

Why all the excitement about Electric Vehicles?



Presenter info

- Tony Billera
 - 35 years in telecom, wireless, and IT product development and program mgt.
 - Senior Fellow at the Center for Advanced Transportation and Energy Solutions (www.aboutCATES.org)
 - Autonomous
 - Connected
 - Electric
 - Shared Vehicles
 - 3 years Student Transportation
 - Owner of 2 EVs:
 - KIA Niro (250-300 mile range)
 - FIAT 500e (75-90 mile range)
 - BMW C Evolution motorcycle (sold)

CATES

Center for Advanced Transportation and Energy Solutions

Call on CATES for technical and management consulting, policy advisory services, and contract research on small vehicle automation and electrification.

The End of Driving
Transportation Systems and Public Policy Planning
for Autonomous Vehicles
Bern Grush • John Niles

Focusing on the urban and social issues of automated vehicles deployment, the book provides research-based paths for creating flexible transportation systems and policies that capture the opportunities and avoid the pitfalls of a driverless environment.

- Foreword by Susan Shaheen, PhD, Adjunct Professor and Co-Director, Transportation Sustainability Research Center, University of California, Berkeley
- Offers a workable public transit solution design melding the traditional acquire-and-operate mode with the absorption of new technology as it is ready,
- Provides a step-by-step discussion of digital system designs and effective regulation-by-data approaches needed for a new urban mobility;
- Learning aids include case study scenarios, chapter objectives and discussion questions, sidebars, and a glossary.

While many transportation and city planners, researchers, students, and practitioners are familiar with the technical nature and promise of vehicle automation, consensus is not yet often seen on the impact that will result, or the policies and actions that those responsible for transportation systems should take.

The End of Driving: Transportation Systems and Public Policy Planning for Autonomous Vehicles explores both the potentials of vehicle automation technology and its barriers to forming coherent urban development. The book evaluates the case for deliberate development of a public transit system that can accommodate the needs of automated, sustainable mobility, describing critical approaches to the planning and management of vehicle automation technology. It serves as a reference for understanding the full life cycle of the multi-layer transportation systems planning processes, including regulation, planning, and acquisition tools for regional transportation.

Application-oriented, research-based, and solution-oriented rather than predict-and-warn, the book concludes with a detailed discussion on the systems design needed for accomplishing this shift.

Related Titles:
Chalamkurti / Intelligent Vehicular Network and Communications: Fundamentals, Architectures and Solutions / 9780128092688
Kala / On-Road Intelligent Vehicles Motion Planning for Intelligent Transportation Systems / 9780128037294
Rossetti and Liu / Advances in Artificial Transportation Systems and Simulation / 978012897048

The End of Driving



The End of Driving

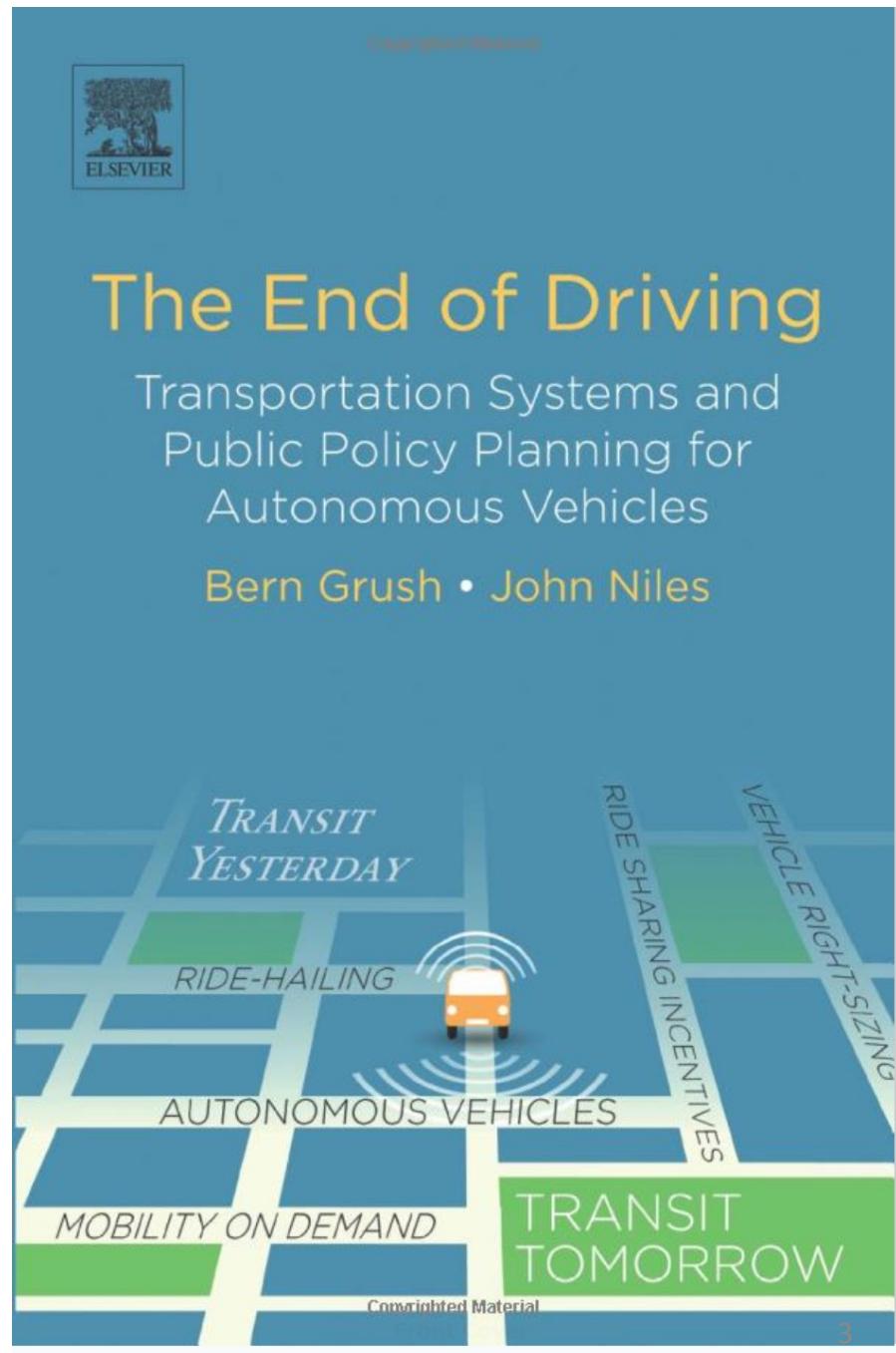
Transportation Systems and
Public Policy Planning for
Autonomous Vehicles

Bern Grush • John Niles



The End of Driving: Transportation Systems and Public Policy Planning for Autonomous Vehicles

- explores the potential of **vehicle automation technology**
- the barriers to urban deployment
- evaluates the case of automated public transportation and **mobility-as-a-service** as paths toward sustainable mobility



Why all the excitement about EVs?

1. EVs Past
2. Why Now?
3. Batteries
4. EVs & Hybrid Efficiency
5. Owning an EV
6. Market Disruption
7. Charging Stations
8. Charging Networks
9. Tax Incentives

Early EVs



1919 Rauch & Lang
Vintage Electric car



Battery Scooter
London 1916

THE SATURDAY EVENING POST

A Four-Passenger Coupé with removable top which may be replaced with Leather Victoria or Buggy top. Exide, Waverley or National Batteries. Choice of solid or pneumatic tires.

Price \$2,250

An advertisement for the Waverley electric car. It features a side-view illustration of a dark-colored four-passenger coupé with its top down. Three women are visible inside the car. The text above the car describes it as a "Four-Passenger Coupé" with various top options and battery choices. To the left, the price is listed as "\$2,250". The word "Waverley" is written in a large, stylized script font. Below it, a smaller text reads: "Perfection of Style and Service In an Electric".

Studebaker
ELECTRICS

VEHICLES OF GREAT UTILITY
FOR THE BUSINESS MAN

An advertisement for Studebaker electric vehicles. The top half features the "Studebaker" logo in a script font and the word "ELECTRICS" in a serif font. Below this, the text "VEHICLES OF GREAT UTILITY FOR THE BUSINESS MAN" is displayed. The bottom half shows a side-view illustration of a dark-colored "ELECTRIC STANHOPE" car, a four-door model with a high roof and a small front-mounted headlight. The car is shown from a three-quarter perspective.

GM EV1 2,300 built 1996 - 1999

Movie : “Who killed the electric car?”



Why all the excitement today?

- Impacts of GHG emissions are recognized thru the climate science research and evidence, driving the urgent need to rapidly reduce anthropogenic co2 emissions
 - Transportation sector is largest share of U.S. co2 emissions at 29%
 - One gallon of gas or diesel emits about 21 lbs of co2
- Advanced Battery Technology
 - Lighter
 - Denser
 - Reliable
- Battery costs are falling thru mass production economies of scale and making electric vehicles more affordable and life cycle costs very compelling



CH₄ (ppb)

CO₂ (ppm), N₂O (ppb)

2000

1800

1600

1400

1200

1000

800

600

1000

2017

GREENHOUSE GAS CONCENTRATIONS

CO₂ persists for over 100 yrs

CH₄ persists for 20 yrs- 90X
more potent than CO₂

CARBON DIOXIDE

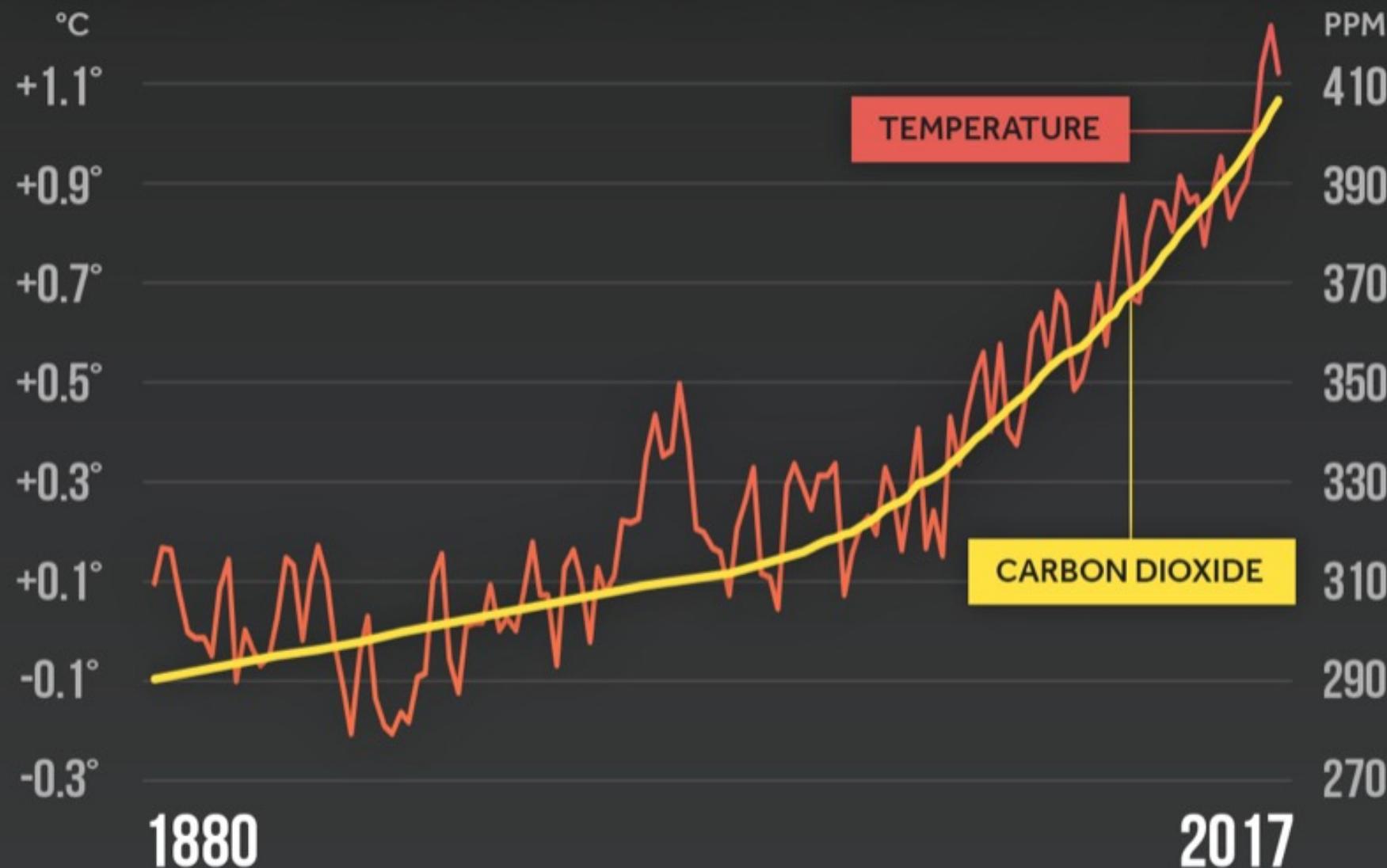
METHANE

NITROUS OXIDE

POST-INDUSTRIAL

Post-Industrial defined as 1750 and beyond
Source: US EPA's Climate Change Indicators

GLOBAL TEMPERATURE & CARBON DIOXIDE

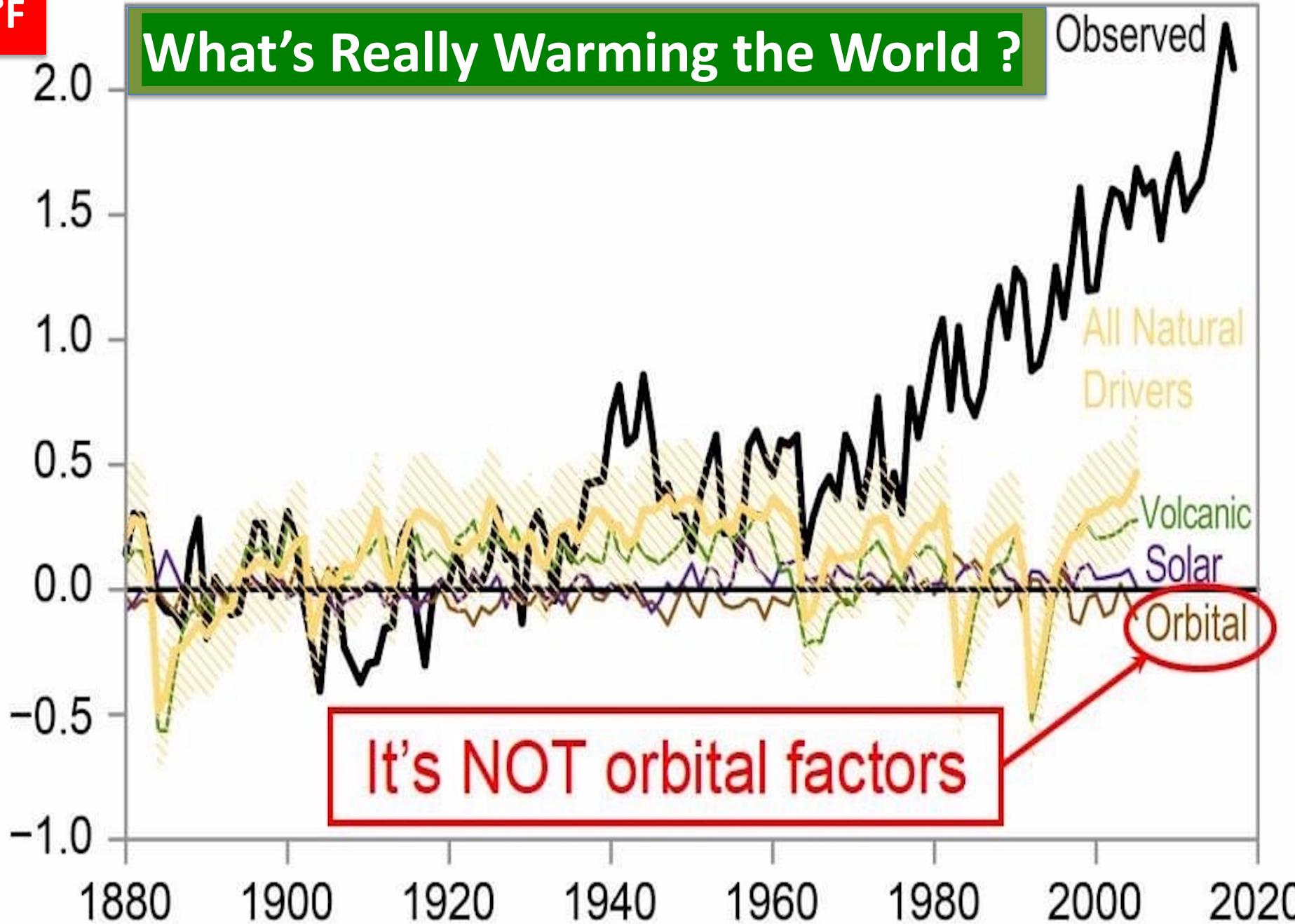


Global temperature anomalies averaged and adjusted to early industrial baseline (1881-1910)
Source: NASA GISS, NOAA NCEI, ESRL

CLIMATE  CENTRAL

°F

What's Really Warming the World ?

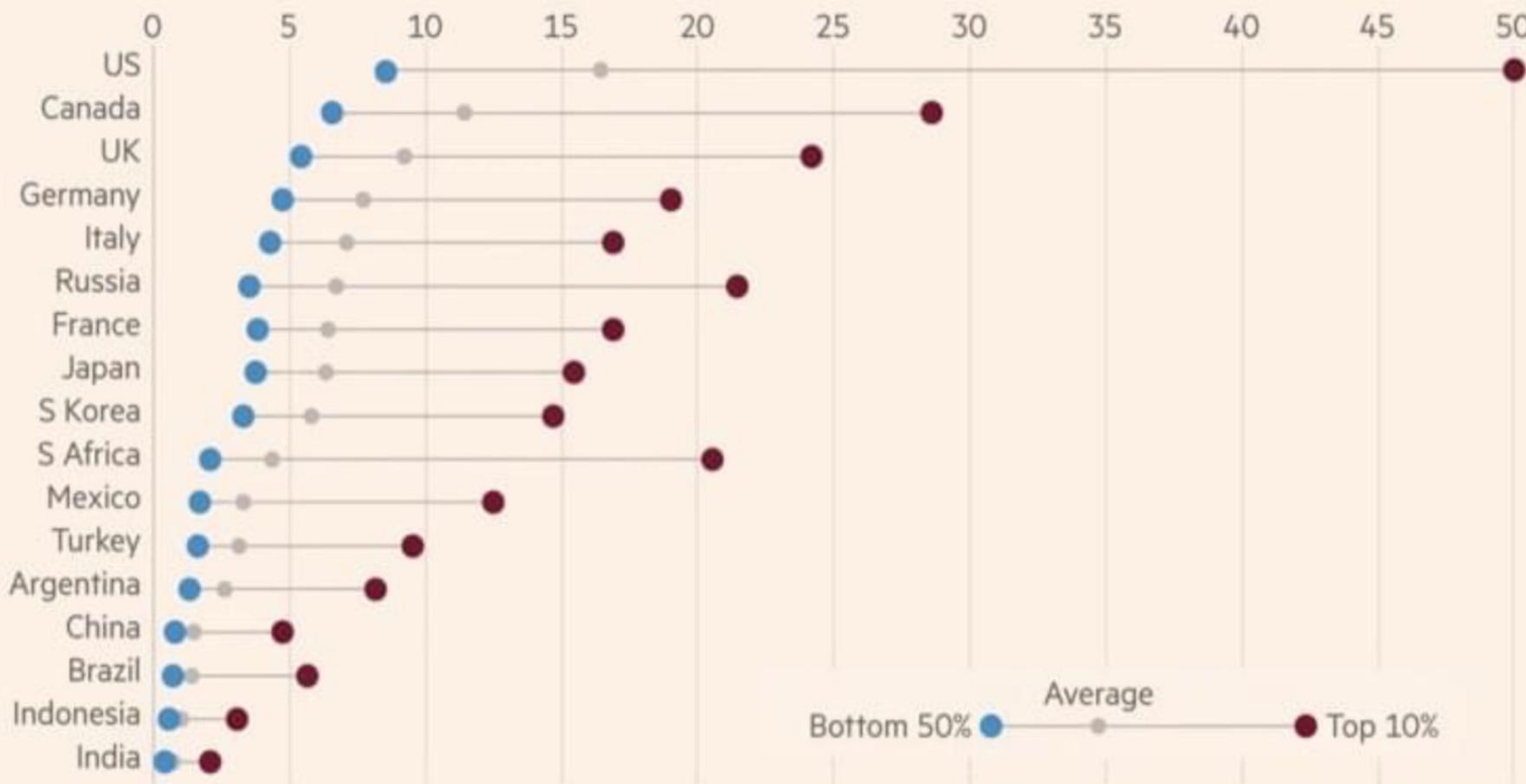


- WHATS REALLY WARMING THE WORLD?

