Why all the excitement about Electric Vehicles?

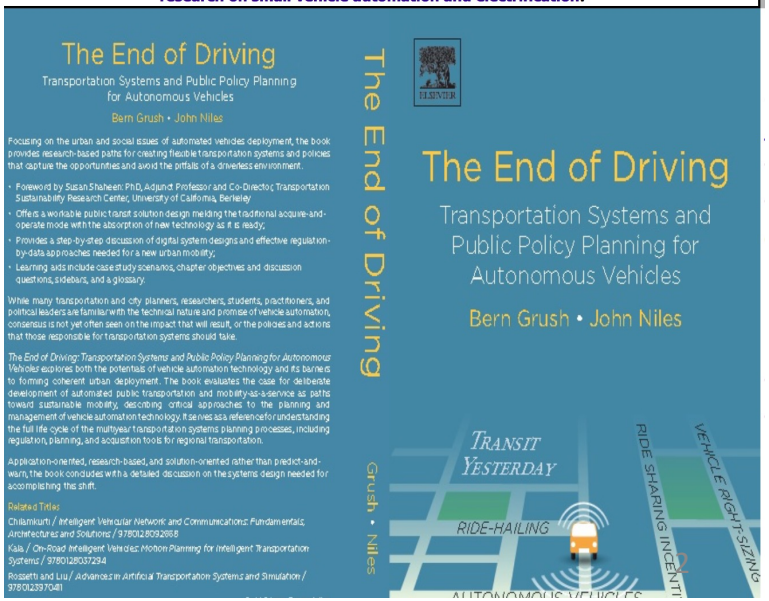
Presenter info

- 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
  - CTE Middle School para-educator
  - Experienced owner of 4 EVs:
    - KIA EV6 (250-300 mile range)
    - KIA Niro - sold (250-300 mile range)
    - FIAT 500e - sold (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.

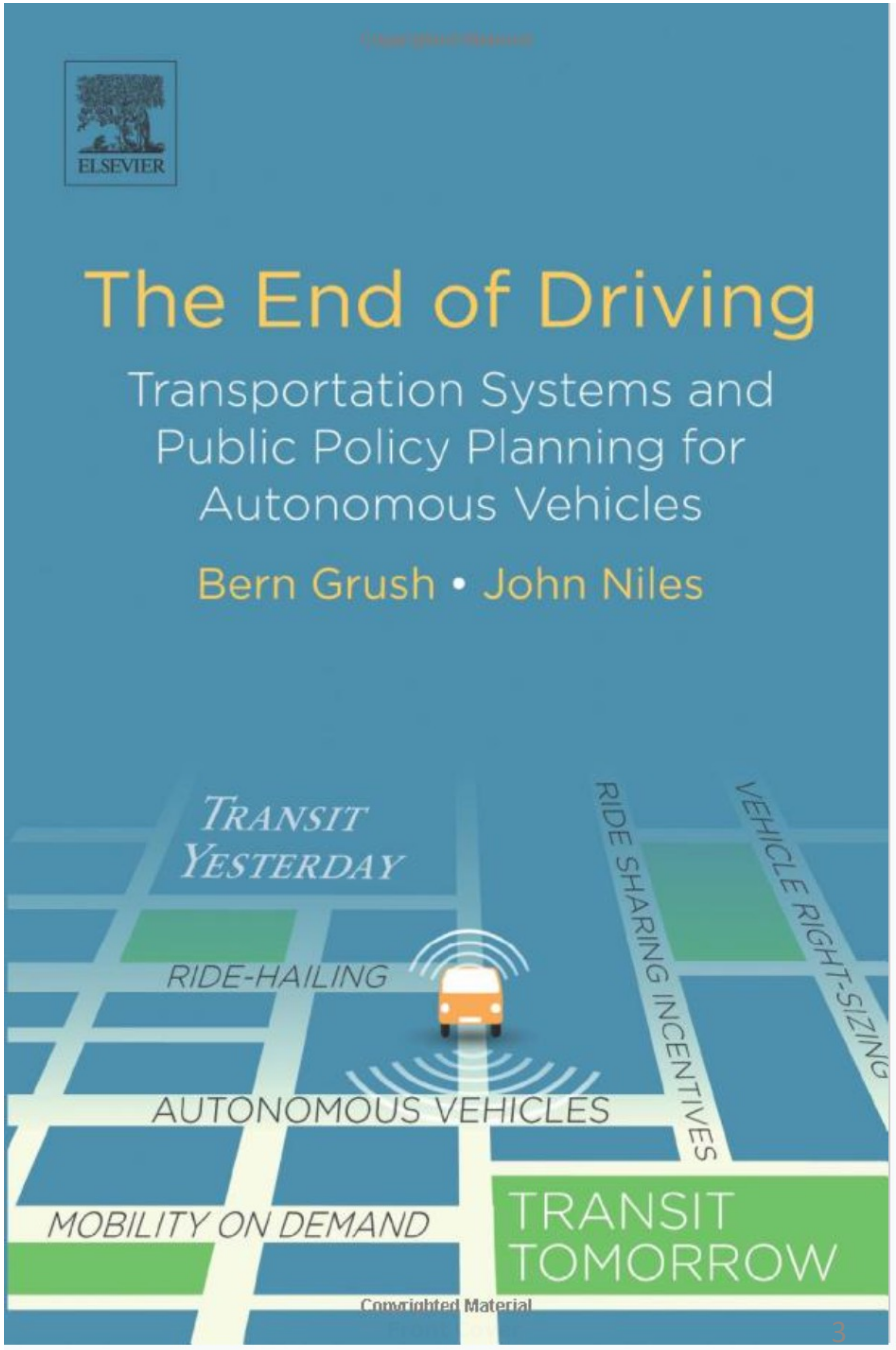


The End of Driving: Transportation Systems and Public Policy Planning for Autonomous Vehicles

- 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



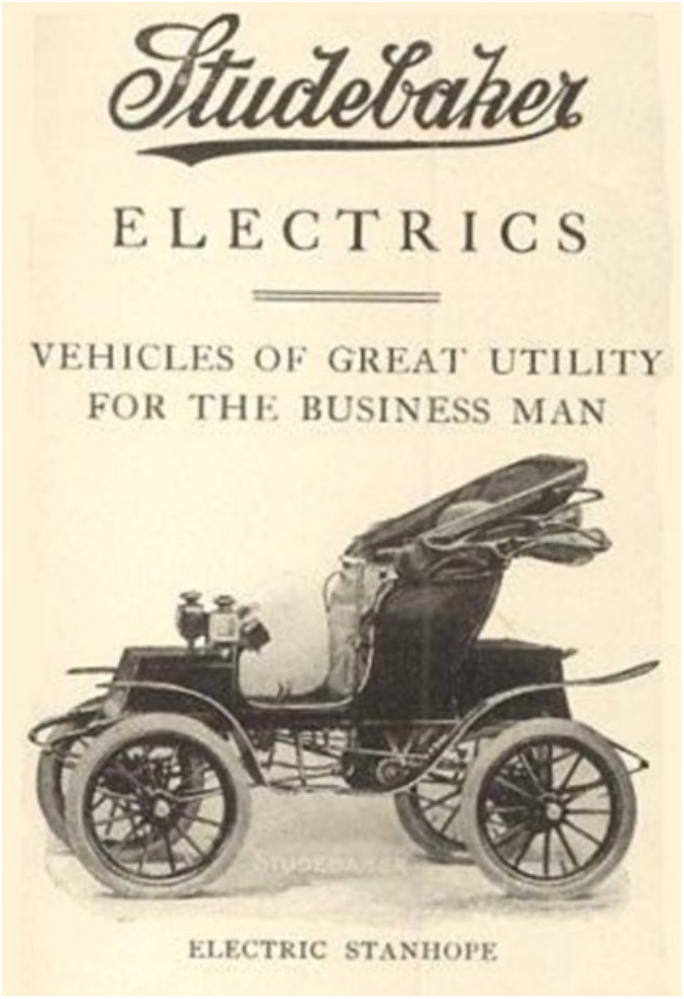
Why all the excitement about EVs?

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



GM EV1 2,300 built 1996 - 1999

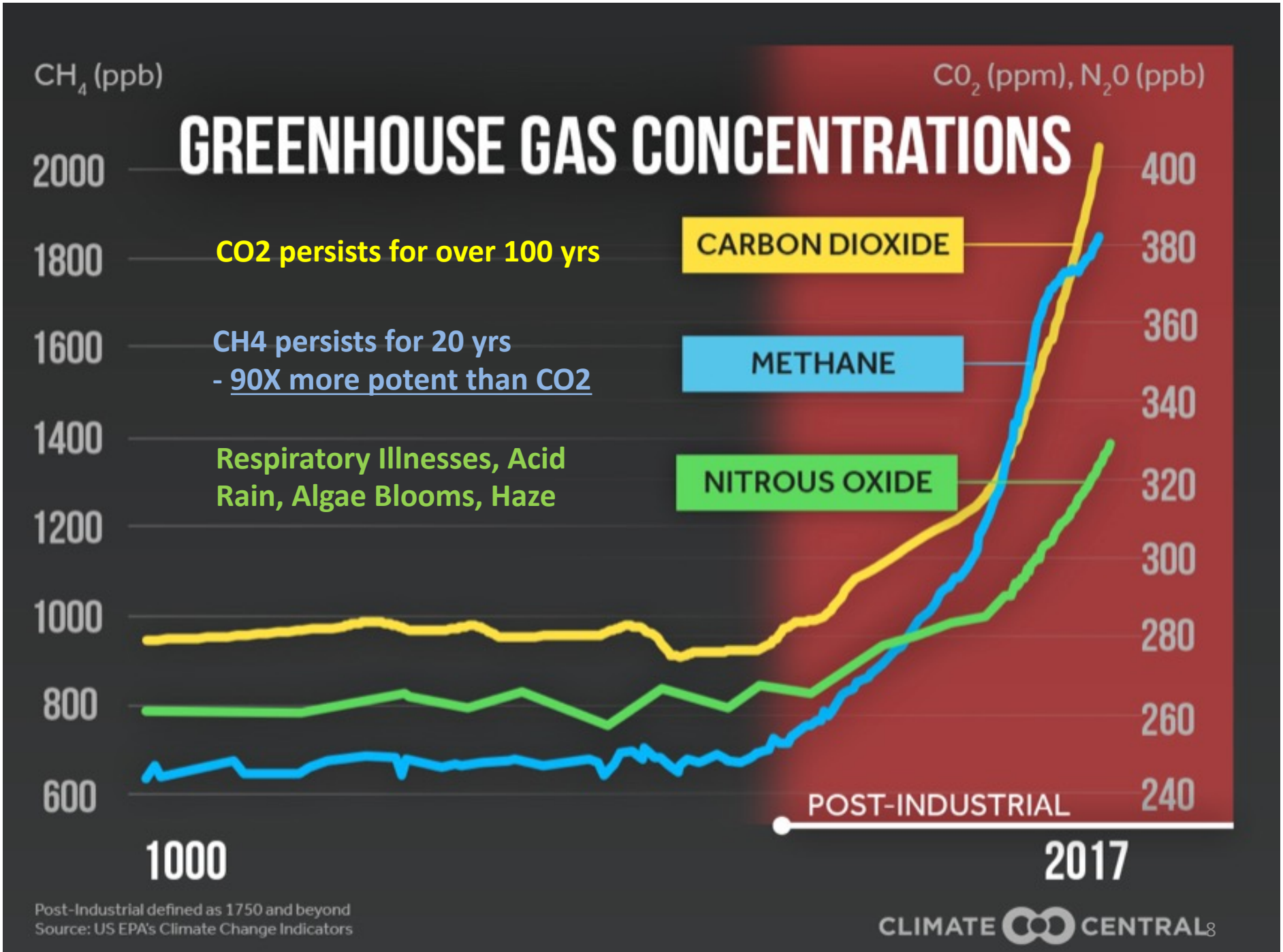
Movie : “Who killed the electric car?”

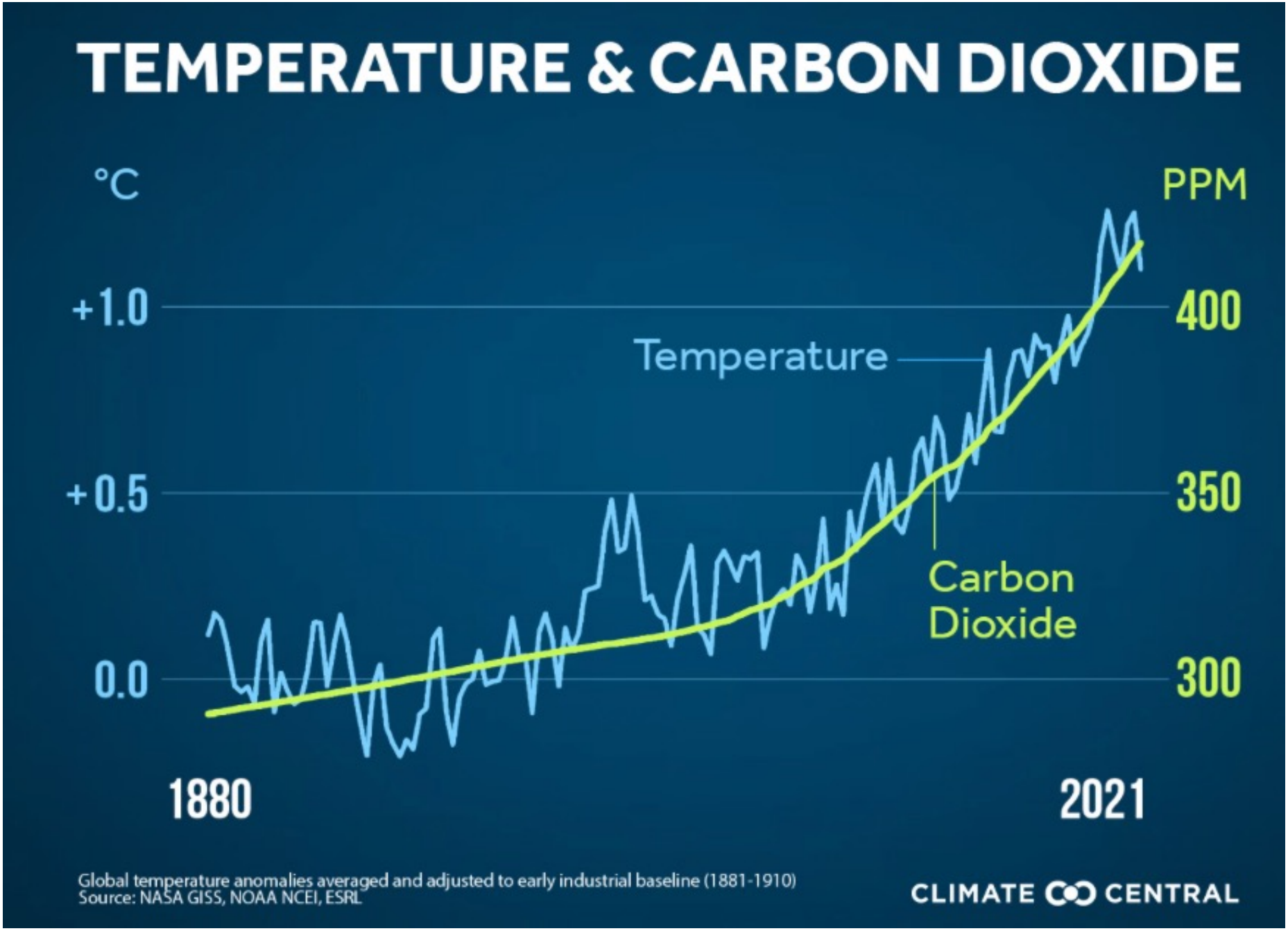
Why all the excitement today?

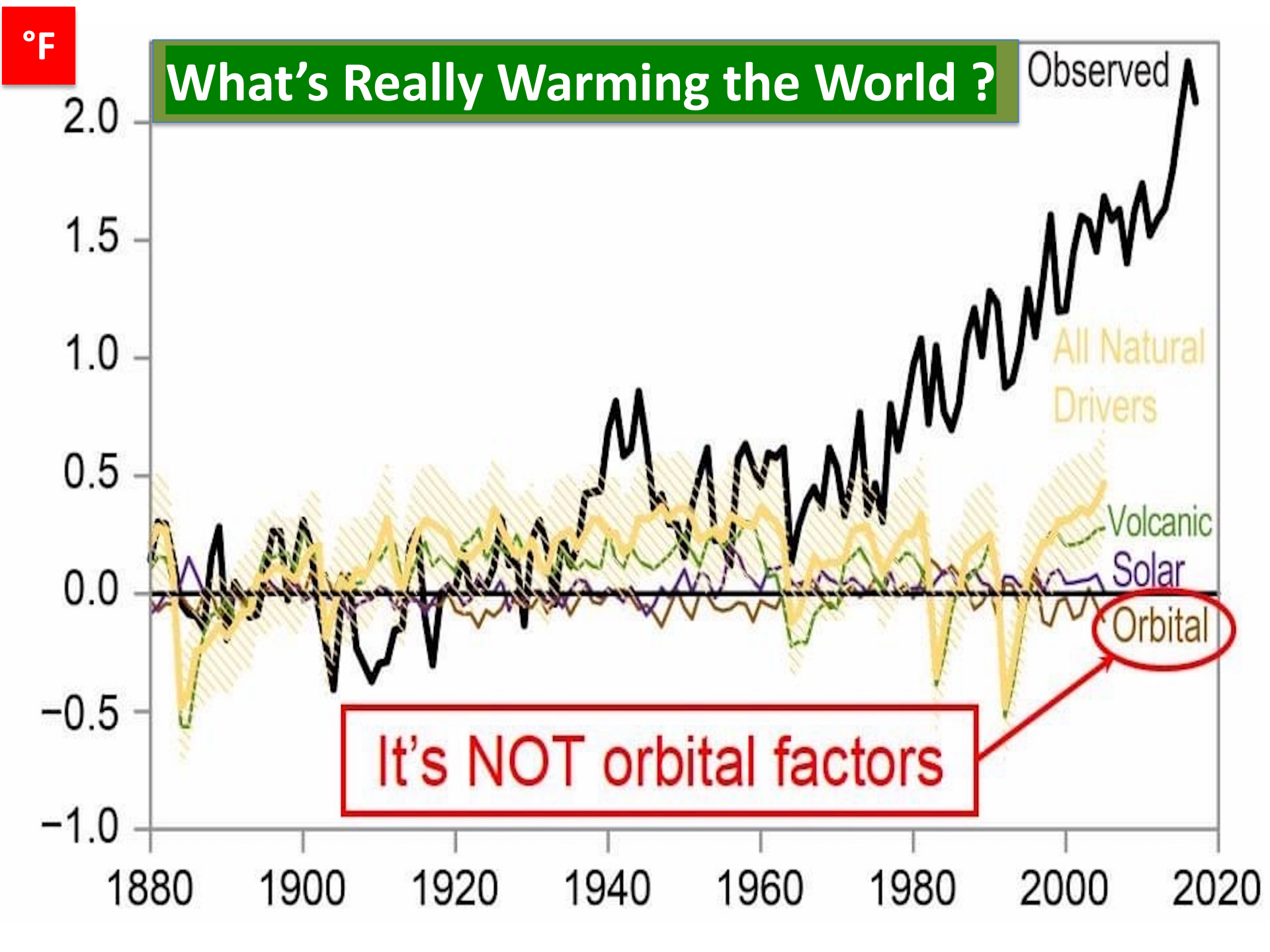
- Impacts of GHG emissions are recognized thru the climate science research and evidence, driving the urgent need to rapidly reduce anthropogenic co2 emissions
    - Transportation sector is largest share of U.S. co2 emissions at 27%
    - One gallon of gas or diesel emits about 21 lbs of co2

- 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

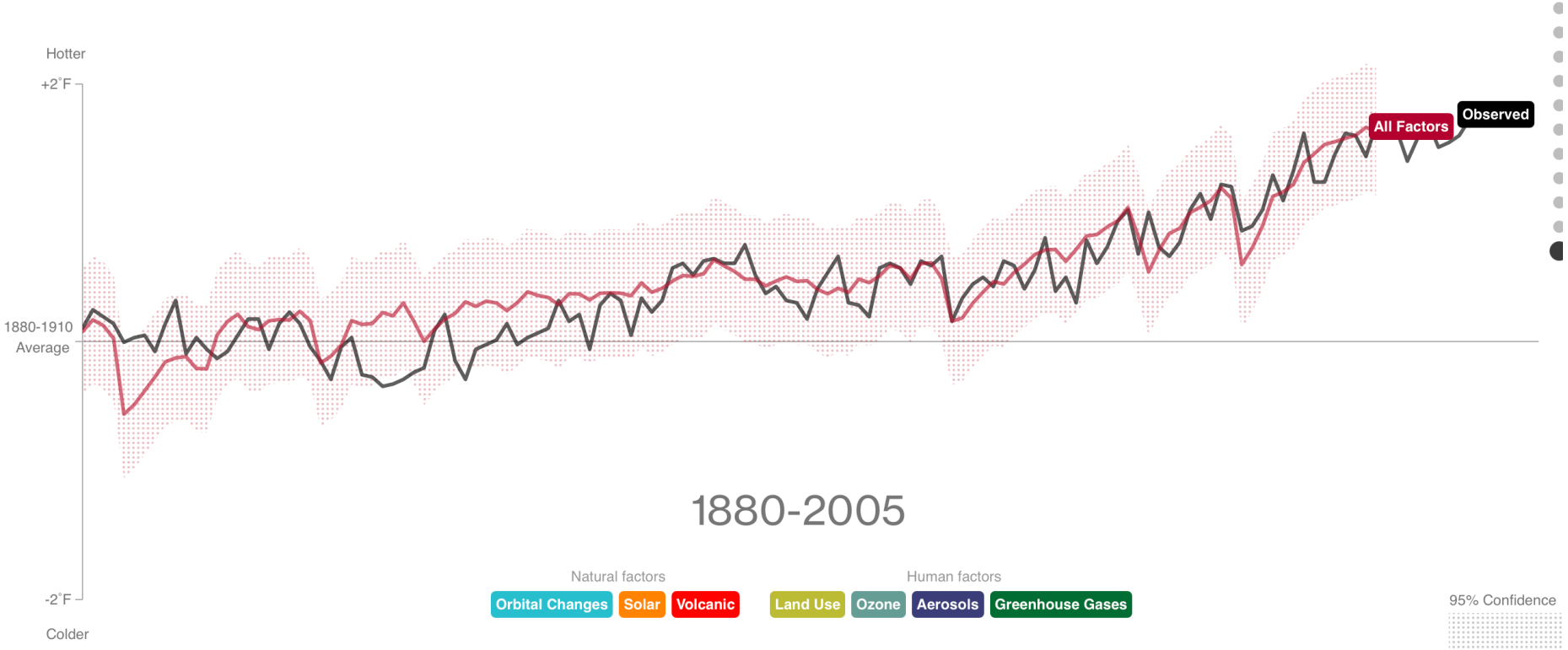

CH_4 (ppb)
CO_2 (ppm), N_2O (ppb)
GREENHOUSE GAS CONCENTRATIONS
2000
1800
1600
1400
1200
1000
800
600
400
380
360
340
320
300
280
260
240
CO2 persists for over 100 yrs
CH4 persists for 20 yrs
- 90X more potent than CO2
Respiratory Illnesses, Acid Rain, Algae Blooms, Haze
CARBON DIOXIDE
METHANE
NITROUS OXIDE
POST-INDUSTRIAL
1000
2017
Post-Industrial defined as 1750 and beyond
Source: US EPA's Climate Change Indicators
CLIMATE CENTRAL


TEMPERATURE & CARBON DIOXIDE
°C
+1.0
+0.5
0.0
PPM
400
350
300
Temperature
Carbon Dioxide
1880
2021
Global temperature anomalies averaged and adjusted to early industrial baseline (1881-1910)
Source: NASA GISS, NOAA NCEI, ESRL
CLIMATE CENTRAL

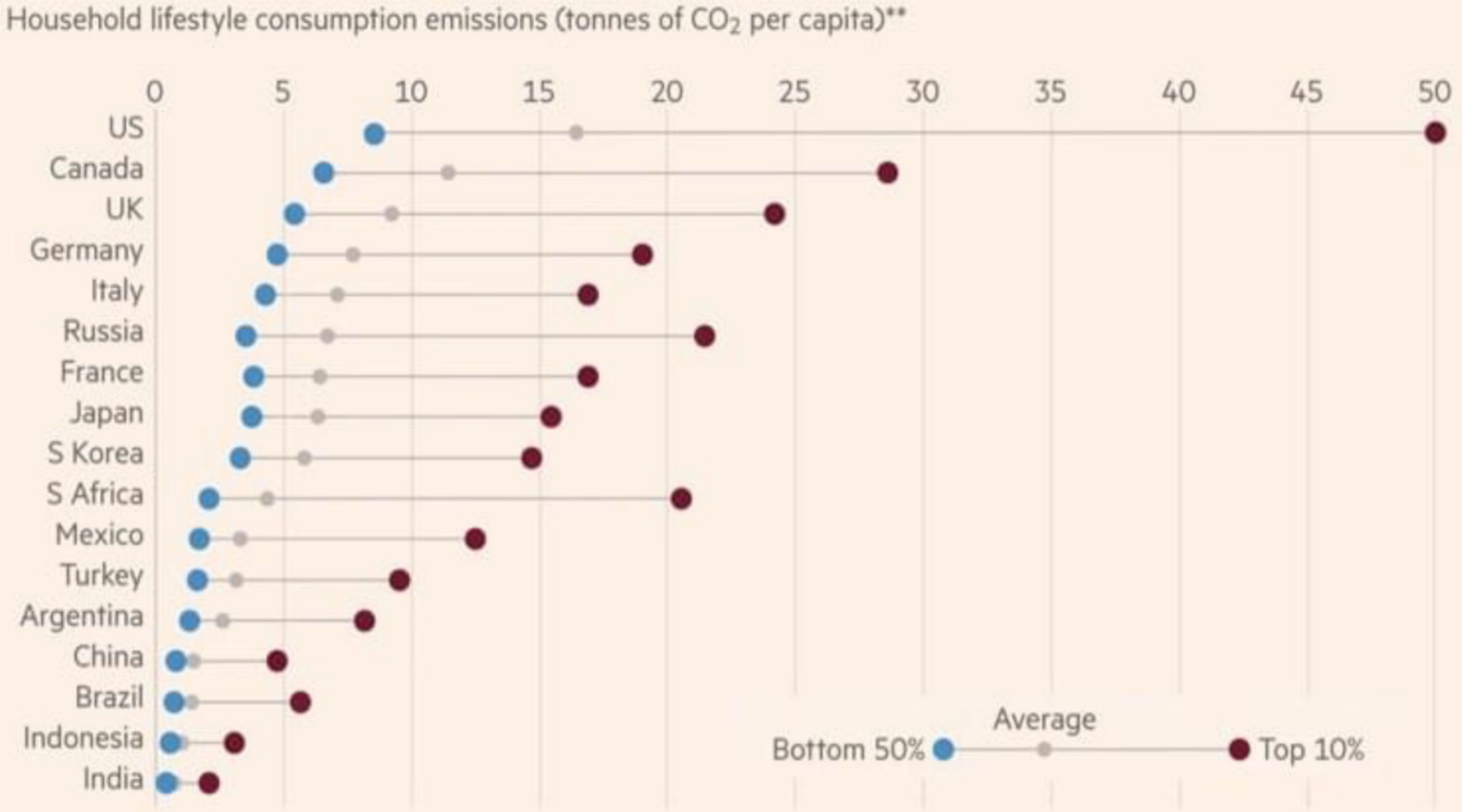

°F
What's Really Warming the World ?
Observed
All Natural Drivers
Volcanic
Solar
Orbital
It's NOT orbital factors
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
1880
1900
1920
1940
1960
1980
2000
2020

- WHATS REALLY WARMING THE WORLD?

