy Report (Feb 2011)

For every EV sold, we expect there will be demand for 1.4 charging stations

Fundamental Transformation



GE provides the electrical infrastructure to support charging station infrastructure



Key Drivers for EV Growth

1. Government Funding and Incentives



2. Auto Manufacturer EV Pipeline



3. The Environmental Consumer



#1 Federal Government Activity

1. American Recovery and Reinvestment Act (ARRA) Funding – \$2.4B for manufacturing and infrastructure

- \$1.5B for US-based manufacturers to produce batteries and EV components
- \$500MM to produce other EV components like motors
- \$400MM to demonstrate and evaluate PHEV and related infrastructure

2. Auto Manufacturer Incentives - \$8B loans for Advanced Vehicle Technologies

- \$5.9B to Ford (factories in Ohio, Illinois, Kentucky, Michigan, Missouri, Ohio)
- \$1.6B to Nissan (factory in Tennessee)
- \$465MM to Tesla (factory in California)

3. Fuel Efficient Vehicles Tax Incentives for Consumers

- Tax credit for EV's, up to \$7,500
- Tax credit for charging stations up to \$2,000 for consumer and \$50,000 for public charging or 50% of the cost
- Final guidance is pending the issuance of EV regulations



Legislative Update

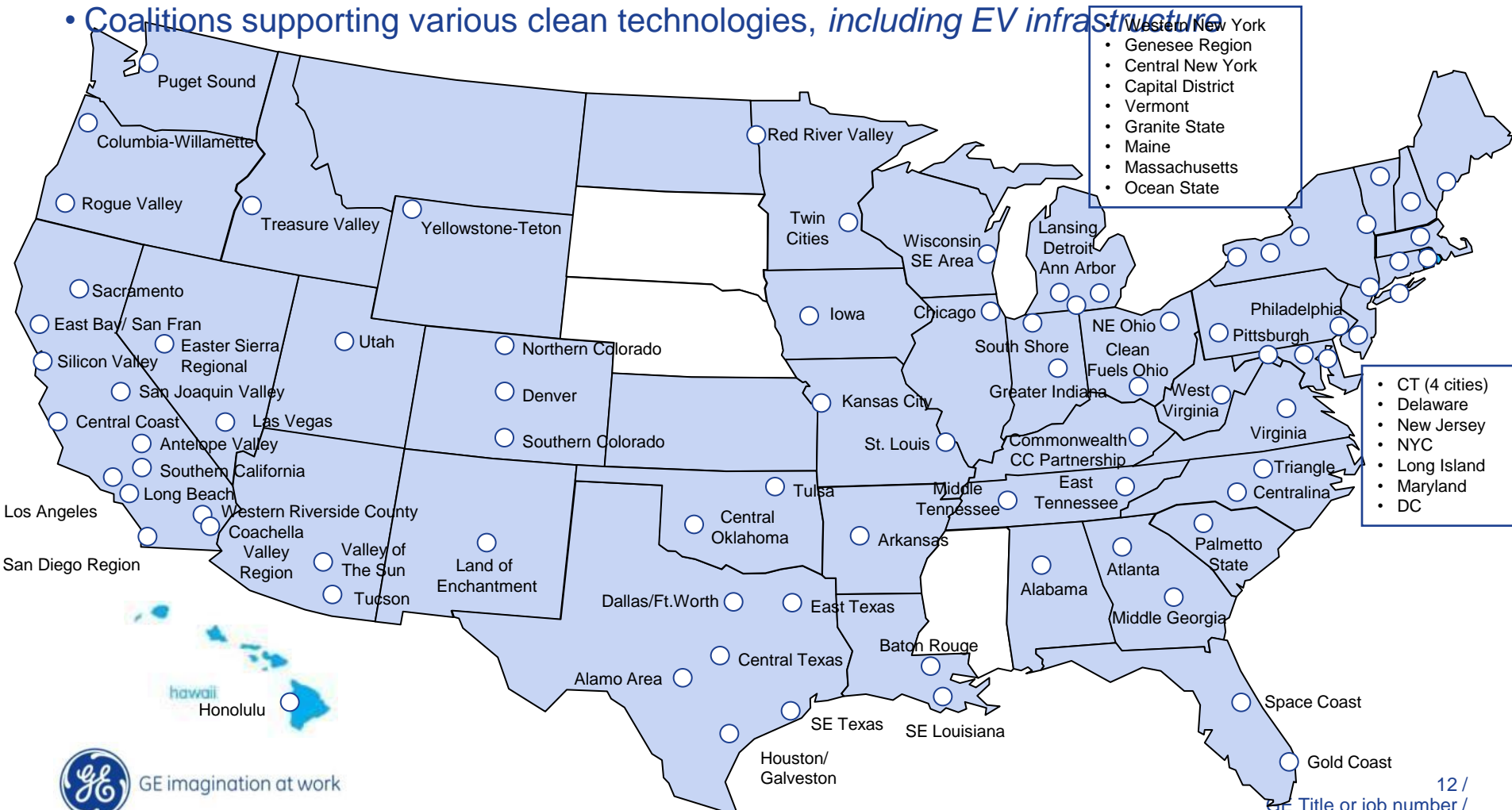
State	Type	Incentive	Amount
Federal	Credit	ARRA 2009.	\$7,500
Federal	Credit	Charging Station: 30% of charging station cost.	Up to \$1,000
CA	Purchase rebate	BEV (< \$5,000). PEV (\$3,000). Various discounted utility rates for electricity used to charge EVs.	\$3,000 - \$5,000
TX	Cash grant	The Texas Light Duty Motor Vehicle Purchase or Lease Incentive Program reimburses the purchase or lease of an eligible new on-road light-duty motor vehicle.	Determined by type of vehicle
FL	Exemption	EVs are exempt from most insurance surcharges.	
PA	Purchase rebate	Purchase of qualified new EV, (< 6 months after purchase date).	\$500
NJ	Exemption	Sales of zero emission vehicles are exempt from sales tax.	
NY	Credit	Available for installation of alternative fuel vehicle fueling infrastructure located in the state.	50% of cost
IL	Credit	The Alternative Fuel Vehicle and Alternative Fuels Rebates Program provides rebates of 80% of approved incremental costs for purchase of a new alternative fuel vehicle.	Up to \$4,000
GA	Credit	Income tax credits (< 20% of EV cost)	Up to \$5,000

