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Should My Next Car Be An EV?

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SHOULD MY NEXT CAR BE AN EV?

LORENZO CENA, PHD

ENVIRONMENTAL HEALTH
PROGRAM

DEPARTMENT OF PUBLIC HEALTH
SCIENCES



VEHICLE OPTIONS

- ICE
- Hybrid
- PHEV
- EV



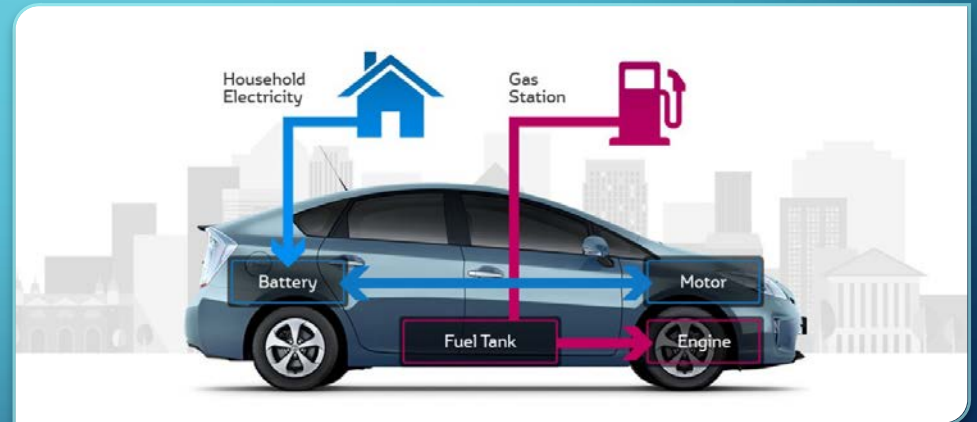
EV VS. HYBRID VS. PLUG-IN HYBRID

- Hybrid = Internal combustion engine (ICE) + Battery
 - Charges battery with combustion engine and regenerative braking
 - 1-2 miles battery range
- Plug-in hybrid electric vehicle (PHEV) = 10-40 miles per charge
 - Small amount of driving on most days and longer trips with some regularity
- Electric vehicle (EV) = complete reliance on electric power



WHY NOT PLUG-IN HYBRID?

- ICE + Heavy battery
 - Extra cost while running regular combustion engine
- Expensive battery pack
 - Additional upfront cost for battery and electric motor
- Still has a combustion engine, tailpipe emissions, maintenance costs
- I have another vehicle for long trips



EV AVAILABILITY IN USA

- Luxury Brands EV exclusive
 - Tesla
 - Rivian
 - Lucid
 - Polestar
 - Fisker
- Luxury Brands w/EV options
 - Volvo
 - Mercedes
 - Audi
 - BMW
 - Porsche
 - Cadillac



EV AVAILABILITY IN USA IN 2023

- Consumer Brands (Base price starting ~\$30K)
 - Ford Mustang Mac-e
 - Mazda MX-30 (California only)
 - Hyundai Ioniq
 - Hyundai Kona
 - Chevrolet Bolt
 - Nissan Leaf
 - Nissan Ariya
 - Subaru Solterra
 - Volkswagen ID.4
 - Mini Cooper SE
 - Kia Nero
 - Toyota bZ4X



MY TOP CHOICES IN 2022



Tesla model 3



Ford Mustang Mac-e



Mercedes EQB



Volkswagen ID.4



Hyundai Ioniq 5

WHY ID.4?