<https://www.bloomberg.com/graphics/2015-whats-warming-the-world/>

Emissions per capita

Household lifestyle consumption emissions (tonnes of CO₂ per capita)**



** In G20 countries for which data is available

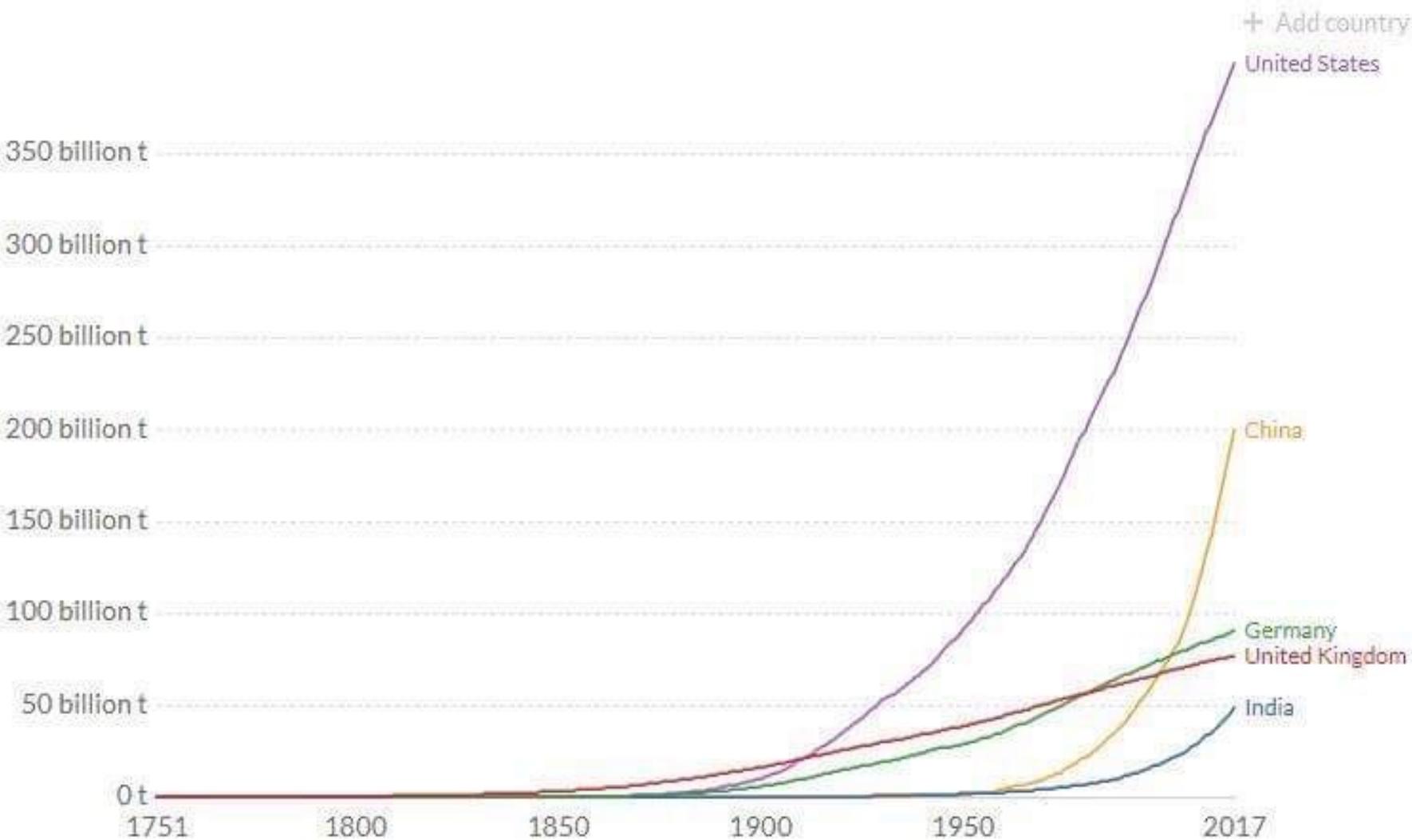
Visual journalism: Steven Bernard/@sdbernard and Chelsea Bruce-Lockhart/@C_BruceLockhart

Source: Oxfam

© FT

Cumulative CO₂ emissions

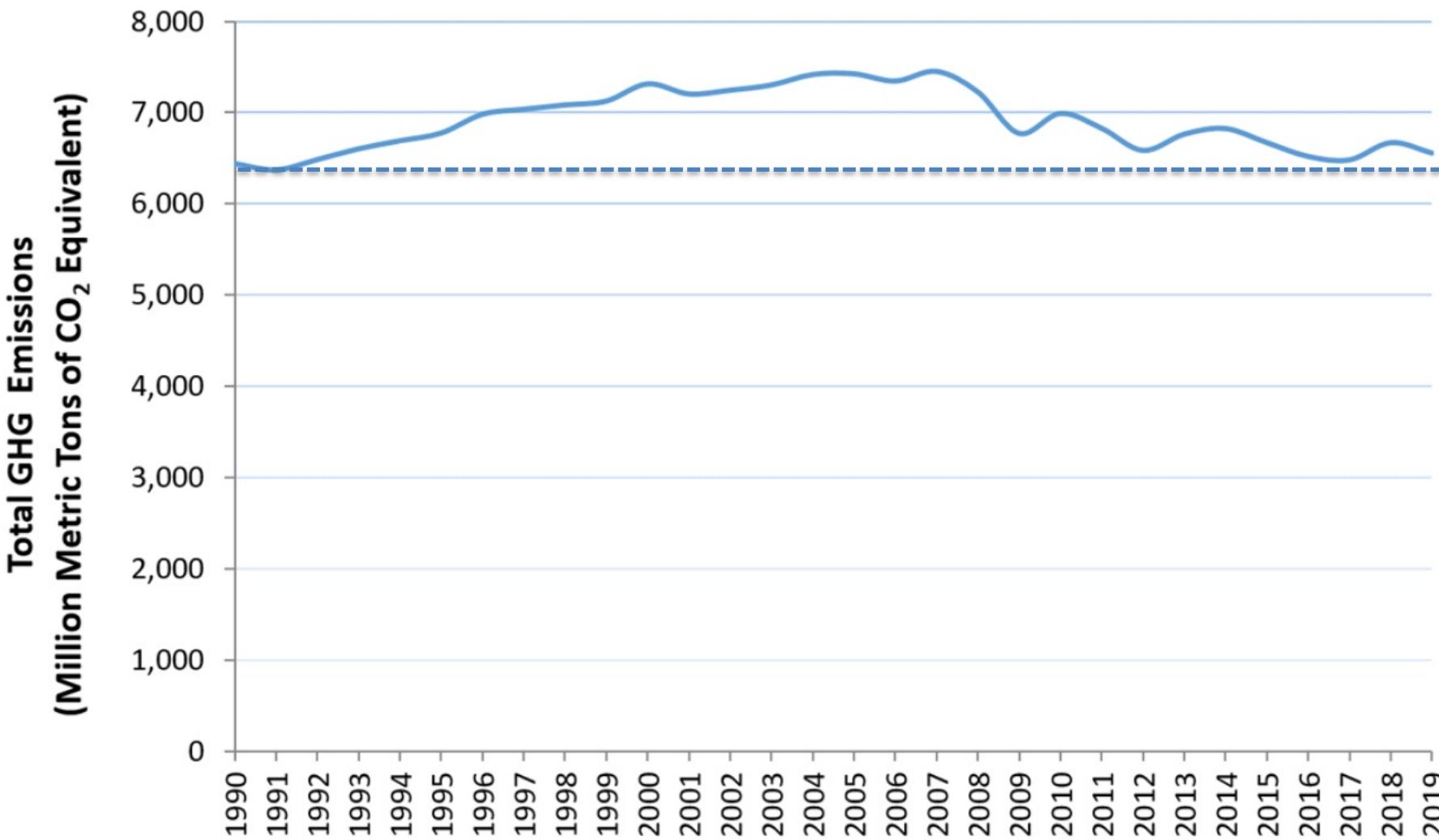
Cumulative carbon dioxide (CO₂) emissions represents the total sum of CO₂ emissions produced from fossil fuels and cement since 1751, and is measured in tonnes.



Source: Global Carbon Project (GCP); Carbon Dioxide Information Analysis Centre (CDIAC)

CC BY

Total U.S. Greenhouse Gas Emissions, 1990 - 2019

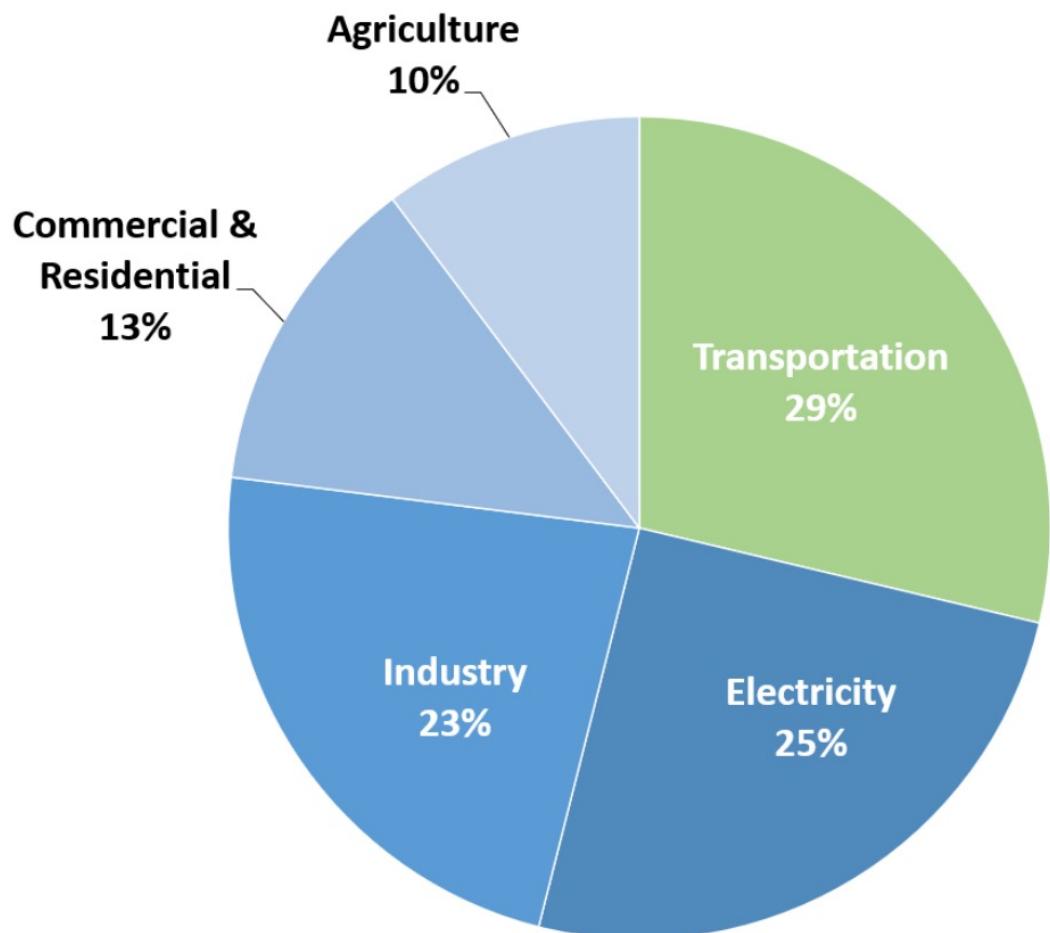


Note: All emission estimates from the [Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2019](#).

Total U.S. Greenhouse Gas Emissions By Sector in 2019

Transportation is largest share

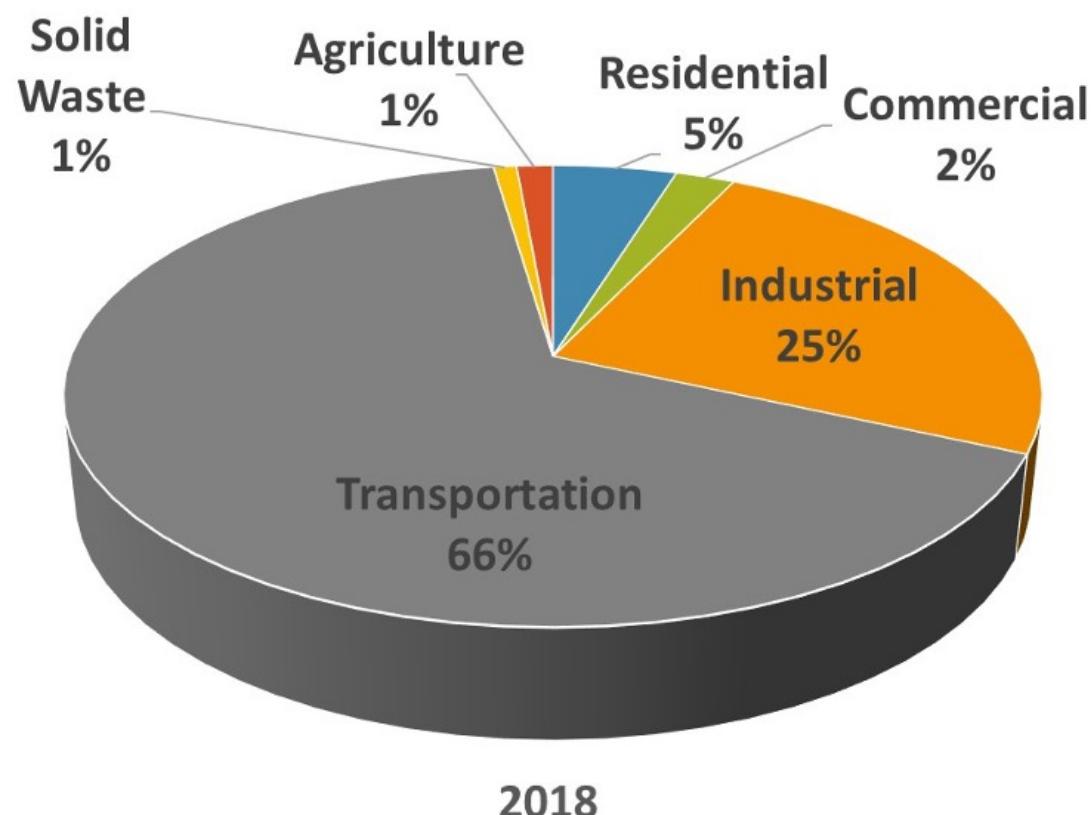
- Primarily :
passenger cars, medium-
and heavy-duty trucks,
buses, and light-duty
trucks
- commercial aircraft,
ships, boats, and trains,
as well as pipelines and
lubricants



Total Emissions in 2019 = 6,558 [Million Metric Tons of CO₂ equivalent](#).

Jefferson County 2018 Community Emissions By Sector

- Jefferson County / Port Townsend Climate Action Committee in 2020
- Transportation emissions increased 13% since 2005
- Electricity > 90% hydroelectric



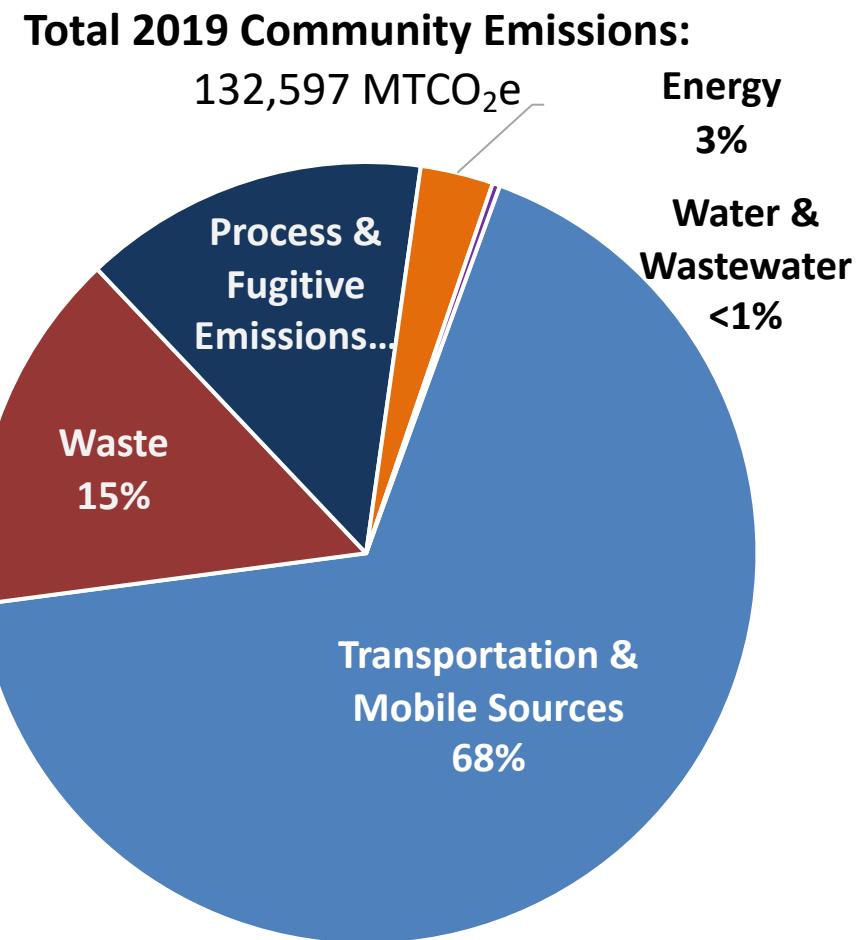
Port Angeles Climate Resiliency Project

Inventory Results: 2019 Community Snapshot

Main Sources of Emissions

(in order):

1. Transportation & mobile sources
2. Solid waste generation & landfill operations
3. Process & fugitive emissions (e.g., refrigerants)
4. Residential, Commercial, & Industrial Energy
5. Electricity > 90% hydroelectric



Global greenhouse gas emissions and warming scenarios

- Each pathway comes with uncertainty, marked by the shading from low to high emissions under each scenario.
- Warming refers to the expected global temperature rise by 2100, relative to pre-industrial temperatures.

Annual global greenhouse gas emissions
in gigatonnes of carbon dioxide-equivalents

150 Gt

100 Gt

50 Gt

Greenhouse gas emissions
up to the present

0

1990 2000 2010 2020 2030 2040 2050 2060 2070 2080 2090 2100

No climate policies
4.1 – 4.8 °C

→ expected emissions in a baseline scenario
if countries had not implemented climate
reduction policies.

Current policies
2.7 – 3.1 °C

→ emissions with current climate policies in
place result in warming of 2.7 to 3.1°C by 2100.

Pledges & targets (2.4 °C)
→ emissions if all countries delivered on reduction
pledges result in warming of 2.4°C by 2100.