2010 CAFE standard: 34.1 MPG by 2016 or ~250 grams CO2 per mile.



#1 DOE Clean Cities Initiative

- DC-based initiative of the DOE's Office of Energy Efficiency and Renewable Energy
- Over 90 coalitions established with 6,500 stakeholders from both the public and private sectors
- Coalitions supporting various clean technologies, *including EV infrastructure*



#2 Auto Manufacturer Activity

Battery Electric Vehicles (BEV):

2010 Coda Automotive Sedan
2010 Mitsubishi iMiEV BEV
2010 Nissan LEAF
2010 Ford Battery Electric Van
2010 Tesla Roadster Sport EV
2010 Chevy Volt Extended Range EV

2011 Peugeot Urban EV*
2011 Renault Kangoo Z.E.
2011 Renault Fluence Z.E.
2011 Tesla Model S
2011 BYD e6 Electric Vehicle
2011 Ford Battery Electric Small Car
2011 Opel Ampera Extended Range*

2012 Fiat 500 minicar
2012 Renault City Car*
2012 Renault Urban EV*
2012 Audi e-tron

2013 Volkswagen E-Up*
2016 Tesla EV
Source: www.electricdrive.org

*European Launch



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Hybrid Electric Vehicles (PHEV):

2010 Lexus HS 250h
2010 Mercedes E Class Hybrid
2010 Porsche Cayenne S Hybrid
2010 Toyota Camry Hybrid
2010 Toyota Prius Hybrid

2011 Audi A8 Hybrid (likely introduction)
2011 BMW 5-Series ActiveHybrid
2011 Honda CR-Z sport hybrid coupe
2011 Lexus CT 200h Hybrid Hatchback
2011 Peugeot Diesel Hybrid*
2011 Suzuki Kizashi Hybrid
2011 Audi Q5 Crossover Hybrid
2011 Hyundai Sonata Hybrid
2011 Infiniti M35 Hybrid