- 255 miles range
- Free level-3 charging for 3 years
- Vast charging network
- Tax rebate eligible
- Assembled in the US
- 100k miles battery warranty
- Easy transition to EV (peace of mind)
- Save thousands of \$ over 5 years



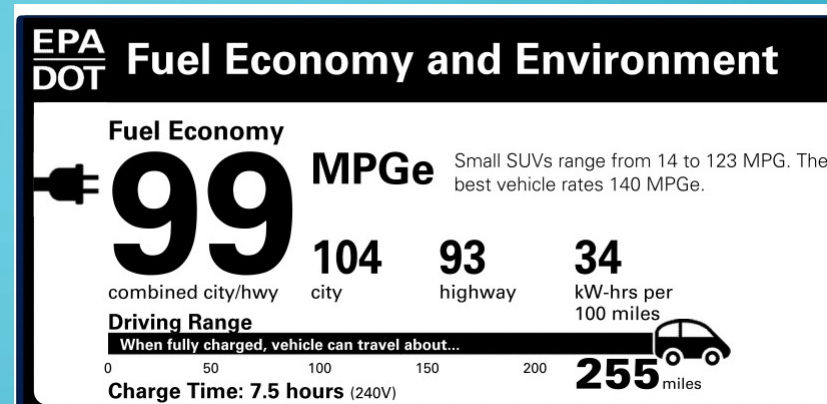
EV RANGE - WHAT TO LOOK FOR:

- 300+ miles = exceptional
- 200+ miles = good
- 100-200 miles = poor



- Battery capacity (kWh) determines how long it takes to charge
 - Gross vs. Net
- Range depends on battery capacity, car weight, Hp, size, aerodynamics, etc.
- Battery warranty (8 years, 100k miles is great)

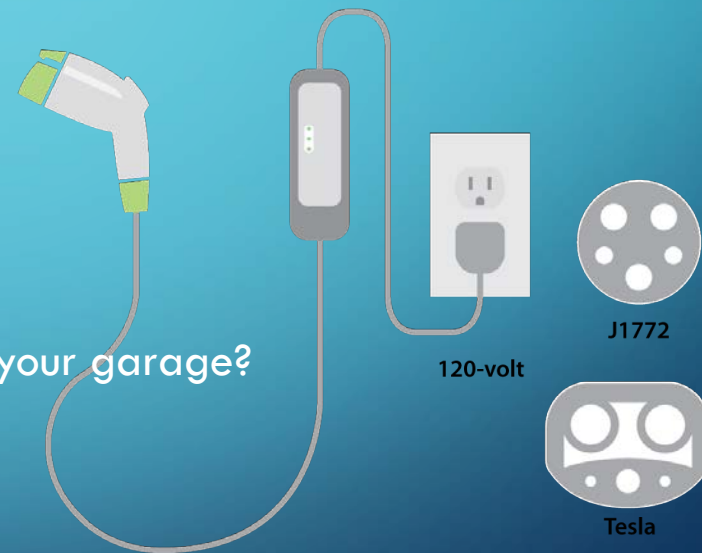
MPG VS MPGe



- Typical ICE vehicles has fuel economy of 25 MPG, usually 22 city - 28 highway
- Typical EV has fuel economy of 100 MPGe, usually 105 city - 94 highway

THINGS TO CONSIDER BEFORE BUYING

- Range and personal needs
- Where do you plan to charge?
 - Rent vs own your house
 - Can you install a charging station in your garage?
- Type of charger connector
 - CHADEMO, CCS, Tesla NACS
- Battery warranty

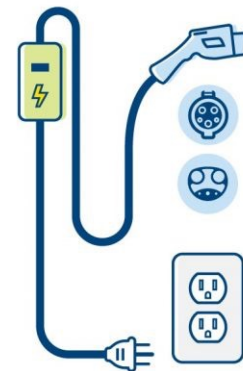


CHARGE TIMES

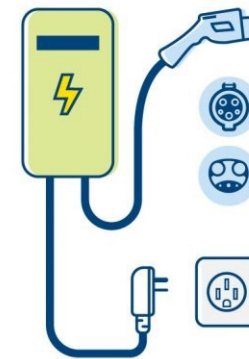
- Level 1 = standard home outlet (1-2 kW) = 2-5 miles/hr = 2-5 days full charge
- Level 2 = EV charger (up to 11 kW) full charge in 7.5 hrs typical charge in 4 hrs
- Level 3 = DC Fast charger (up to 350 kW) full charge 45 min, typical charge 30 min

