There is an Electric Vehicle in your future!

A talk for students of
St. Mary C. S. S.

From the EV Society
Northumberland Chapter

By: Steve Lapp

Carbontakedown.com

45 Minutes:

- GHG Emissions
  - What's happening?
  - What to do?
- Electric Vehicles (EVs)
  - Performance, Range and Charging
  - Mining, Recycling
  - The Electricity Grid
- Your questions!

Our Home


50 km

The BIG Picture

- Up until 1960's environmental problems were widely seen as local or regional issues.
- Climate Change is different. It threatens the existence, health and safety of billions of people around the globe.
- No one country can solve climate change, a vast majority of the world's countries must cooperate.

Greenhouse Gases (GHGs) and Global Warming - Climate Change

GHG

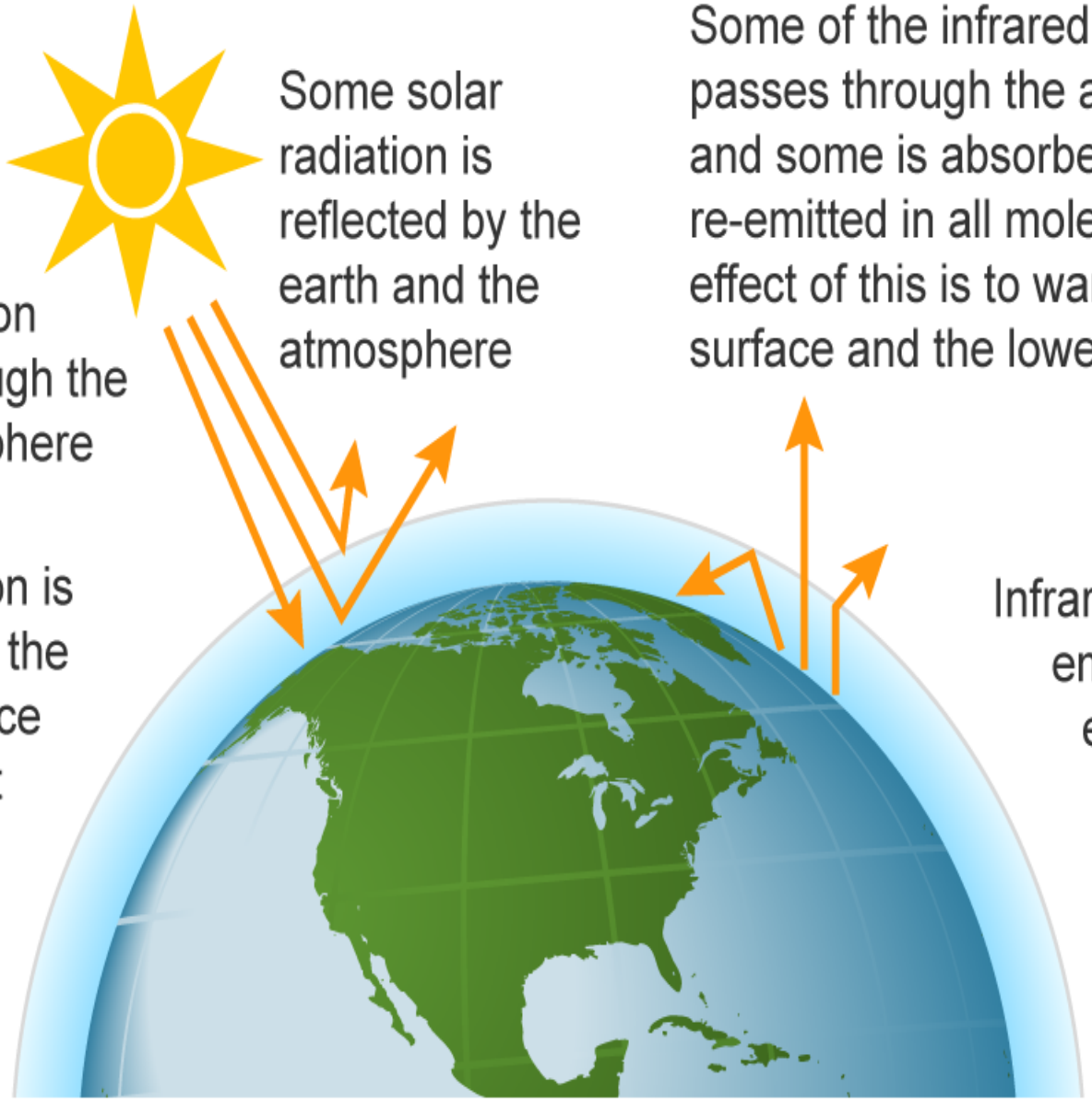
"Greenhouse Gas"

a gas that reflects infrared radiation back to earth

1 Tonne of GHG

That's the same as:

The greenhouse effect



US EPA

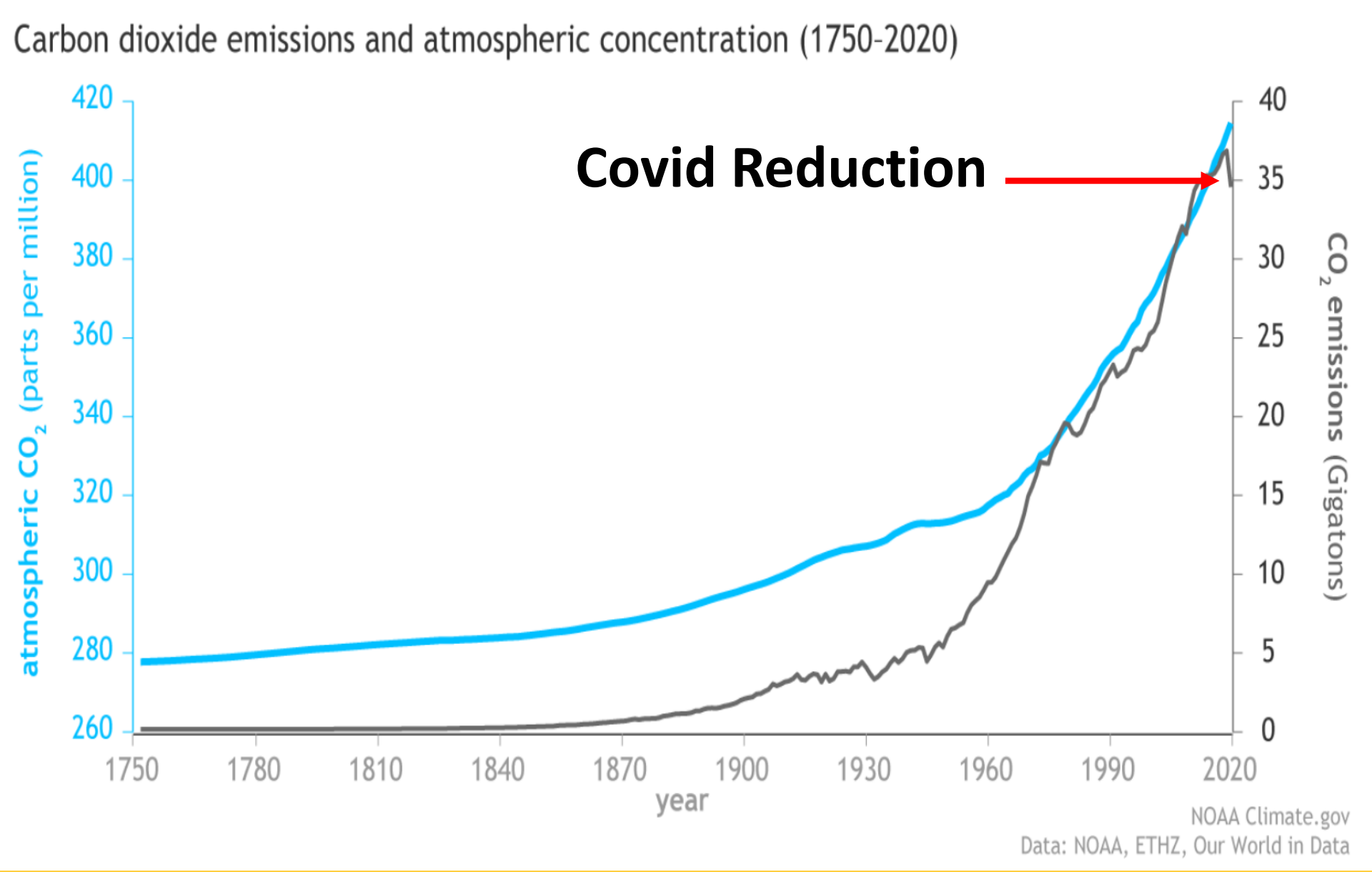
The six GHG's and GWP
(Global Warming Potential)