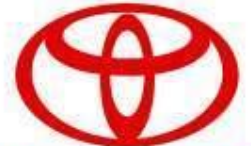
2014 Ferrari Hybrid



Mercedes-Benz



CHEVROLET

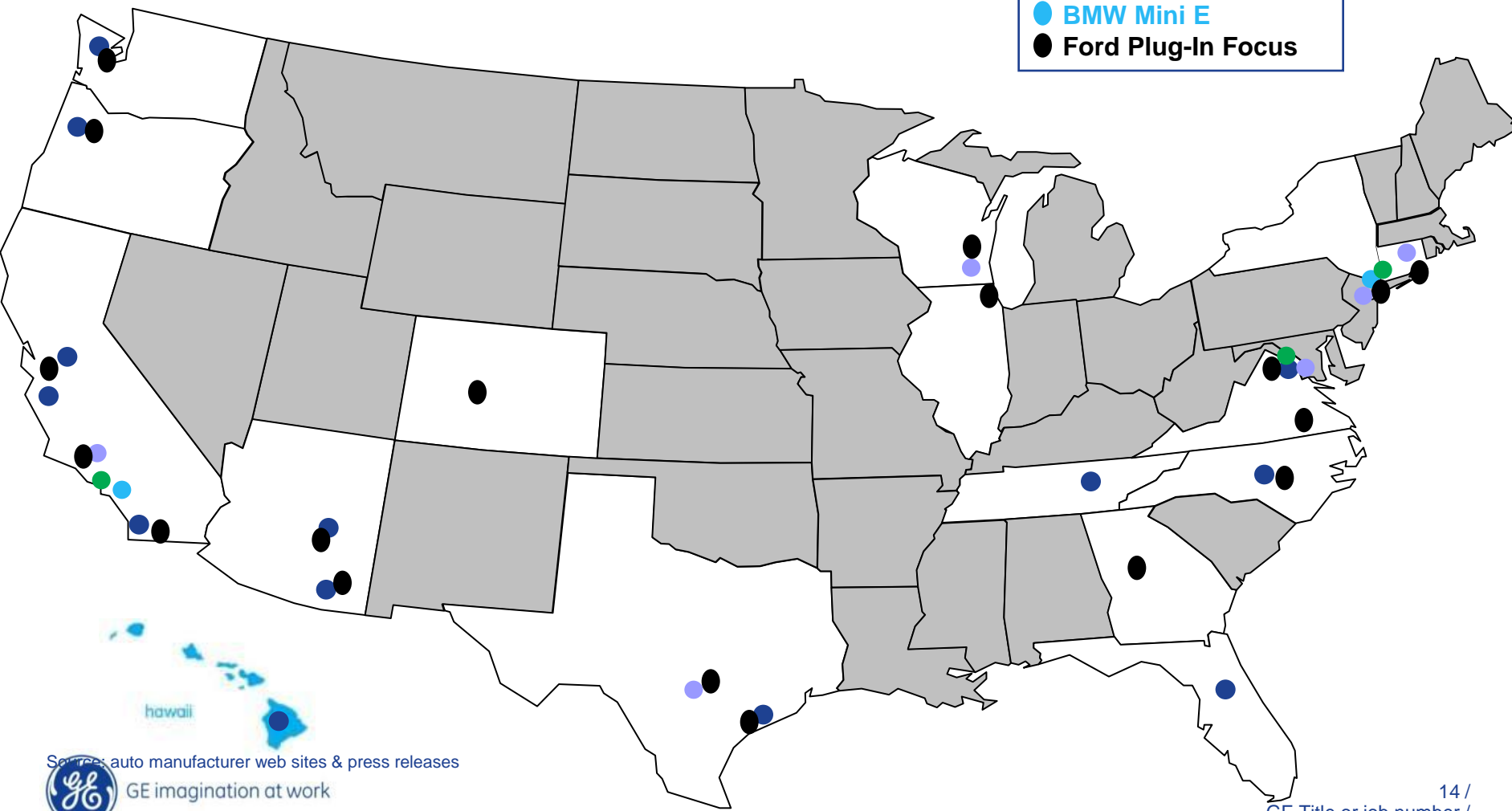


TOYOTA



#2 Auto Manufacturer Launch Cities

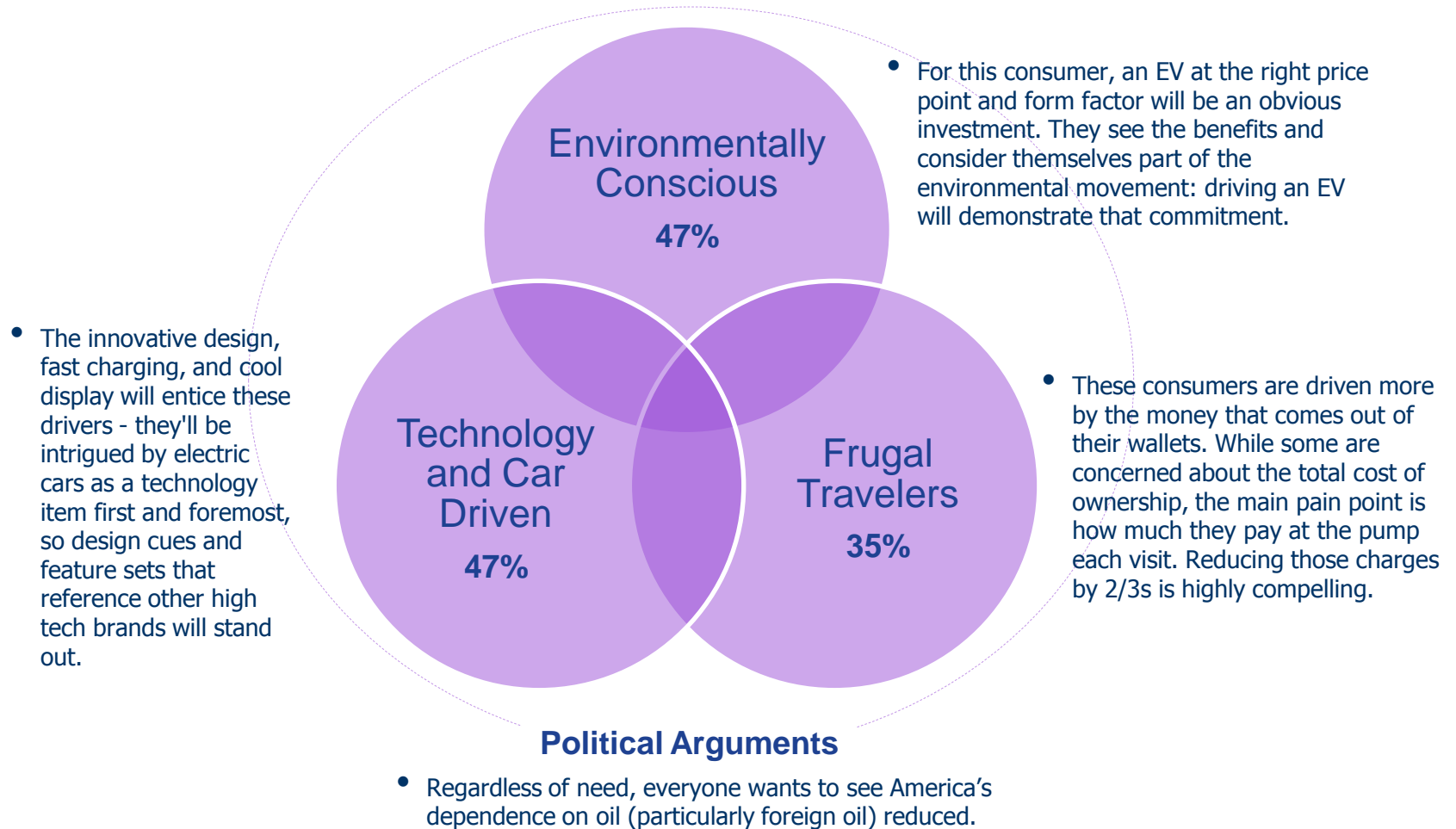
- Nissan Leaf
- GM/Chevy Volt
- Toyota Plug-In Prius
- BMW Mini E
- Ford Plug-In Focus



Sources: auto manufacturer web sites & press releases



#3 The 3 Core Consumer Mindsets



Survey of Global Initiatives

Americas

United States

Offers up to \$7,500 for qualified vehicles (Chevrolet Volt, Nissan Leaf, Coda sedan, Tesla Roadster). \$2.8 billion overall budget allocated.

Canada

Plans to have 1 in 20 vehicles driven in Ontario to be electrically powered by 2020. Quebec offers up to \$8,000.

Mexico

Mexico City signed an agreement with Nissan to deliver recharging infrastructure for EVs in 2011.

Brazil

Plans to develop electric vehicles and build solar-powered charging stations in near future.



GE imagination at work

Europe

United Kingdom

Offers £ 5,000 max or 25% of retail. Plans to have more than 1,000 electric vehicles for its fleet and 25,000 charging points by 2015 to support running of a target 100,000 electric vehicles.

France

Offers €5000 or 20% of retail, valid up to 2012. Offers up to 1,000 charging stations. €400 million budget allocated for incentives, technology, and infrastructure.

Germany

€3,000 to 5,000 for the first 100,000 vehicles. €500 million budget allocated for EV incentives, technology, and infrastructure.

Asia

China

Offers up to USD \$8,800 in subsidies. Plans to invest USD \$15 billion to help domestic automakers put 20 million fuel-efficient vehicles on China's roads by 2020.

India

Offers \$2,200 or 20% of retail for electric vehicles, plus other smaller subsidies for electric 2-wheelers which is majority of the market.

Japan

Enforces periodic vehicle inspection, testing, and taxation based on engine size to drive adoption.

By 2020, 1 in 5 will be an EV
Sources: Frost & Sullivan, J.D. Power Associates

¥106 billion budget allocated.