EV Charging Levels

Level 1
Chargers



Level 2
Chargers



DC Fast
Chargers



EV CONNECTORS



J1772



NORTH AMERICAN
CHARGING STANDARD
(NACS)



COMBINED
CHARGING
SYSTEM (CCS)

LEVEL 2 CHARGERS WORK INDOORS AND OUTDOORS



Installation cost: \$1000 for parts + DIY or pay an electrician

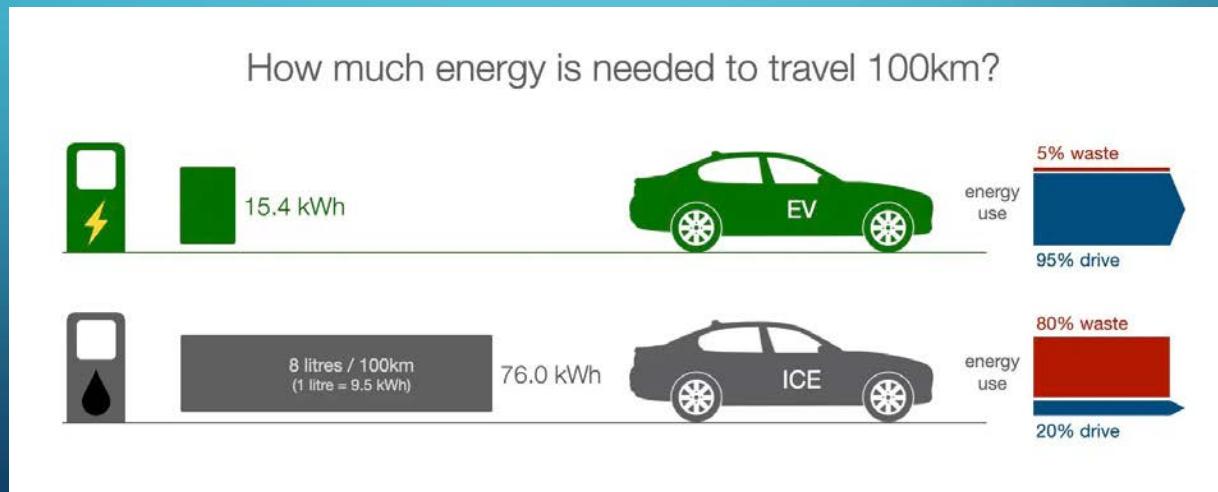
CHARGING COST

- At home \$0.094 per Kw
 - 0%-100% = \$7.2
 - 20%-80%= \$4.3
 - \$21.7/week
- Charging Station \$0.36 per Kw
 - 0%-100% = \$27
 - 20%-80%= \$17
 - \$83/week