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



Emissions per capita



** In G20 countries for which data is available

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

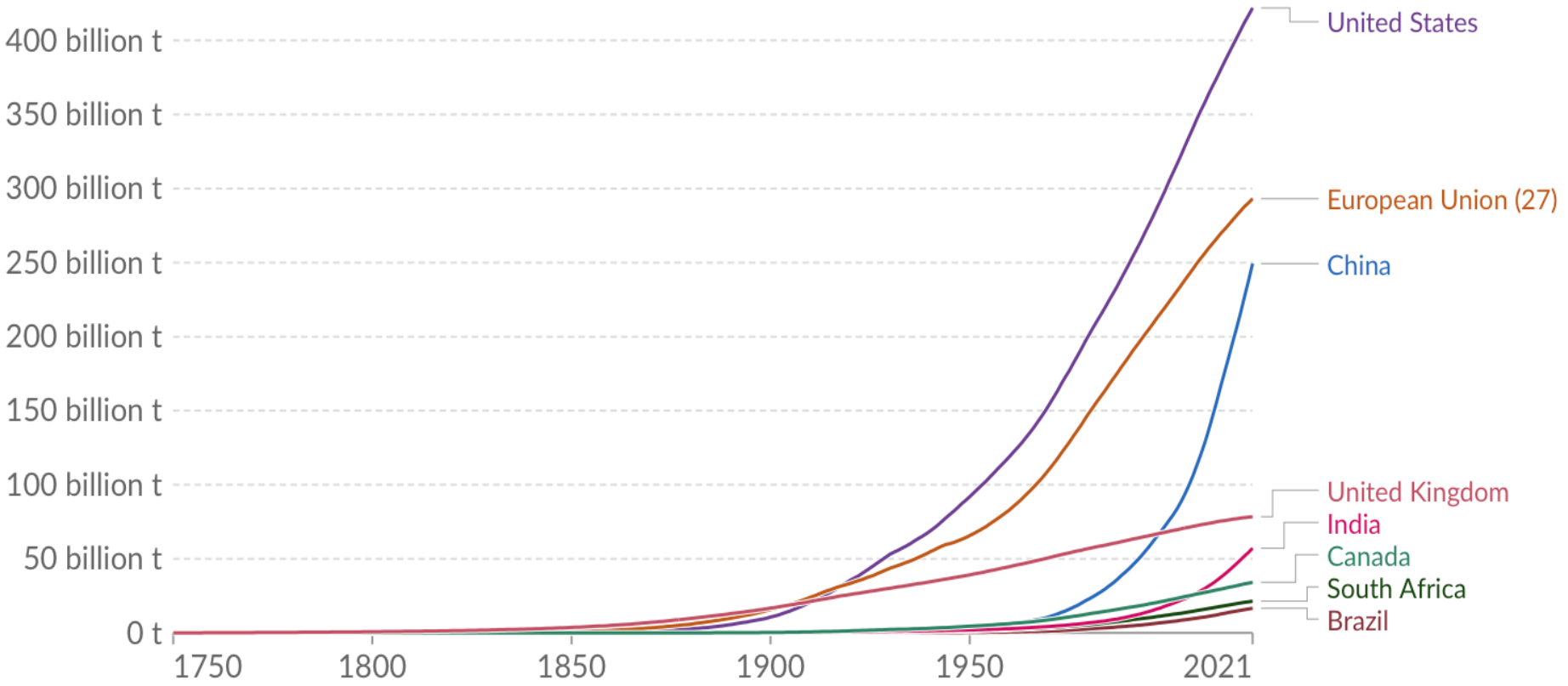
Source: Oxfam

Cumulative CO_2 emissions

Cumulative emissions are the running sum of CO_2 emissions produced from fossil fuels and industry since 1750. Land use change is not included.

Our World in Data

Add country or region | All together | Relative change



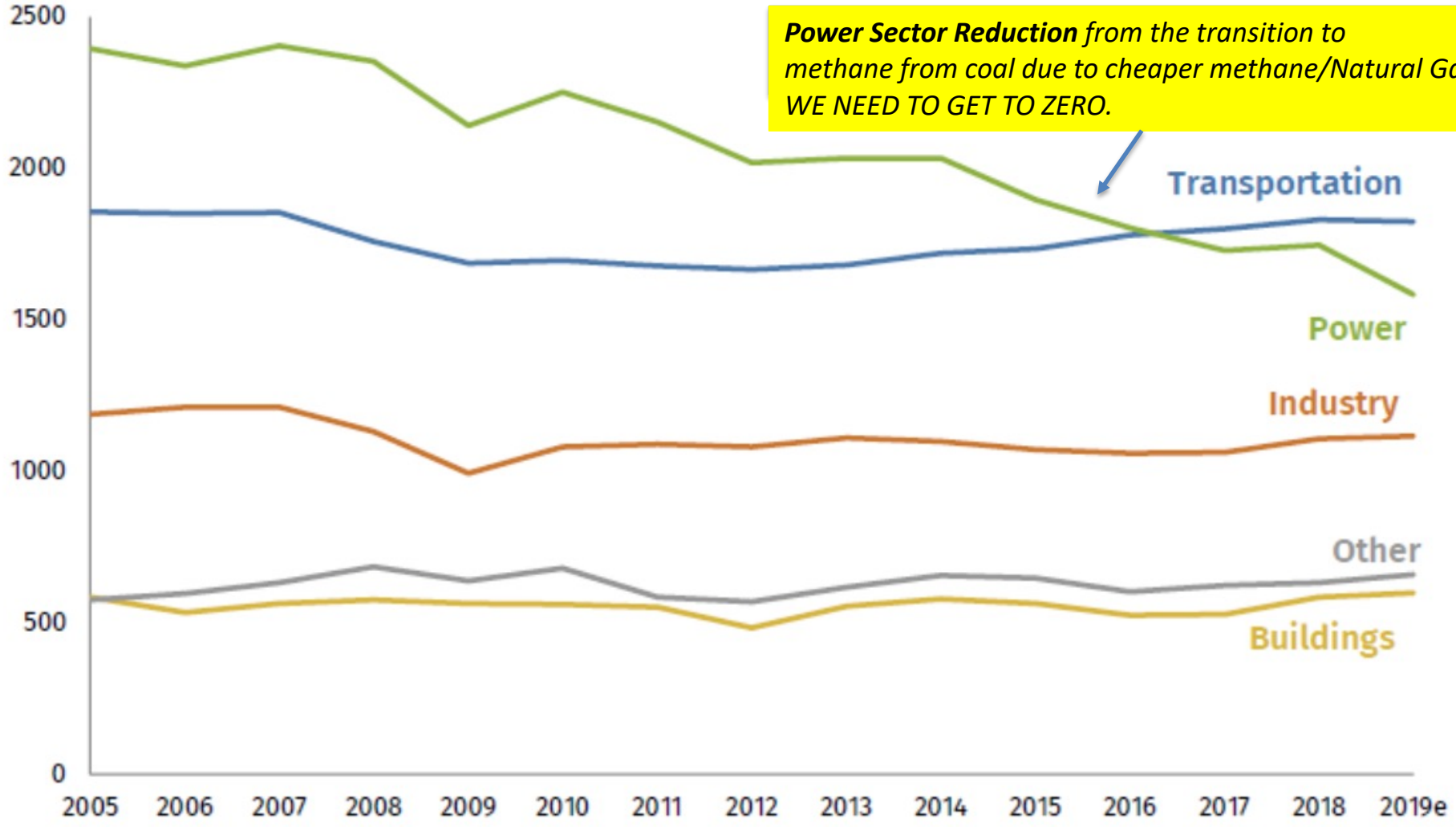
Source: Global Carbon Budget (2022)

OurWorldInData.org/co2-and-greenhouse-gas-emissions • CC BY

1750 2021

Net US GHG emissions by sector

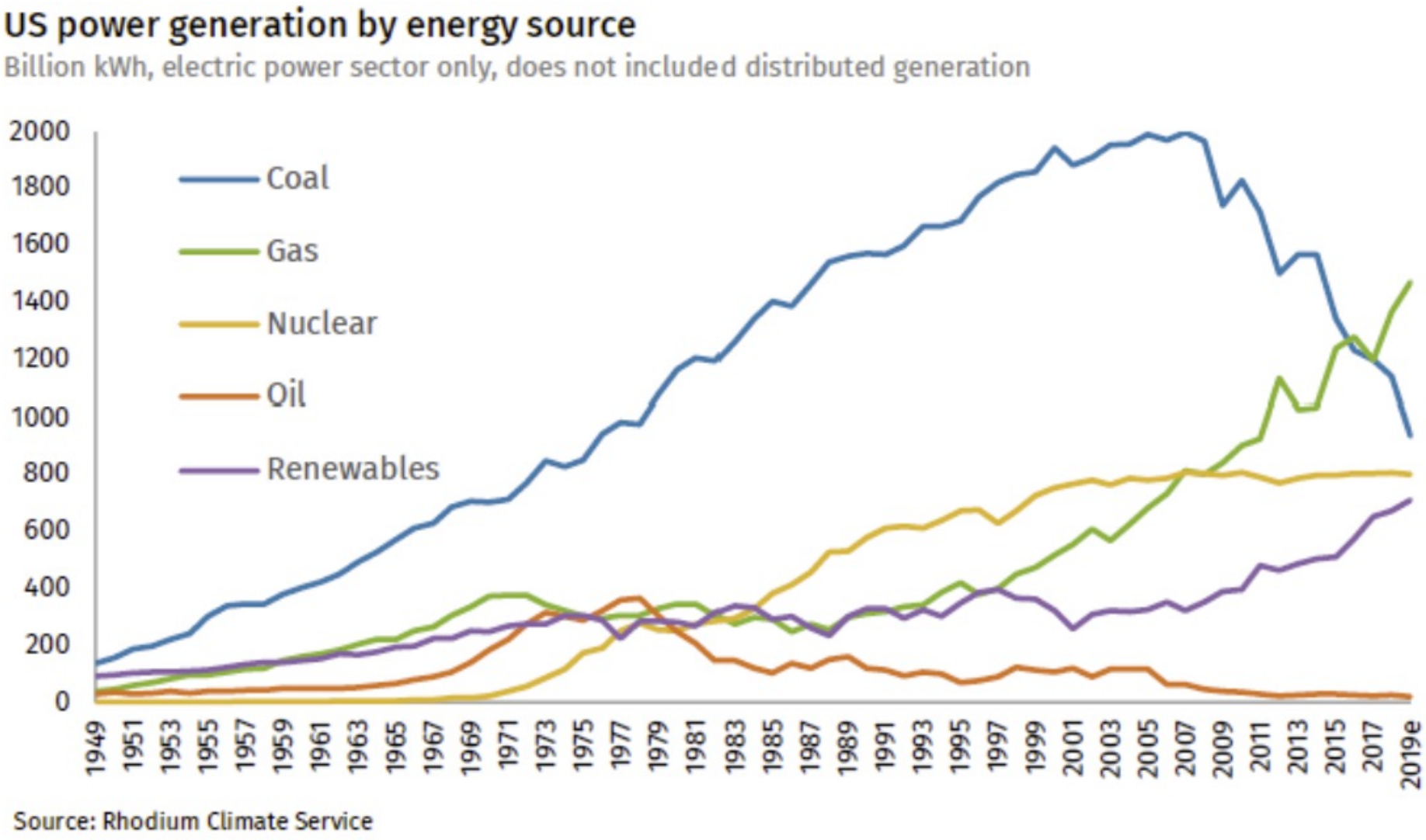
Million metric tons CO2e, IPCC definitions, excludes international bunkers



Power Sector Reduction *from the transition to methane from coal due to cheaper methane/Natural Gas, WE NEED TO GET TO ZERO.*

Source: Rhodium Climate Service

Sources of Power Grid , United States

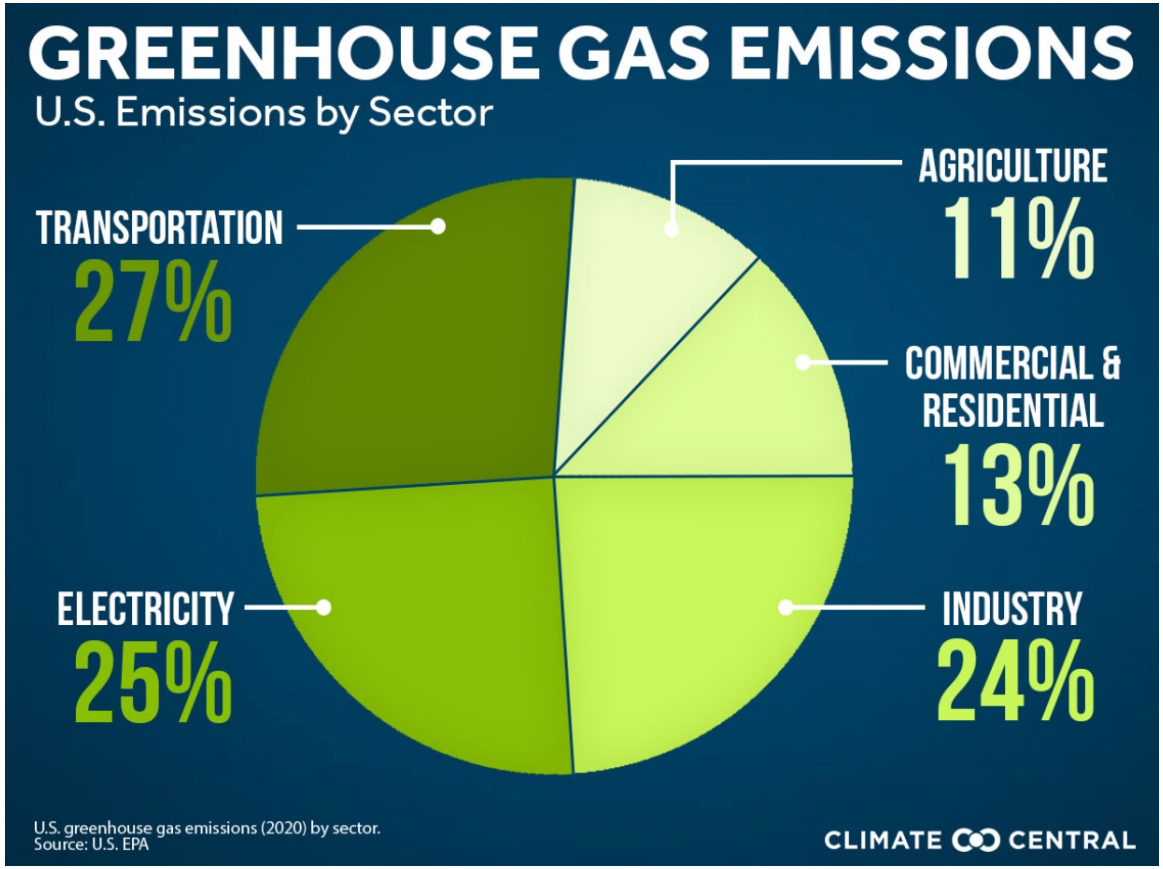


Total U.S. Greenhouse Gas Emissions By Sector in 2019

Transportation is largest share

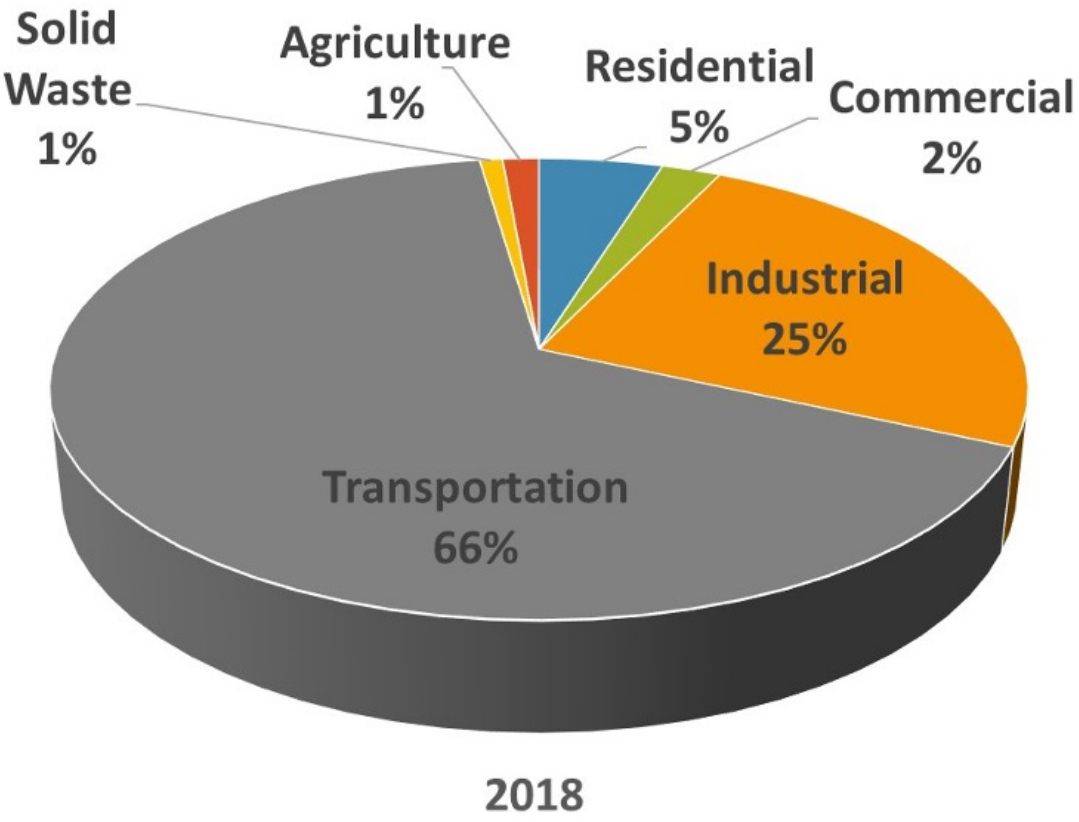
- Primarily :
  passenger cars, medium- and heavy-duty trucks, buses, and light-duty trucks

  - commercial aircraft, ships, boats, and trains, as well as pipelines and lubricants



Jefferson County 2018 Community Emissions By Sector

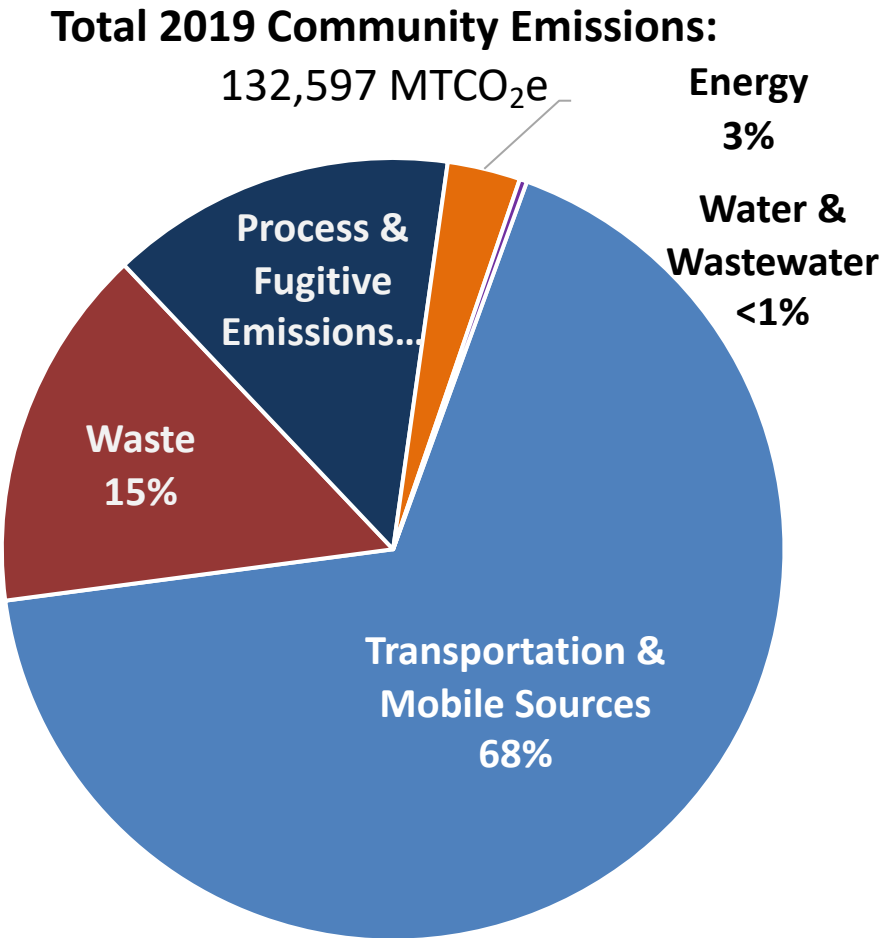
- Jefferson County / Port Townsend Climate Action Committee in 2020
- Transportation emissions increased 13% since 2005
- Electricity > 90% hydroelectric



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

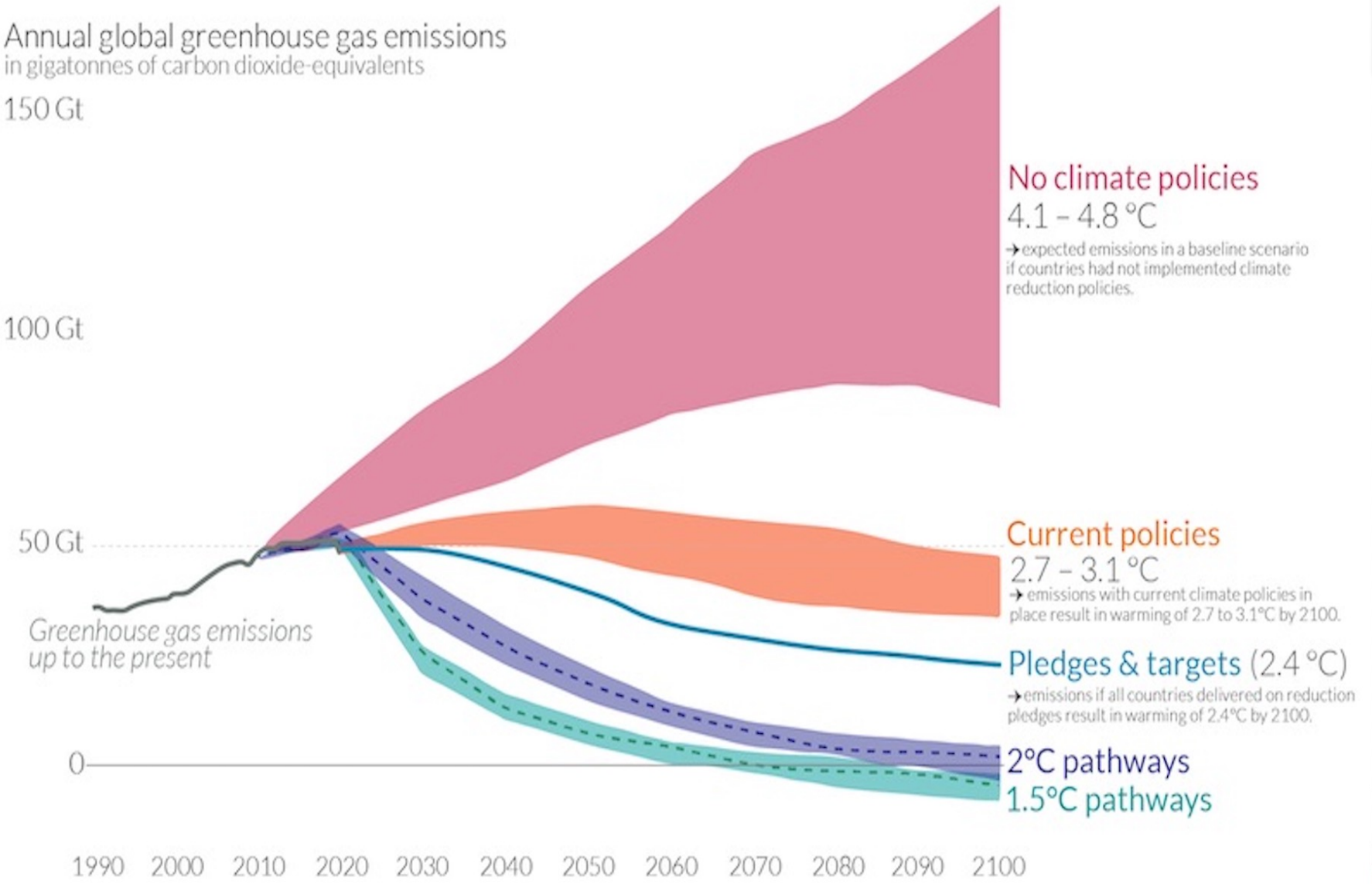


Global greenhouse gas emissions and warming scenarios

Our World in Data

– 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.