Operational / Environmental Metrics

- On average the GE DuraStation decreases EV charging time from 12-18 hours to as little as 4-8 hours compared to standard charging, assuming a 24 kWh battery and a full-cycle charge.
- If 10,000 vehicle owners switched from gas-powered passenger cars to EVs, over 33,000 metric tons of CO2 emissions could be avoided annually.
- This is equivalent to the annual CO2 emissions of approximately 6,500 gas-powered passenger cars on U.S. roads.
- On average, an EV owner will save about 75% of the annual fuel costs by switching from gas to electric

Assumptions: EVs have a typical 24 kWh battery with 100 mile range, vehicles travel a typical 12,000 miles per year, and the EVs are powered by the average US electricity grid mix.

a product of
ecomagination



EV-Related LEED Status Points

LEED-NC: Sustainable Sites Credit 4.3

3 points available if 5% of parking is made available for low-emission & fuel efficient vehicles

LEED-EB: Sustainable Site Credit 4.0

3 to 15 points available for the reduction in conventional commuting trips from 10-75%



For more information on LEED, please visit www.geelectrical.com/energy

Electric Vehicle Supply Equipment (EVSE) Infrastructure



Vehicle



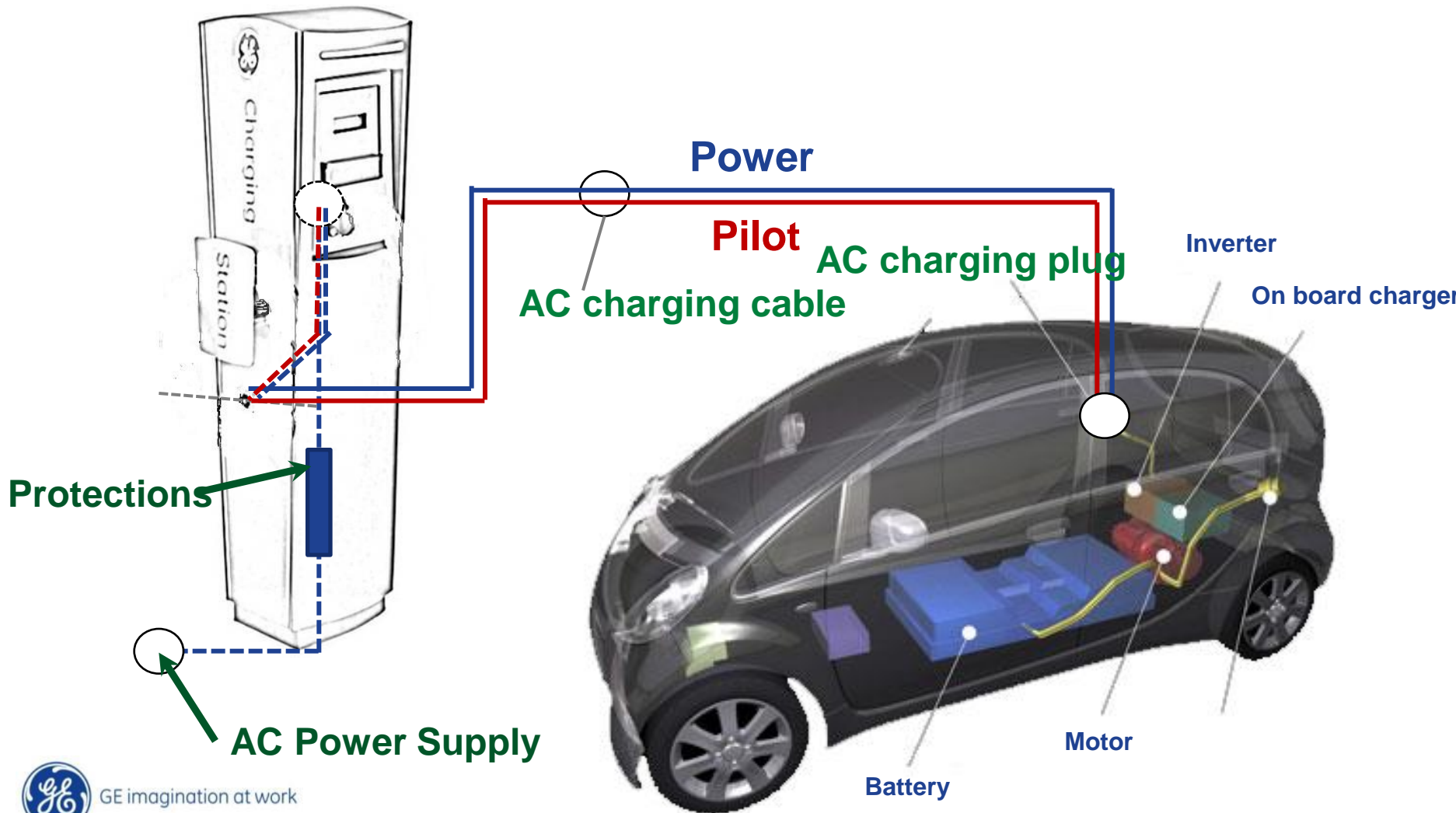
	Petrol (ICE)	Hybrid (HEV)	Plugin Hybrid (PHEV)	100% Battery (EV, GEV, BEV)
Range:	440 miles	440 miles	440 miles	100 miles
Refuel Time:	5min	5min	<1h Level 2 Charge	4– 8h Level 2 Charge
Usage:	1st car Family car	1st car Family car	1st car Family car	2nd car City car
Energy Efficiency	Not Efficient	Efficient	More Efficient	Most Efficient
Customer Mind:	Benchmark	Electric motor	+ Charging	+ 100% Battery
	PHEV	Range Extended Electric Vehicle		
	REEV:	Battery Electric Vehicle		
	BEV:	Electric Vehicle		
	EV:			