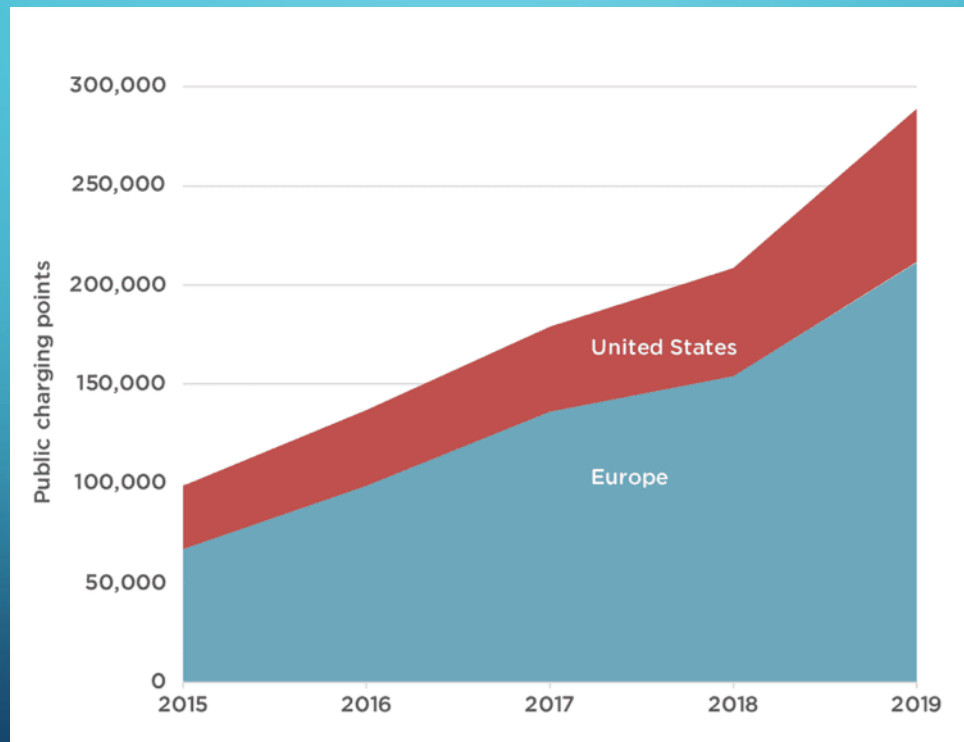


COST OF OPERATION OF EV VS. ICE

- EV: $\$21.7/\text{week} \times 52 \text{ weeks} \times 5 \text{ years} = \$5,642$
- ICE: $\$80/\text{week} \times 52 \text{ weeks} \times 5 \text{ years} = \$20,800$