°F



Data source: Climate Action Tracker (based on national policies and pledges as of May 2021).
OurWorldinData.org – Research and data to make progress against the world's largest problems.

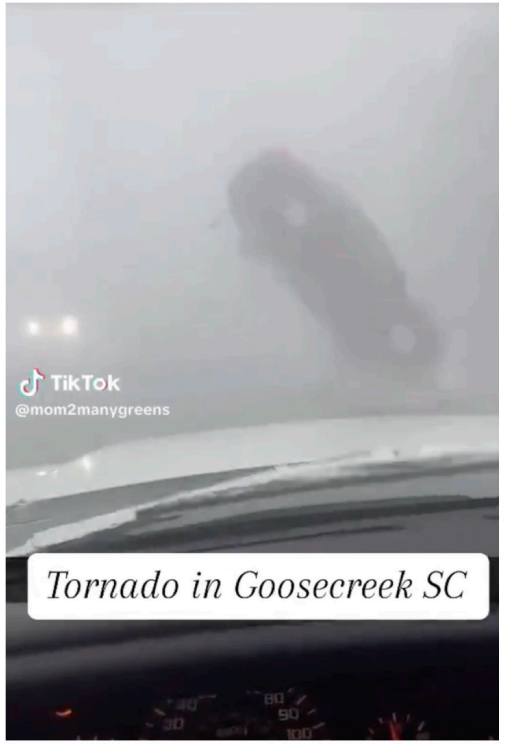
Last updated: July 2021.

Inside Climate News August 23, 2023…….Connect the global dots

“The Climate Crisis Is Here Now, Experts Warn, as Death Tolls From Summer Disasters Mount

- **From the United States to China, to northern Europe, hundreds of people have died in devastating floods and fires around the world in recent weeks with thousands more displaced.”**

@momtoomanygreens / Via Twitter: @csnetkova76



@momtoomanygreens / Via Twitter: @csnetkova76

Every week another record…..
“Historic”…”Unprecedented”

WEATHER

The Pacific Northwest sets new records for daily high temperatures amid heat wave

August 16, 2023 · 5:49 PM ET

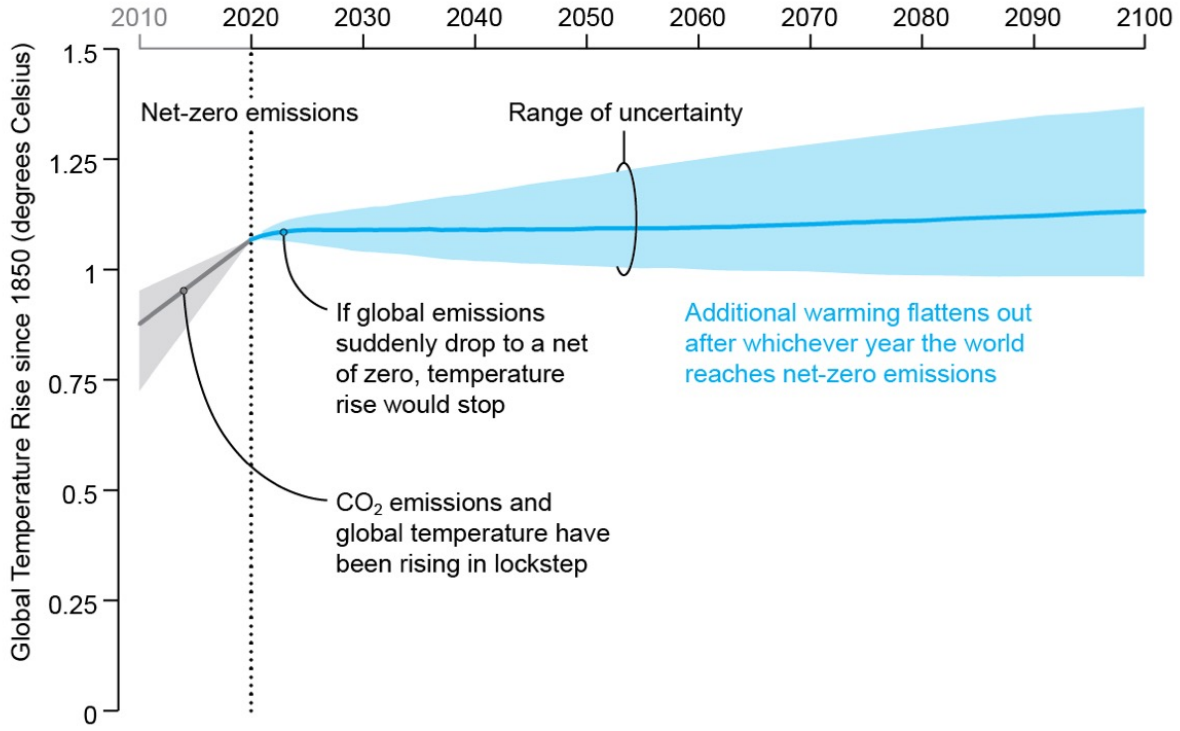
Heard on All Things Considered

By Austin Amestoy

2-Minute Listen + PLAYLIST

The Pacific Northwest is in the middle of a record breaking heatwave. People unaccustomed to 100 degree-plus temperatures are trying to stay cool and nervously watching tinder dry forests.

Urgency and Hope

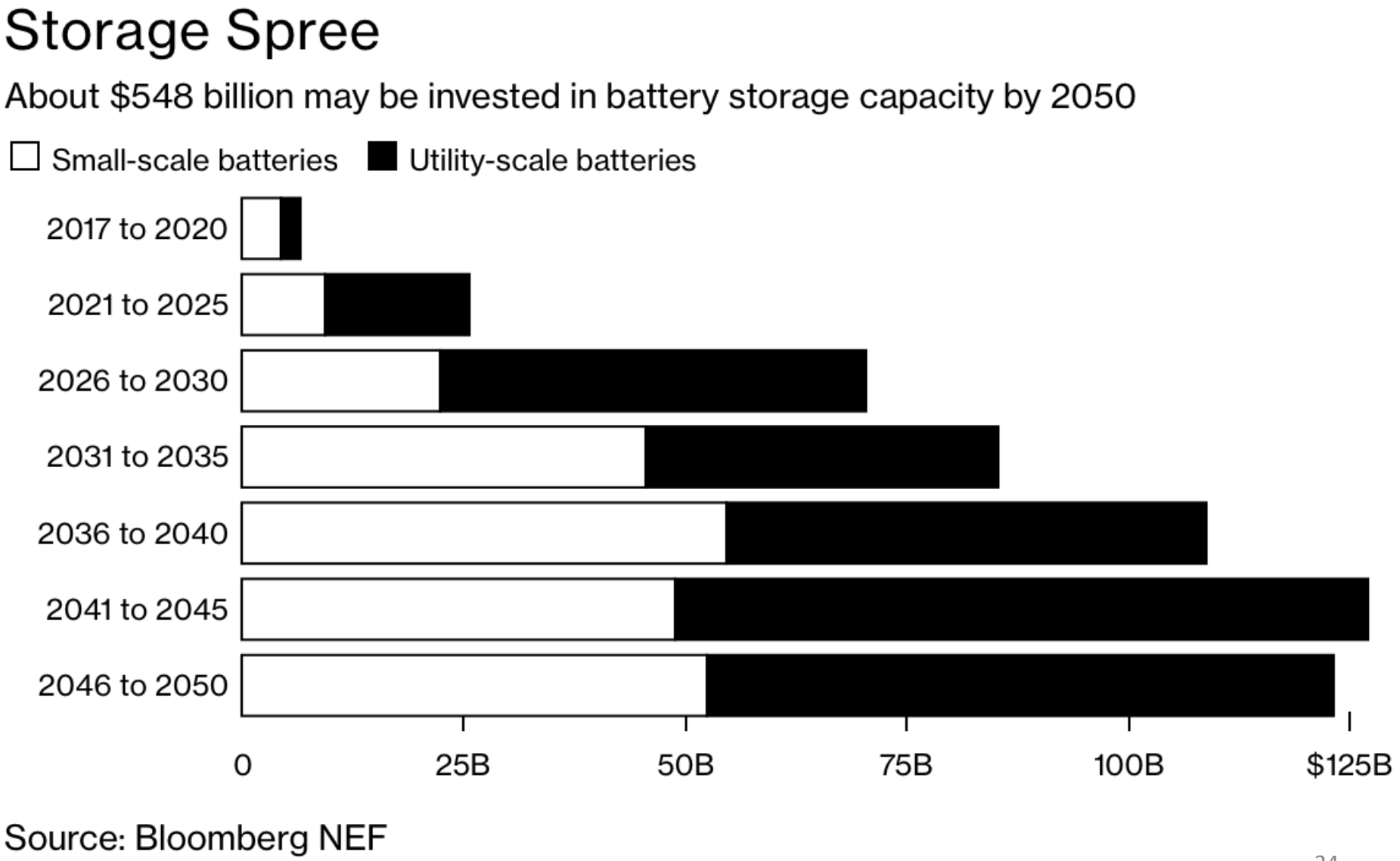


Credit: Amanda Montañez; Source: IPCC, 2018: *Global Warming of 1.5°C: An IPCC Special Report on the Impacts of Global Warming of 1.5°C above Pre-industrial Levels and Related Global Greenhouse Gas Emission Pathways, in the Context of Strengthening the Global Response to the Threat of Climate Change, Sustainable Development, and Efforts to Eradicate Poverty,* edited by V. Masson-Delmotte et al. Intergovernmental Panel on Climate Change

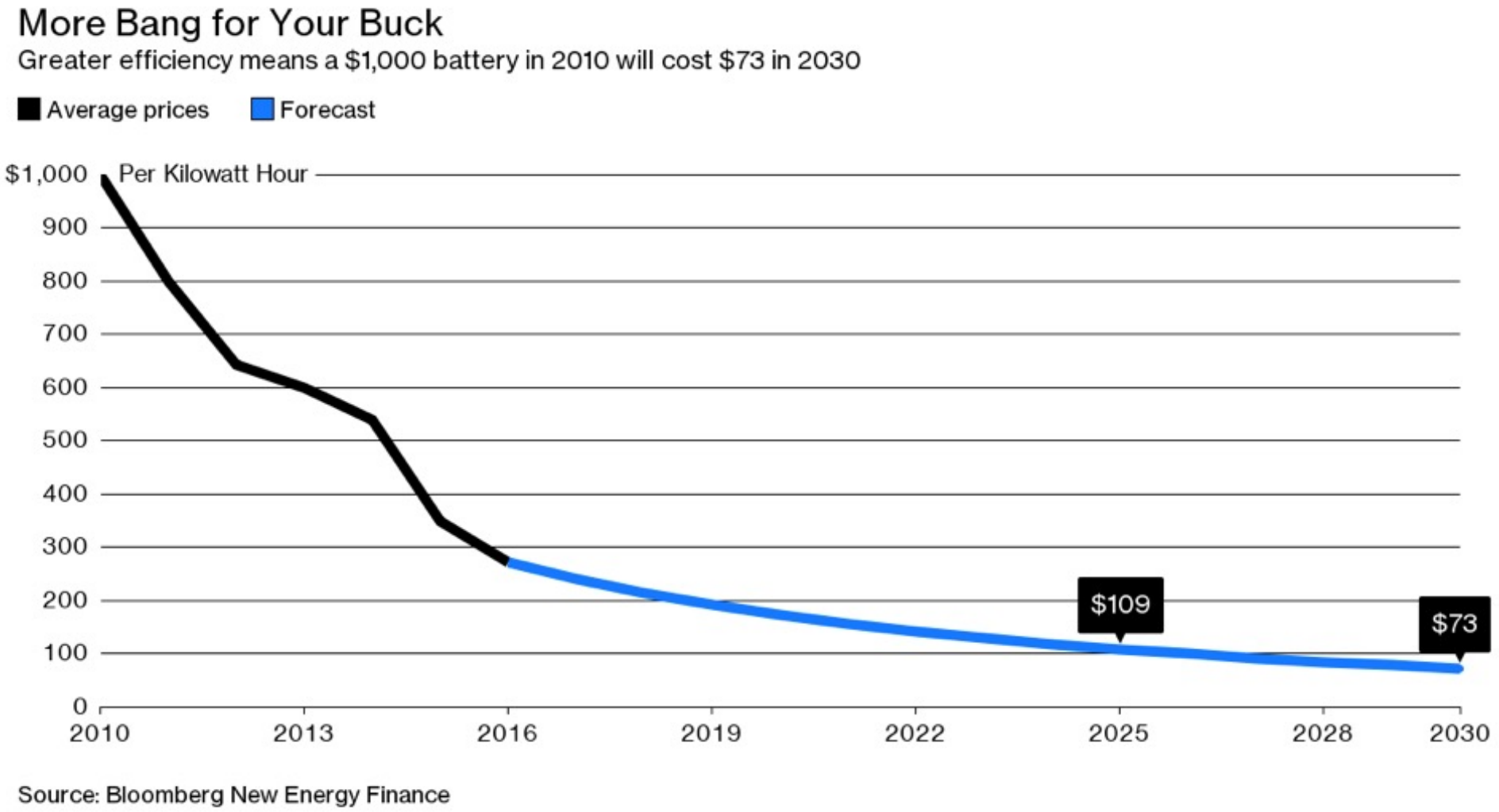
"...As soon as CO_2 emissions stop rising, the atmospheric concentration of CO_2levels off and starts to slowly fall because the oceans, soils and vegetation keep absorbing CO_2, as they always do. Temperature doesn't rise further. It also doesn't drop, because atmospheric and ocean interactions adjust and balance out. The net effect is that "temperature does not go up or down,"

The Future of clean energy includes batteries

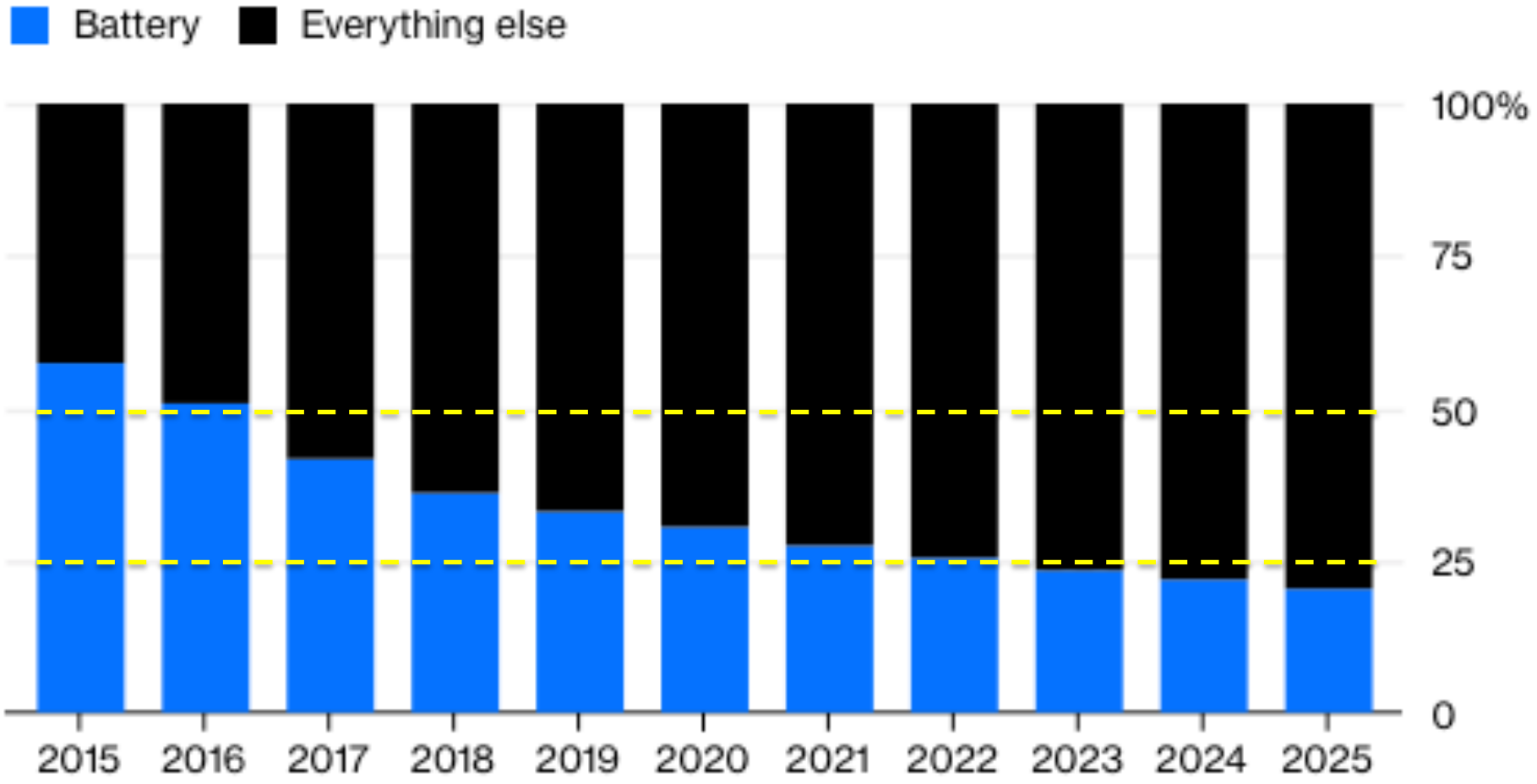
Battery Investments



Battery costs falling rapidly …….

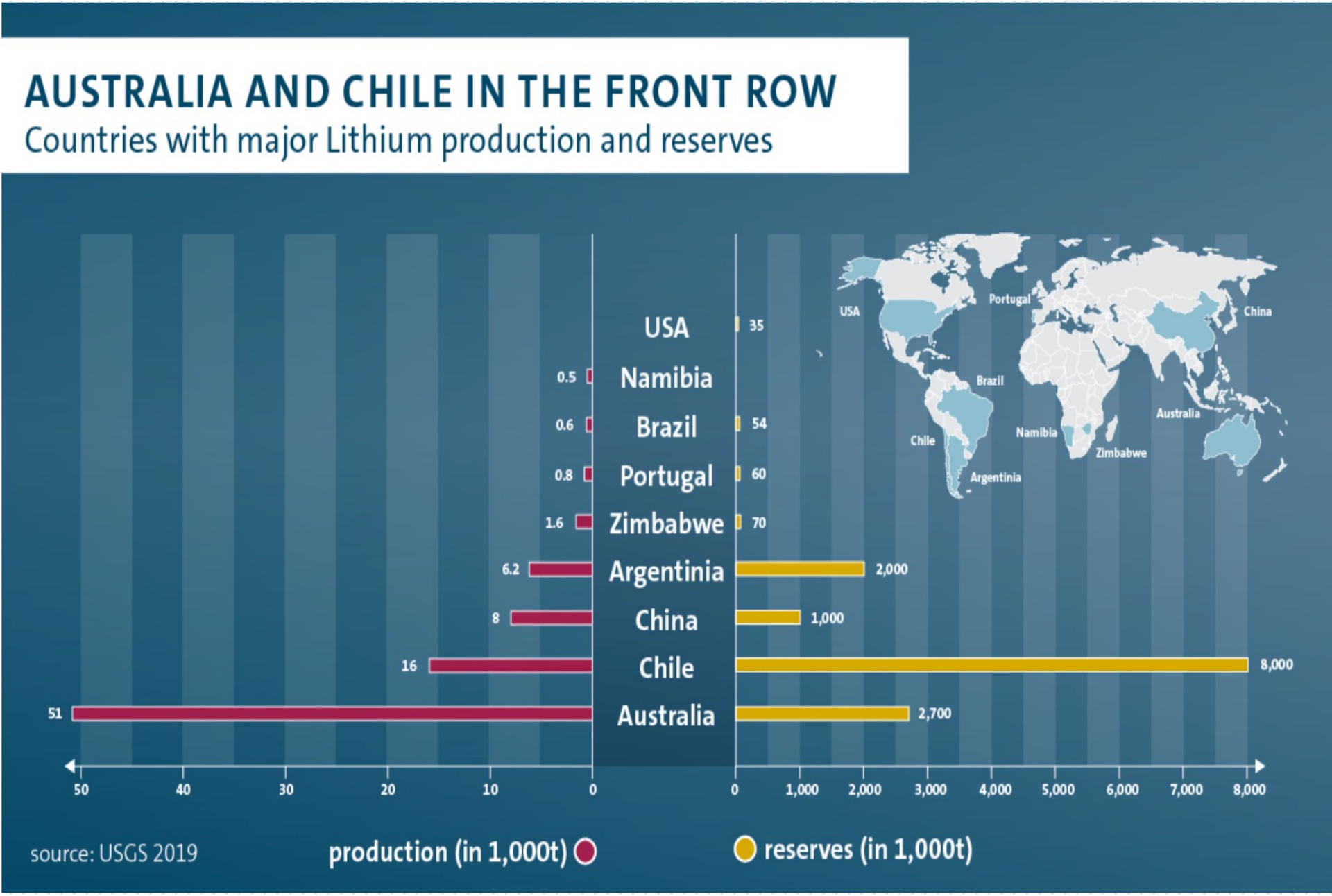


EV battery cost for U.S. medium-size car as a percentage of retail price



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

Where will the Lithium come from ?