1/ Carbon Dioxide (CO_2)
2/ Methane (CH_4)

92 %

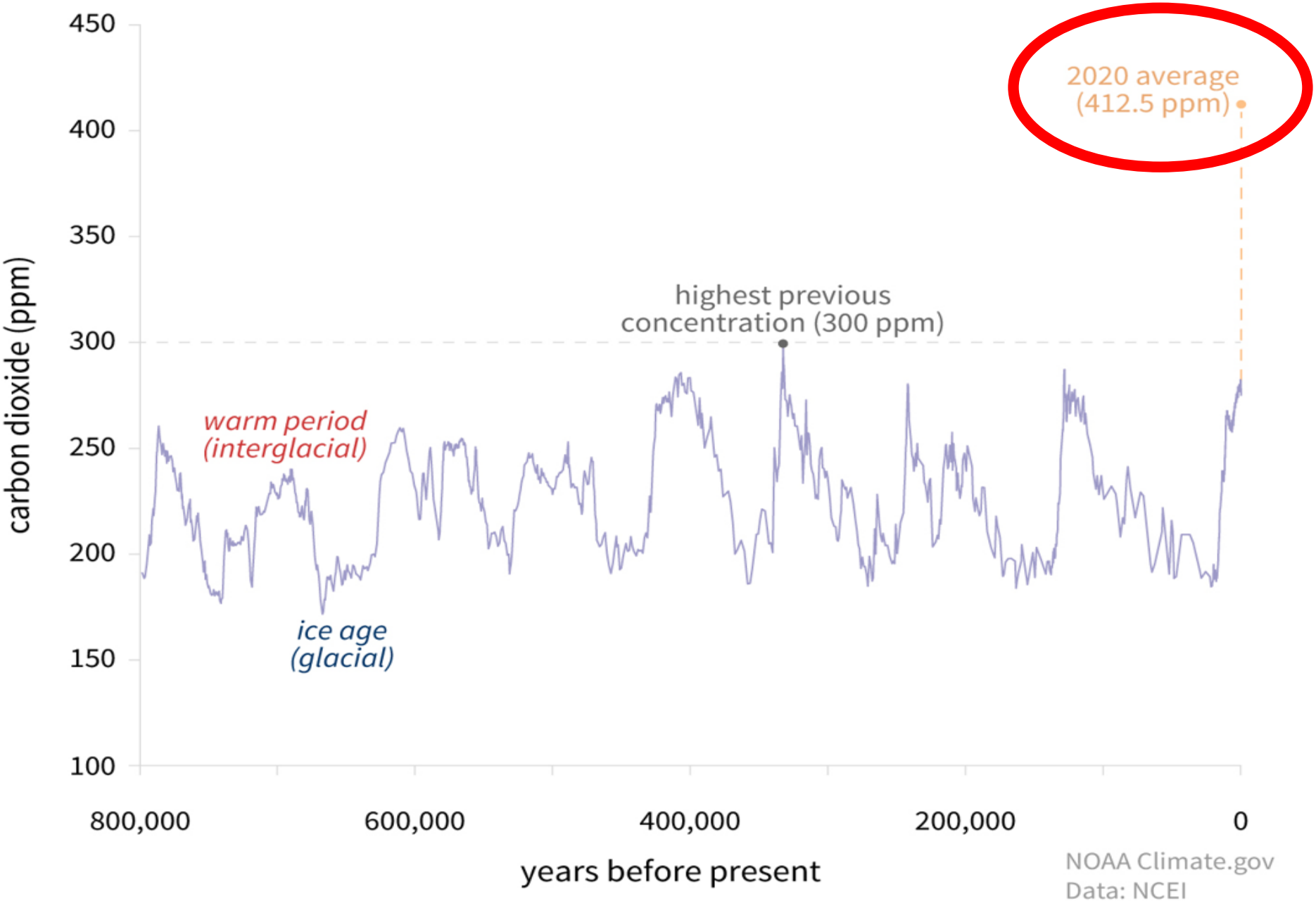
3/ Nitrous Oxide (N_20)
4/ Hydrofluorocarbons (HFCs)
5/ Perfluorocarbons (PFCs)
6/ Sulfur hexafluoride (SF_6)