2°C pathways
1.5°C pathways

7.2 –
8.6F

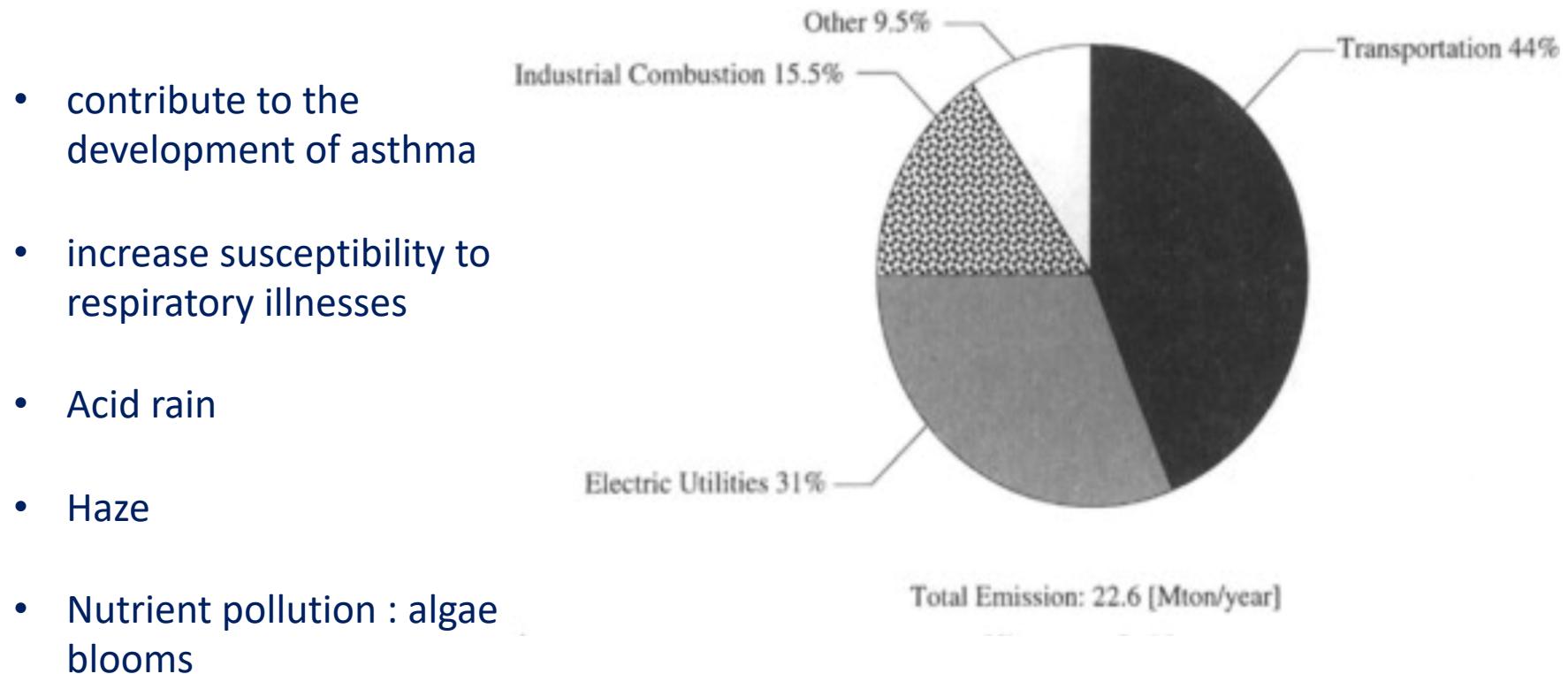
4.5 –
5.5F

4.3F

2.7 –
3.8F

...and don't forget about Nitrogen oxides

- Primarily burning of fossil fuel
- NO_2 forms from emissions from cars, trucks and buses, power plants, and off-road equipment



- contribute to the development of asthma
- increase susceptibility to respiratory illnesses
- Acid rain
- Haze
- Nutrient pollution : algae blooms

The Future of clean energy includes batteries

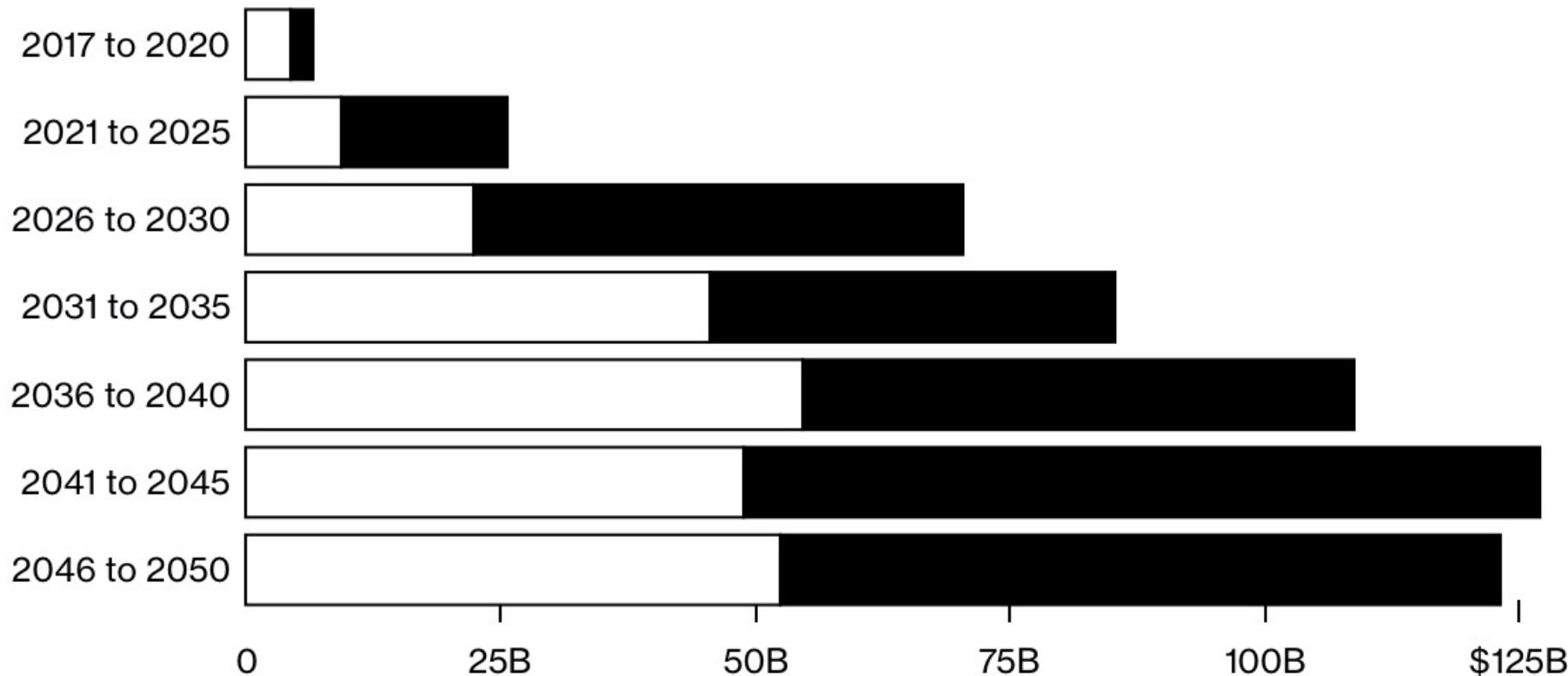


Battery Investments

Storage Spree

About \$548 billion may be invested in battery storage capacity by 2050

Small-scale batteries Utility-scale batteries



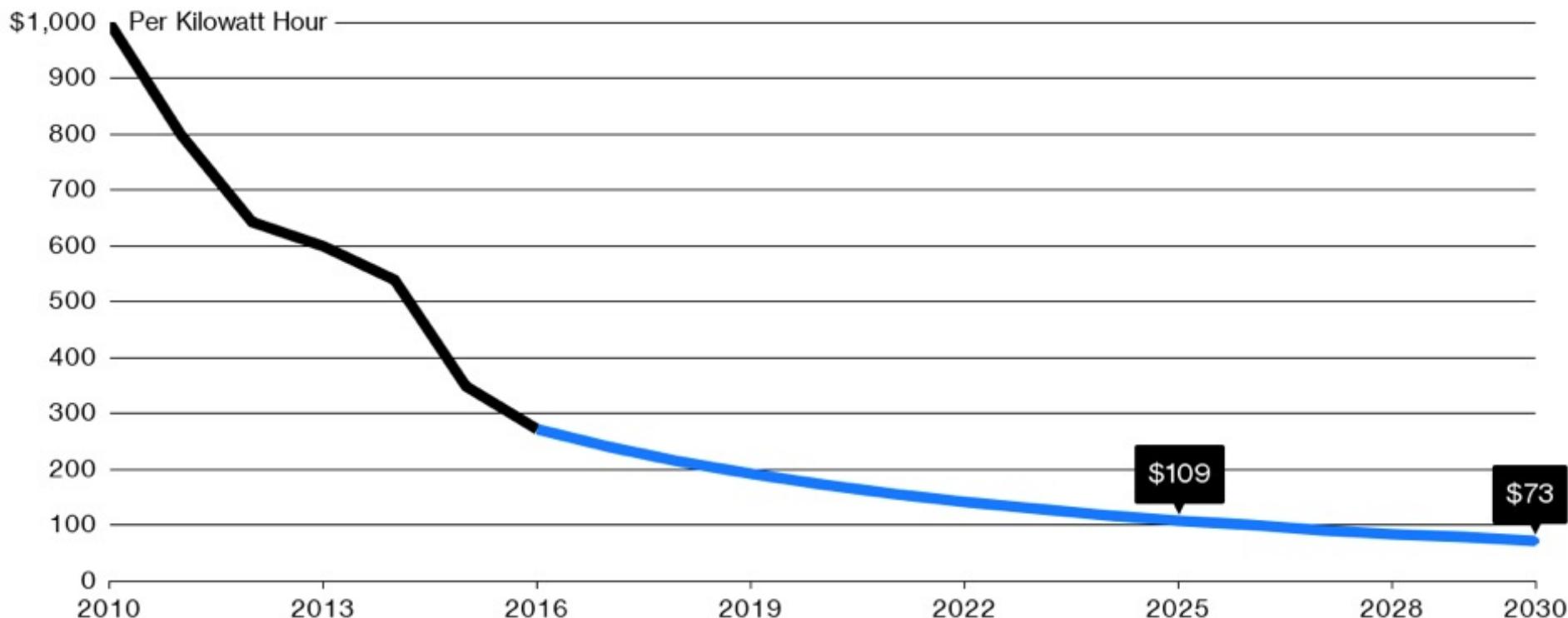
Source: Bloomberg NEF

Battery costs falling rapidly

More Bang for Your Buck

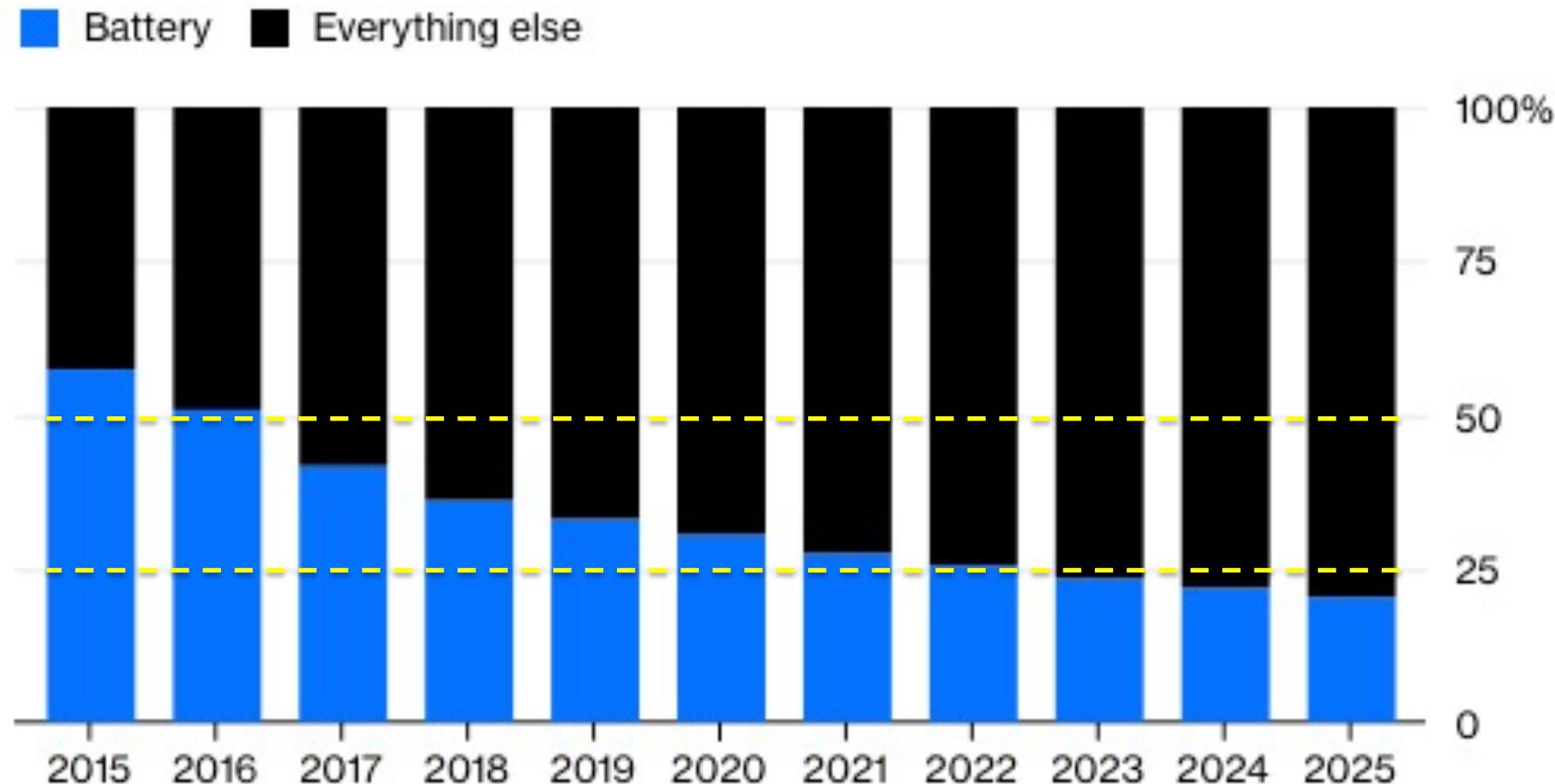
Greater efficiency means a \$1,000 battery in 2010 will cost \$73 in 2030

■ Average prices □ Forecast



Source: Bloomberg New Energy Finance

EV battery cost for U.S. medium-size car as a percentage of retail price



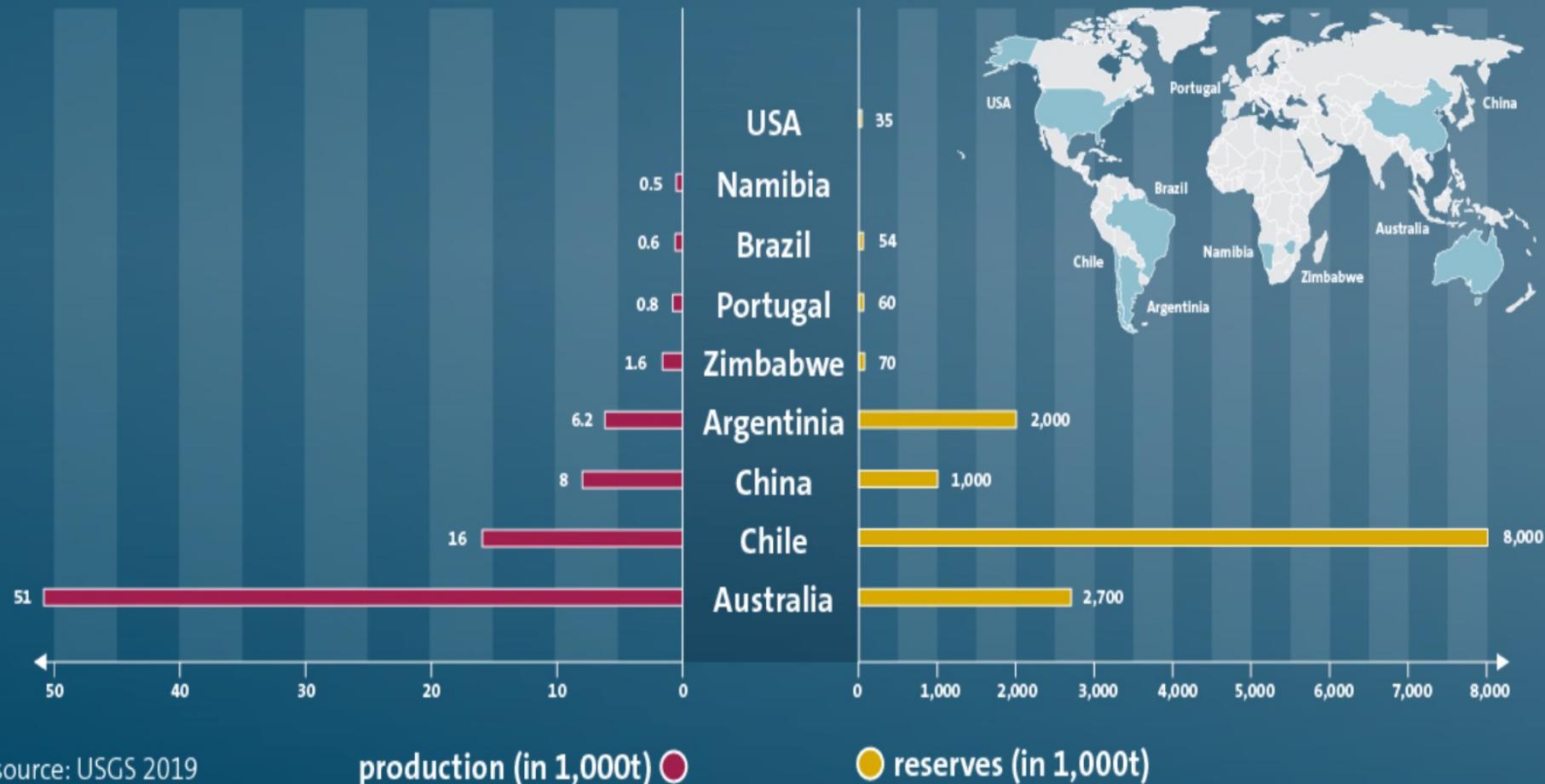
Source: BloombergNEF

Note: Includes profit margins and costs other than direct manufacturing costs.

Where will the Lithium come from ?