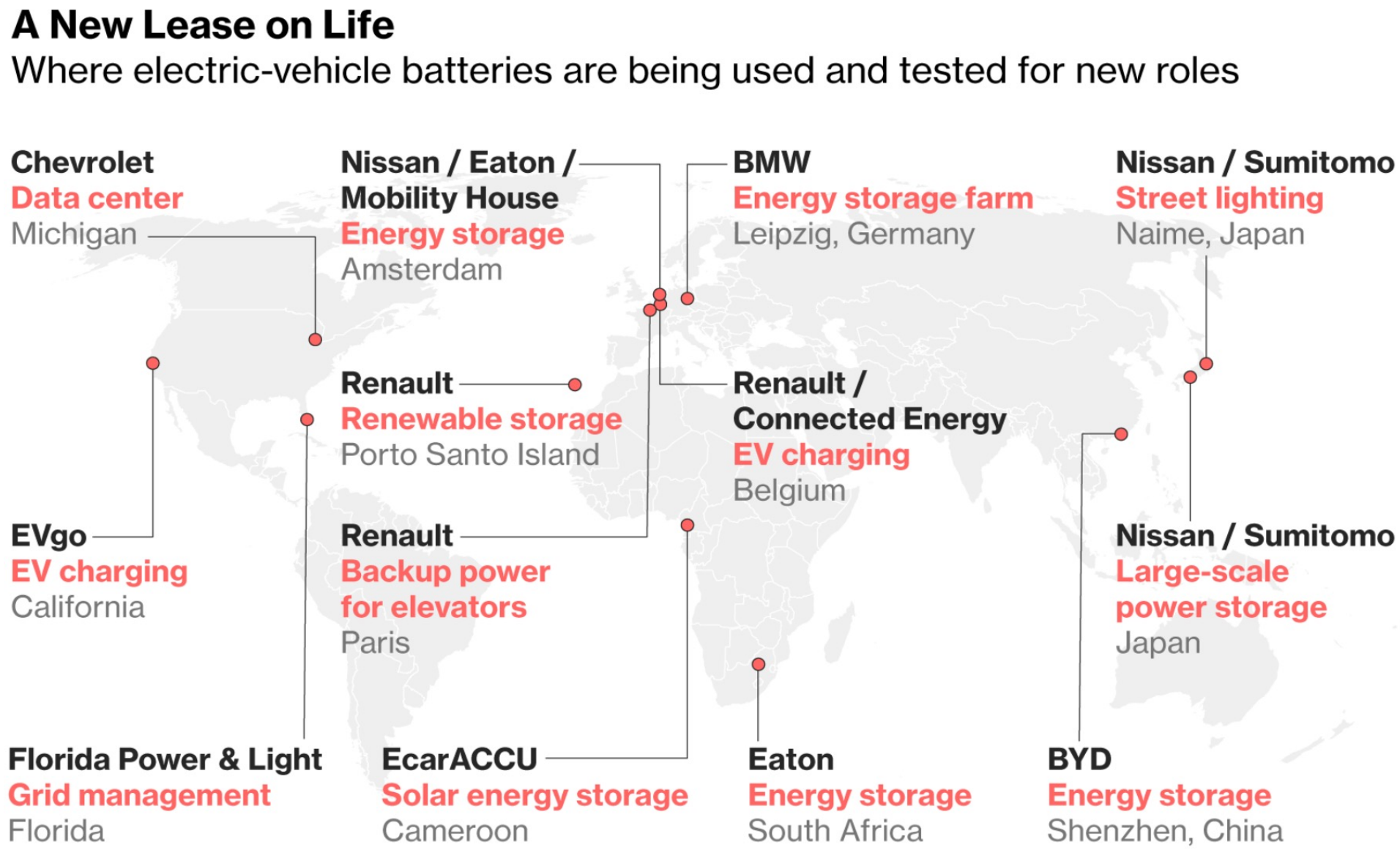


GM Will Suck Lithium from the Salton Sea to Make Batteries

"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

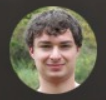
Estimated to be approximately 40 years of lithium for global EV battery production needs !

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



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.

Source : IEEE Spectrum

Ford, Redwood form 'circular' supply chain for EV battery materials

Sept 22, 2022 (Reuters) - Ford Motor Co (F.N) and startup Redwood Materials said on Wednesday they are partnering to form *a "closed loop" or circular supply chain for electric vehicle batteries, from raw materials to recycling.*

The aim is to lower the cost of EVs by reducing the dependence on imported materials, while also narrowing the environmental impact from mining and refining of battery materials.

Ford bets $11.4B on battery plants, EV factories in biggest-ever investment

Recycling …It's Happening Now

Base 1 EV Battery Recycling Facility

When fully operational in Q4 2022, the **facility** will **recycle** 30,000 metric tons of lithium-ion **batteries** and **manufacturing** scrap a year. That's about 70,000 ...

Construction Dive
https://www.constructiondive.com › news › turner-tea...

Turner teams up on $1B EV battery recycling plant

Dec 7, 2022 — Turner Construction, Kokosing Industrial and SSOE Group landed a $1 billion design-build contract to construct an electric vehicle **battery** ...

live5news.com
https://www.live5news.com › 2022/12/13 › berkeley-co-...

Berkeley Co. approves $3.5B, 30-year deal with battery ...

Dec 12, 2022 — Berkeley County ...

Fast Company
https://www.fastcompany.com › the-largest-battery-recyc...

The largest battery recycling plant in North America is ...

Jan 10, 2022 — Along with **recycling** old **batteries**, **battery** recyclers can **recycle** scrap that's produced at **battery factories**; in **Battery** Resourcers' case, it ...

Reuters
https://www.reuters.com › markets › commodities › cirba...

Cirba Solutions to pour $300 mln into South Carolina ...

Mar 22, 2023 — U.S.-based Cirba Solutions will invest more than $300 million in a lithium-ion EV **battery recycling plant** in South Carolina that will ...

Our Plants - Lithion Technologies

Lithion deploys global **battery recycling plants**, through strategic partnerships and licensing of our proprietary technologies.

electrive.com
https://www.electrive.com › 2023/03/31 › us-ascend-e...

US: Ascend Elements opens battery recycling plant in Georgia

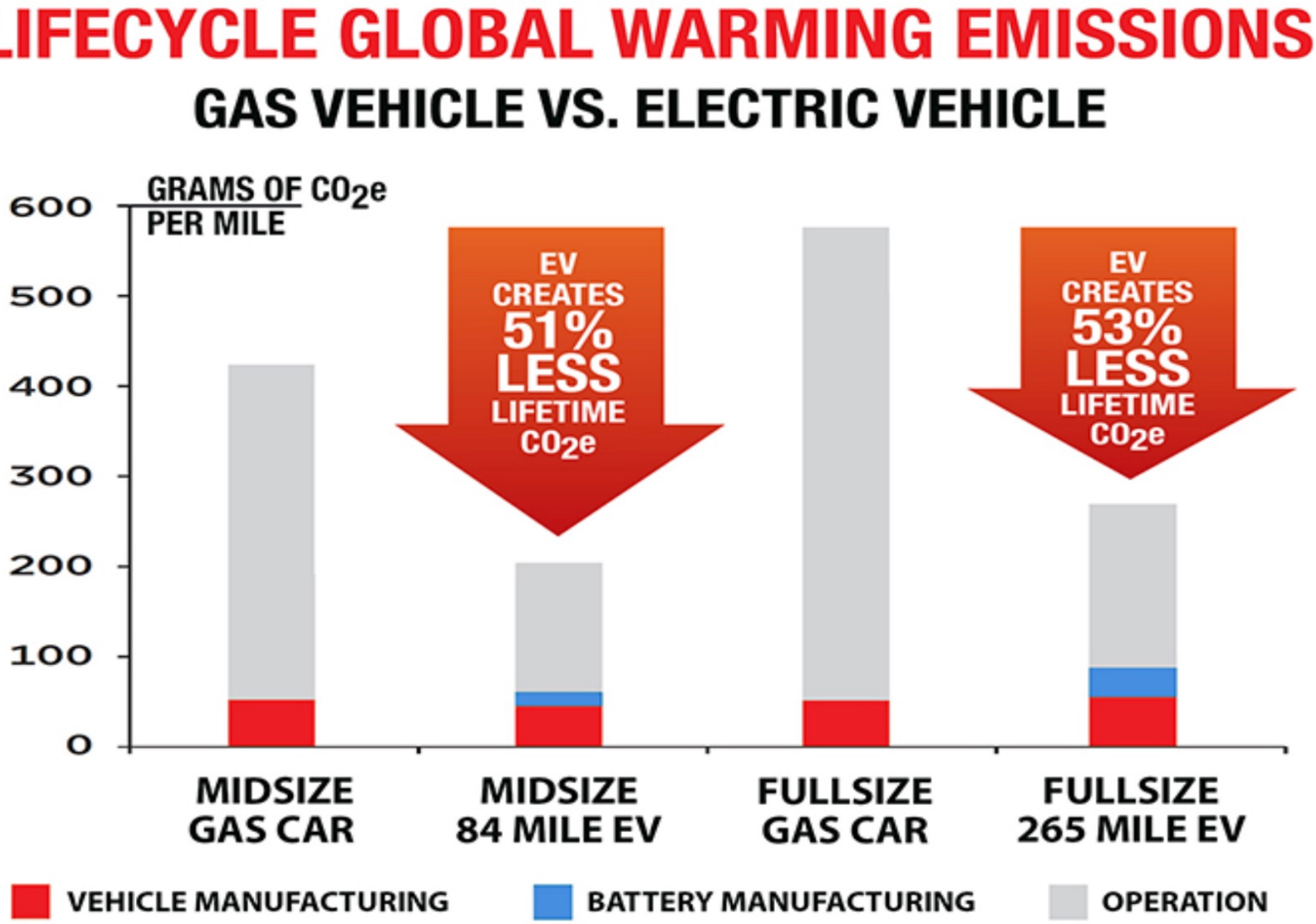
Mar 31, 2023 — US: Ascend Elements opens **battery recycling plant** in Georgia ... The US American company Ascend Elements has opened its commercial-scale lithium- ...

Waste360
https://www.waste360.com › recycling › nations-large...

Nation's Largest EV Battery Recycling Plant Opens in ...

Mar 30, 2023 — Ascend Elements has opened a new electric vehicle **battery facility** in Georgia, which measures out to be the largest **facility** of its type in ...

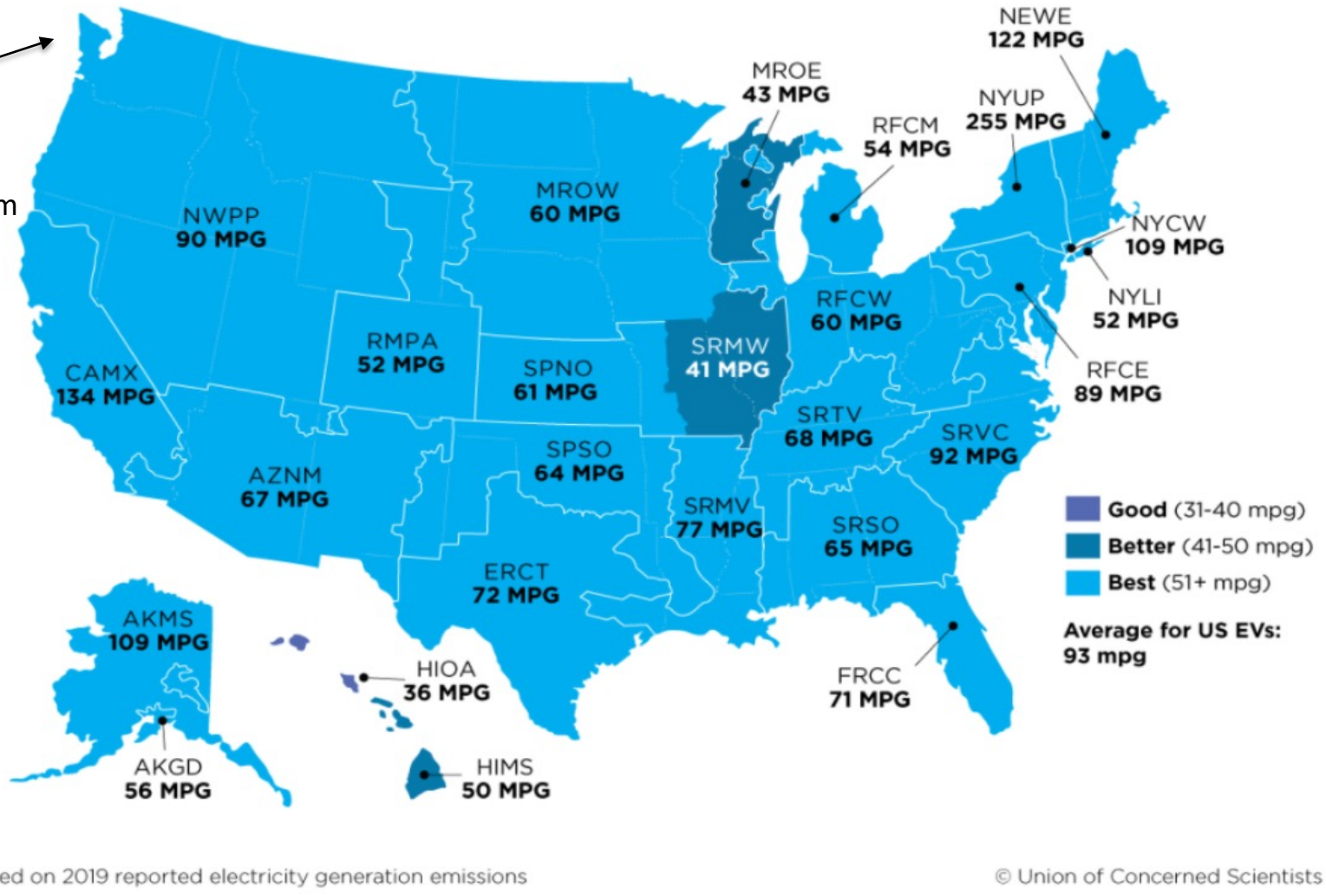
CO_2 Footprint of EV



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 driving. OP is far lower.

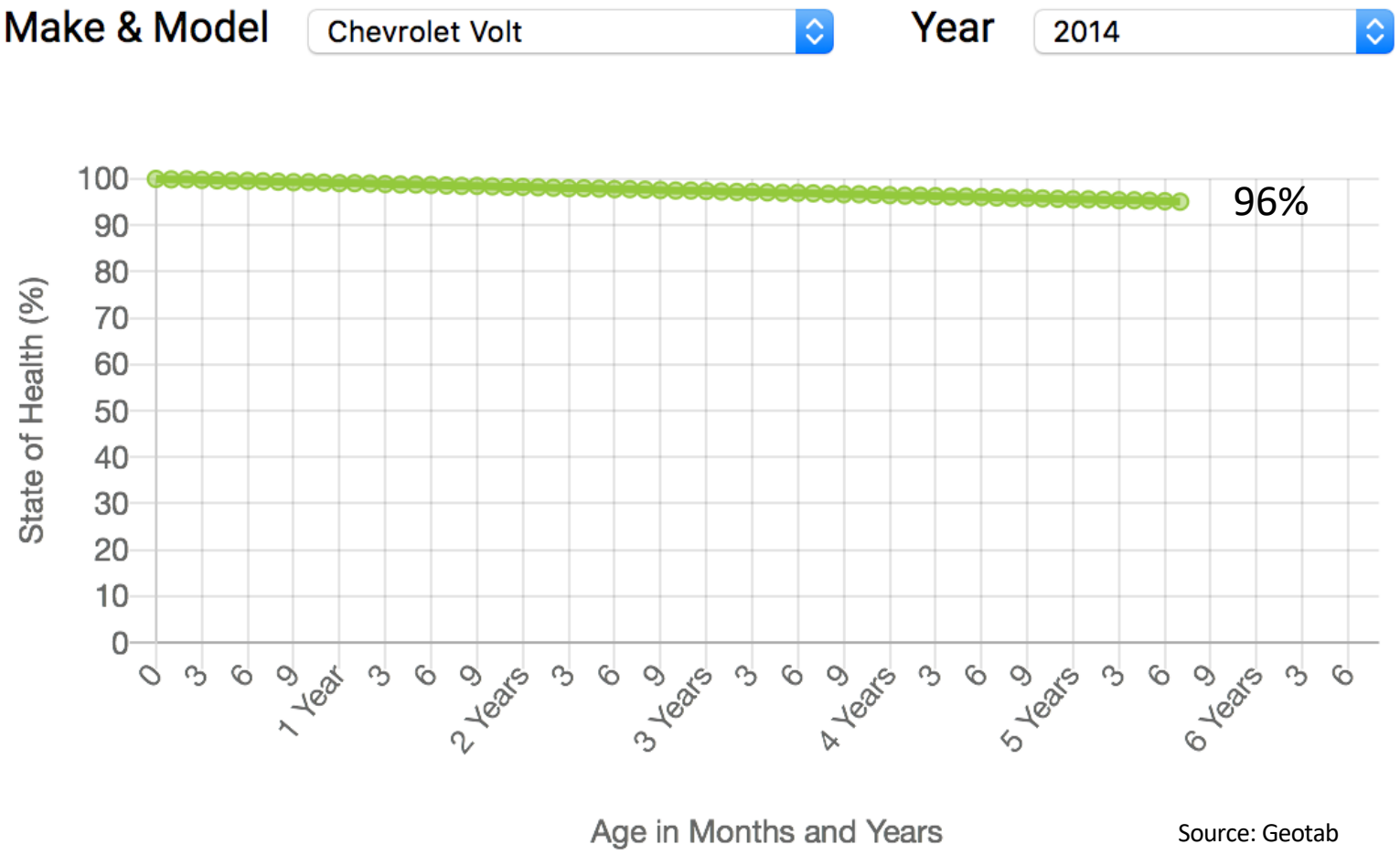
Where you live makes a difference

> 2,000 MPG Equivalent in Port Angeles, Clallam & Jeff Co.



Source: Union of Concerned Scientists, 2021

What about Degradation?



Source: Geotab

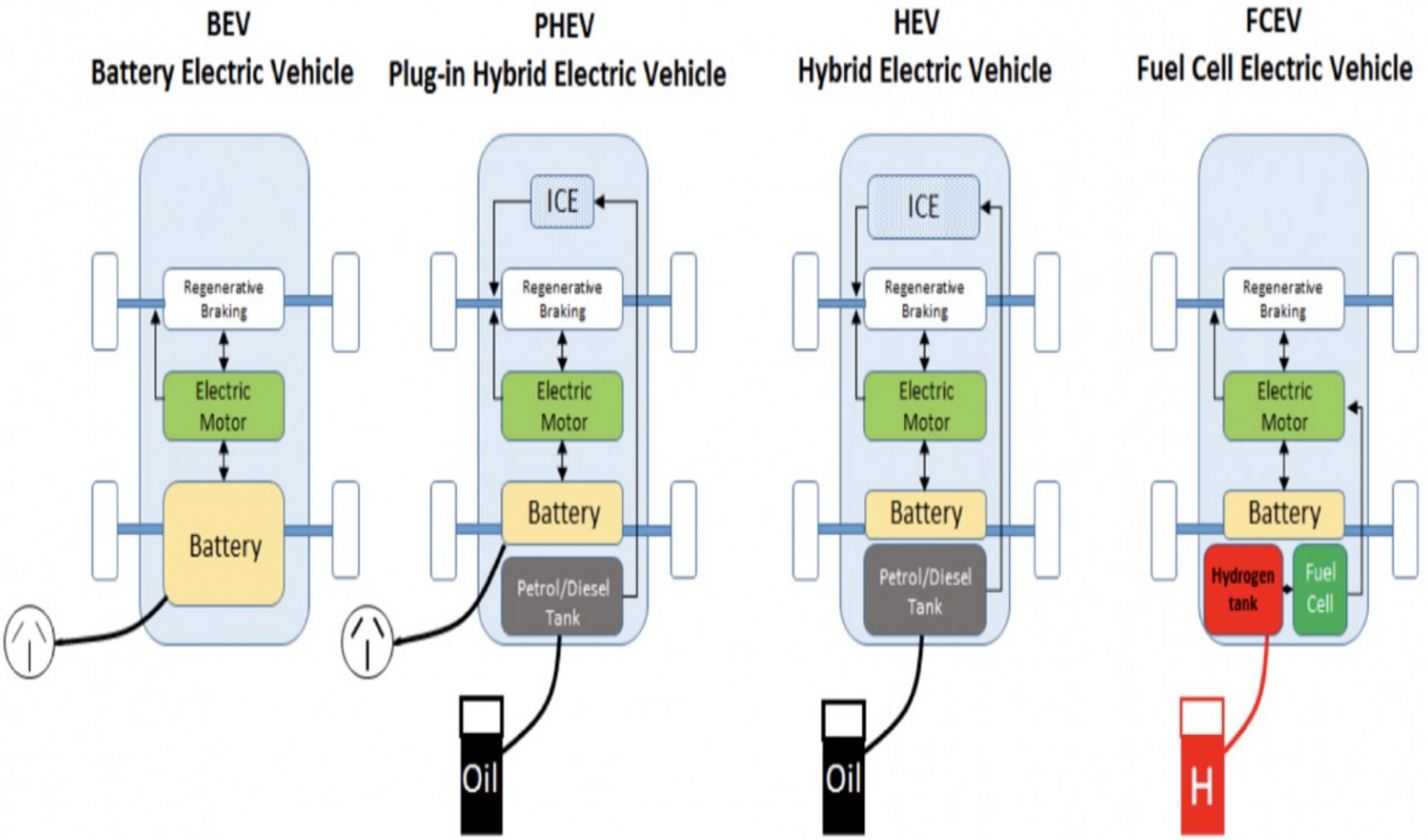
Causes:

- **Degradation increases if using DCFC frequently (DC fast charging)**

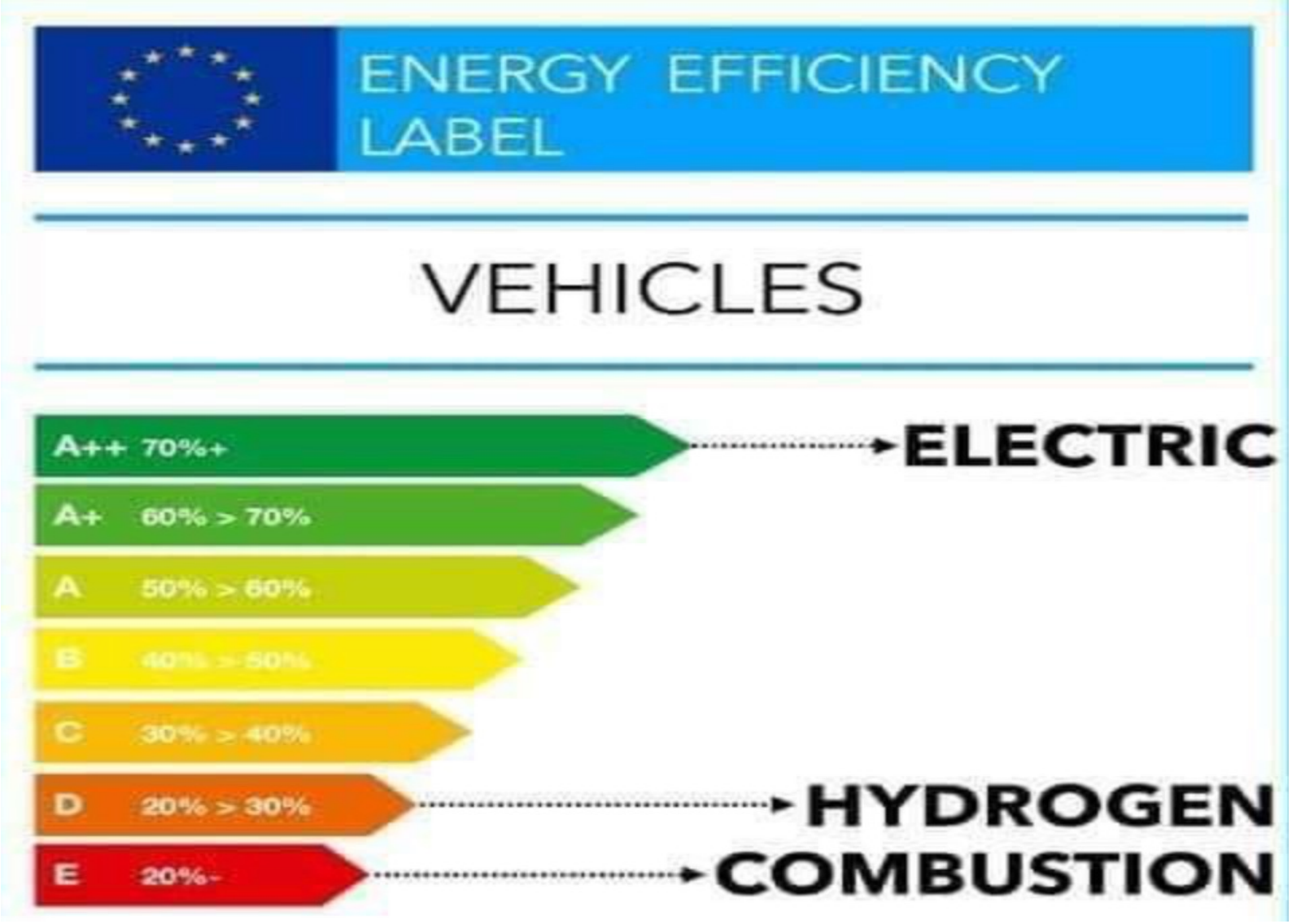
- Battery Mgt Systems differ between vehicles

Passive Thermal management systems (ex. Leaf) vs Active liquid cooled & heated (preferred)

Types of Electrified Vehicles Today



Source: Thedriven.io, **The ICE age is over: Why battery cars will beat hybrids and fuel cells** NOVEMBER 14, 2018



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%.