CHARGING NETWORK



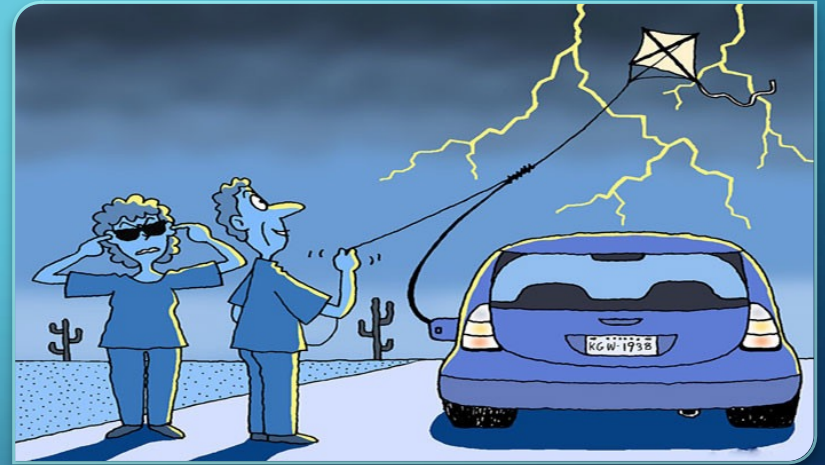


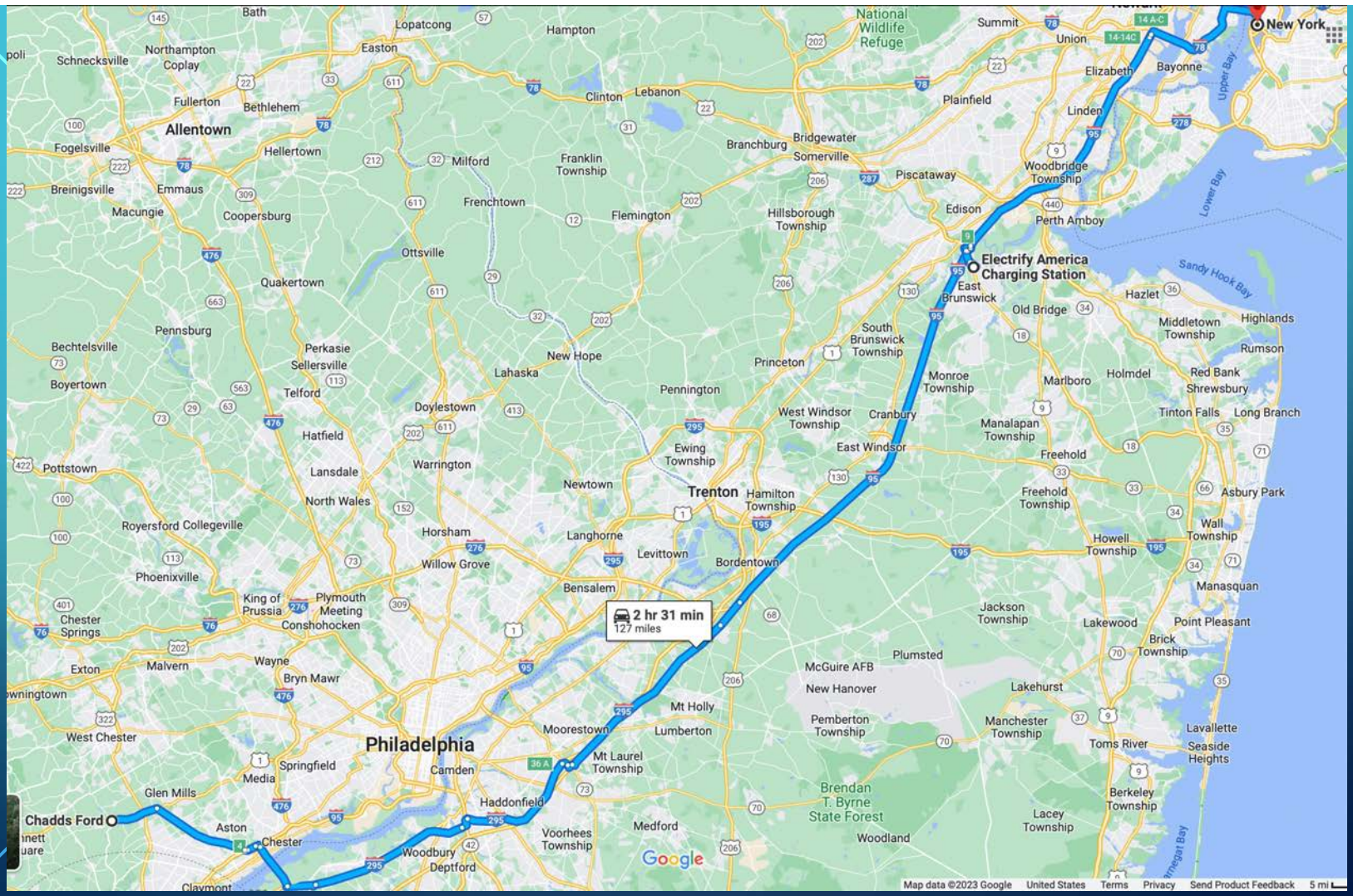
DRIVING EXPERIENCE

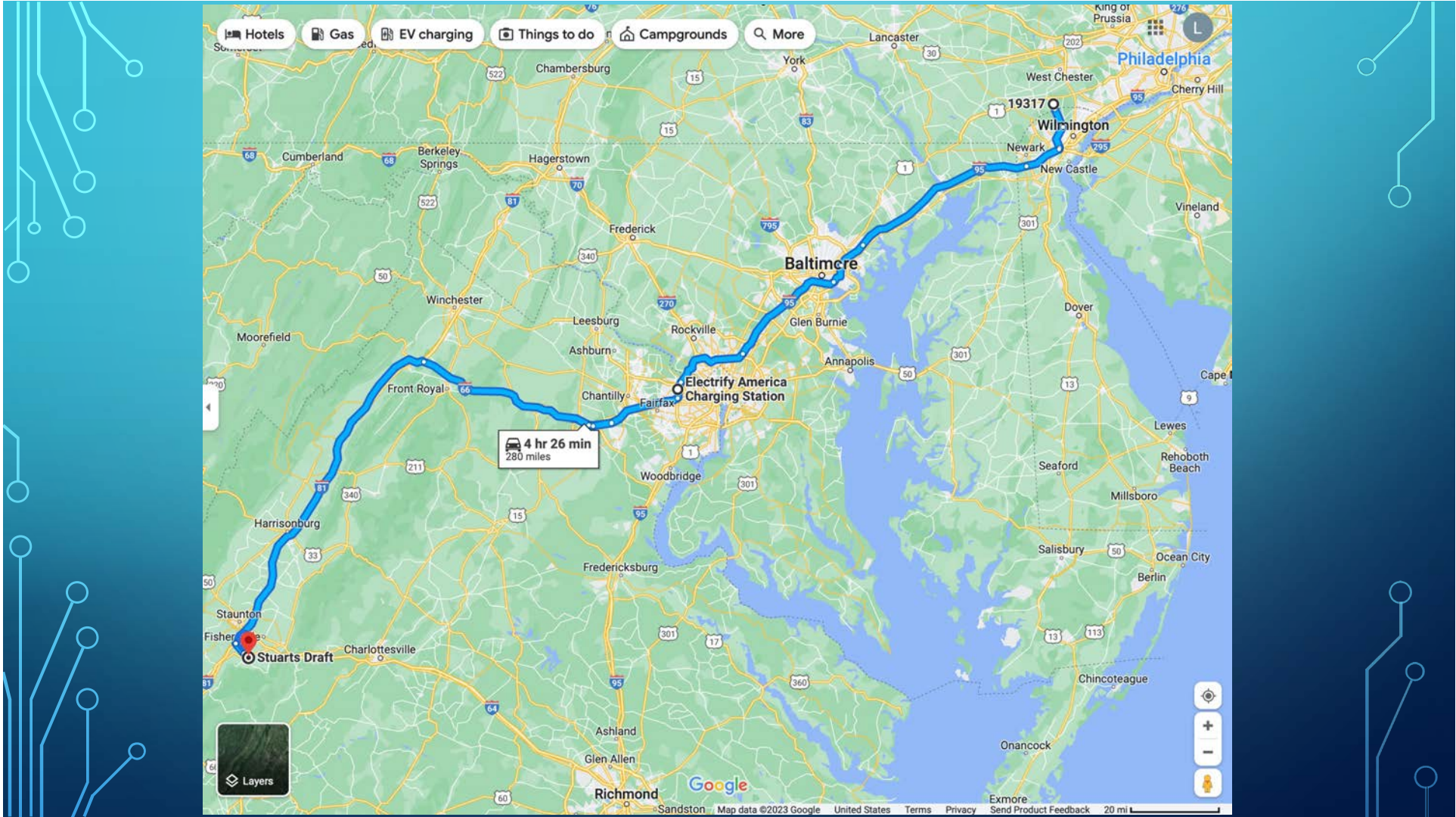
- Quiet
- Smooth
- Immediate response
- Instant torque
- One-pedal driving option

LONG TRIPS AND RANGE ANXIETY

- Built-in navigation system calculates distance and battery level and finds charging stations along the route
- The vehicle warns you at 20% battery and asks if you wish to be navigated to the closest charging station