AUSTRALIA AND CHILE IN THE FRONT ROW

Countries with major Lithium production and reserves





GM Will Suck Lithium from the Salton Sea to Make Batteries

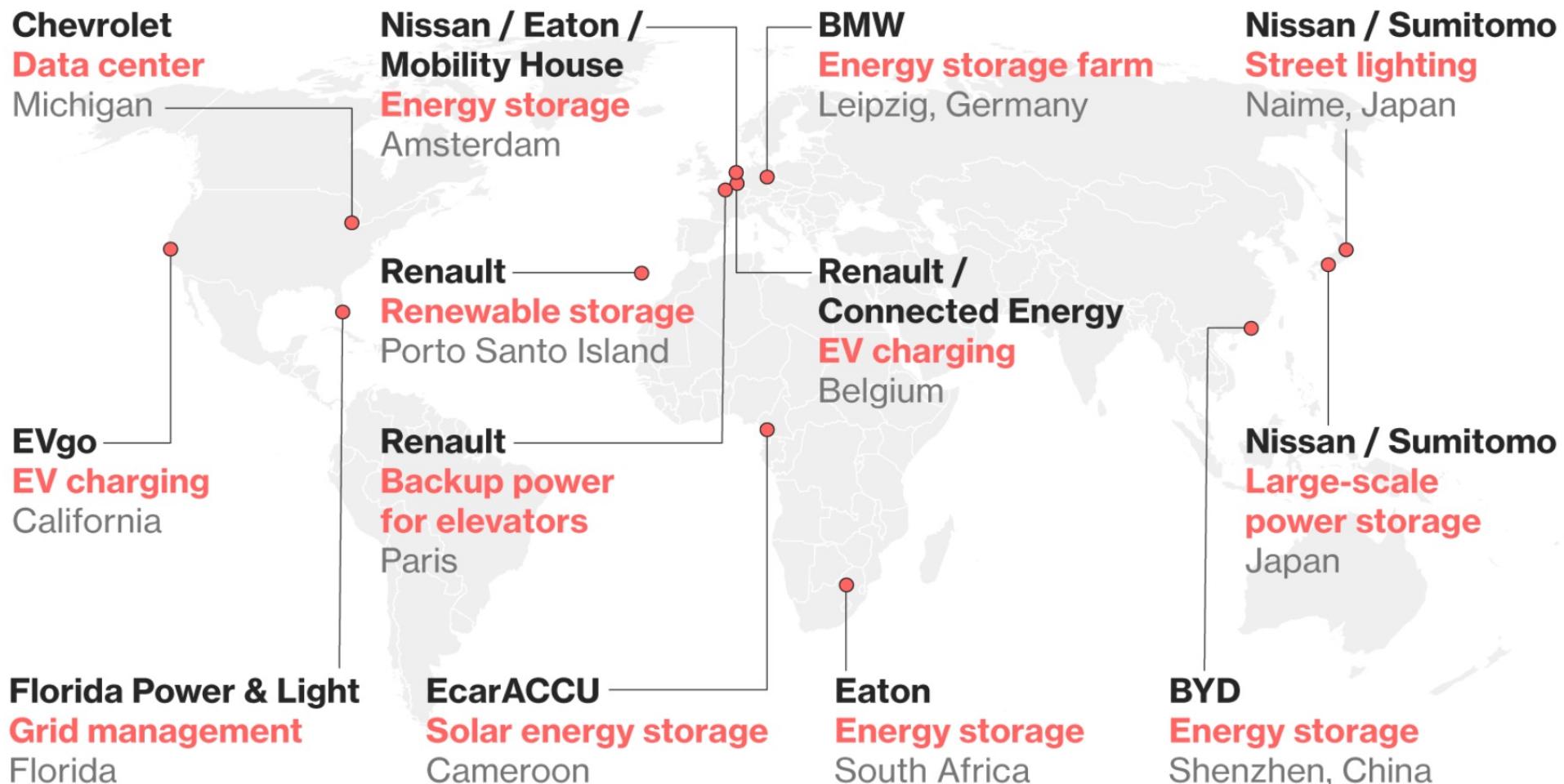
“California Energy Commission’s estimate that the Salton Sea area could produce 600,000 tons of lithium per year, which is amazing since the entire world’s industry produced a mere 85,000 tons of lithium in all of 2019..”

Source: AutoWeek July 2021

What about the “old” batteries?- Re-purposing

A New Lease on Life

Where electric-vehicle batteries are being used and tested for new roles



What about the “old” batteries? – Re-cycling

VW plans to scale up process to recover 95% of EV batteries' raw materials



STEPHEN EDELSTEIN

MARCH 10, 2021

9 COMMENTS



View Gallery

Volkswagen is just starting to ramp up production of electric cars based on its MEB platform, but the automaker is already thinking of how to recycle battery packs once those vehicles have reached the end of their lifecycles.

VW announced on Tuesday that it will scale up a process for recovering raw materials from used EV batteries. The automaker opened what it calls a pilot battery-recycling plant in Salzgitter, Germany, earlier this year, and hopes to open similar plants around the world.

LITHIUM-ION BATTERY RECYCLING FINALLY TAKES OFF IN NORTH AMERICA AND EUROPE

Li-Cycle, Northvolt, and Ganfeng Lithium are among those building recycling plants, spurred by environmental and supply-chain concerns

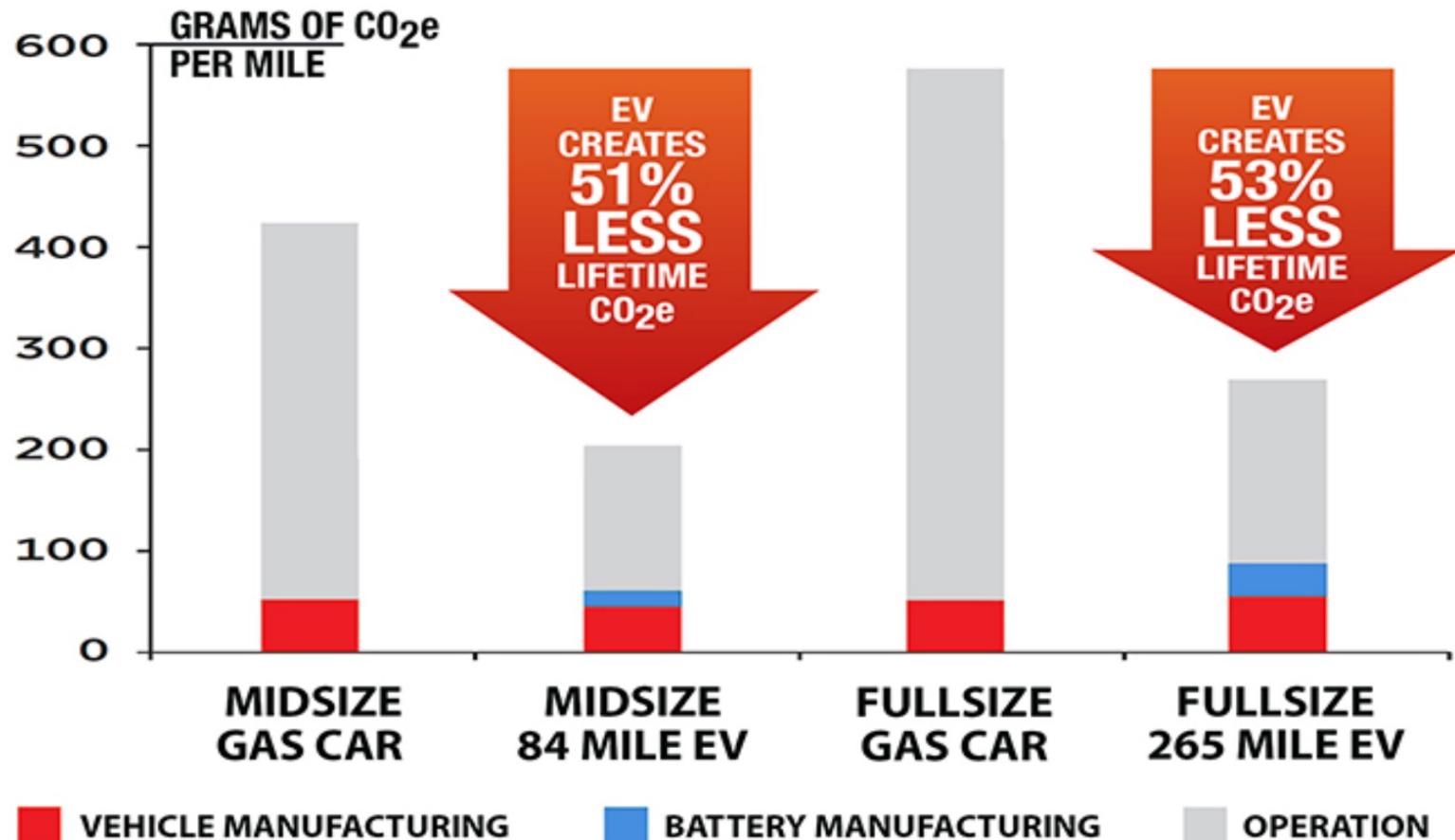
LATER THIS YEAR, the Canadian firm Li-Cycle will begin constructing a US \$175 million plant in Rochester, N.Y., on the grounds of what used to be the Eastman Kodak complex. When completed, it will be the largest lithium-ion battery-recycling plant in North America.

The plant will have an eventual capacity of 25 metric kilotons of input material, recovering 95 percent or more of the cobalt, nickel, lithium, and other valuable elements through the company's zero-wastewater, zero-emissions process.

"We'll be one of the largest domestic sources of nickel and lithium, as well as the only source of cobalt in the United States," says Ajay Kochhar, Li-Cycle's cofounder and CEO.

CO2 Footprint of EV

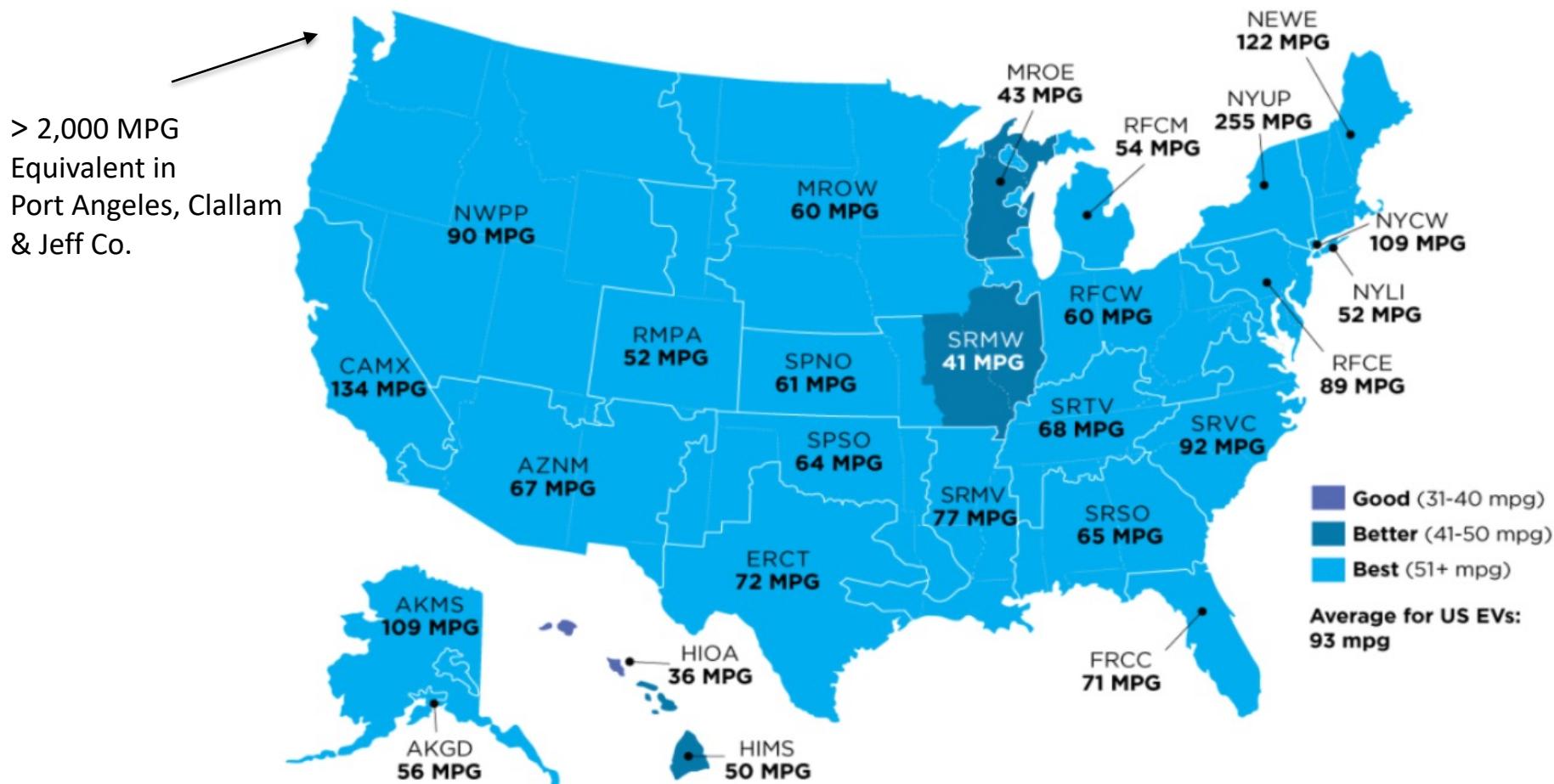
LIFECYCLE GLOBAL WARMING EMISSIONS GAS VEHICLE VS. ELECTRIC VEHICLE



Based on modeling of the two most popular BEVs available today and the regions where they are currently being sold, excess manufacturing emissions are offset within 6 to 16 months of average 29 driving.

Where you live makes a difference

EV Emissions as Gasoline MPG Equivalent Average EV, 2021*



* based on 2019 reported electricity generation emissions

© Union of Concerned Scientists

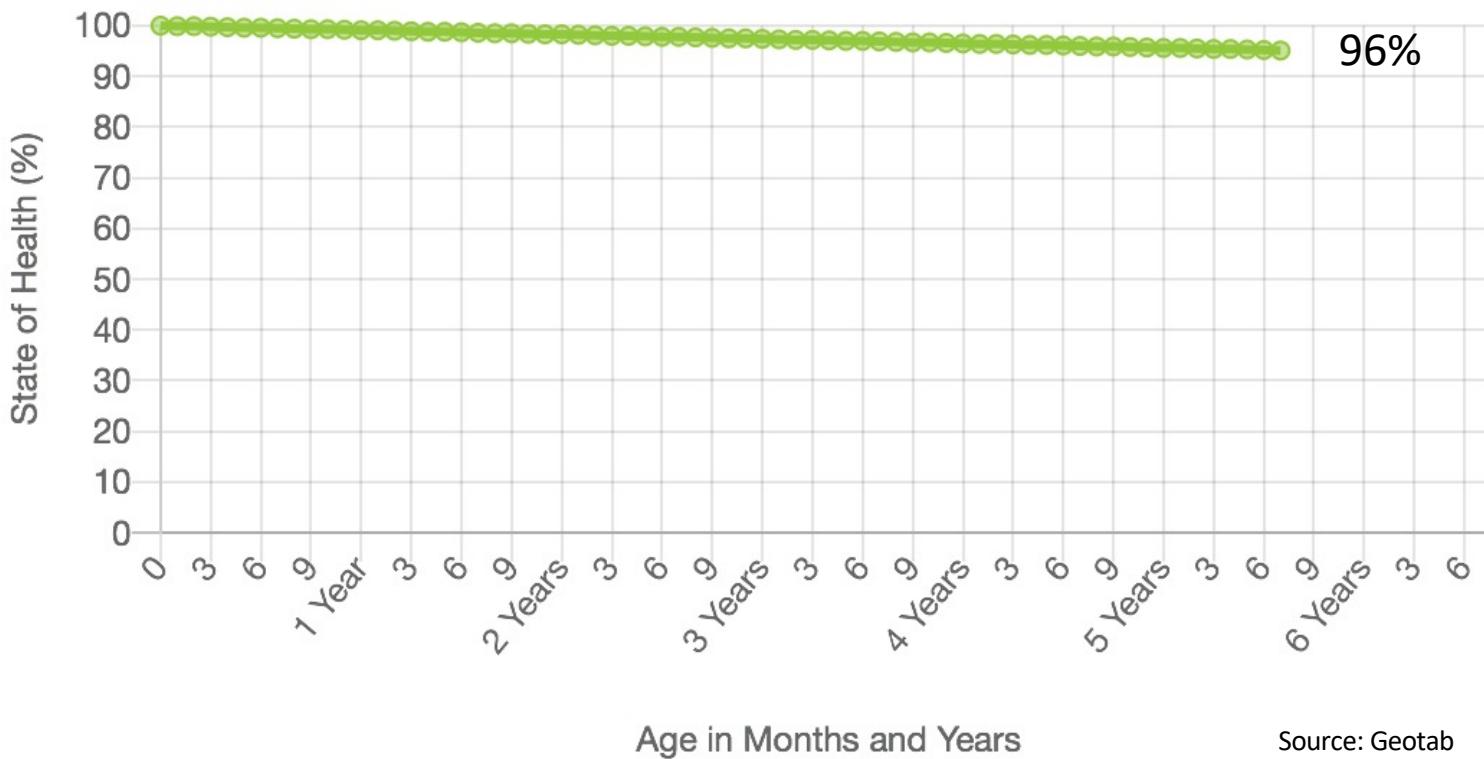
What about Degradation?

Make & Model

Chevrolet Volt

Year

2014

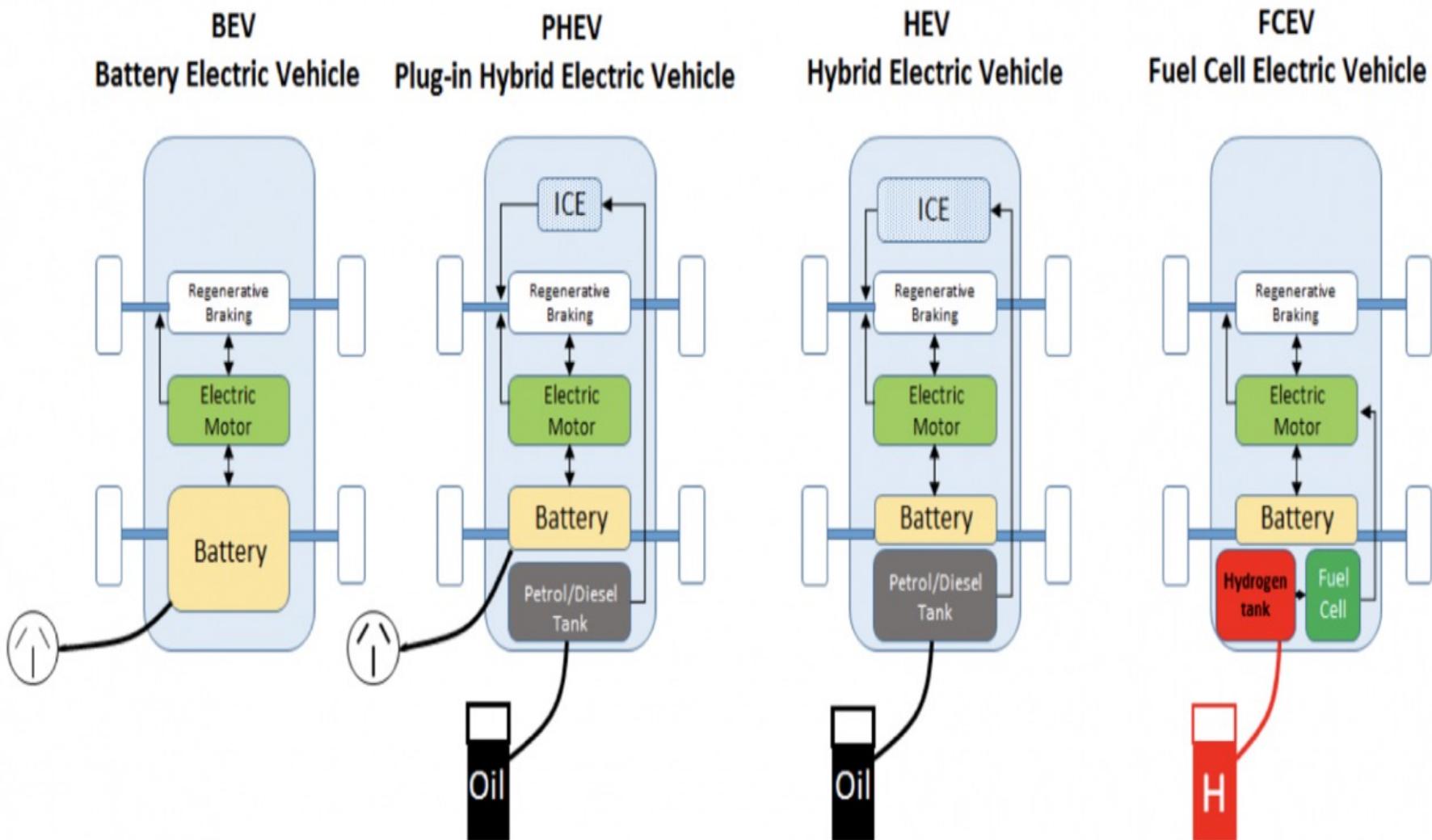


Causes:

- Degradation increases if using DCFC frequently (DC fast charging)
- Avoid operating much below 10%

• Battery Mgt Systems differ between vehicles
Passive Thermal management systems (ex. Leaf)
vs Active liquid cooled & heated (preferred)³¹

Types of Electrified Vehicles Today



- *Series or parallel ?*



ENERGY EFFICIENCY LABEL

VEHICLES

A++ 70%+

A+ 60% > 70%

A 50% > 60%

B 40% > 50%

C 30% > 40%

D 20% > 30%

E 20%-

→ **ELECTRIC**

→ **HYDROGEN
COMBUSTION**

The World requires your Leadership and contribution in order to better use the energy and ensure the transition from fossil sources to renewable sources. Hence, it is important to realize 30% of the energy contained in the fuel of a conventional vehicle (know as 'ICE' Internal Combustion Engine) is actually used to power the car. Even worse, when adding the required energy to produce the final product (fuel) and its transport, the efficiency drops to 13% whereas an electric vehicle obtains a general score of 73%.