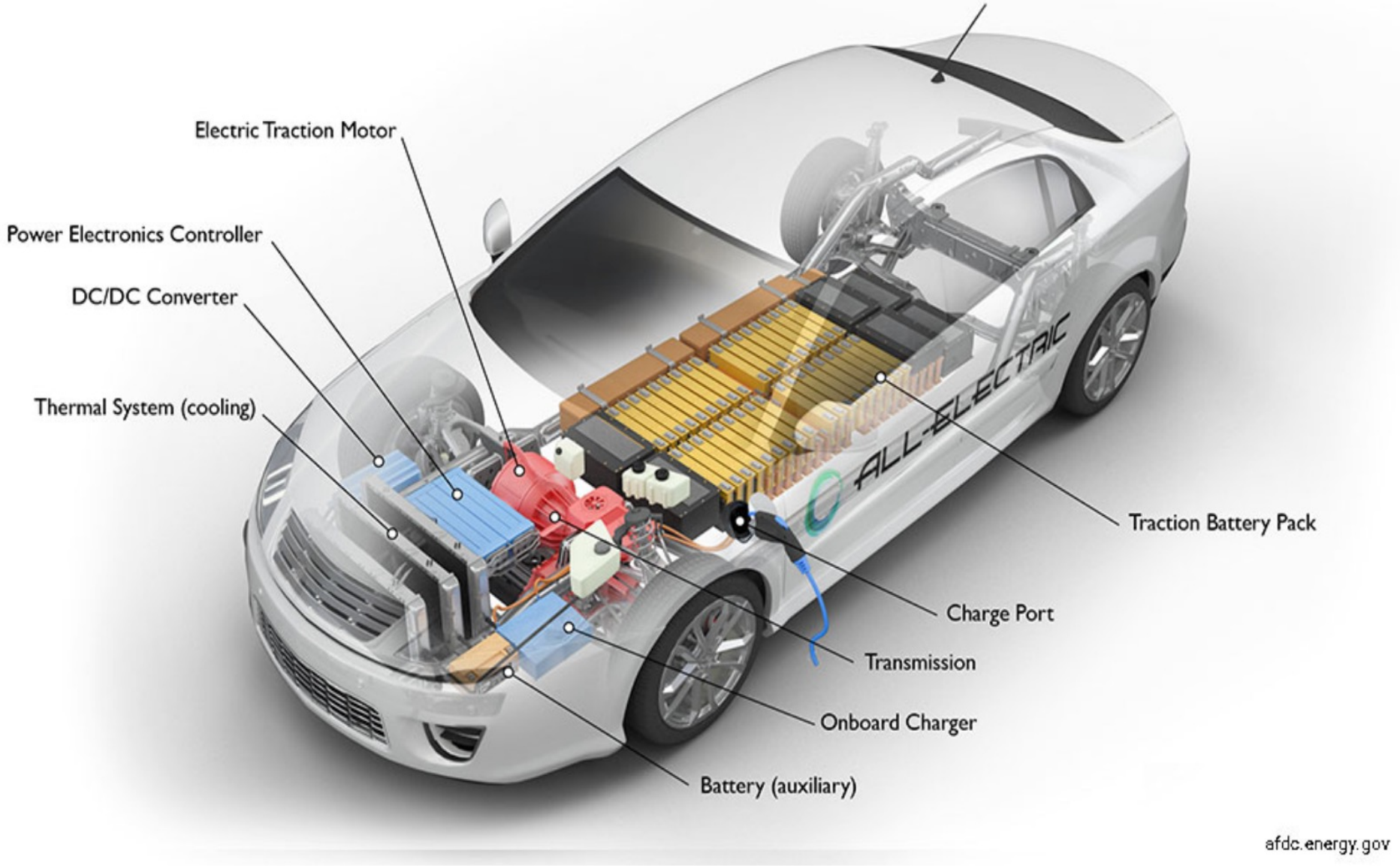
Battery Electric Simplicity & Efficiency

GAS ENGINES	ELECTRIC MOTORS
	
2,000 Moving Parts	20 Moving Parts

VS

Large amount of energy lost as heat

100% Battery Electric Simple Design



afdc.energy.gov

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.																				✓

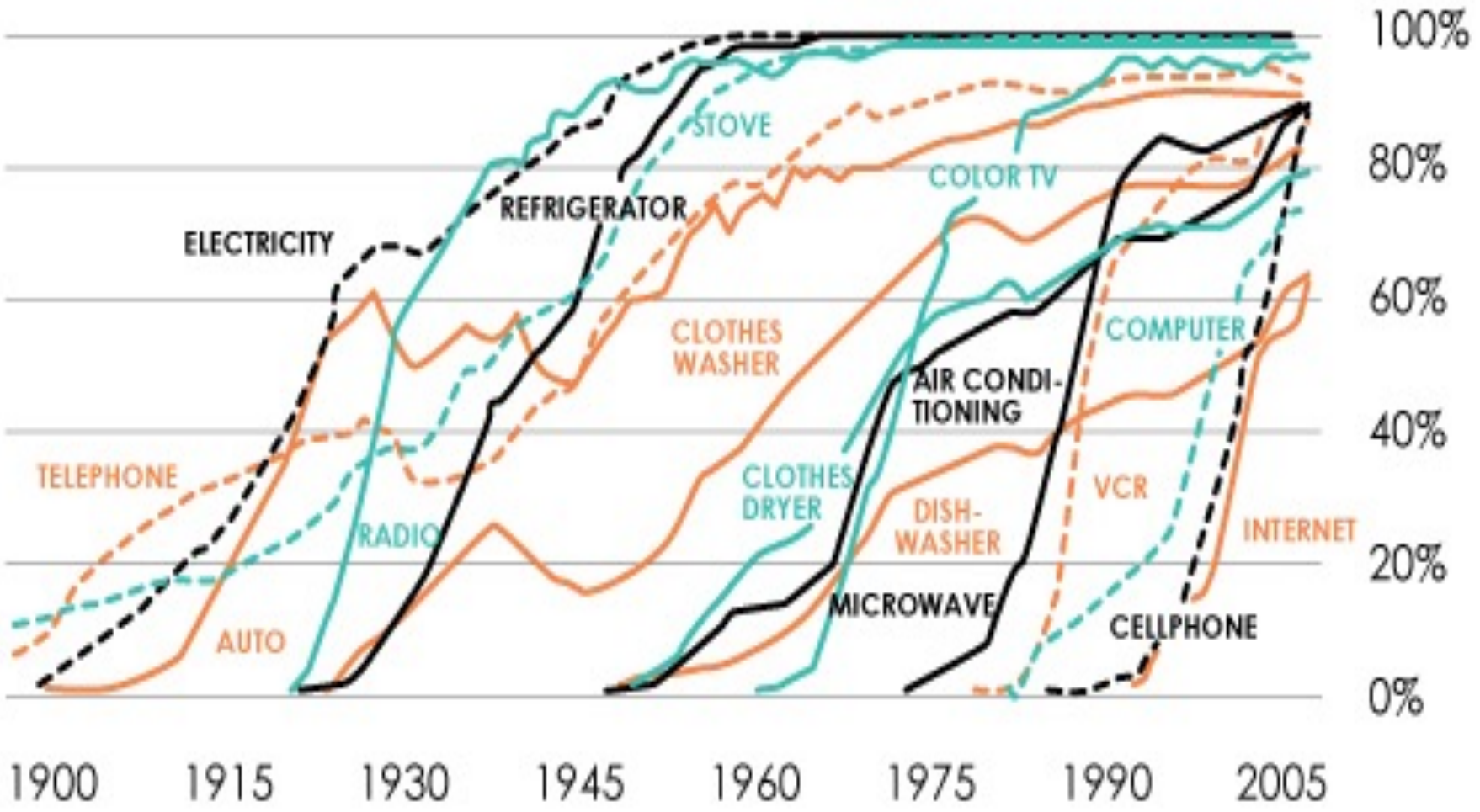
Owning an EV

	ICE (Internal Combustion Engine)	Electric Vehicle
Fuel @ 10,000 miles	$1,600 (25 mpg @ $4/gal)	$285 (3.5 miles/Kwh @$0.10/kwh)
Total Fuel $ at 100,000 mi.	$16,000	$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 90k	$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	**~ $19,700+** VS	**~ $3,150**

Decreasing Battery $, Increasing Production Volumes, Consumer Comprehending Benefits, Regulations

Market Transition

New Technologies and Mainstream Adoption



Source: Michael Felton, *The New York Times*

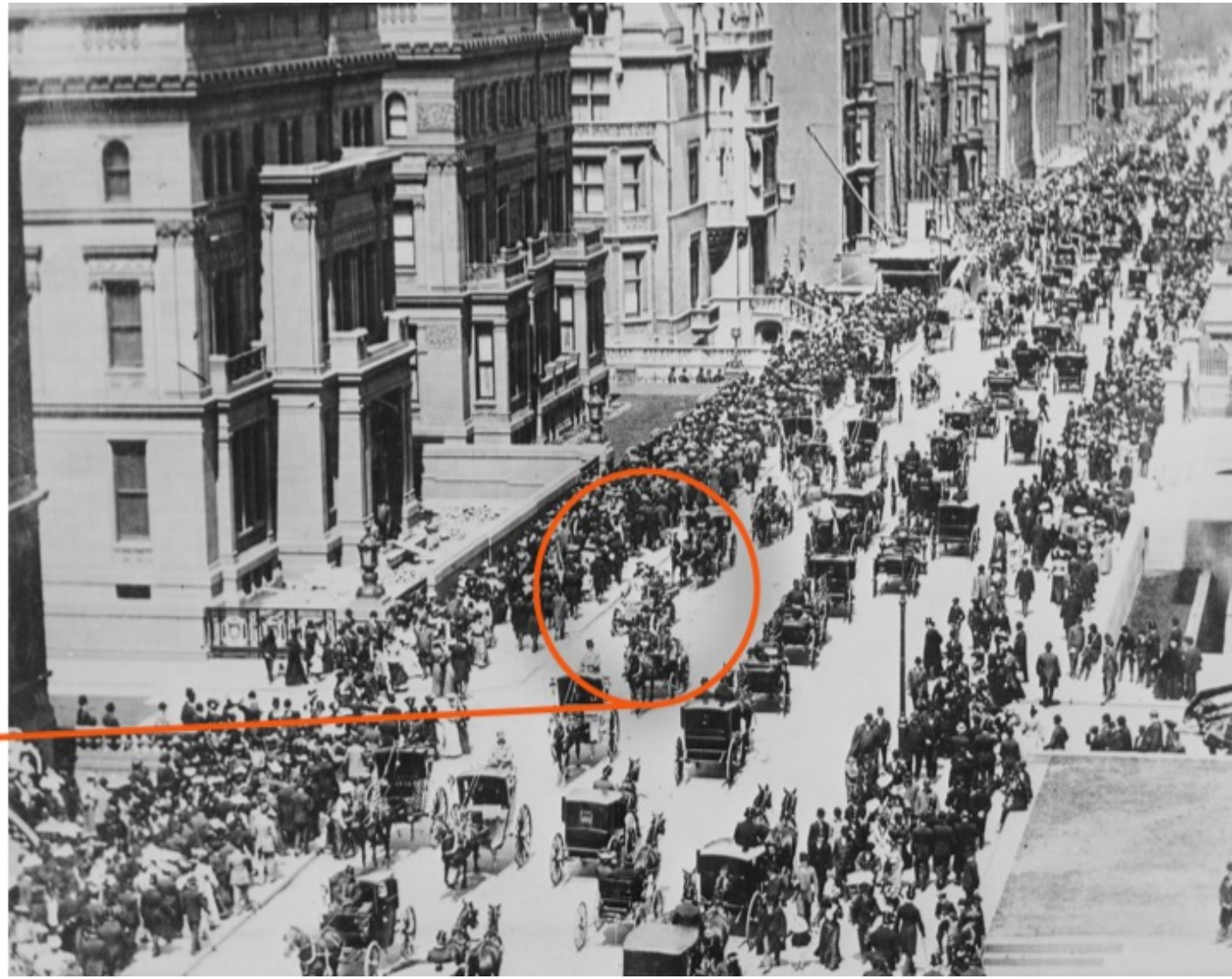
www.earlyinvesting.com

Speed of Disruption

5th AVE NYC

1900

Where is the car?

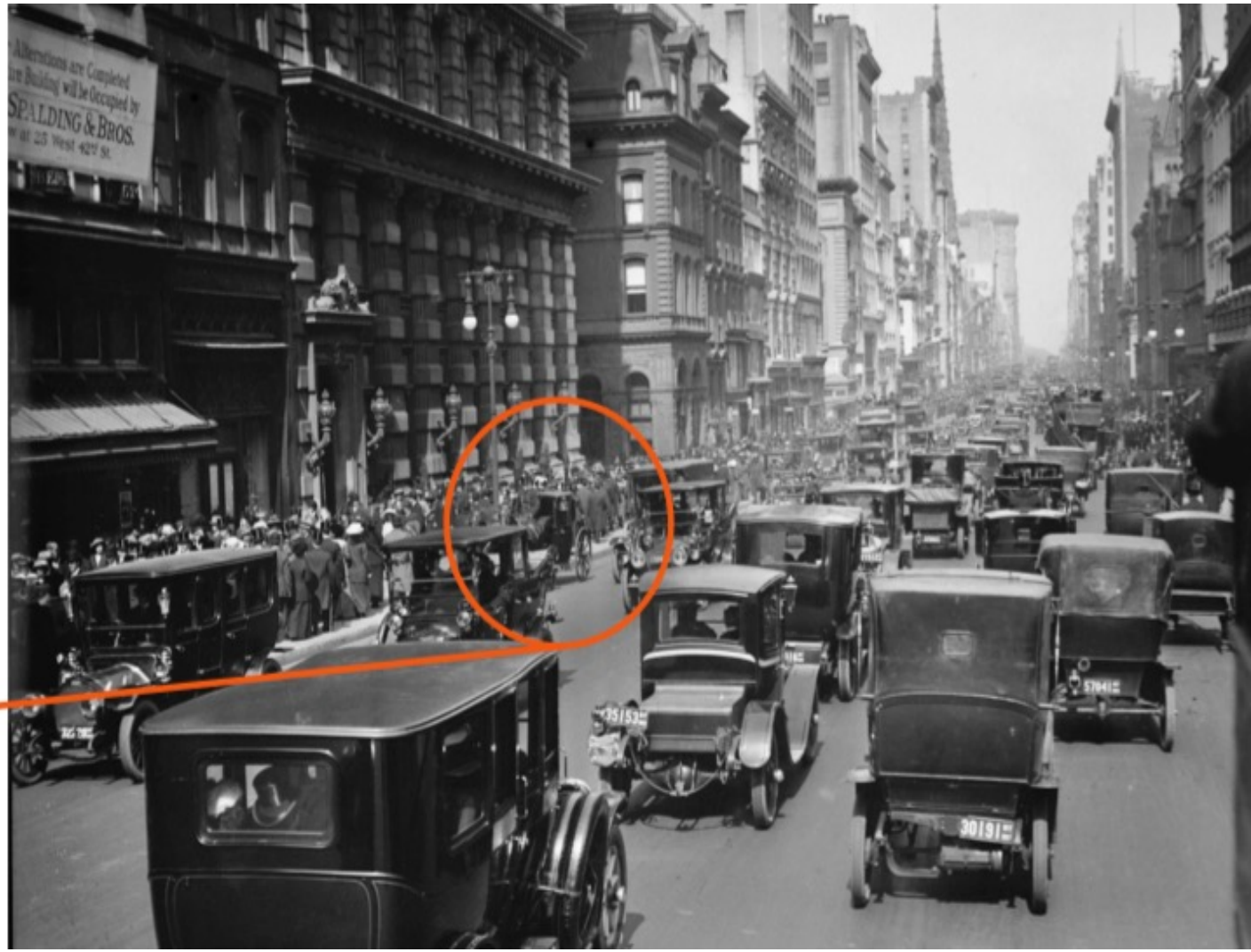


Speed of Disruption

5th AVE NYC

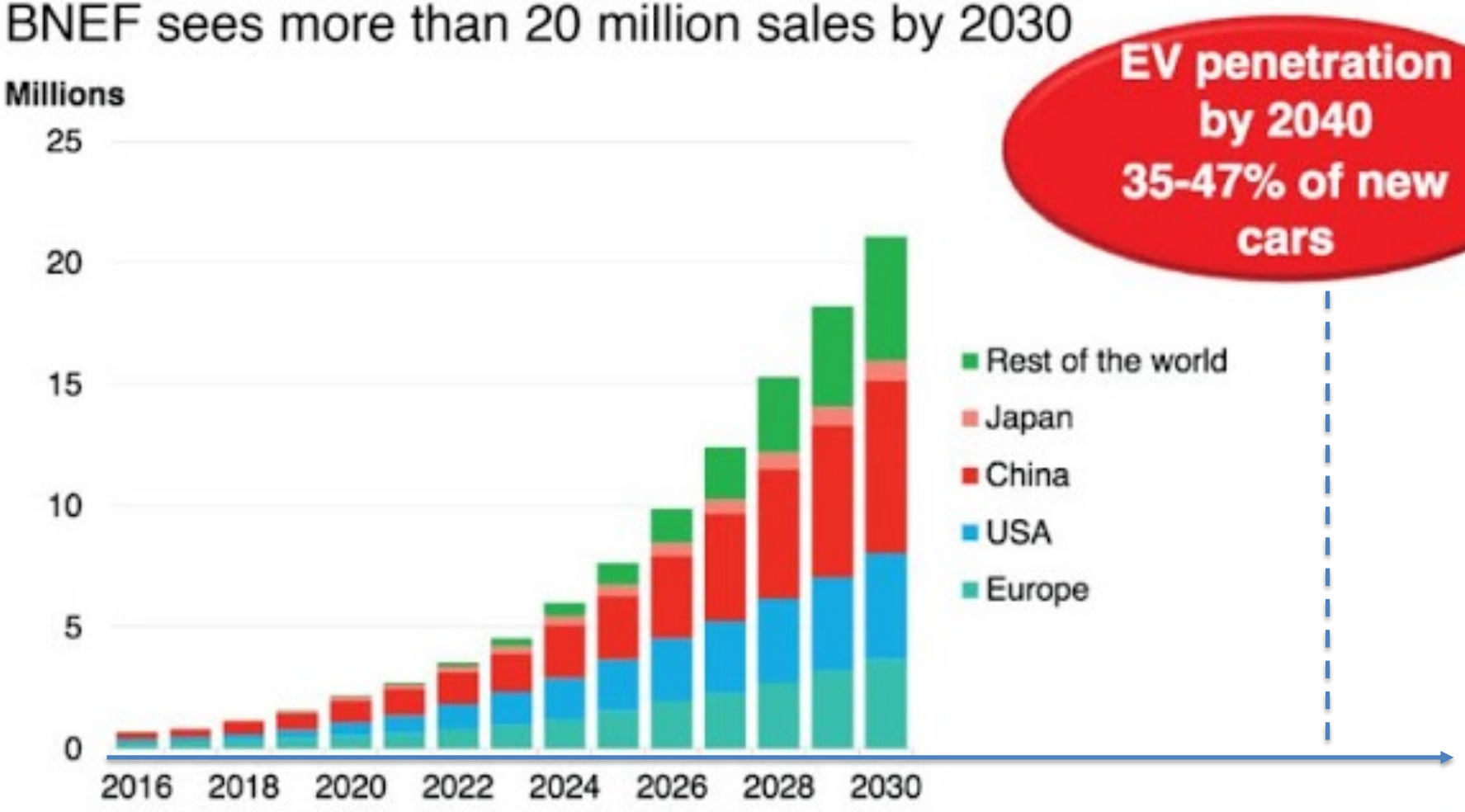
1913

Where is the horse?



The Rise of Electric Cars

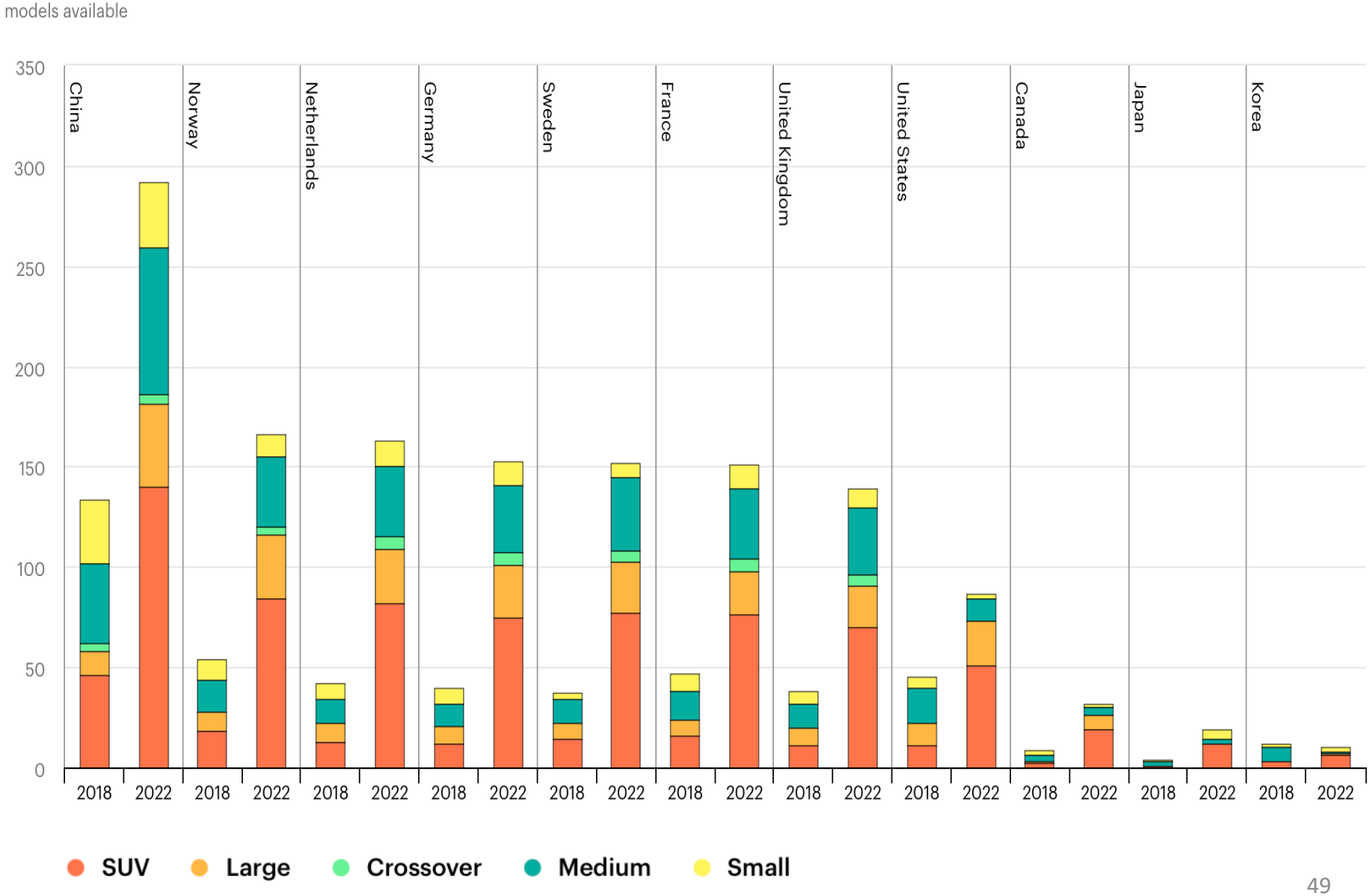
BNEF sees more than 20 million sales by 2030



Source : Bloomberg New Energy Fund

- ***By <u>2025</u> EVs projected to be priced <u>equal to or less</u> than gasoline vehicles***

EV Models Available by Size, 2022



EV Models -U.S. Availability 2022/23 - 33 models (+ versions)
- by 2025 there will be over 2X more, at least three more light trucks