Overview

▶ **EVSE** electric vehicle supply equipment

▶ **EV** electric vehicle



Charging Options – Why use Level 2?



Level 1 Charging

Level 2 Charging

Power Source	110 VAC, 15 A (16A peak), Household Wall Outlet	208 – 240 VAC, 30 A, Dual Pole Dedicated Circuit
Max Charging Power Output	Up to 1.65 KW	▶ Up to 7.2 KW (240V @ 30A)
Speed	12 – 18 hours	▶ 4 – 8 hours
Installation	Plug-in wall outlet connector	Electrician Installation Needed
Safety	Household Circuit Breaker, UL, Ground Fault, Cable only energized when charging	Household Circuit Breaker, UL, Ground Fault, Cable only energized when charging
Accessibility	Accessible everywhere	Dedicated equipment and cable
Procurement	Typically included w/car	After-Market Purchase

GE Hardware Lineage

Charging Station

- POS Interface (Credit Card Swipe)
- Smart Metering
- Flex Charging
- Wireless Communications



Watt Station Residential

- Home Use
- Low Cost
- Lightweight Plastic



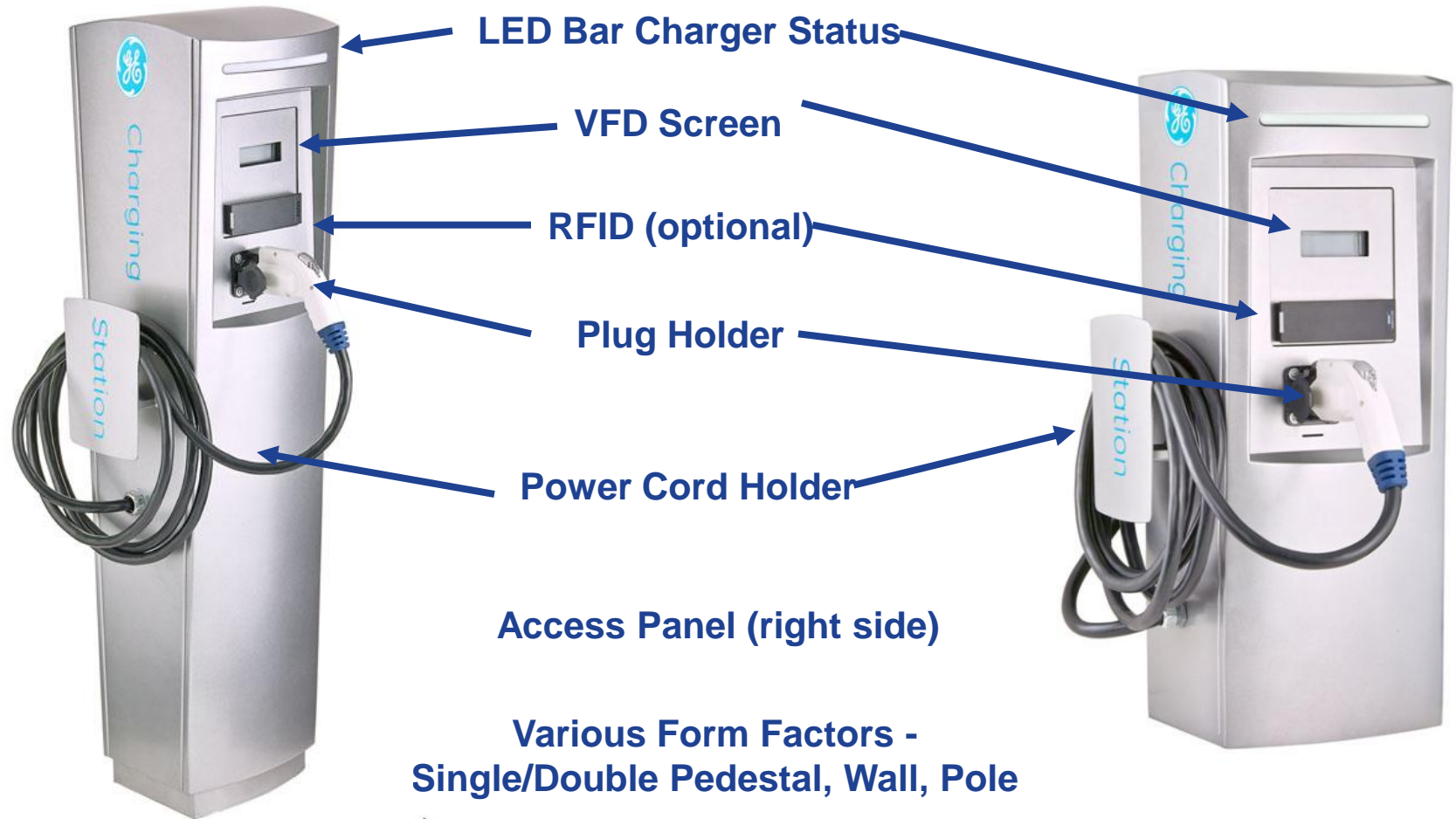
Watt Station

- Touch Screen Monitor
- Ergonomic Design
- Curb Appeal
- Retractable Cord Management



GE EV Charging Station

GE EV Charging Station presents a highly modular design that can be upgraded as new technology arrives and customer needs evolve



rk



GE EV Charging Station Specification

- Supply Needs: 208-240VAC @ 30A with 40A overload (2 pole)
- GF Protection with Ground Monitor (UL 2231)
- Charger & Vehicle Communication (NEC 625)
 - Connection Interlock
 - Personnel Protection
 - Automatic De-Energizing Device
 - Ventilation Interlock
- Connection for SAE J1772 Plug & Cord
- LED Lights & Display
- RFID User Authorization Option
- Indoor & Outdoor Enclosure (NEMA 3R)



GE imagination at work

RFID Reader Option

Optional Radio Frequency Identification (RFID) to control user access

Details:

- Wave card in front of reader to initiate charging