Battery Electric Simplicity & Efficiency

GAS ENGINES



2,000 Moving Parts

ELECTRIC MOTORS

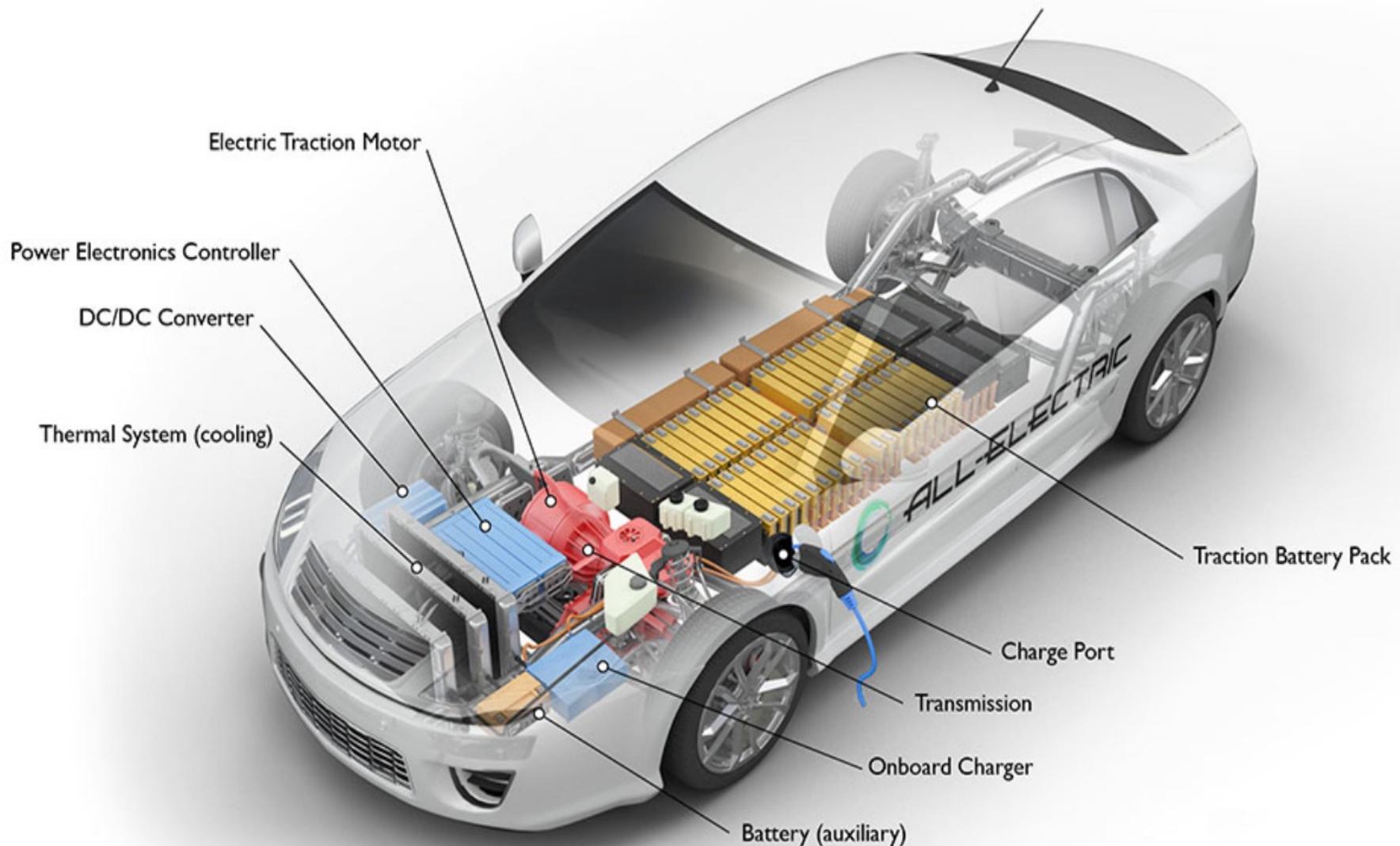


20 Moving Parts

Energy Efficiency



100% Battery Electric Simple Design



Owning an EV

- Highly reliable – 20 moving parts vs 2000 (ICE)

Maintenance Schedule for your 2017 Chevrolet Bolt EV

Certified Service	7,500 miles	15,000 miles	22,500 miles	30,000 miles	37,500 miles	45,000 miles	52,500 miles	60,000 miles	67,500 miles	75,000 miles	82,500 miles	90,000 miles	97,500 miles	105,000 miles	112,500 miles	120,000 miles	127,500 miles	135,000 miles	142,500 miles	150,000 miles
Rotate tires, if recommended for the vehicle, and perform Required Services.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Replace passenger compartment air filter (or 2 years, whichever comes first).			✓		✓		✓		✓		✓		✓		✓		✓		✓	
Drain and fill vehicle coolant circuits.																				✓

Owning an EV

ICE (Internal Combustion Engine)

Electric Vehicle

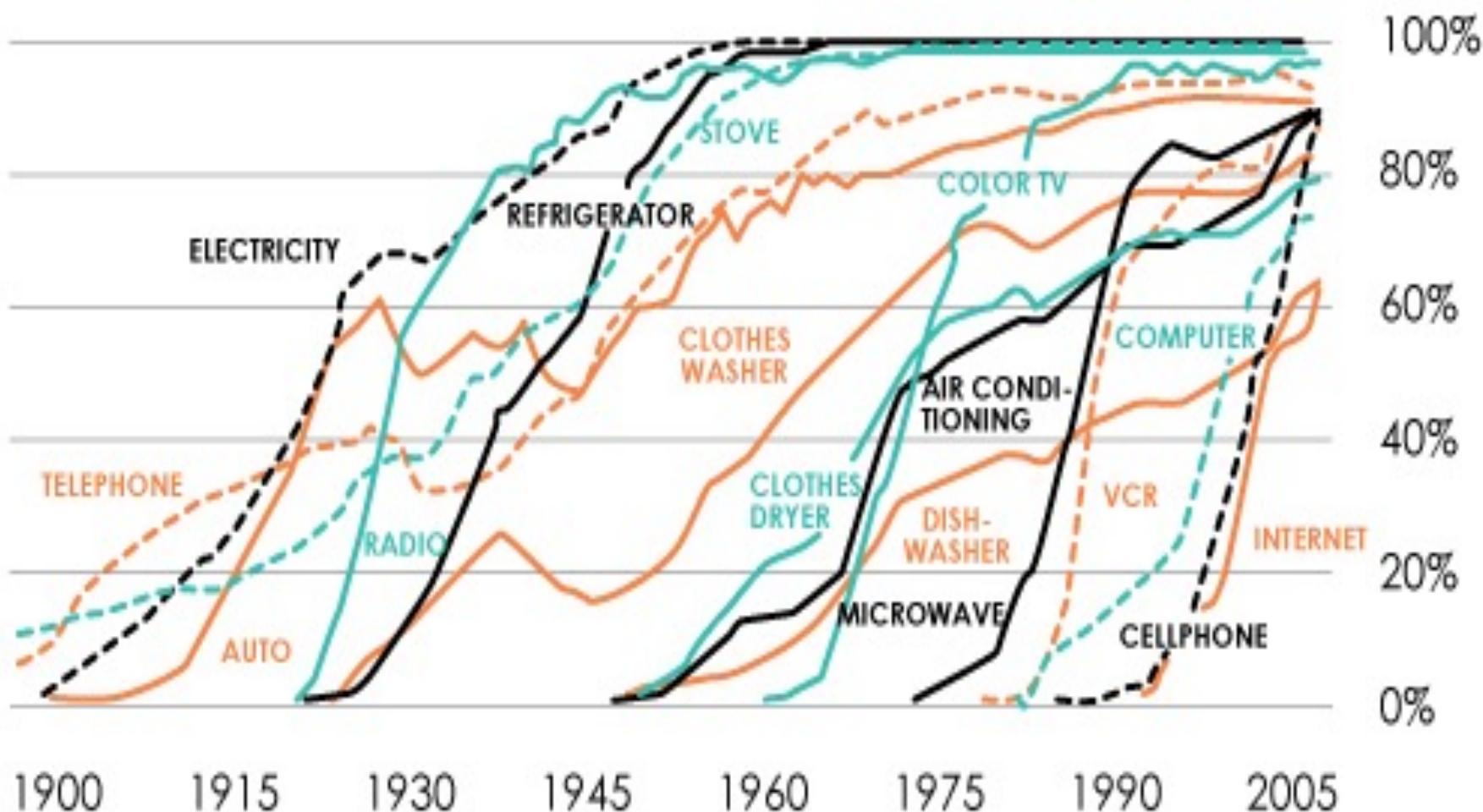
Fuel @ 10,000 miles	\$1,400 (25 mpg @ \$3.50/gal)	\$285 (3.5 miles/Kwh @\$0.10/kwh)
Total Fuel \$ at 100,000 mi.	\$14,000	\$2,850
Oil Changes	\$60 every 5,000 miles	\$0
Brakes	\$500 to \$800 every 50k	\$0 (over 200k+)
Radiator Flush	\$100 every 100k	\$0
Timing Belt	\$1000 every 60k	\$0
Alternator	\$500 every 100k	\$0
Water pump	\$500 every 70k	\$0
Transmission service	\$200 every 60k	\$0
Battery Coolant Flush	-	\$300 Once every 10 yrs or 100k
Spark plugs, spark plug wires, fuel filters, ...	???? Repairs ?\$?	
Total fuel & maint. @100k	<u>~ \$17,700+</u>	VS
		<u>~ \$3,150</u>

**Decreasing Battery \$
& Low Operating Costs**



Market Transition

New Technologies and Mainstream Adoption



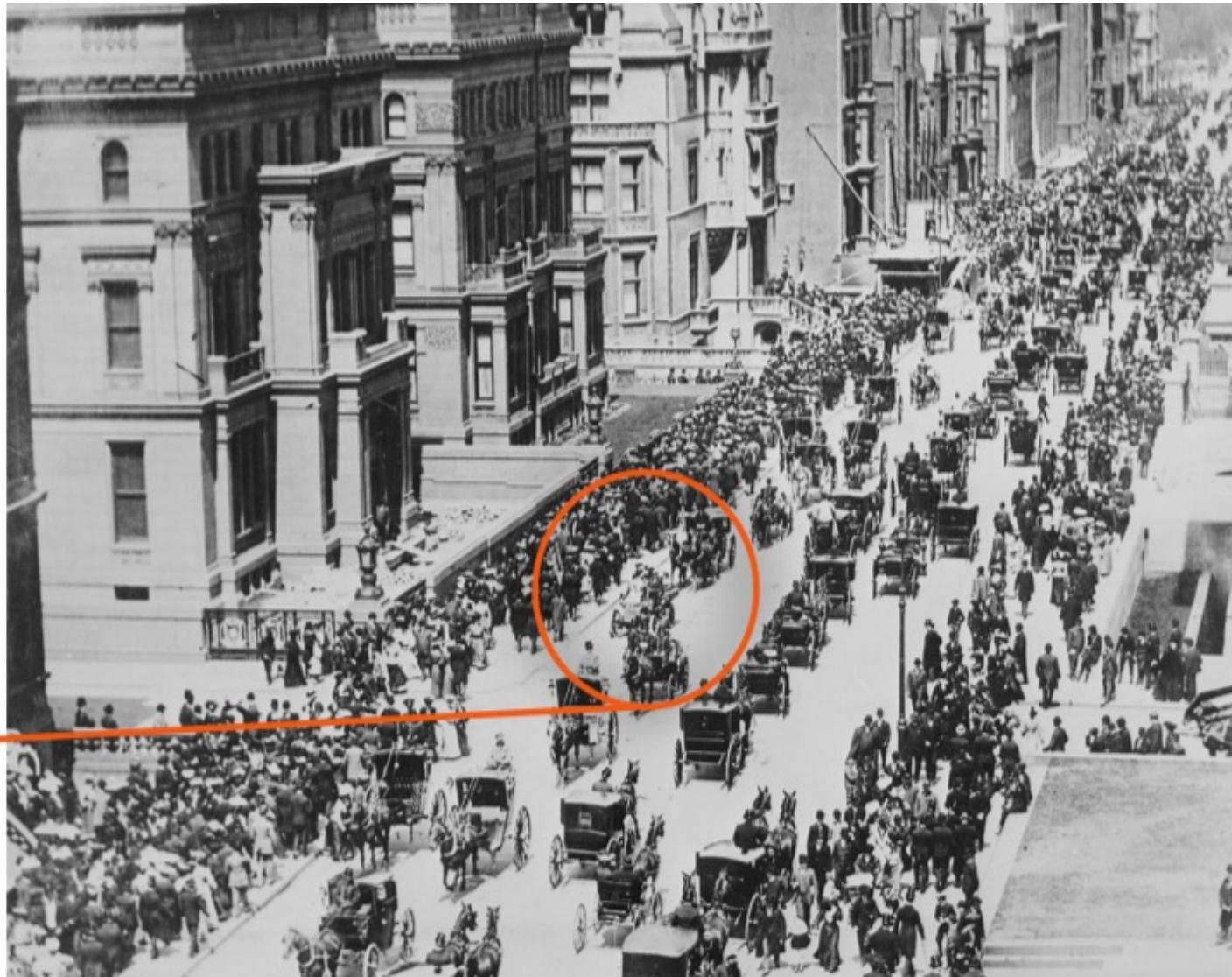
Source: Michael Felton, *The New York Times*

www.earlyinvesting.com

Speed of Disruption

5th AVE NYC
1900

Where is
the
car? —



Speed of Disruption

5th AVE NYC
1913

Where is
the
horse? —



The Rise of Electric Cars

BNEF sees more than 20 million sales by 2030

Millions

25

20

15

10

5

0

2016 2018 2020 2022 2024 2026 2028 2030

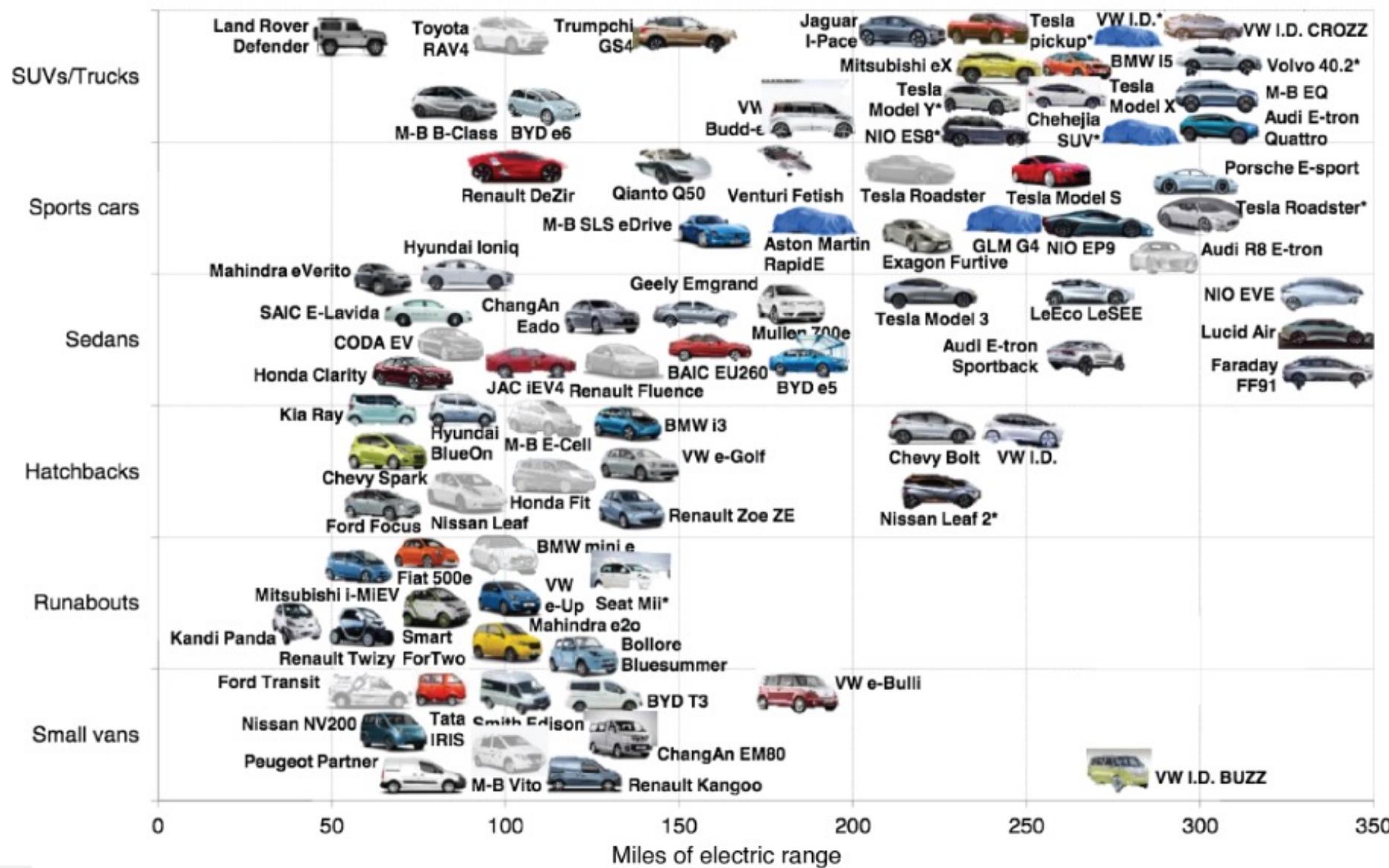
EV penetration by 2040
35-47% of new cars

- Rest of the world
- Japan
- China
- USA
- Europe

Source : Bloomberg New Energy Fund

- *By 2025 EVs projected to be priced equal to or less than gasoline vehicles*

EV Models by Style and Range – existing & coming



Cities & Municipalities



 CITY OF SEATTLE



Trucking



Vehicle to Load (V2L)

- **Worksite**
- **Camping**
- **Residential back up**
- **Christmas lights.....**



FORD F150 LIGHTNING REAR V2L SOCKET POSITION. IMAGE: FORD.

Performance - Instant Torque!