Audi	e-tron GT quattro 20" (2022)	AWD
Audi	RS e-tron GT quattro 20" (2022)	AWD
Audi	e-tron quattro 20" (2022)	AWD
Audi	e-tron Sportback quattro 20" (2022)	AWD
Audi	e-tron S 20" (2022)	AWD
Audi	e-tron S 21" (2022)	AWD
Audi	e-tron S Sportback 20" (2022)	AWD
Audi	e-tron S Sportback 21" (2022)	AWD
Audi	Q4 40 e-tron 19" (2022)	RWD
Audi	Q4 50 e-tron quattro 19" (2022)	AWD
Audi	Q4 Sportback 50 e-tron quattro 20" (2022)	AWD
BMW	i4 eDrive40 18" (2022)	RWD
BMW	i4 M50 19" (2022)	AWD
BMW	iX xDrive50 20" (2022)	AWD
Cadillac	Lyriq Debut Edition (2023)	RWD
Chevrolet	Bolt EV (2022)	FWD
Chevrolet	Bolt EUV (2022)	FWD
Ford	F-150 Pro SR 18" (2022)	AWD
Ford	F-150 Pro ER (fleets) 18" (2022)	AWD
Ford	F-150 Lightning XLT SR 18" (2022)	AWD
Ford	F-150 Lightning XLT ER 20" (2022)	AWD
Ford	F-150 Lightning Lariat SR 20" (2022)	AWD
Ford	F-150 Lightning Lariat ER 20" (2022)	AWD
Ford	F-150 Lightning Platinum ER 22" (2022)	AWD
Ford	Mustang Mach-E Select SR RWD 18" (2022)	RWD
Ford	Mustang Mach-E Select SR AWD 18" (2022)	AWD
Ford	Mustang Mach-E Premium SR RWD 19" (2022)	RWD
Ford	Mustang Mach-E Premium SR AWD 19" (2022)	AWD
Ford	Mustang Mach-E Premium ER RWD 19" (2022)	RWD
Ford	Mustang Mach-E Premium ER AWD 19" (2022)	AWD
Ford	Mustang Mach-E Route 1 ER RWD 18" (2022)	RWD
Ford	Mustang Mach-E Route 1 ER AWD 18" (2022)	AWD
Ford	Mustang Mach-E GT ER AWD 20" (2022)	AWD
Ford	Mustang Mach-E GT Perf. ER AWD 20" (2022)	AWD
GMC	Hummer EV Pickup (Edition 1) (2022)	AWD

Hyundai	Ioniq 5 SE SR RWD 19" (2022)	RWD
Hyundai	Ioniq 5 SE RWD 19" (2022)	RWD
Hyundai	Ioniq 5 SE AWD 19" (2022)	AWD
Hyundai	Ioniq 5 SEL RWD 19" (2022)	RWD
Hyundai	Ioniq 5 SEL AWD 19" (2022)	AWD
Hyundai	Ioniq 5 Limited RWD 19" (2022)	RWD
Hyundai	Ioniq 5 Limited AWD 20" (2022)	AWD
Hyundai	IONIQ Electric (2021)	FWD
Hyundai	Kona Electric (2022)	FWD
Jaguar	I-PACE EV400 (2022)	AWD
Kia	EV6 Light RWD SR 19" (2022)	RWD
Kia	EV6 Wind RWD LR 19" (2022)	RWD
Kia	EV6 Wind AWD LR 19" (2022)	AWD
Kia	EV6 GT-Line RWD LR 19" (2022)	RWD
Kia	EV6 GT-Line AWD LR 19" (2022)	AWD
Kia	EV6 First Edition AWD LR 20" (2022)	AWD
Kia	Niro EV (2022)	FWD
Lucid	Air Dream Edition Performance 19" (2022)	AWD
Lucid	Air Dream Edition Performance 21" (2022)	AWD
Lucid	Air Dream Edition Range 19" (2022)	AWD
Lucid	Air Dream Edition Range 21" (2022)	AWD
Lucid	Air Grand Touring 19" (2022)	AWD
Lucid	Air Grand Touring 21" (2022)	AWD
Mazda	MX-30 (2022)	FWD
Mercedes	EQS 450+ (RWD; 20") (2022)	RWD
Mercedes	EQS 580 4MATIC (AWD; 21") (2022)	AWD
MINI	Cooper SE (2022)	FWD
Nissan	Ariya Venture+ FWD 19" (2023)	FWD
Nissan	Ariya Evolve+ FWD 19" (2023)	FWD
Nissan	Ariya Premiere FWD 19" (limited) (2023)	FWD
Nissan	Ariya Platinum+ e-4ORCE AWD 19" (2023)	AWD
Nissan	LEAF S (40 kWh) (2022)	FWD
Nissan	LEAF e+ S (62 kWh) (2022)	FWD
Nissan	LEAF e+ SV (62 kWh) (2022)	FWD
Polestar	2 Single Motor 19" (2022)	FWD
Polestar	2 Dual Motor 19" (2022)	AWD

Porsche	Taycan (79 kWh) 19" (2022)	RWD
Porsche	Taycan (93 kWh) 19" (2022)	RWD
Porsche	Taycan 4S (79 kWh) 19" (2022)	AWD
Porsche	Taycan 4S (93 kWh) 19" (2022)	AWD
Porsche	Taycan GTS (93 kWh) 20" (2022)	AWD
Porsche	Taycan Turbo (93 kWh) 20" (2022)	AWD
Porsche	Taycan Turbo S (93 kWh) 21" (2022)	AWD
Porsche	Taycan 4 Cross Turismo 19" (2022)	AWD
Porsche	Taycan 4S Cross Turismo 19" (2022)	AWD
Porsche	Taycan GTS Sport Turismo 20" (2022)	AWD
Porsche	Taycan Turbo Cross Turismo 20" (2022)	AWD
Porsche	Taycan Turbo S Cross Turismo 20" (2022)	AWD
Rivian	R1S (Large pack, 21") (2022)	AWD
Rivian	R1T (Large pack, 21") (2022)	AWD
Tesla	Model 3 RWD 18" (2022)	RWD
Tesla	Model 3 RWD 19" (2022)	RWD
Tesla	Model 3 Long Range AWD 18" (2022)	AWD
Tesla	Model 3 Long Range AWD 19" (2022)	AWD
Tesla	Model 3 Perf. LR AWD 20" (2022)	AWD
Tesla	Model S LR AWD 19" (2022)	AWD
Tesla	Model S LR AWD 21" (2022)	AWD
Tesla	Model S Plaid 19" (2022)	AWD
Tesla	Model S Plaid 21" (2022)	AWD
Tesla	Model X LR AWD 20" (2022)	AWD
Tesla	Model X LR AWD 22" (2022)	AWD
Tesla	Model X Plaid 20" (2022)	AWD
Tesla	Model X Plaid 22" (2022)	AWD
Tesla	Model Y Long Range AWD 19" (2022)	AWD
Tesla	Model Y Long Range AWD 20" (2022)	AWD
Tesla	Model Y Perf. LR AWD 21" (2022)	AWD
Volvo	C40 Recharge (2022)	AWD
Volvo	XC40 Recharge (2022)	AWD
Volkswagen	ID.4 Pro 19" (2022)	RWD
Volkswagen	ID.4 Pro S 19" (2022)	RWD
Volkswagen	ID.4 AWD Pro 19" (2022)	AWD
Volkswagen	ID.4 AWD Pro S 19" (2022)	AWD

Subaru Solterra
Toyota bZ4X

Cities & Municipalities

CITY OF SEATTLE

Trucking


ups
Worldwide Services
Electric Vehicle


prime
prime


ACTROS
100% electric.


VOLVO
T730

GM Acquires 25 Percent Stake in Pure Watercraft to Accelerate All-Electric Boating

Agreement combines GM technology with Pure Watercraft propulsion systems to expand all-electric marine transportation

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

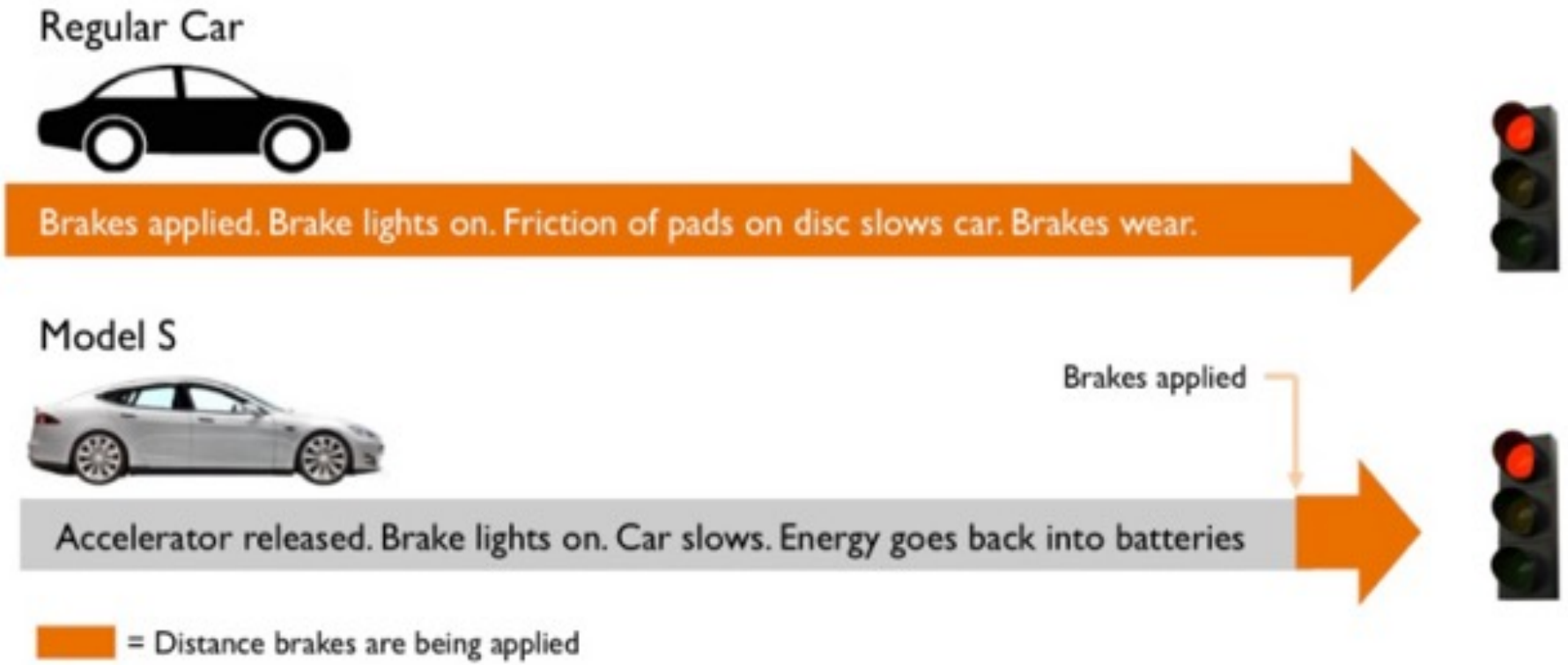
0-60 MPH	6.3 sec
QUARTER MILE	14.9 sec @ 93.1 mph

Benefits - Driving an EV is Fun!

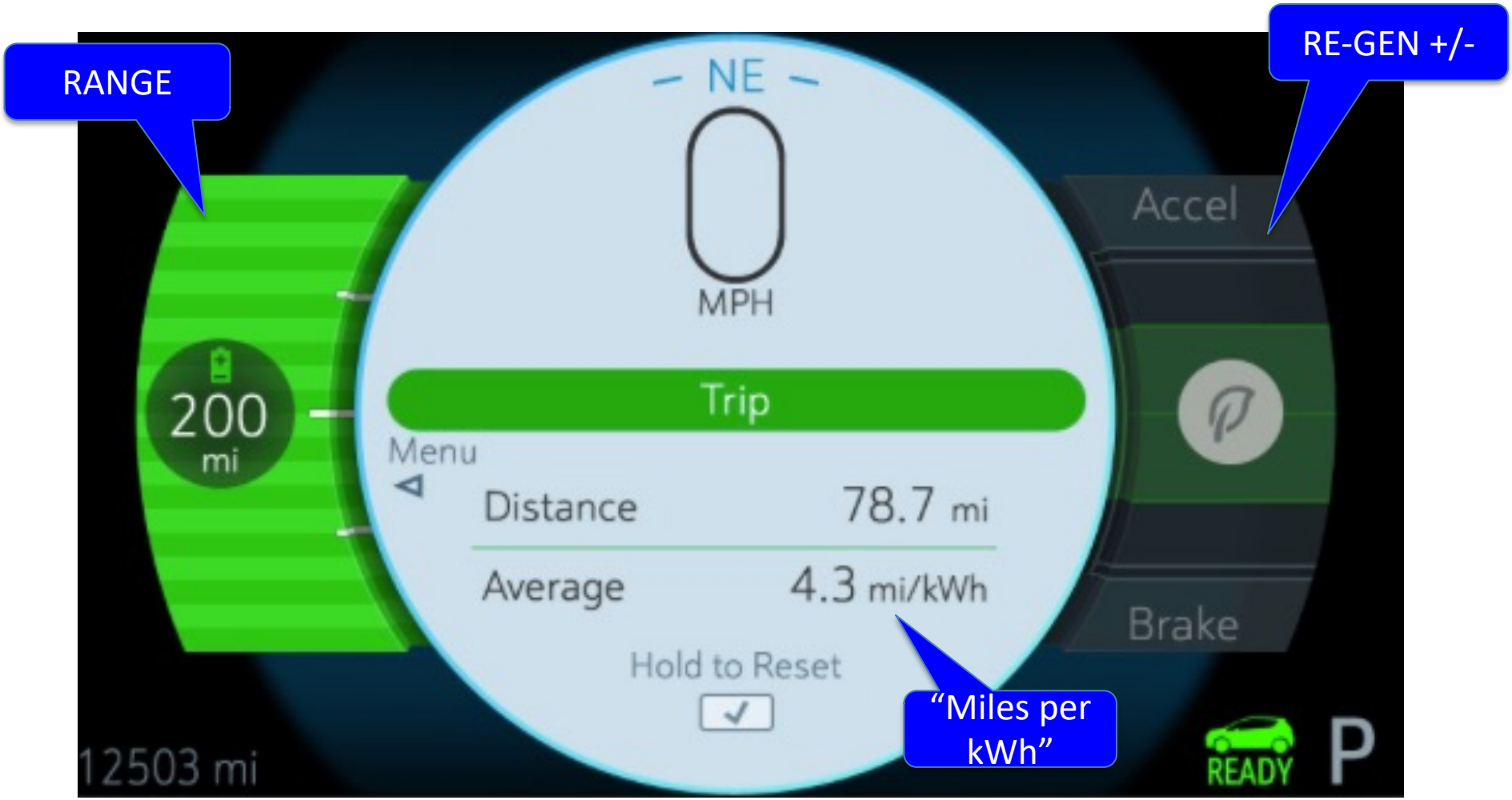
- **Instant Power**, 100% torque at 0 RPM! Bolt is 0 – 60mph in 6.3 Seconds!
- Low Center of Gravity – **handles curves better**
- **Silent** – no transmission – direct drive
- **Pre-heat or Pre-air condition** while charging & before leaving home
- Heating and Cooling sitting in ferry line – no "idling"
- **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**



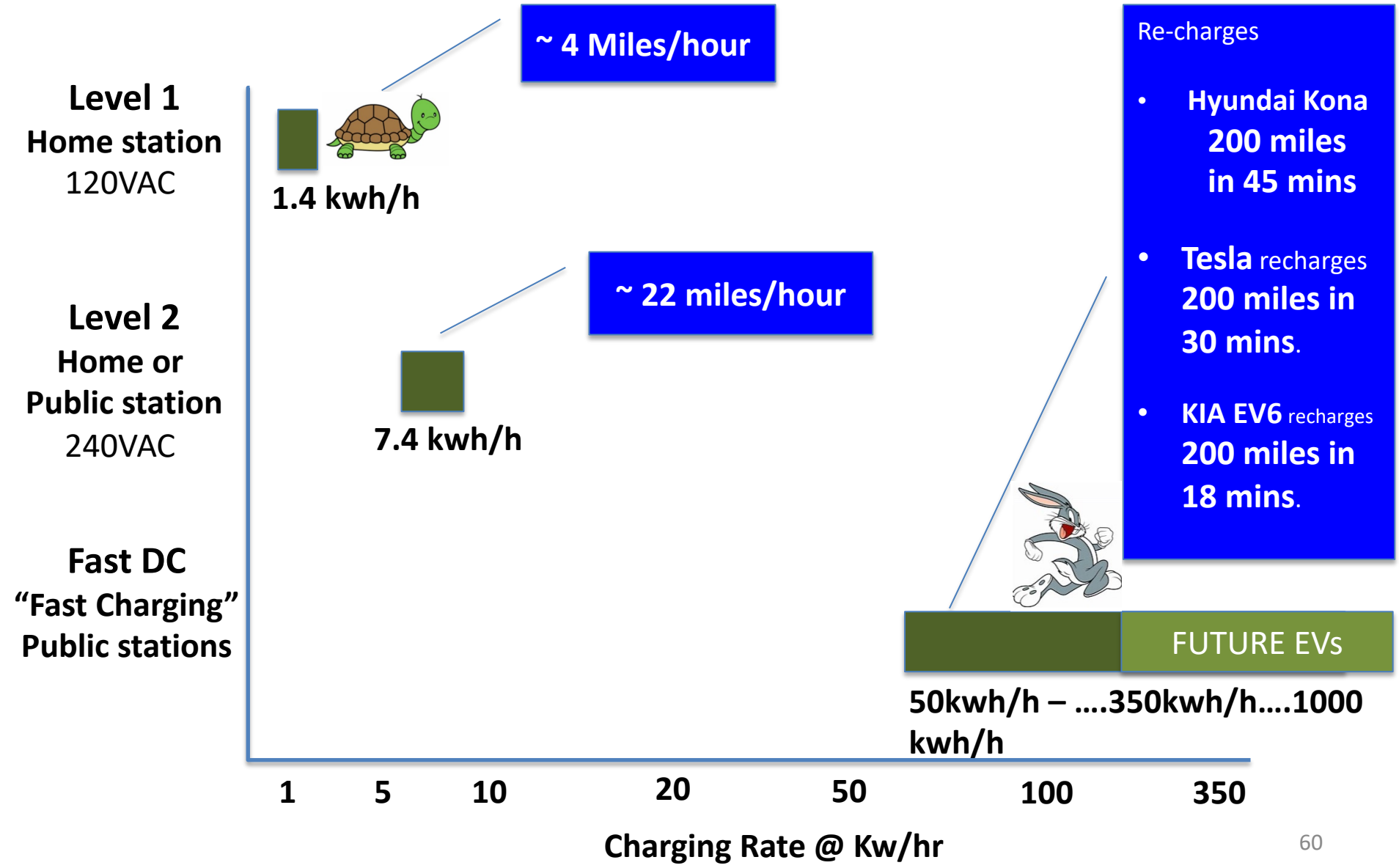
Simple to operate



- **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



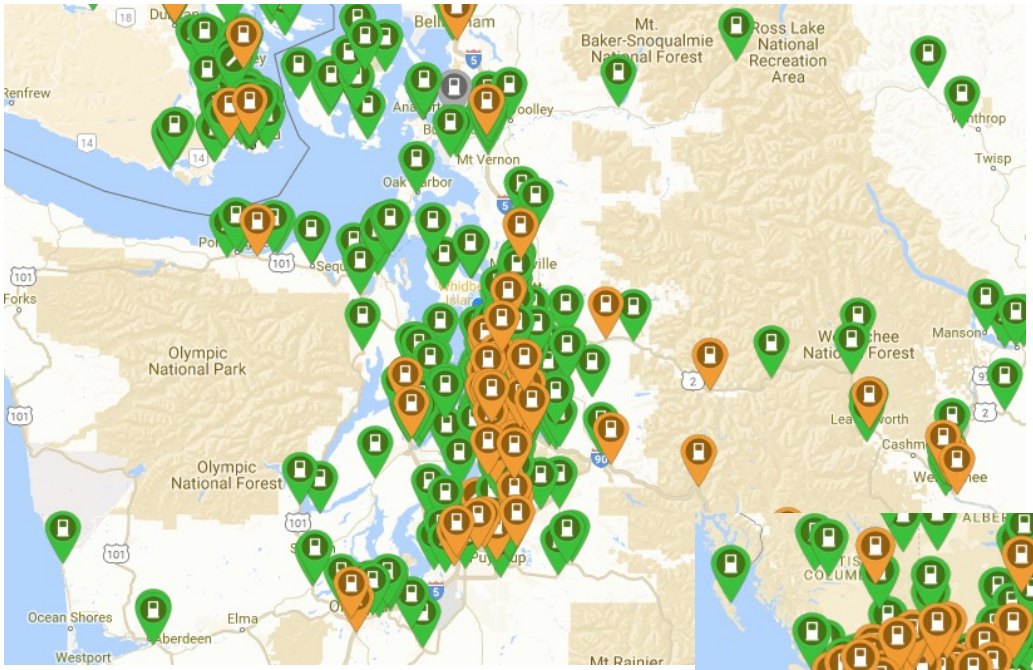
Charging Stations

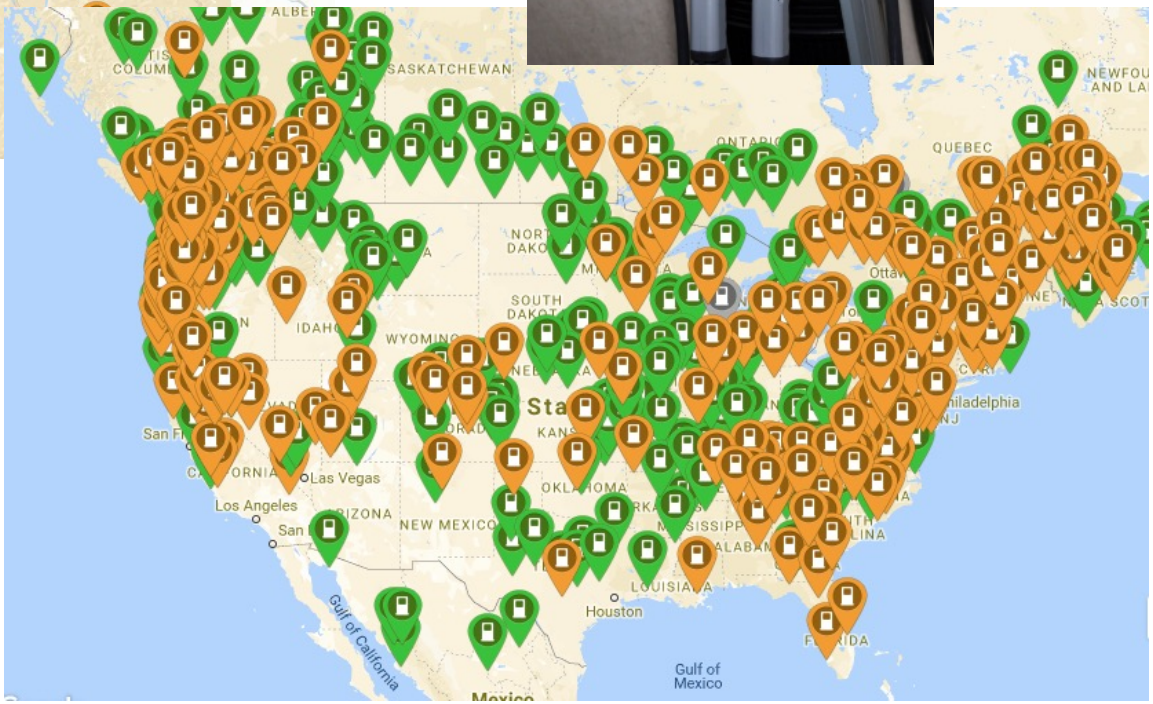
Slow **Faster** **Fast**

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

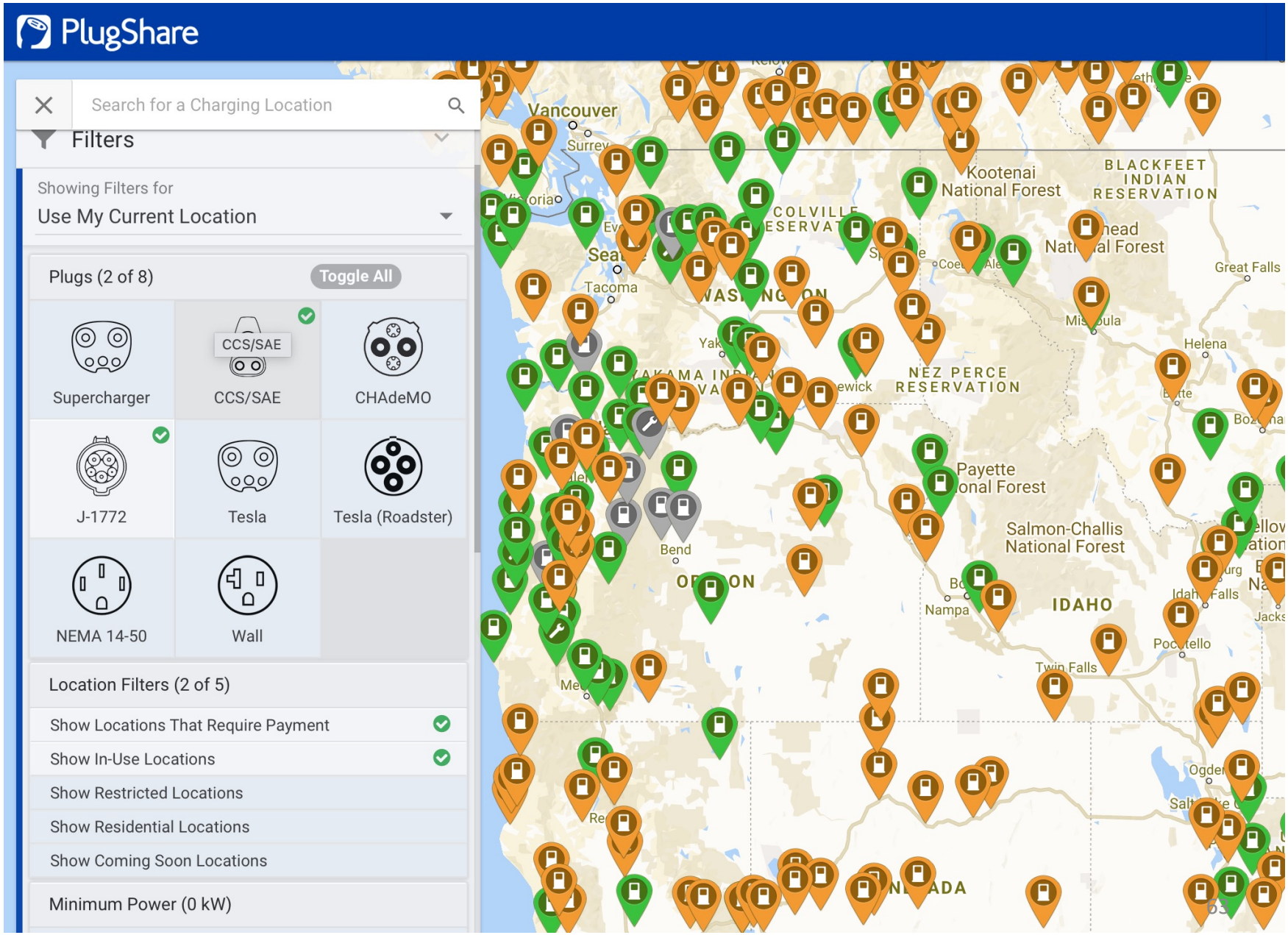
SemaConnect

blink

electrify america

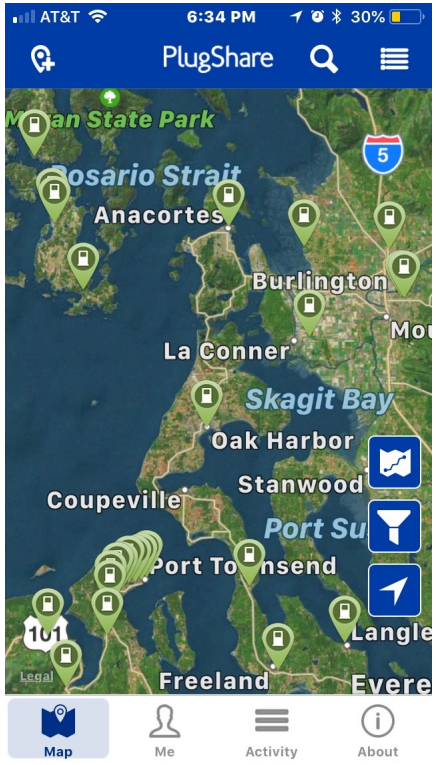
Map images from PlugShare App and Plugshare.com