- Monitor/Control of Driver Access/Usage
- Ethernet network to support RFID authorization service
- Straightforward In Field Installation

Administration – Programming Cards

- USB connected RFID programmer
- Lightweight and Portable
- Determines class authorization, user control



Administrator Main Screen Welcome JAGG14

Home

Drivers Management

- Add
- Edit
- List
- Transaction

Administrator

- Data Clean Up
- Application Users
- EVSE Status

Help

Logout

EVSE Status

Status	Charging Station ID	Last Connectivity Date	Last Connectivity Time	Connectivity Frequency
●	124	12.09.2011	14:30	300
●	126	12.09.2011	12:30	300
●	120	12.09.2011	11:30	300
●	121	12.09.2011	16:30	300
●	128	12.09.2011	11:30	300
●	126	12.09.2011	10:30	300
●	127	12.09.2011	09:30	300
●	118	12.09.2011	16:30	300
●	119	12.09.2011	16:30	300

Download

Active Driver's List

First Name	Last Name	Card Number	Card Status	Status Last Changed	Email	Department	Phone Number
Rahner	Zufall	303-543-7647	Active	Fri Jun 11 00:00:00 IST 2010	rahner.a@ge.com	IT	12345670
Rahner	Babbal	303-585-7647	Active	Fri Jun 11 00:00:00 IST 2010	rahner.b@ge.com	IT	12345671
Walter	Harris	303-505-7647	Active	Fri Jun 11 00:00:00 IST 2010	walter.a@ge.com	Finance	12345672
Holger	Adams	303-505-7647	Active	Fri Jun 11 00:00:00 IST 2010	holger.a@ge.com	Strategy	12345673
Jillane	Adams	303-585-7647	Active	Fri Jun 11 00:00:00 IST 2010	jillane.a@ge.com	HR	12345674
King	Adams	303-585-7648	Active	Fri Jun 11 00:00:00 IST 2010	king.a@ge.com	IT	12345675
Walter	Babbal	303-585-7649	Active	Fri Jun 11 00:00:00 IST 2010	walter.b@ge.com	Admin	12345676
Poll	Adams	303-585-7640	Active	Fri Jun 11 00:00:00 IST 2010	poll.a@ge.com	IT	12345678
Jimmy	Adams	303-585-7641	Active	Fri Jun 11 00:00:00 IST 2010	jimmy.a@ge.com	IT	12345679
Symonds	Andrew	303-585-7642	Active	Fri Jun 11 00:00:00 IST 2010	Symonds.a@ge.com	Marketing	12345680