- Google and Apple maps allow you to set the fuel type of your vehicle
- Easy to find charging stations along your route
- Third party Apps help plan long trips based on charging needs









ENVIRONMENTAL IMPACTS

- **ARGUMENTS AGAINST EVs:**

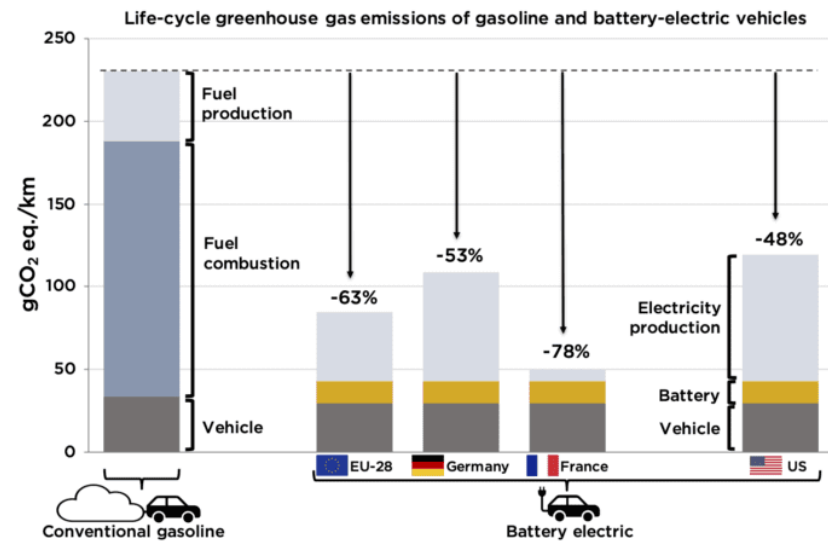
- Manufacturing EV batteries is very energy-intensive
- Emissions from manufacturing the battery
- Emissions from mining and processing raw materials
- Making electricity produces just as much carbon emissions as burning gas in an engine