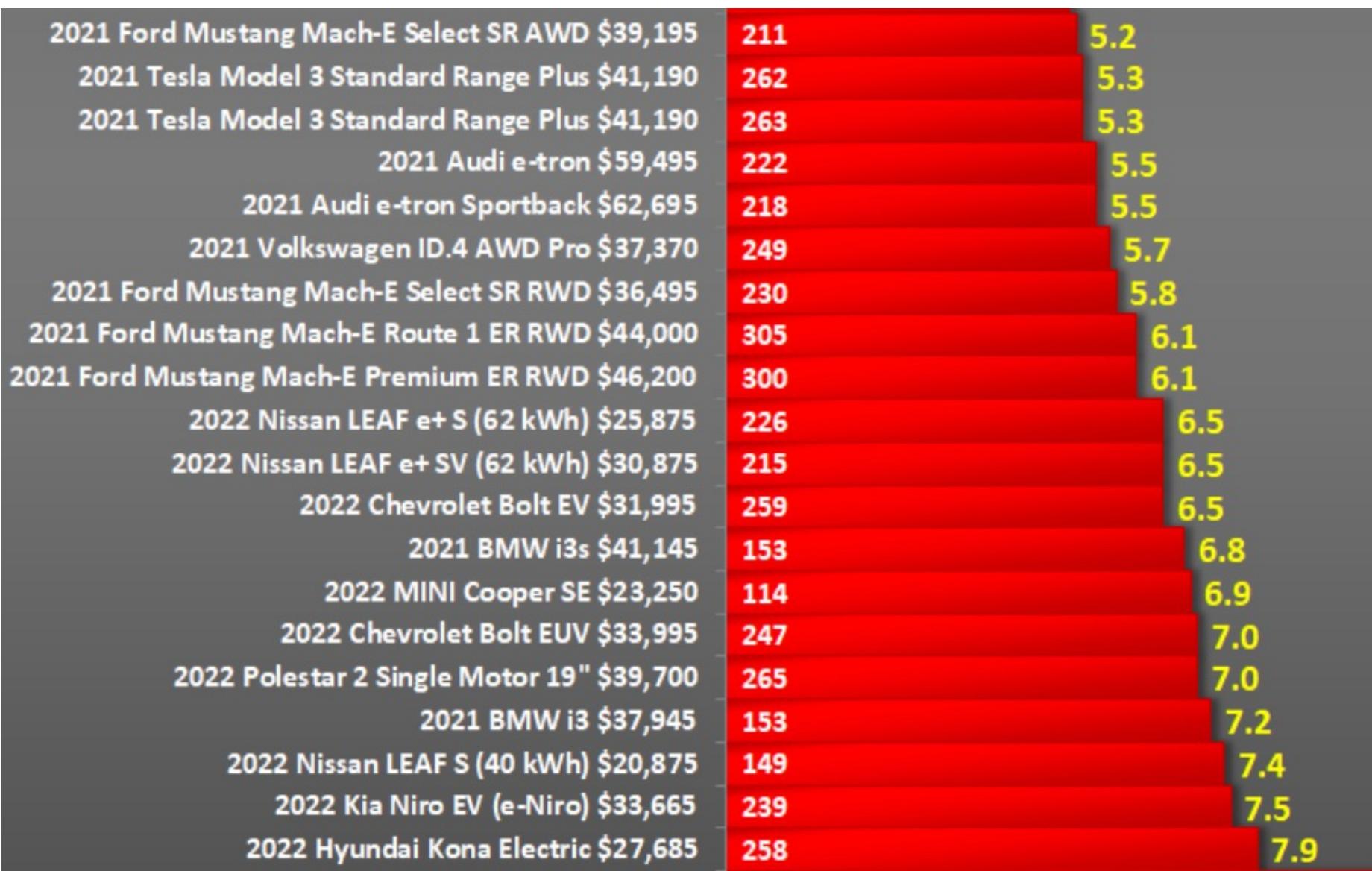


Chevrolet Bolt

0-60 MPH 6.3 sec

QUARTER MILE 14.9 sec @ 93.1 mph

Electric Vehicles are Quick!



Benefits - Driving an EV is Fun!

- **Instant Power**, 100% torque at 0 RPM! Bolt is 0 – 60mph in 6.3 Seconds!
- Low Center of Gravity – **handles curves better**
- **Silent** – no transmission – direct drive
- **Pre-heat or Pre-air condition** while charging & before leaving home
- Heating and Cooling sitting in ferry line – no “idling”
- **Leave home with a “full tank”**
 - – no gas station stops or oil checks (no drips)
- **Regenerative Braking** - “One Pedal Driving” – **Minimal brake pad wear!**

Regenerative Braking – “one pedal driving”

- Electric motor acts like a generator when decelerating
- Greatly reduces brake wear

Regular Car



Brakes applied. Brake lights on. Friction of pads on disc slows car. Brakes wear.



Model S



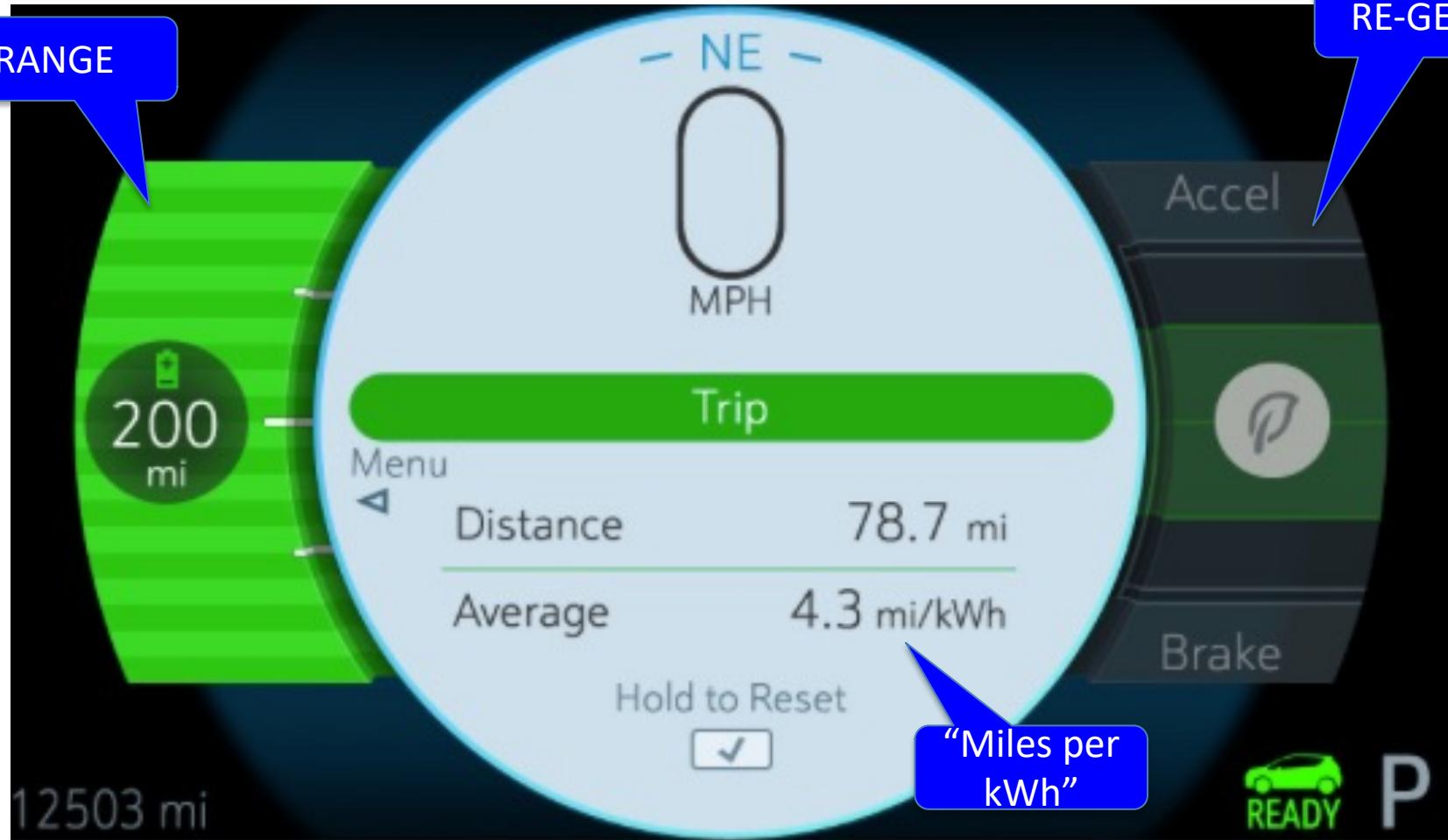
Brakes applied

Accelerator released. Brake lights on. Car slows. Energy goes back into batteries



■ = Distance brakes are being applied

Simple to operate

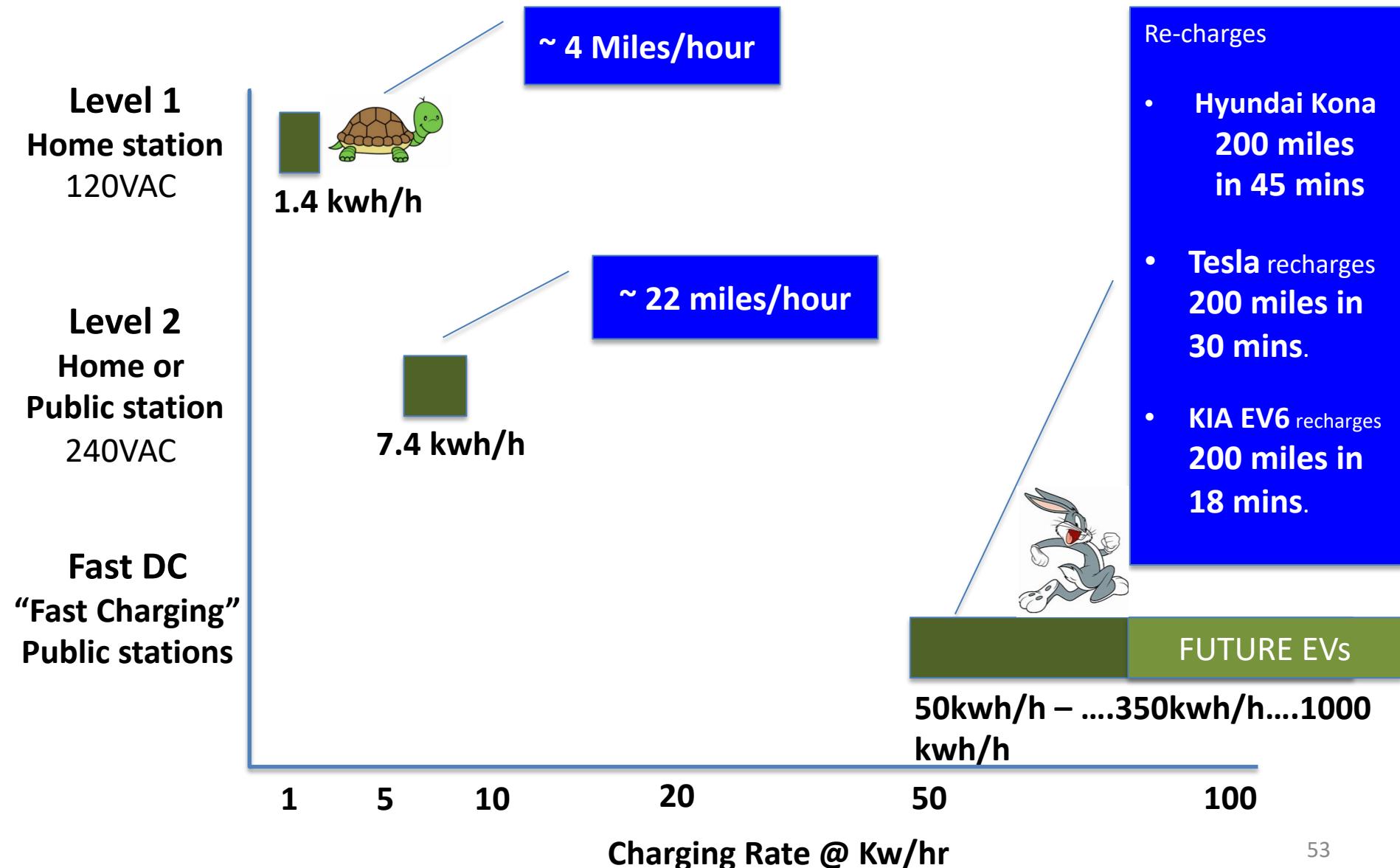


- No oil pressure
- No water temp
- No engine coolant
- No water pump or alternator
- No belts to adjust or replace
- No exhaust system to rust

Charging Networks



Charging Stations



Charging Stations

Slow



Faster



Fast

Outlet

Level 1

110VAC, 1.4 Kw

- Toaster
- Stereo
- TV
- Lamps



Wall

Level 2

220VAC, 3.3 - 7.4 Kw,

- Ovens, ranges, and cooktops
- Clothes dryers
- Furnaces
- Electric Water heaters



NEMA 14-50

Fast DC “Fast Charge”

- CCS
- CHAdeMO
- Tesla

High Voltage DC
50 kw – 350kw

Vehicle Connection



J-1772



J-1772



CCS/SAE



CHAdeMO



Tesla

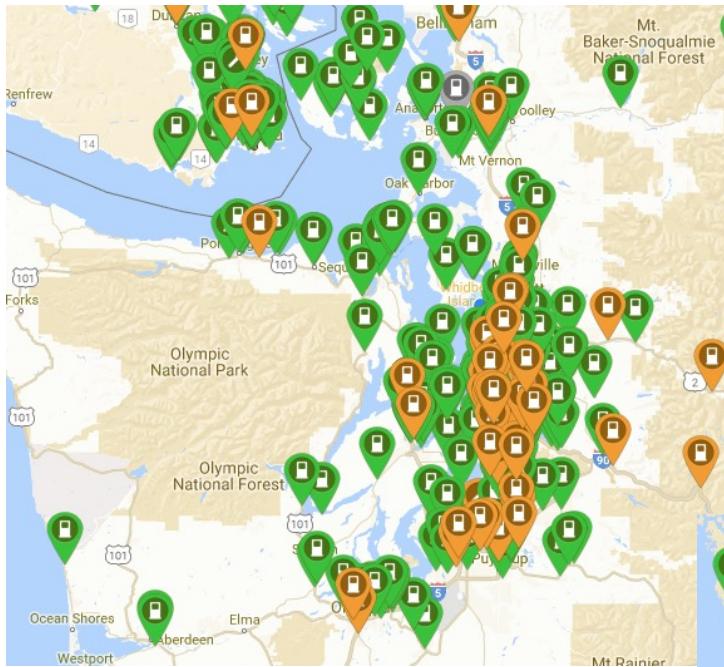
Charging Equipment



Home

Public

Public Charging Networks



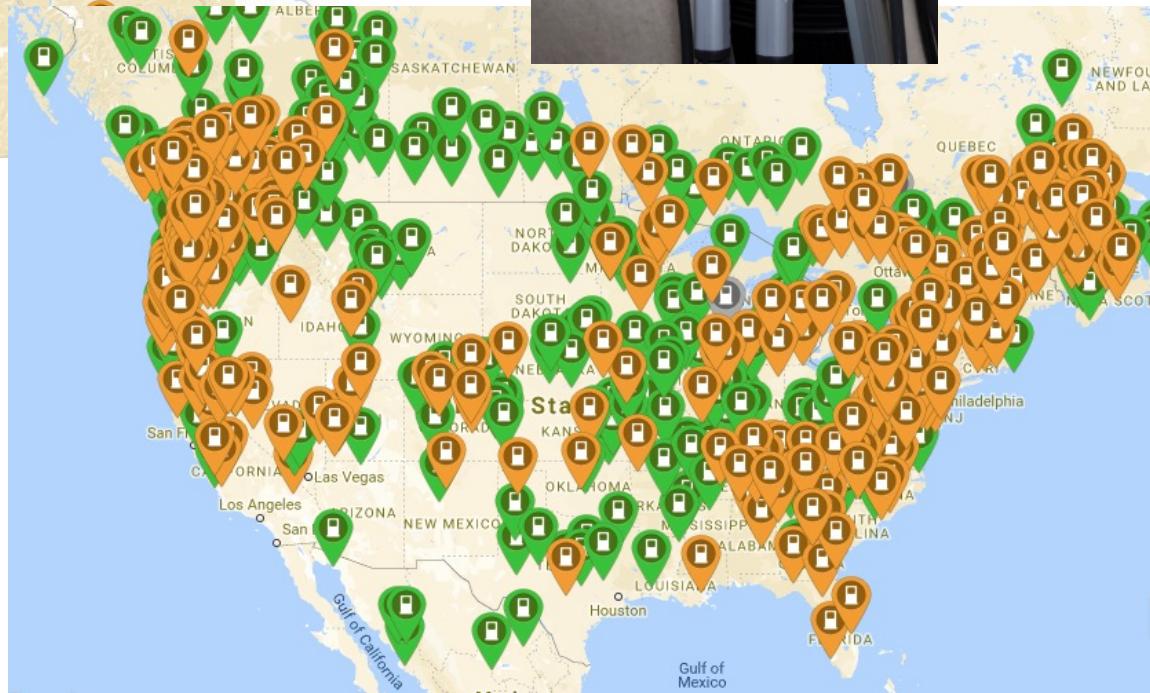
chargepoint

EVgo



SemaConnect

blink



Map images from  **PlugShare App** and Plugshare.com

Mobile apps & Networks – Fast DC & Level 2

 **PlugShare**

Search for a Charging Location

Filters

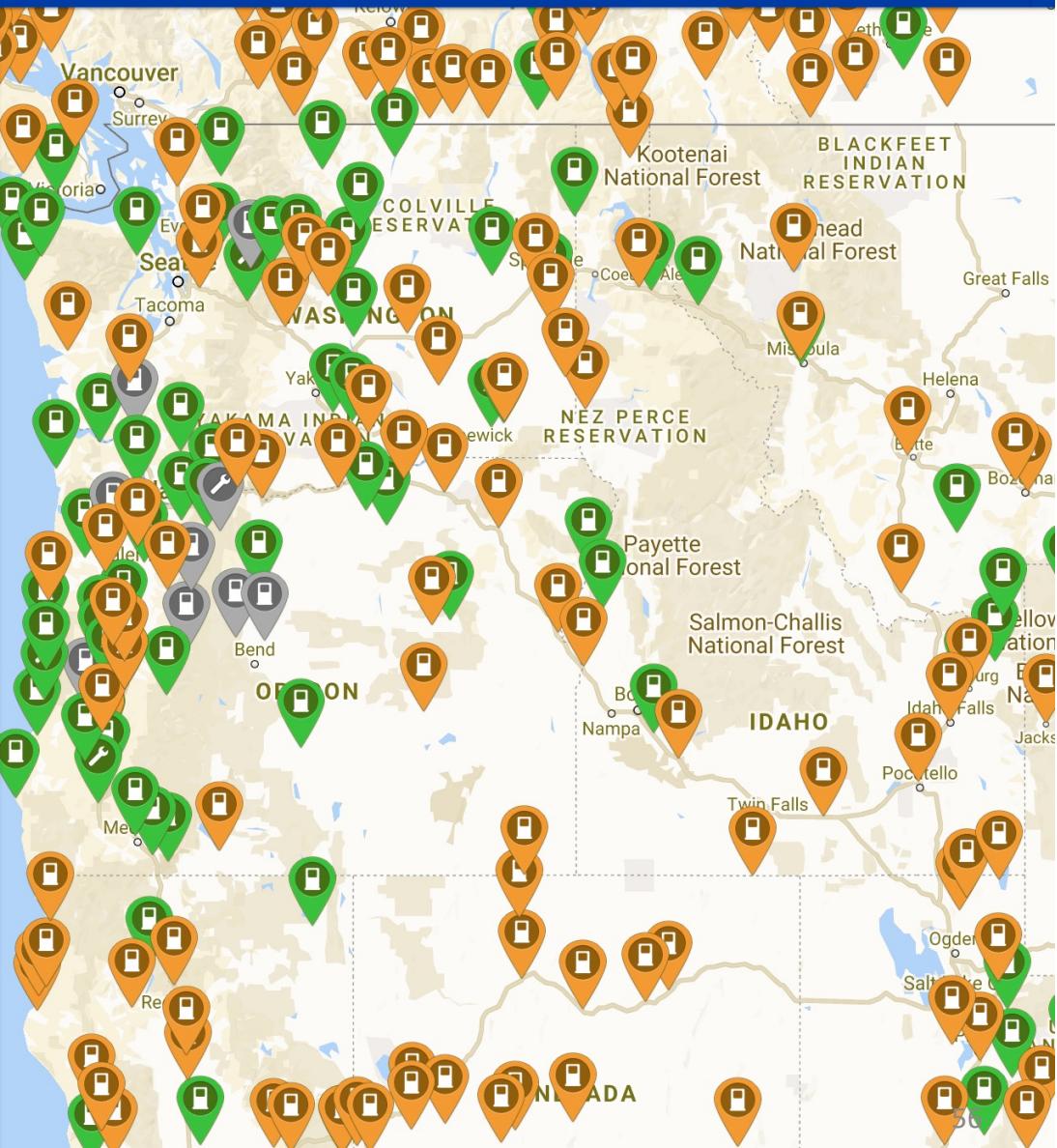
Showing Filters for
Use My Current Location

Plugs (2 of 8)

		
Supercharger	CCS/SAE	CHAdemo
		
J-1772	Tesla	Tesla (Roadster)
		
NEMA 14-50	Wall	

Location Filters (2 of 5)

Show Locations That Require Payment	<input checked="" type="checkbox"/>
Show In-Use Locations	<input checked="" type="checkbox"/>
Show Restricted Locations	
Show Residential Locations	
Show Coming Soon Locations	
Minimum Power (0 kW)	