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US Compliance and Standards

U.S. Electric Vehicle Standards

- **UL 2594, for EVSE**
- **UL 2231, the Standard for Safety of Personnel Protection Systems for EV Supply Circuits**
- **NEC Article 625, Electric Vehicle Charging System**
- **SAE (Society of Automotive Engineers) J1772, Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler**

GE's UL Expertise

- **Certified UL lab facilities for witnessing and testing at Industrial Solutions HQ in Plainville, CT**
- **UL lab capabilities include: handling overload, endurance and short circuit, EMI testing, material and environmental analysis**
- **GE Industrial Solutions has over 3,000 unique catalog numbers that are UL listed**
- **UL collaborates with GE for industry guidance in technology and safety, and managing policy and technical content**



WattStation Home Exterior

Power Button
OFF/standby button

LED interface and Ring
Visualization of station status

Charging Cable
Socket with interlock
SAE J1772



Weatherized Case

Molded Lightweight Plastic
Keylock security
Nema 3R / IP54

Plug-In Option

SKU with plug option for
easy install / removal



WattStation Home

Features

- **Level II – 208-240 VAC, 30 A**
- **Indoor / Outdoor (NEMA-3R)**
- **Flush Mounting System**
- **Safety Protections**
 - **Ground Fault**
 - **Overload**
- **Vehicle Communications**
 - **SAE J1772 Connector**
- **UL Certified**
- **Power Off / Standby Switch**
- **LED Status Indicators**
- **Wrap Around Cord Management**



Introducing the GE WattStation™

An easy-to-use charger designed by renowned industrial designer Yves Behar

“The GE WattStation achieves this with a welcoming design that is seamlessly integrated in the urban landscape and becomes a natural part of our daily driving routine.”



“Good design is when a new technology enters our life and makes it simpler, beautiful and healthy”

GE WattStation™ ... a closer look

GE WattStation provides a modular design to integrate new technology



GE WattStation™ Internal

Components

Supply Needs: 16A @ 230V to 32A @ 400V

Controller

- EV Communications
- Charger status/messages via LED Ring, Interactive Display Panel, or external comms
- Manages Intelligent charging (Flex Charging)
- Allows user configurable overload protection
- Performs CCID20 ground fault protection per UL 2231
- Provides single phase metering
- Communications to Building Management Systems (BMS), EV, smart meters

Contactors

- Responsible for energizing and de-energizing of EVSE connector, Operates in conjunction with controller to meet UL and NEC reqs

Connector

- Compliant with SAE J1772 standard
- UL listed for EVSE applications

Fuses

- Provides overload and short circuit protection

Options:

- Wireless Communications
- Point of Sale (Credit Card)
- RFID, Smart Metering



GE imagination at work

Charging Station Communications

Kiosk / LED

Wireless

- WiFi, GPRS, Zigbee
- Ethernet



BackEnd
(Database, Web Services)

Commercial Interests



Owner

EV



SAE J1772,
Wireless
(future)

Utility



Driver



**Building (BMS) /
Home (HEM)**

Services

- Email
- SMS
- eWallet
- Web

GE Meets Your EV Needs

Customer EV Need

Future Proof EV Equipment

Assistance with Upstream
ED Infrastructure

Support, Service, Experience

GE Solution

- ✓ GE's EVSE Product Line is future proof with modular hardware and remote firmware upgrades
- ✓ GE has the industry expertise and support to help you build a robust EV system and meet all standards
- ✓ GE provides installation services with ServiceMagic network of installers, provides exceptional customer support and has over a century of experience in power engineering. GE is a brand you can rely upon.



GE Is Uniquely Positioned . . .



Power Sources

Electric vehicles will be powered by energy from traditional and renewable sources like solar, wind.



Smart Grid

A smarter grid will transmit information between utilities and charging stations, helping to create additional capacity, and enabling consumers to manage vehicle charging costs.



Infrastructure

GE provides infrastructure solutions, like transformers, submeters, and load centers, that support the roll-out of electric vehicles.



Commercial Charging Stations

Charging Stations will be available on city streets, retail destinations and other parking facilities.



Home Charging Stations

While you can plug an EV into any standard household 120V outlet, you'll get a significantly faster charge and optional internet connectivity if you install a charger like GE's WattStation.

Lightweight Materials

Automotive design have made EVs more powerful and efficient than ever



Better Batteries
Enable longer ranges with decreased charging times.



Recuded Emissions

EVs can reduce CO2 emissions over 30% given the current US grid mix.



Up to 100 Miles On A Full Charge
A full charge with a Level 2 charger like GE's Wattstations takes 4-8 hours and can take a car for up to 100 miles.



Financing Solutions

GE Capital will provide solutions for businesses to finance electric vehicles for their fleets.



Thank You ...

Questions?