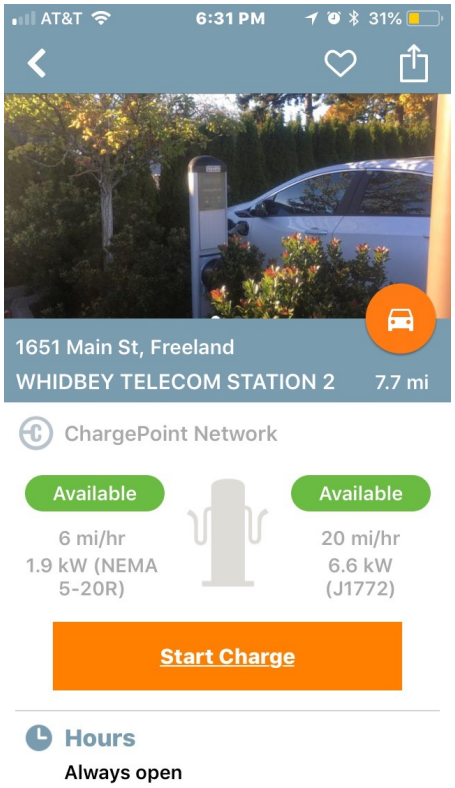
Mobile apps & Networks – Fast DC & Level 2

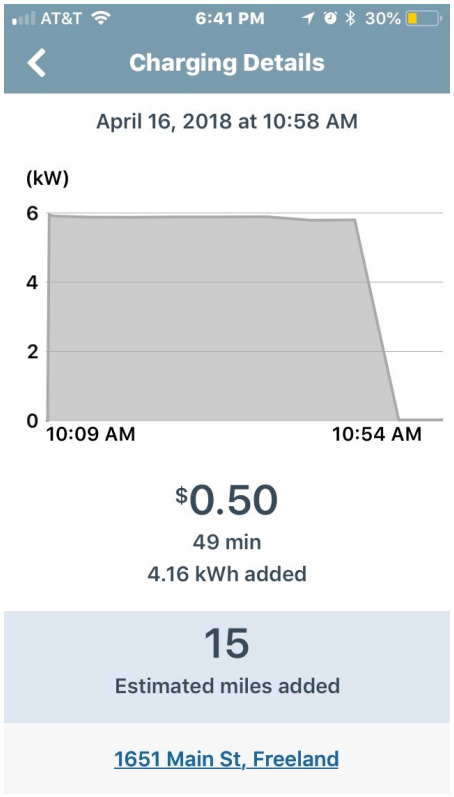


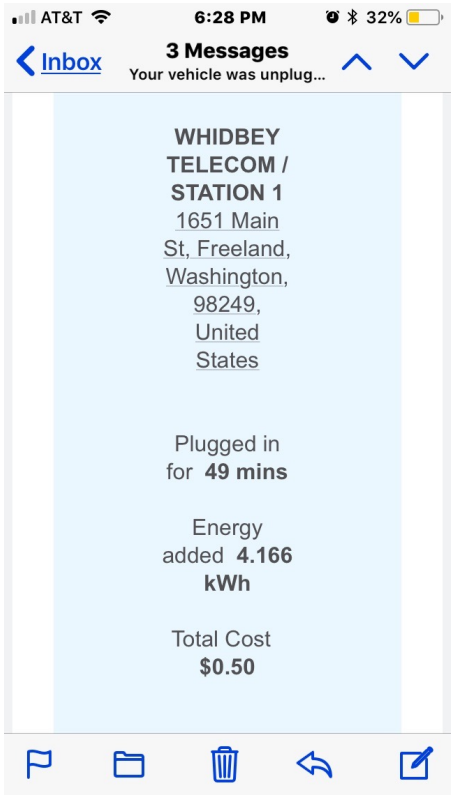
Using a Public Charging Station with Smartphone

Find a charging station → **Connect, Activate, & Pay (App, RFID, Credit Card)** → **Monitor charging & Notify complete** → **Payment confirmation**







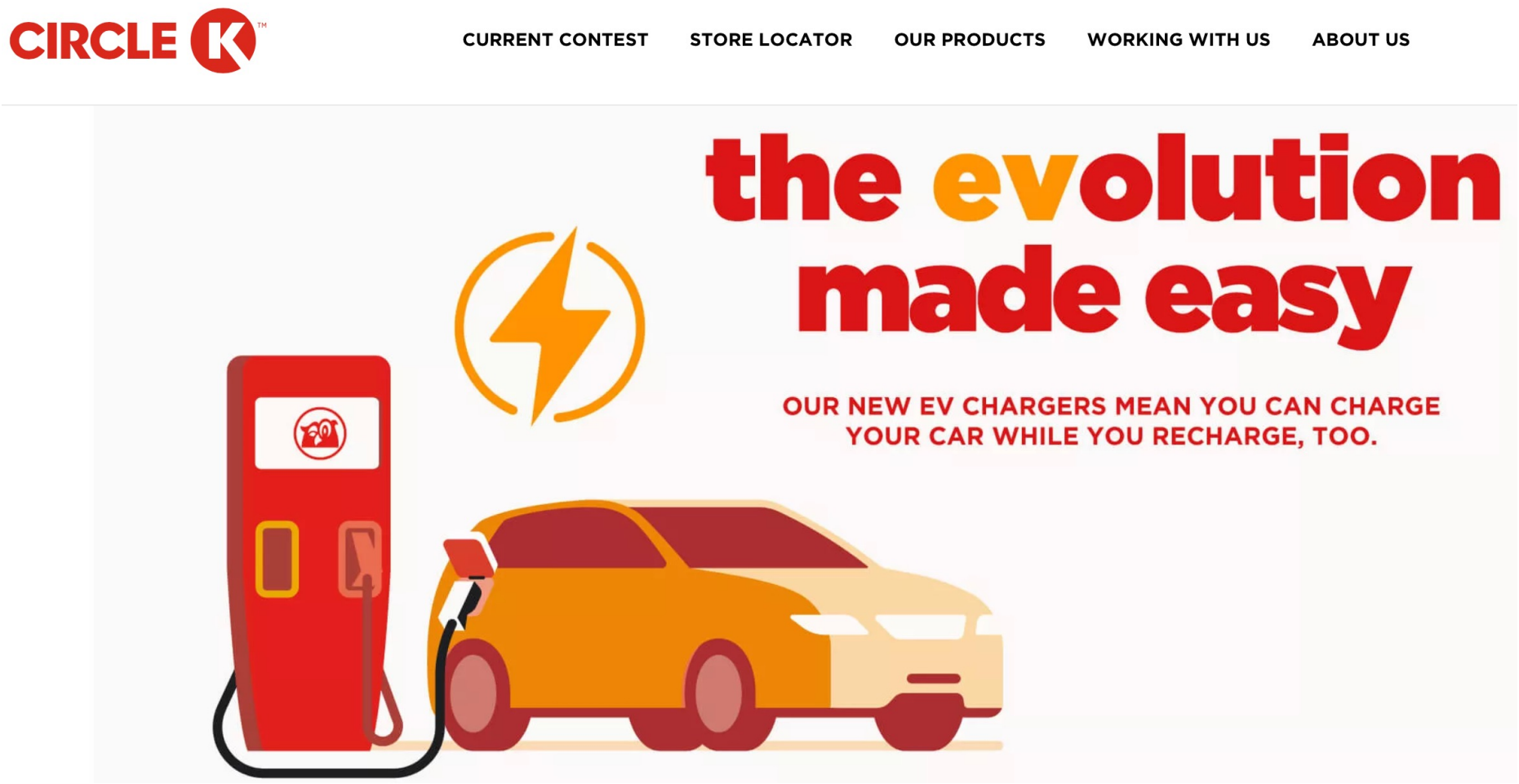


The Future - EV Charging Stations & Convenience Stores

2022 Shell Fulham London EV station

- **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.**

Changing Paradigm



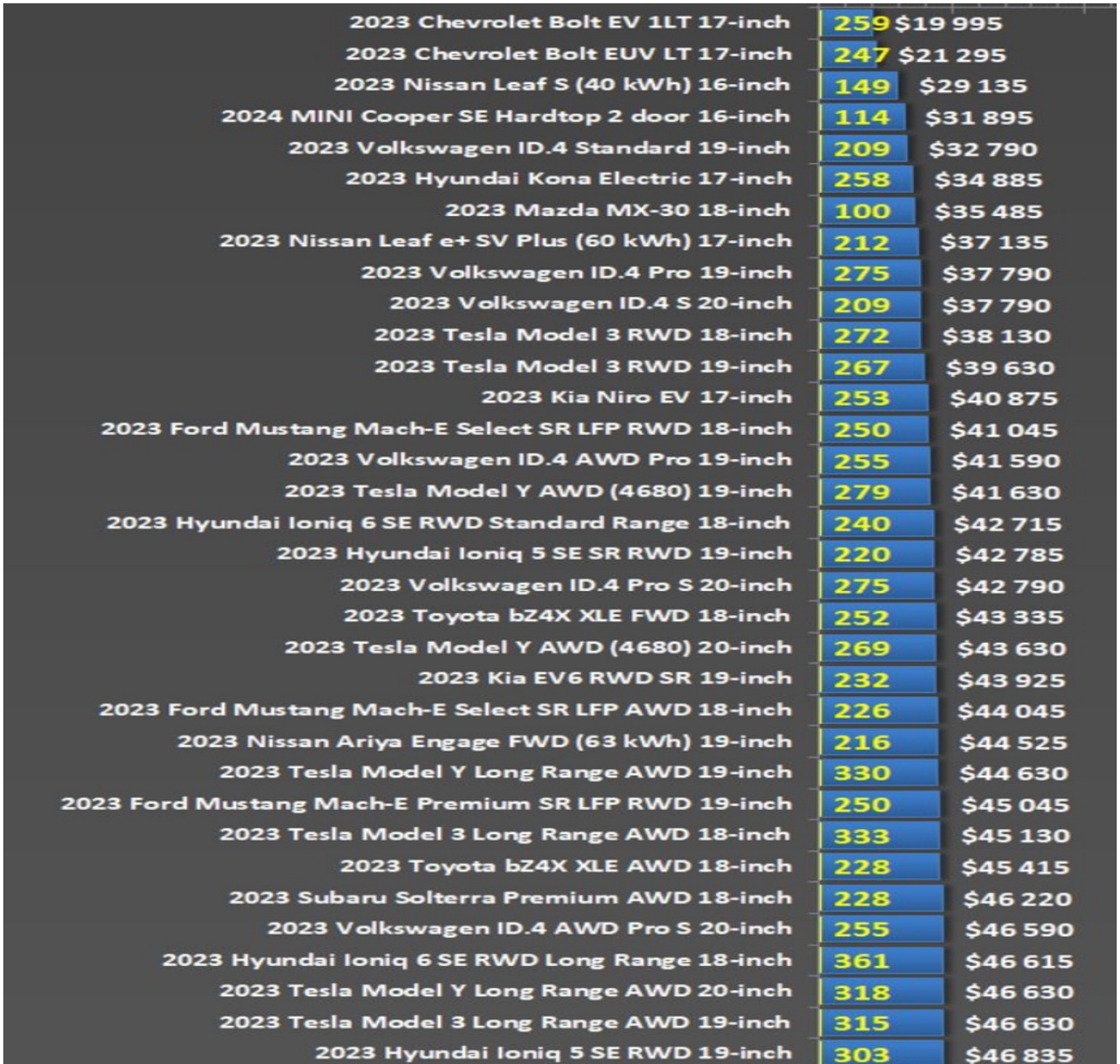
Changing Paradigm

Food Drinks 7REWARDS Order 7NOW Delivery Shop 7Collection

7CHARGE™

Are they affordable ?

Base price (MSRP + DST and after Tax Credit)



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

2021 Volkswagen ID.4 1st Edition

1st Edition 4dr Crossover

Price	Mileage
$29,995	31,130

2018 Chevrolet Bolt EV LT

LT 4dr Hatchback

Price	Mileage
$17,995	44,110

2021 MINI Hardtop 2 Door Cooper SE

Cooper SE 2dr Hatchback

Price	Mileage
$25,995	19,639

2020 Nissan LEAF SV

SV 4dr Hatchback

Price	Mileage
$18,995	12,756

Federal Tax Incentives

Who Qualifies

- credit up to $7,500

new, qualified plug-in EV or fuel cell electric vehicle (FCV).

- individuals and their businesses.

- modified adjusted gross income (AGI) may not exceed:

•$300,000 for married couples filing jointly
•$225,000 for heads of households
•$150,000 for all other filers

Federal Tax Incentives – Jobs to USA

Qualified Vehicles

- Have a battery capacity of at least 7 kilowatt hours
- Have a gross vehicle weight rating of less than 14,000 pounds
- Be made by a qualified manufacturer.
  - (FCVs do not need to be made by a qualified manufacturer to be eligible)

- Undergo final assembly in North America

- Meet critical mineral and battery component requirements

- You buy the vehicle new

(MSRP) can't exceed:

•$80,000 for vans, sport utility vehicles and pickup trucks

•$55,000 for other vehicles

Federal Tax Incentives – Jobs to USA

- **For vehicles placed in service April 18, 2023 and after:**
- Vehicles will have to meet …….new critical mineral and battery component requirements for a credit up to:

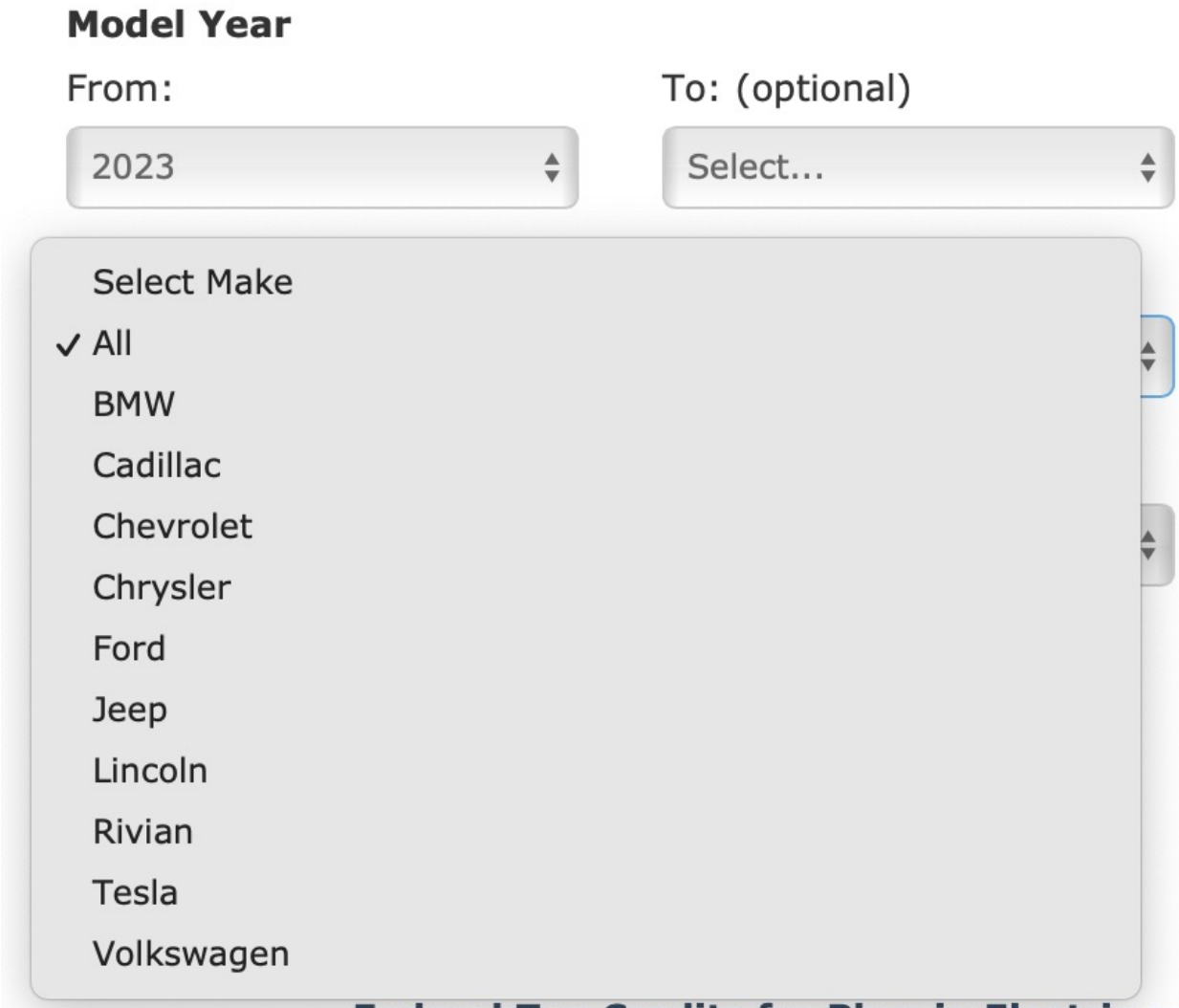
- $3,750 if the vehicle meets the critical minerals requirement only

- $3,750 if the vehicle meets the battery components requirement only

- $7,500 if the vehicle meets both

- A vehicle that doesn't meet either requirement will not be eligible for a credit.

Federal Tax Incentives – FuelEconomy.gov



Several offshore automakers have plans to manufacture EVs in US due to the new US legislation

Federal Tax Credits for Plug-in Electric and Fuel Cell Electric Vehicles Placed in Service in 2023 or After

(Vehicles placed in service on or after April 18, 2023)

https://fueleconomy.gov/feg/tax2023.shtml

Washington State EV Incentive - New light vehicles = 6.8 % sales tax in Washington

Washington Tax Credits

Washington state offers tax credits in the form of tax exemptions for new and used clean/alternative fuel vehicles. Some plug-in hybrids qualify for the exemption, but the sale price or value for a **new vehicle cannot exceed $45,000**, including delivery and other fees. That said, the tax exemption only covers a portion of the purchase price.

As of August 2023, **the amount is $15,000 for a new vehicle** sold or leased.

Washington Tax Credits for Buying Used EVs

Used car buyers in Washington may be eligible for a used EV tax exemption if their chosen **vehicle's purchase price is $30,000 or less**. Like the new EV exemption, the state does not cover the entire purchase price. Instead, **Washington exempts up to $16,000 of the used sales or leased price.**

Washington Credits for Installing Home Charging Stations

Washington offers tax exemptions for "anyone who purchases an electric vehicle battery or fuel cell, or installs an electric vehicle battery, fuel cell charging station, or hydrogen fueling stations."