- **HOWEVER**

- Life-cycle greenhouse gas emissions = vehicle production + fuel production + vehicle operation

ENVIRONMENTAL IMPACTS

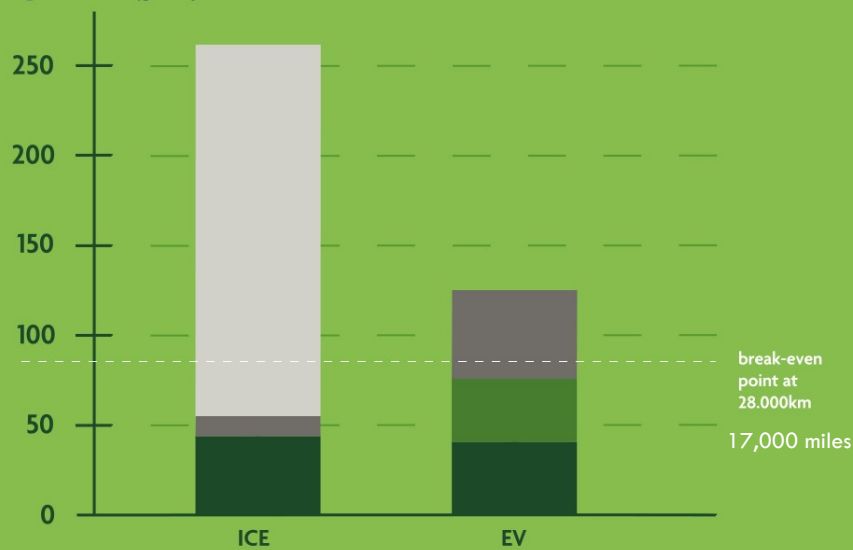
- Considering both production and operation over a vehicle's lifetime, the carbon emissions associated with driving an EV in the US are about half those of a conventional car
- As the electric grid becomes decarbonized, environmental impacts of EVs will improve
- Electric motor achieves over 80% efficiency compared to 30% for ICE
- MPGe = 100 miles/gallon



Source: The International Council on Clean Transportation

 **150,000km** 93,000 miles

CO₂ emissions (g/km)



source: www.theicct.org

FAQS

- How often do you charge?
 - In summer: once or twice a week
 - Busy driving days during school year: daily
- Is insurance for EVs more expensive?
 - No, it's based on the cost of the car
- What if you get stranded with no battery?
 - 3 years of free towing to charging station
- Does the car need oil changes?
 - No and no emissions inspection, just safety inspections
- Does it have a radiator?
 - Yes, smaller than typical ICE vehicles, for cooling the battery during usage and charging
- Will the resale value decrease as the battery deteriorates?
 - Lithium-ion batteries used in new EVs can power a vehicle for more than 1.6 million kilometers, or a million miles (Harlow et al., 2019 *Journal of Electrochemical Society*)



SUMMARY

- The higher the range the better
- Recommended battery usage can be as little as 80%
- Can charge as often as you wish 20%-80%
- It's fine to charge to 100% for long trips
- Install Level 2 charger at home
- Charging is easy and the convenience from home is priceless
- Batteries do not deplete when sitting unused
- Average person drives <50 miles/day
- No road-usage taxes yet
- Cut your CO₂ emission in half



WIRELESS CHARGING TECHNOLOGIES