Using a Public Charging Station with Smartphone

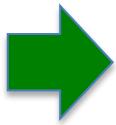
Find a charging station



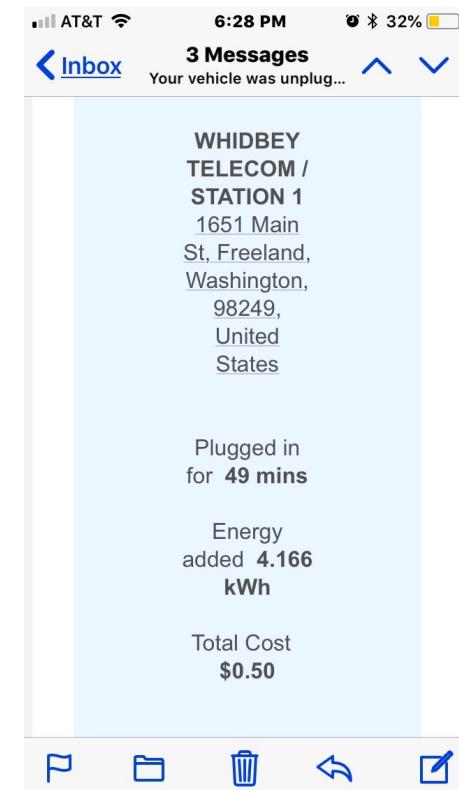
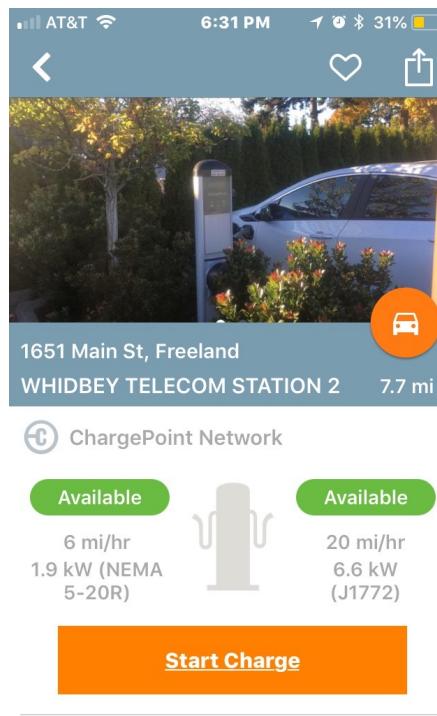
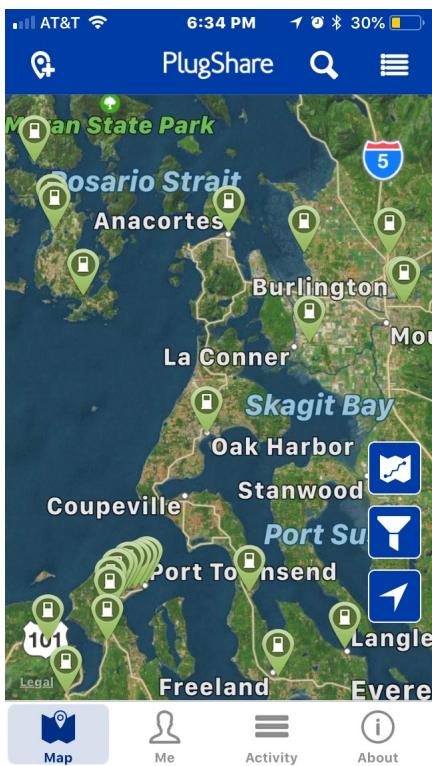
Connect, Activate, & Pay
(App, RFID, Credit Card)



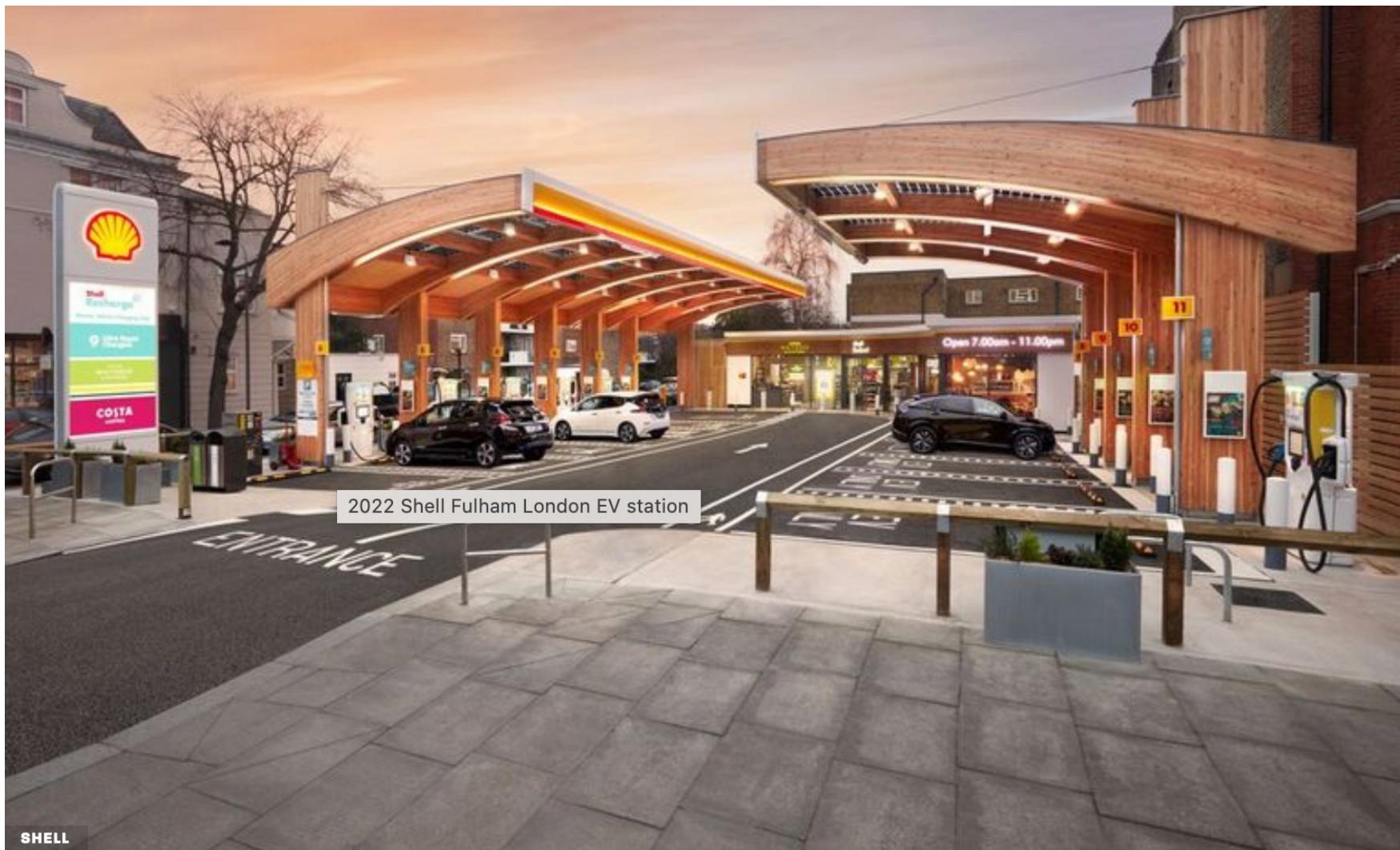
Monitor charging & Notify complete



Payment confirmation



EV Charging Stations & Convenience Stores

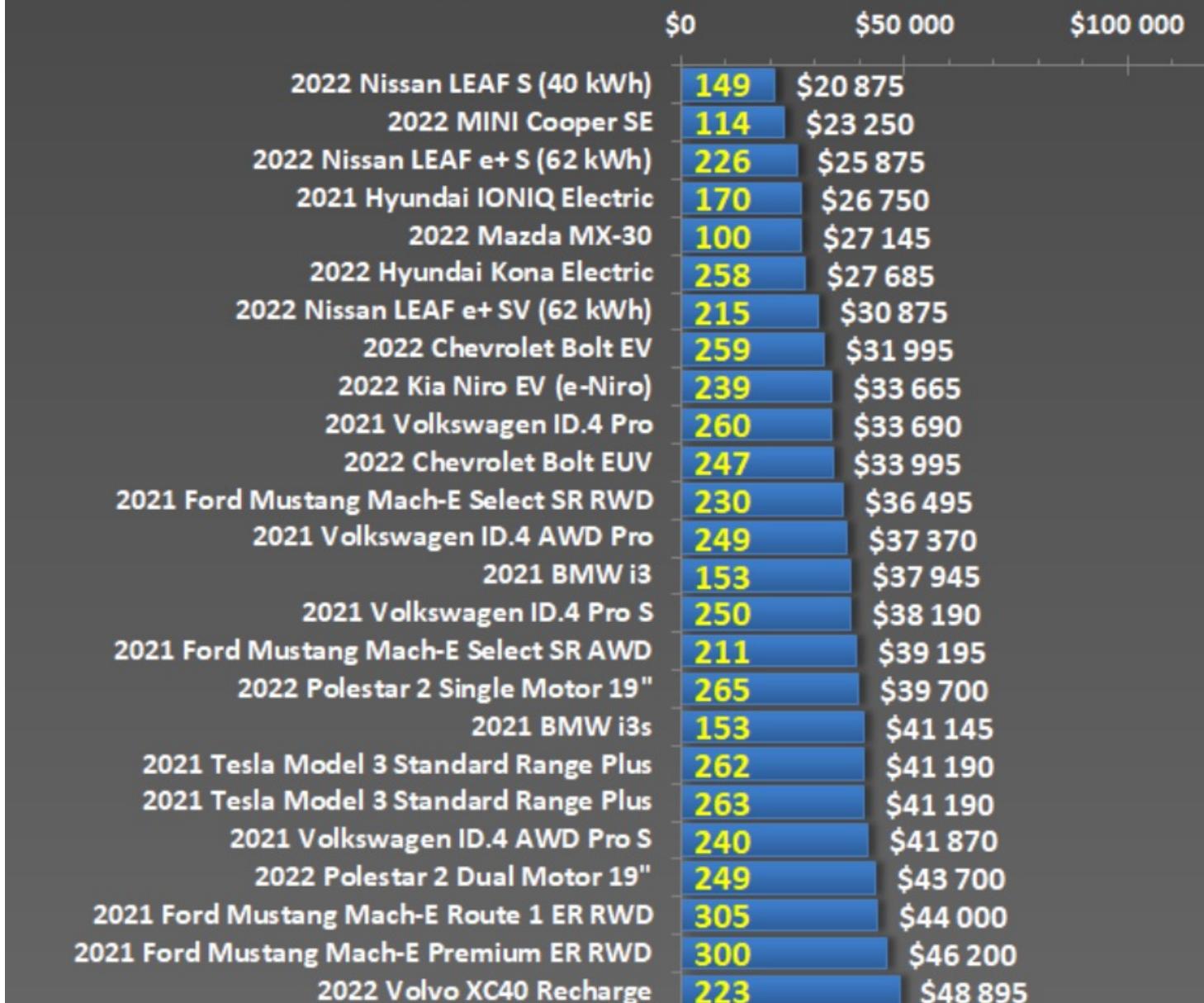


- ◆ Shell converts UK gas stations to EV charging, featuring nine 175-kW chargers, demonstrating a way for stations to adapt to the EV age.
- ◆ The 175-kW chargers can charge most EVs from 0% to 80% state of charge in 10 minutes.

Are they affordable ?

Base price (MSRP + DST and after Tax Credit)

All-electric range (EPA)



Are they affordable? - Used EV prices - Ads from Paramount Motors Seattle



2012 NISSAN LEAF SL

\$6,995

Mileage:

57,482 miles



2014 FORD FOCUS ELECTRIC

\$6,995

Mileage:

86,983 miles



2016 KIA SOUL EV

\$11,995

Mileage:

31,248 miles



2017 CHEVROLET BOLT EV LT

\$22,500

Mileage:

41,077 miles

Federal Tax Incentives

Qualified Plug-in Electric Drive Motor Vehicle Credit

- purchase of a new electric vehicle is eligible for an income tax credit worth between \$2,500 to \$7,500
- Purchased after December 31, 2009
- Battery has at least 5 kilowatt hours (kWh) of capacity
- Uses an external plug-in source to recharge
- Has a vehicle weight rating of up to 14,000 pounds

➤ *This tax credit has a “phase out” built into the program. The phase out will kick in at the beginning of the second calendar quarter after a manufacturer has sold 200,000 eligible BEVs and/or PHEVs*

Washington State EV Incentive

- Sales tax exemption
- New light vehicles are subject to a 6.8 % sales tax in Washington.
 - up to \$2,500 tax reduction for new vehicles < \$45,000
 - up to \$1,600 tax reduction for used vehicles < \$30,000

- 1 (Electric vehicles that are able to travel at least 30 miles using only battery power.
- 2 OR vehicles exclusively powered by a clean alternative fuel (electricity, dimethyl ether, hydrogen, methane, natural gas, liquefied natural gas, compressed natural gas, or propane)
- 3 OR vehicles that use at least one method of propulsion that is capable of being re-energized by an external source of electricity and are capable of traveling at least thirty miles using only battery power.)

Drive Electric

- Performance
- Fuel and Maintenance savings (\$0.03/mile @ \$0.09/kwh)
- Reduce climate disaster for children & grandchildren



Thank you !

Tony Billera

www.linkedin.com/in/tonybillerab333a111

olydriveelectric@gmail.com

Favorite Links :

jeffersoncan.org

coltura.org

cityofpa.us/1010/Climate-Resiliency-Plan

Olyclimate.org

www.aboutCATES.org

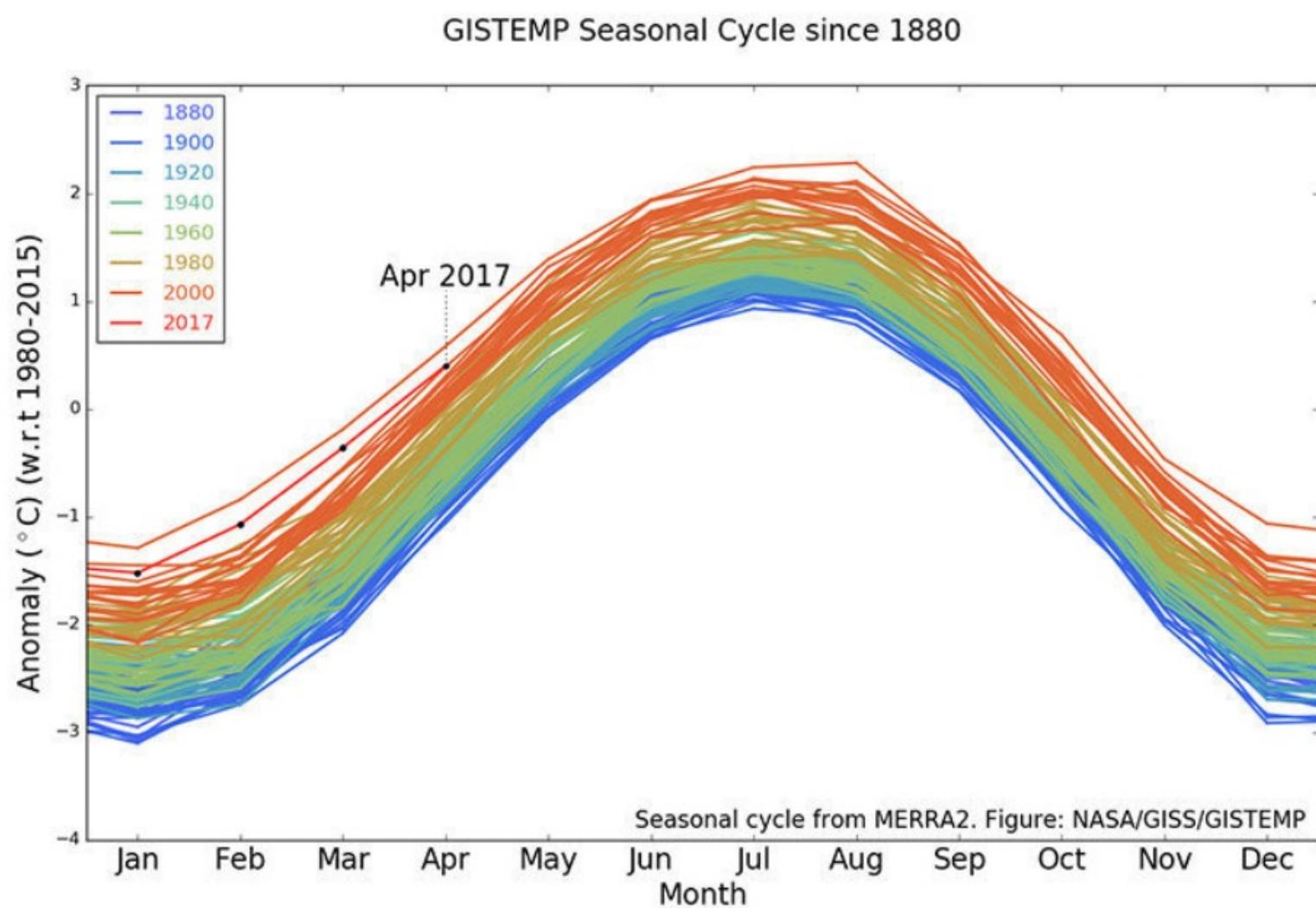


Appendix

- WHATS REALLY WARMING THE WORLD?