- Power Utility Co may offer REBATE for home charging station

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/tonybillera
tony.billera@gmail.com

Favorite Links :

jeffersoncan.org

coltura.org

cityofpa.us/1010/Climate-Resiliency-Plan

Olyclimate.org

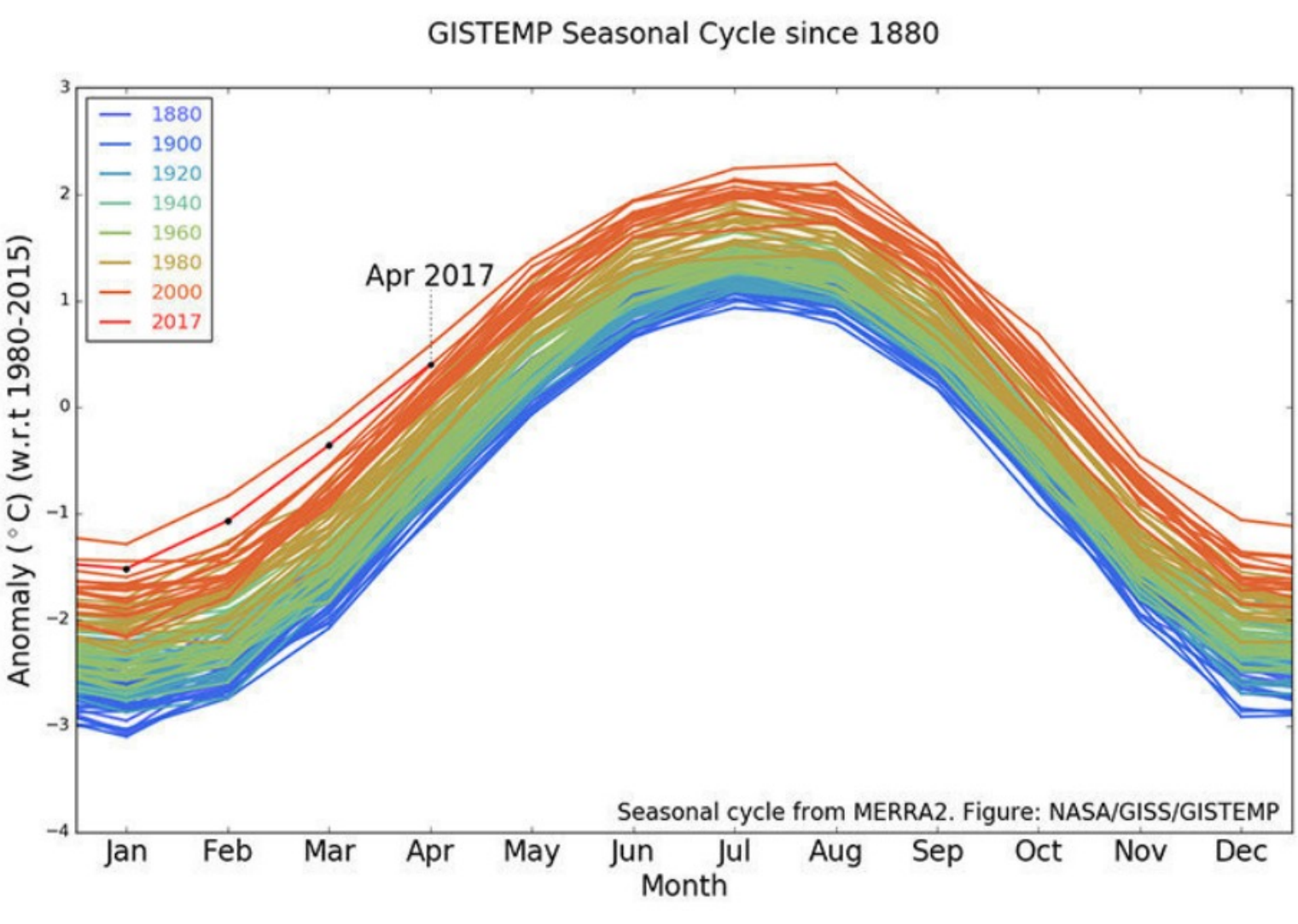
www.aboutCATES.org

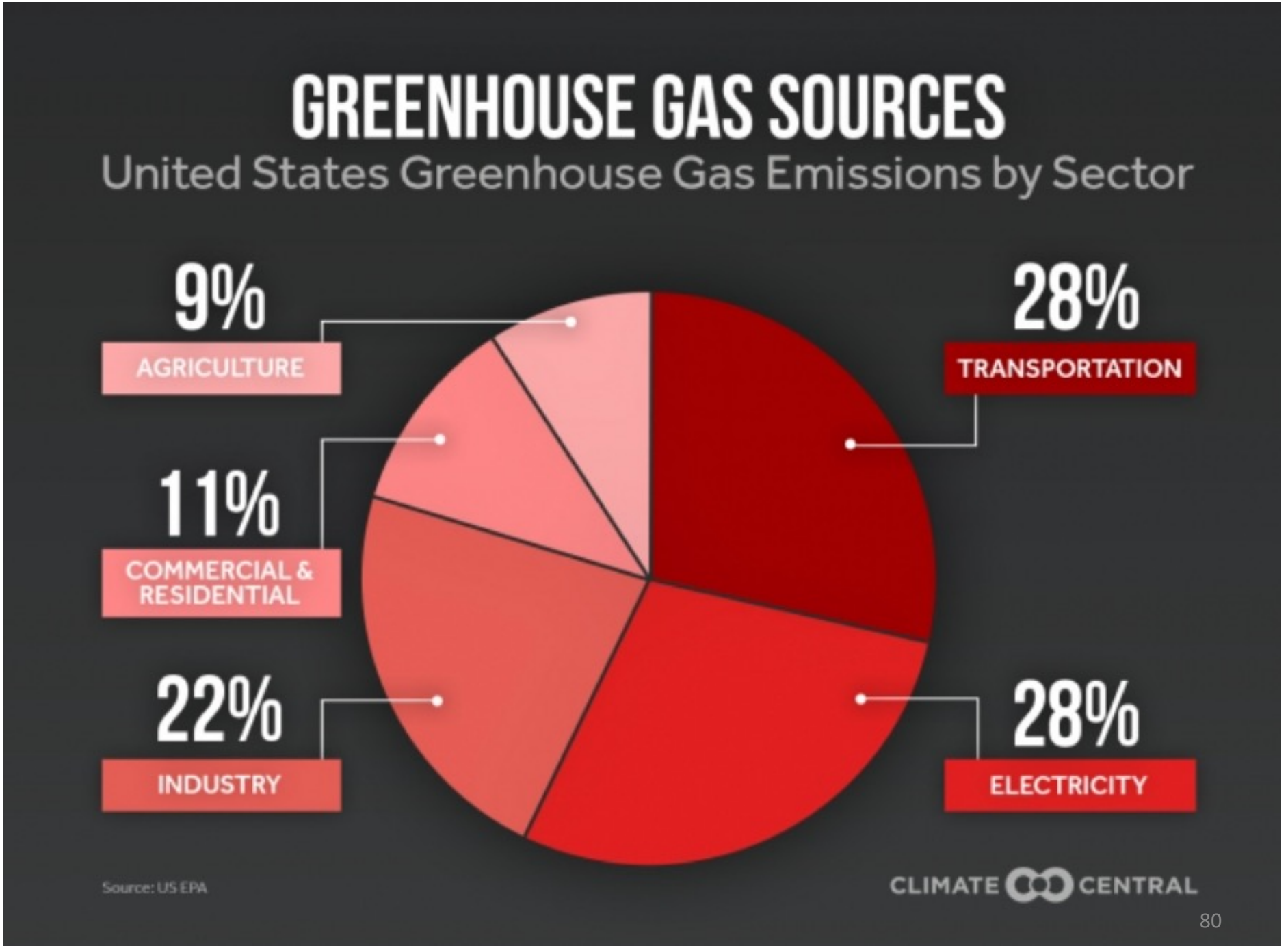
Appendix

- 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
9%
AGRICULTURE
28%
TRANSPORTATION
11%
COMMERCIAL & RESIDENTIAL
22%
INDUSTRY
28%
ELECTRICITY
Source: US EPA
CLIMATE CENTRAL

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)

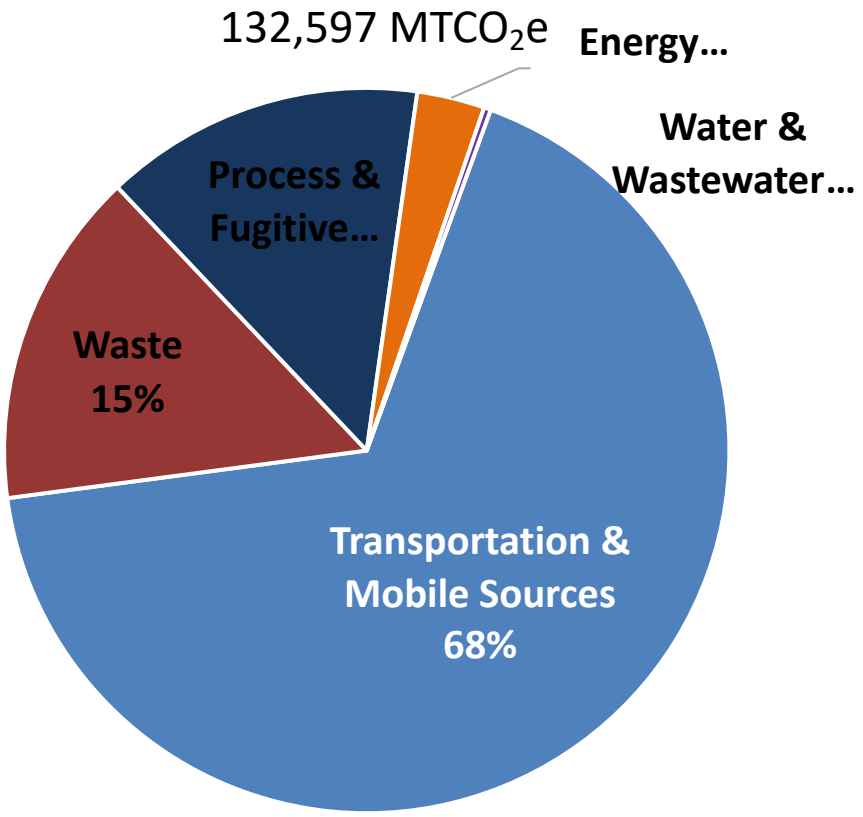
Major Data Sources

- 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:



Inventory Results: Detailed Community Findings

Major Drivers of Emissions:

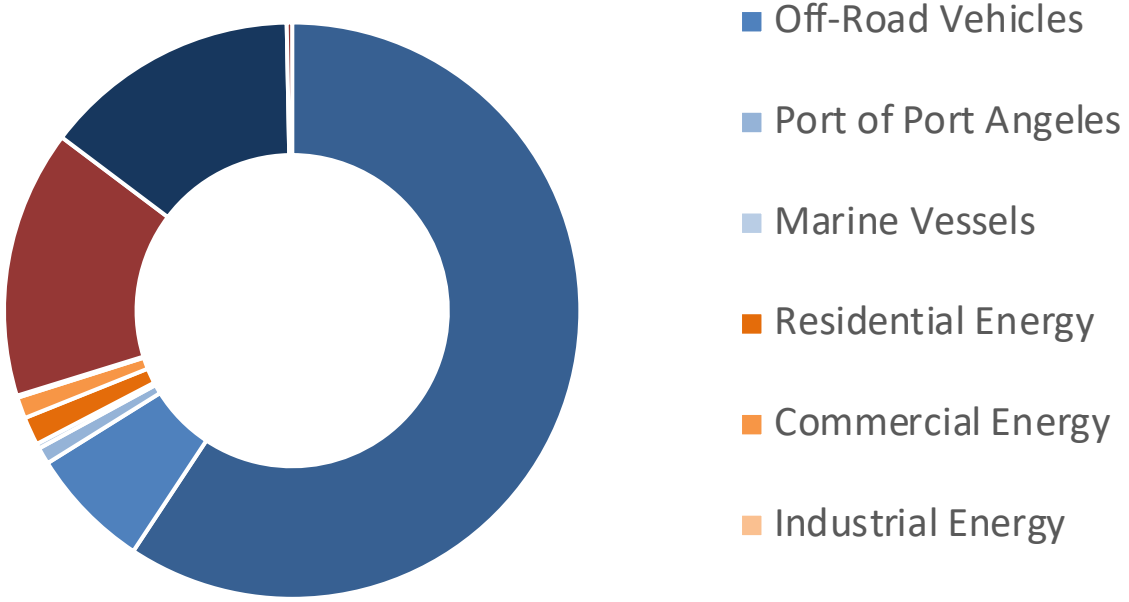
- On-road cars, motorcycles, SUVs, and trucks (59%)
- Solid waste generation & landfill operations (15%)
- Refrigerant leakage & electricity losses (14%)

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*

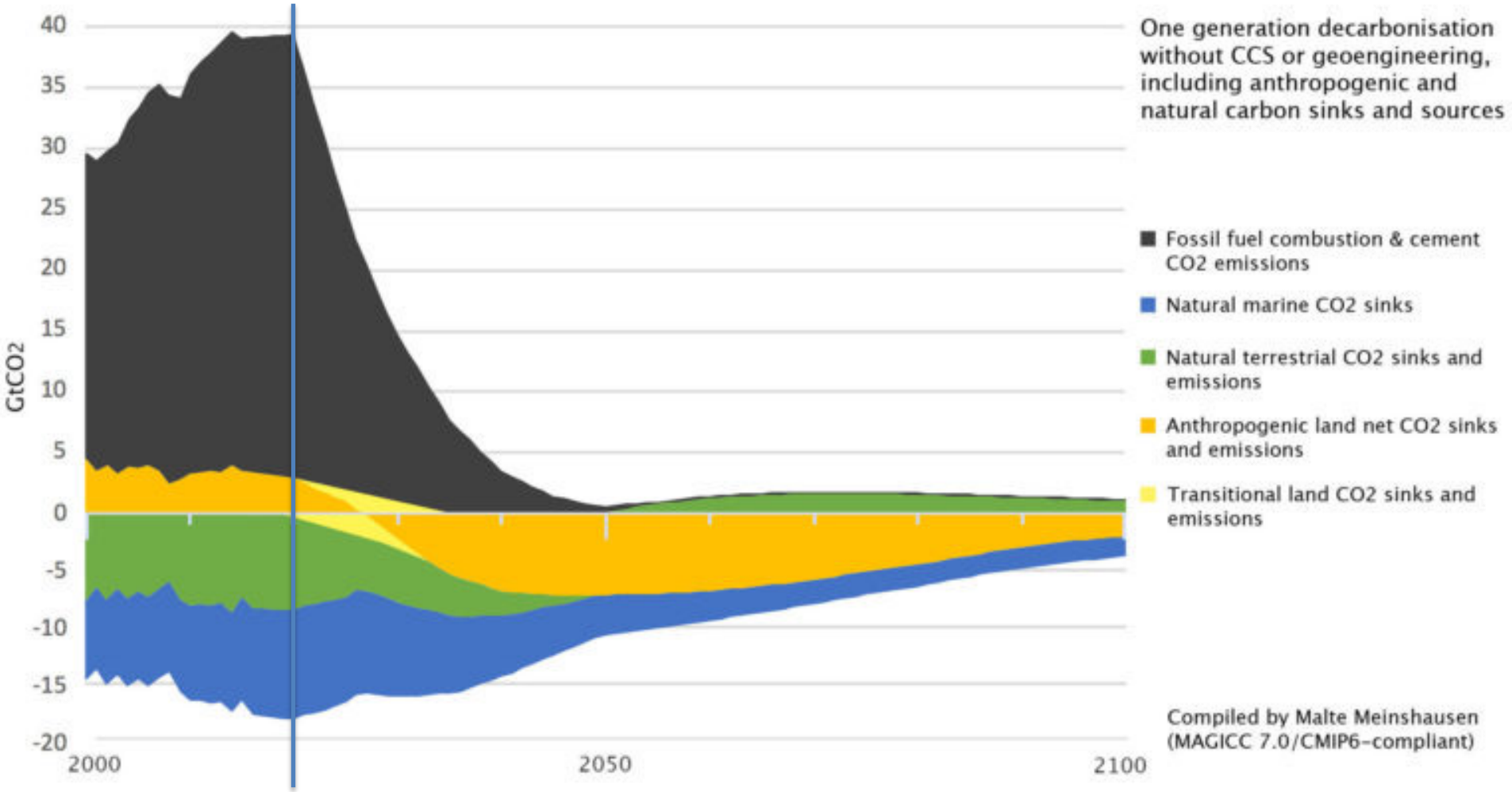
Total 2019 Community Emissions

132,597 $MTCO_2e$



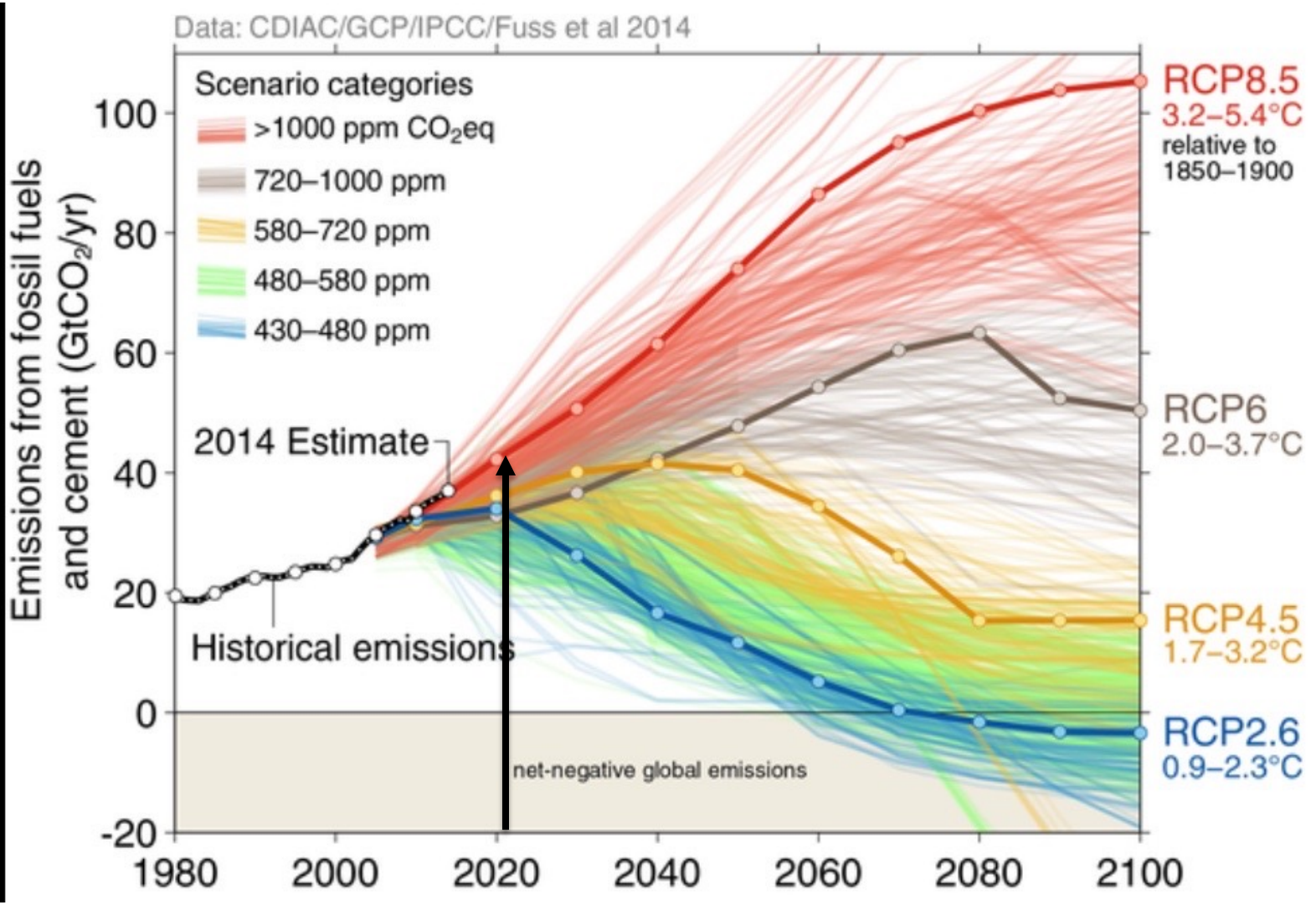
Decarbonization urgency

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)



5.7 - 9.7F

3.6 - 6.6F

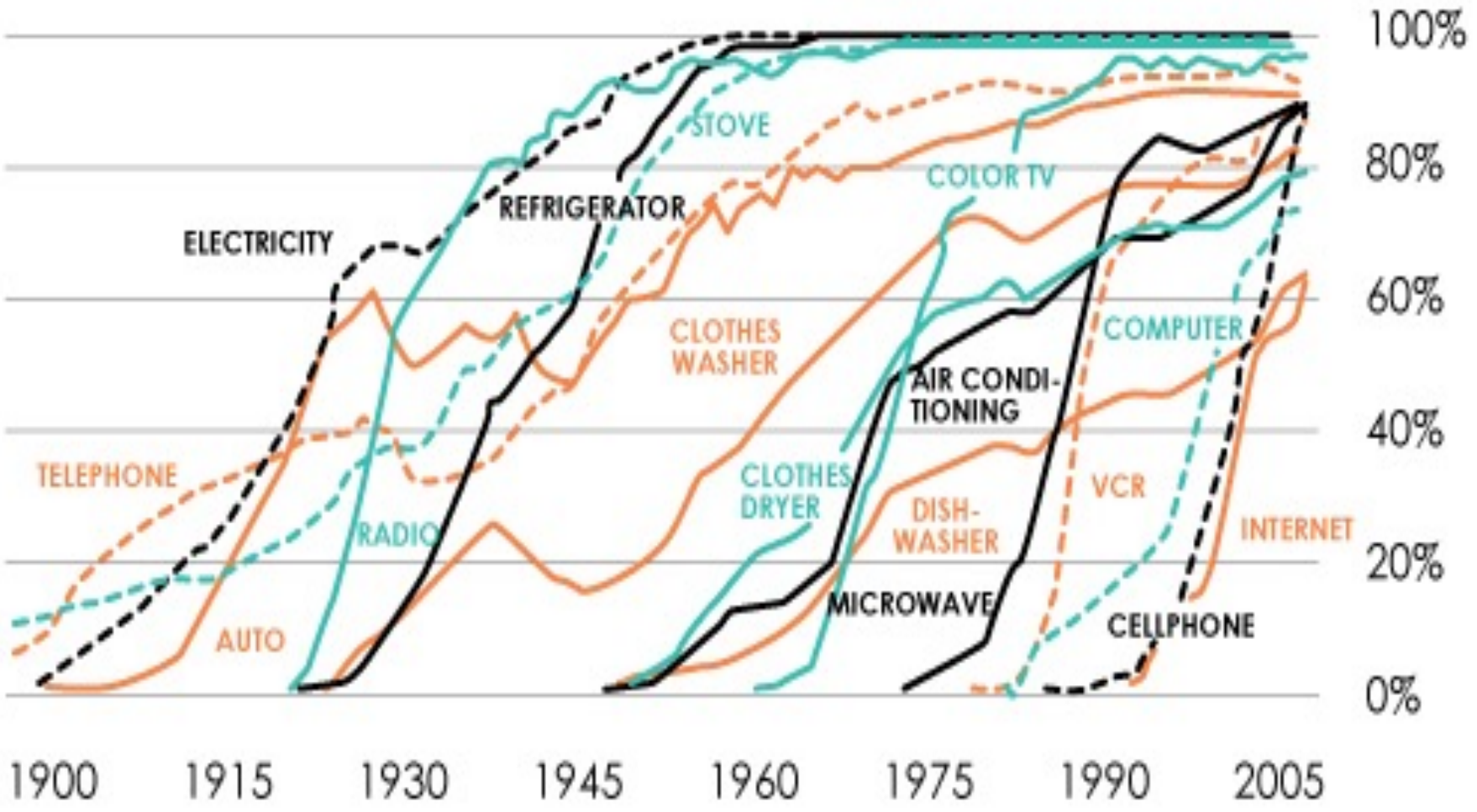
3.0 - 5.7F

1.6 - 4.1F

Quickest Production Cars (0—60)

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

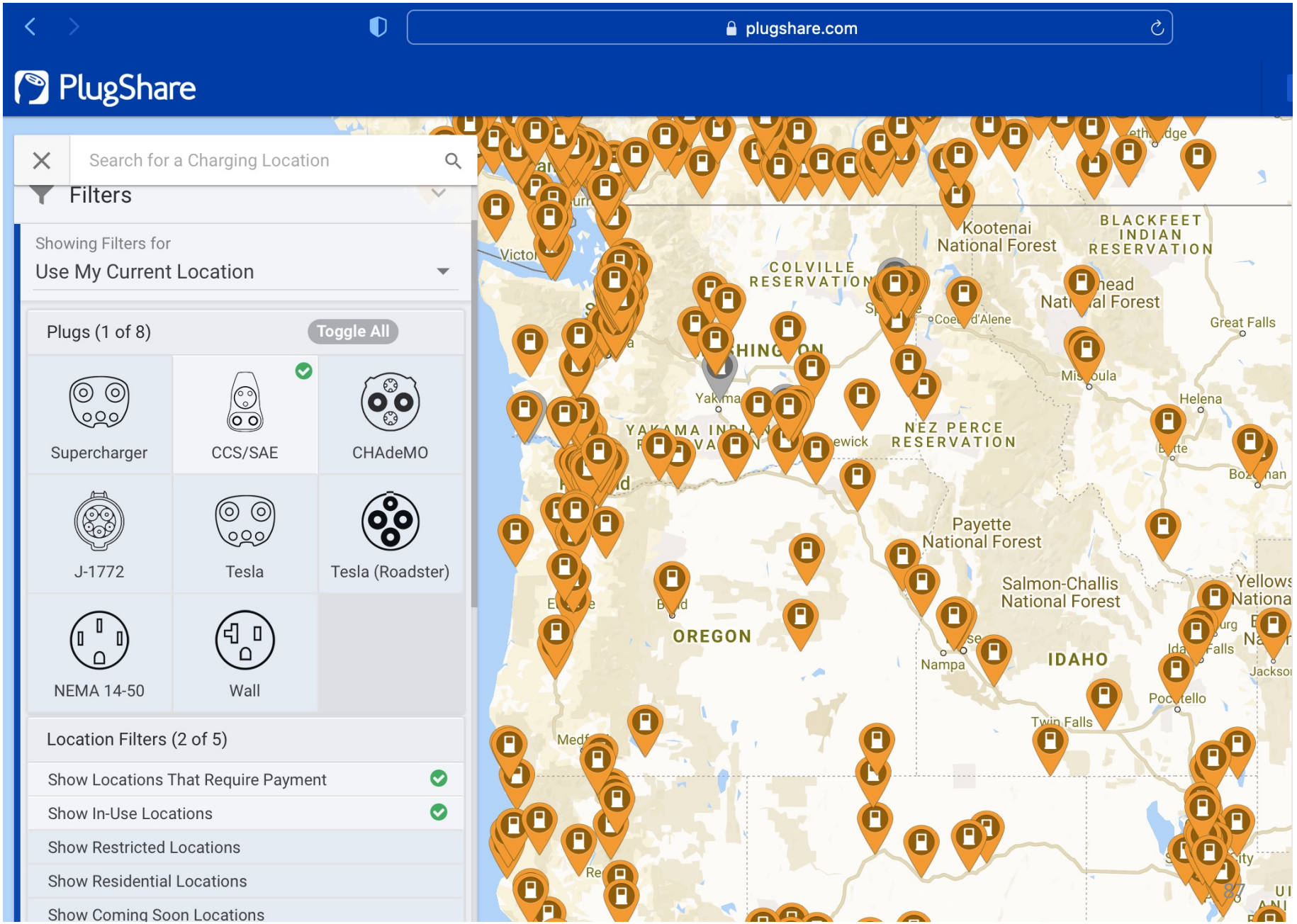
New Technologies and Mainstream Adoption



Source: Michael Felton, *The New York Times*

www.earlyinvesting.com

Mobile apps & Networks – Fast DC



Electric Vehicles are Quick!