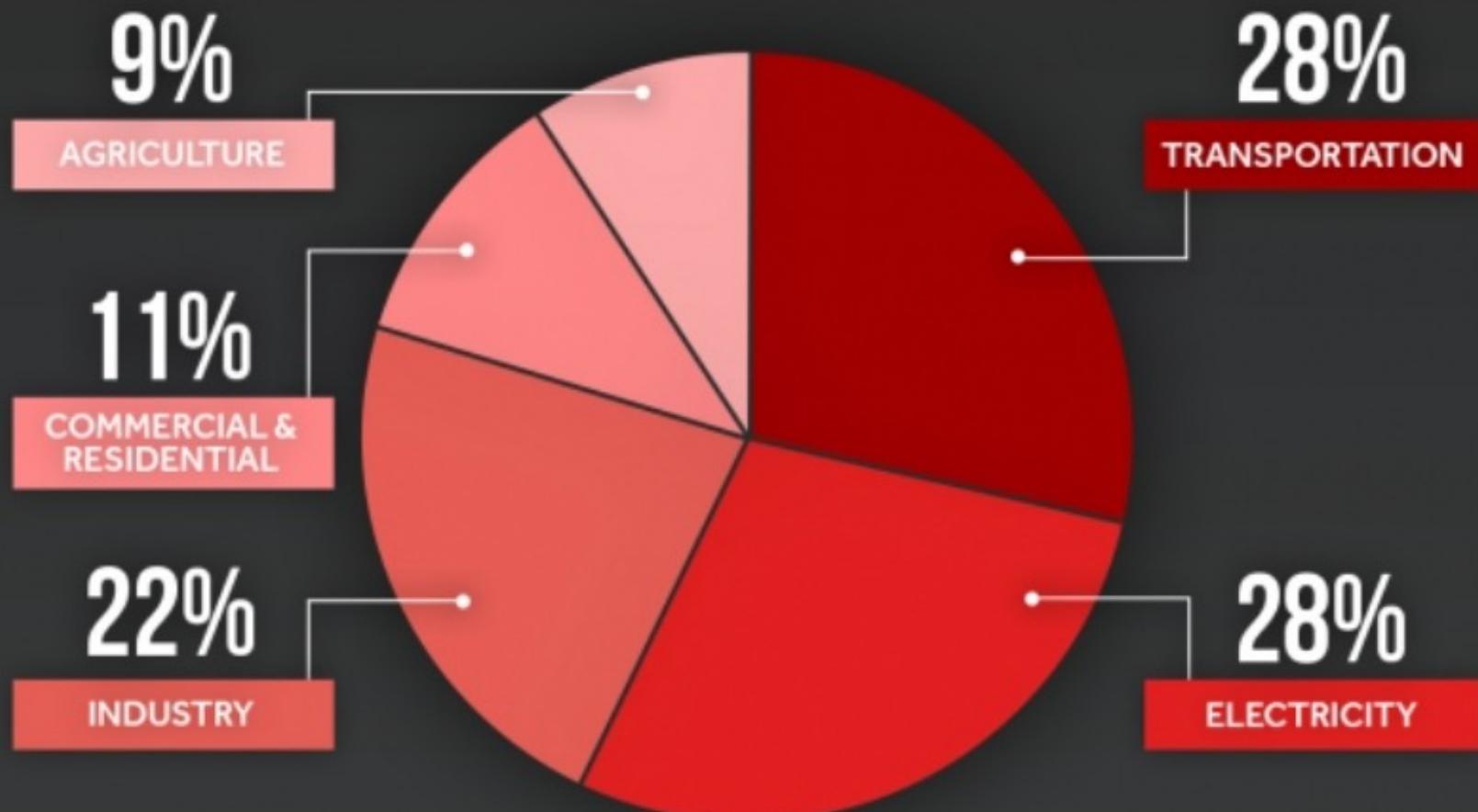
<https://www.bloomberg.com/graphics/2015-whats-warming-the-world/>

Increasing temperatures



GREENHOUSE GAS SOURCES

United States Greenhouse Gas Emissions by Sector



Source: US EPA

CLIMATE  CENTRAL

Port Angeles Climate Resiliency Project

Inventory Results: 2019 Community Snapshot

Main Sources of Emissions (in order):

1. Transportation & mobile sources
2. Solid waste generation & landfill operations
3. Process & fugitive emissions (e.g., refrigerants)

Major Data Sources

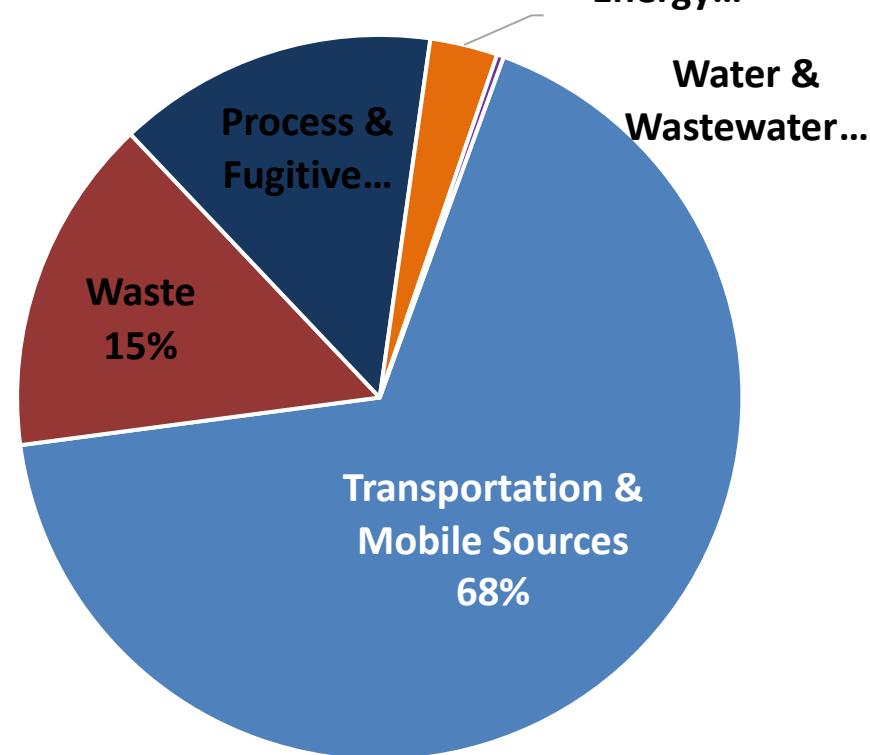
- City of Port Angeles Public Works & Utilities (Energy, Solid Waste, Water & Wastewater)
- Port of Port Angeles & Black Ball Ferry
- Washington State Department of Transportation (WSDOT)
- U.S. Energy Information Administration

Key Considerations

- Propane data downscaled from state-level usage data; scaled based on households
- No commercial/industrial propane estimates available -
- Vehicle mileage data was downscaled from annual county-level data from WSDOT

Total 2019 Community Emissions:

132,597 MTCO₂e Energy...



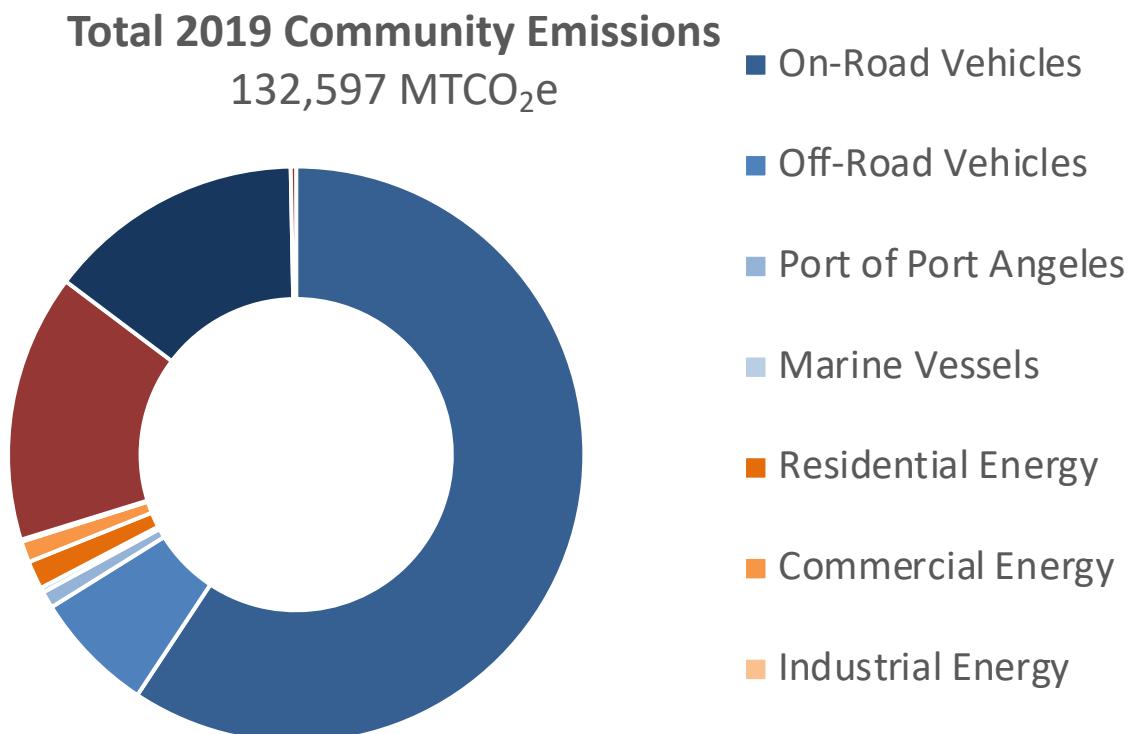
Port Angeles Climate Resiliency Project

Inventory Results: Detailed Community Findings

Major Drivers of Emissions:

- On-road cars, motorcycles, SUVs, and trucks (59%)
- Solid waste generation & landfill operations (15%)
- Refrigerant leakage & electricity losses (14%)

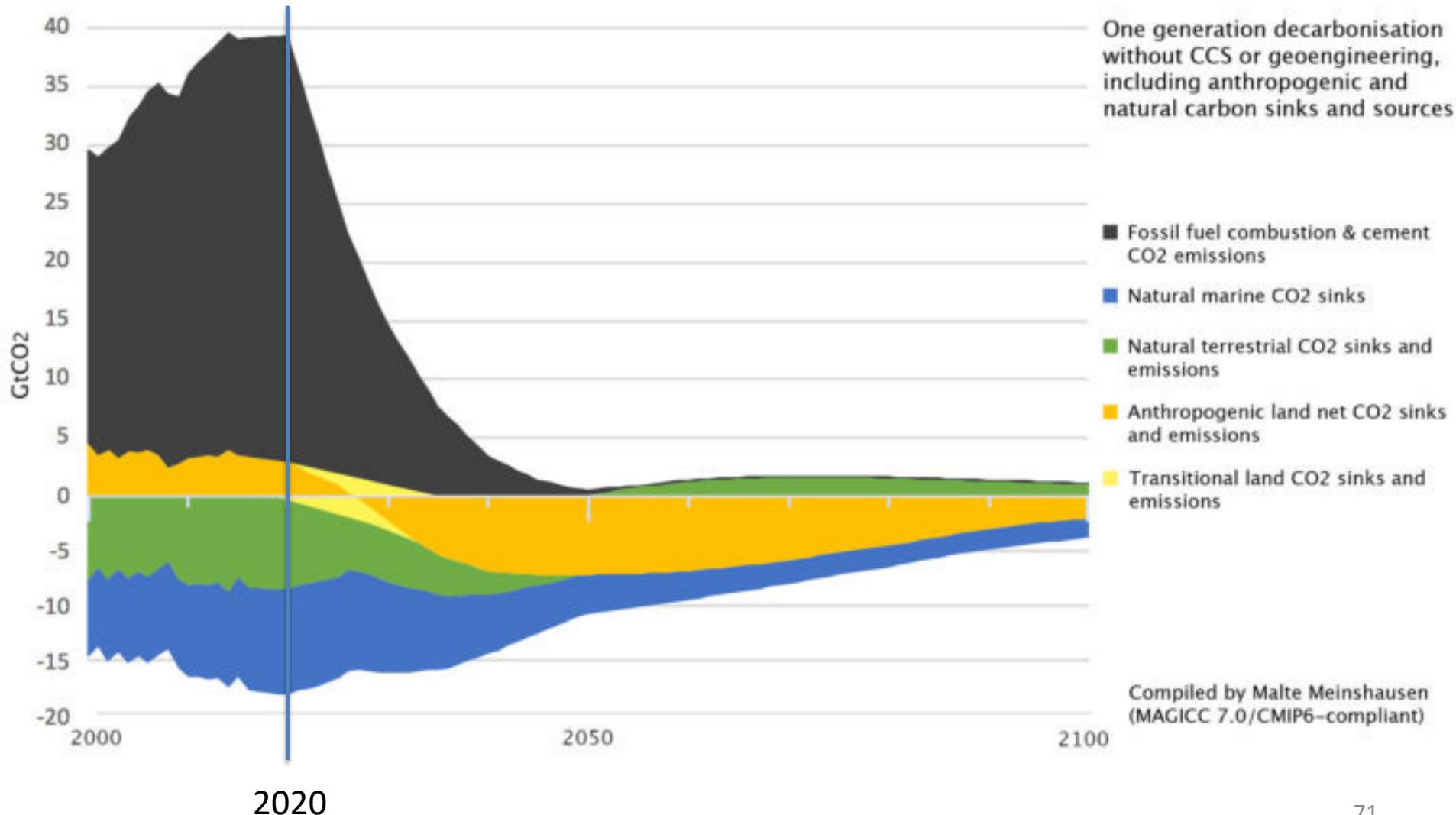
Government operations make up
~1% of total emissions*



**The government operations inventory is still being finalized to include results from an upcoming employee commute survey*

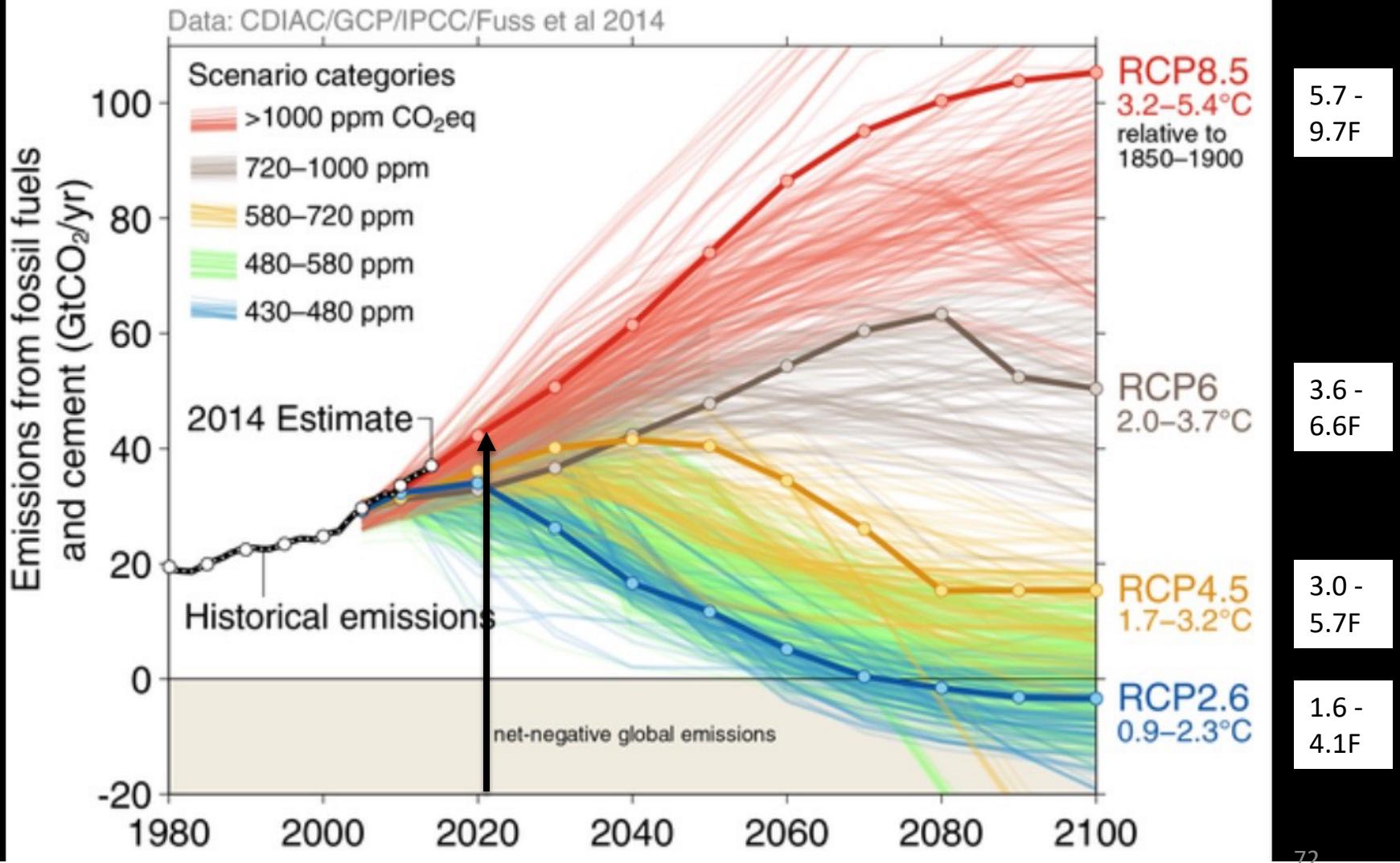
Decarbonization urgency

*Best case still 2C - 3.5C (3.6 - 6F) by 2100
Assuming no GHG extraction CCS tech
or geoengineering*



Climate Models

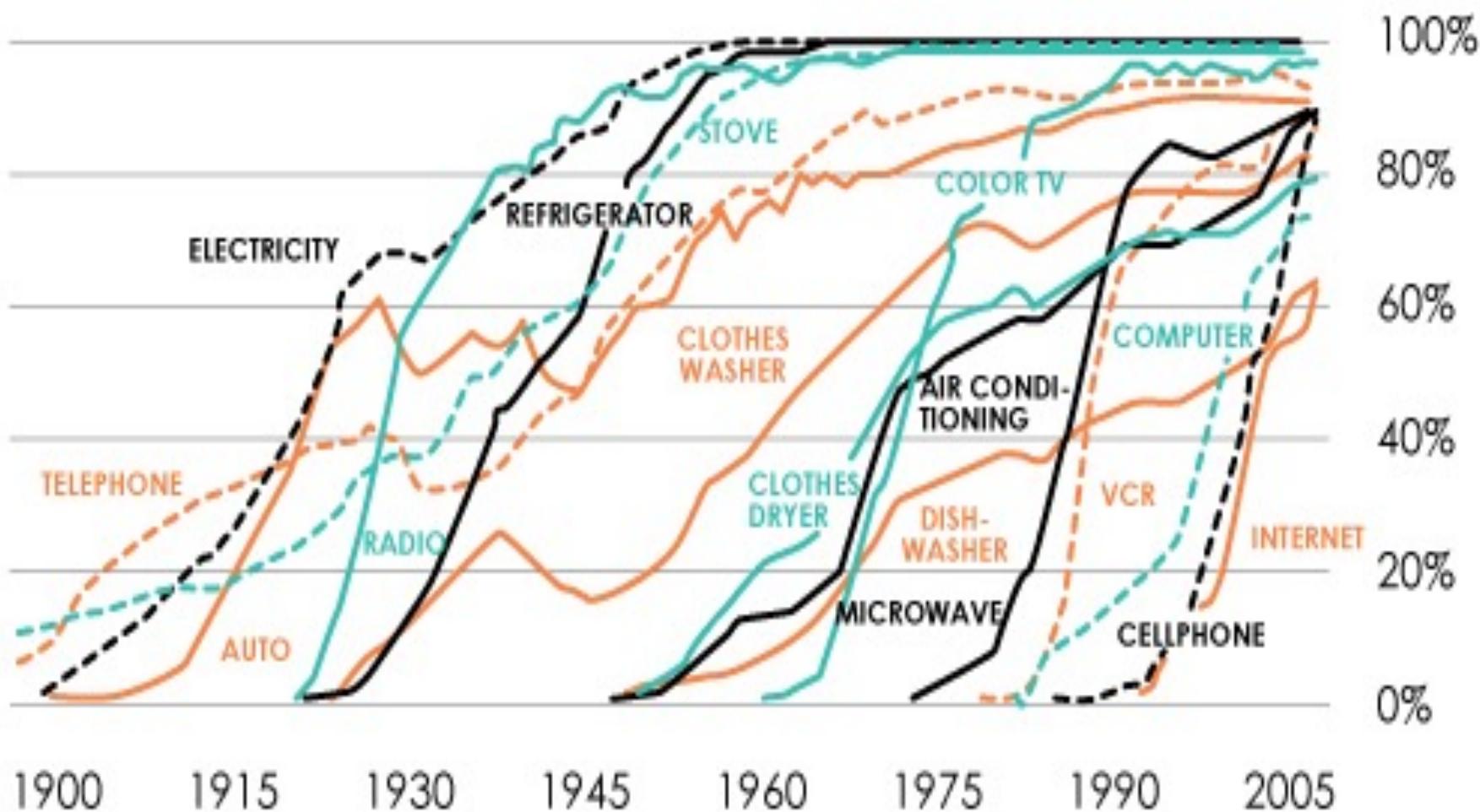
- Representative Concentration Pathways (RCP)



Quickest Production Cars (0—60)

Car ¹	Model Year	Test Results	Noted specs
<u>Porsche 918 Spyder</u>	2015	2.1 sec	<u>naturally aspirated</u>
<u>Tesla Model S P100D</u>	2017 ^[x]	2.28 sec	<u>All-electric</u> , with 5 seats
<u>Lamborghini Huracán Performante</u> ^[viii]	2018	2.3 sec	Naturally aspirated
<u>Porsche Taycan Turbo S</u> ^[xii]	2020	2.4 sec	<u>All-electric</u> , with 4 seats
<u>Tesla Model S Performance w/Ludicrous Model</u>	2020	2.4 sec	<u>All-electric</u> , with 5 seats

New Technologies and Mainstream Adoption



Source: Michael Felton, *The New York Times*

www.earlyinvesting.com

Mobile apps & Networks – Fast DC

PlugShare

Search for a Charging Location

Filters

Showing Filters for Use My Current Location

Plugs (1 of 8) Toggle All

		
Supercharger	CCS/SAE	CHADEMO
		
J-1772	Tesla	Tesla (Roadster)
		
NEMA 14-50	Wall	

Location Filters (2 of 5)

Show Locations That Require Payment

Show In-Use Locations

Show Restricted Locations

Show Residential Locations

Show Coming Soon Locations