8 %

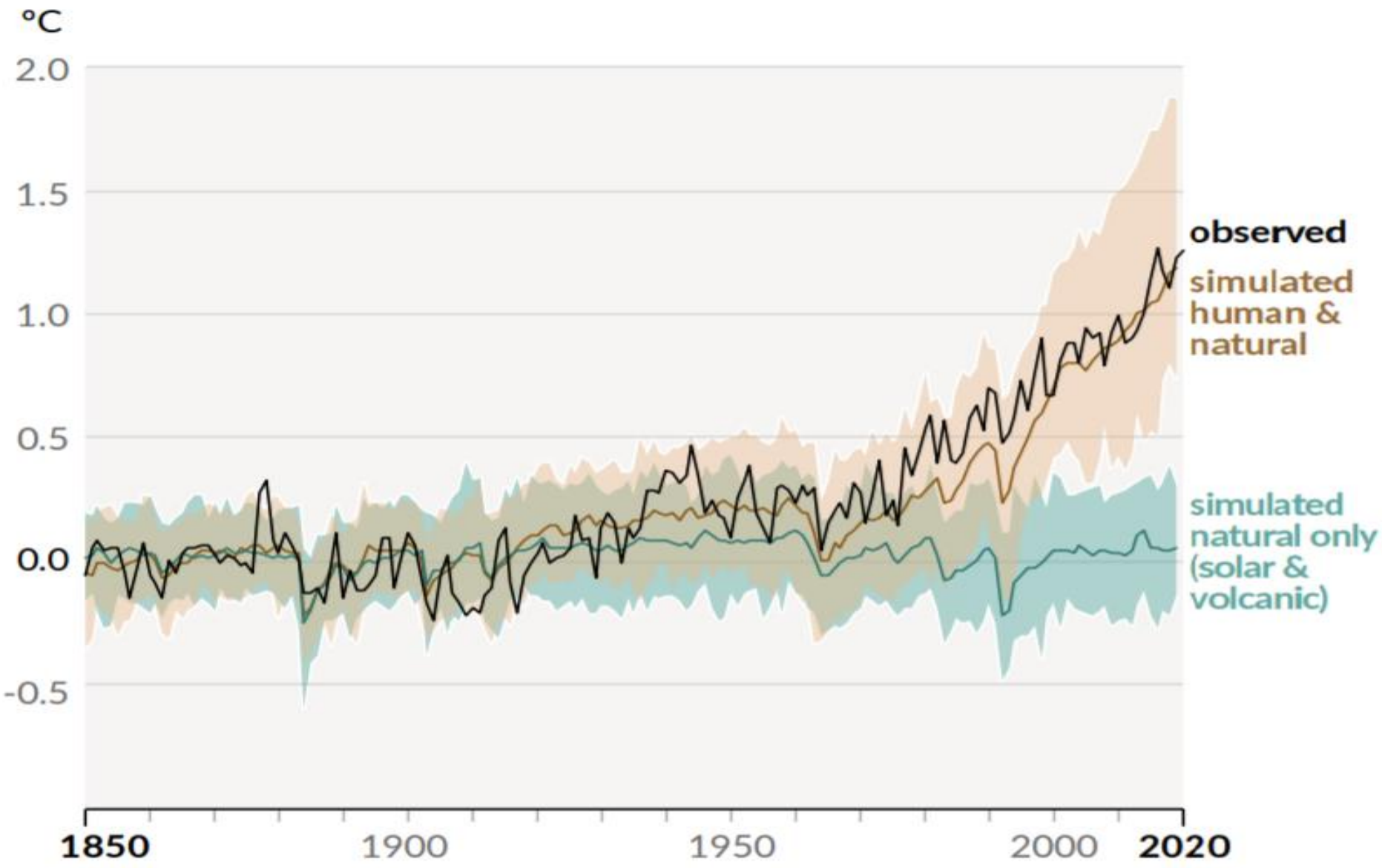


The Industrial Age

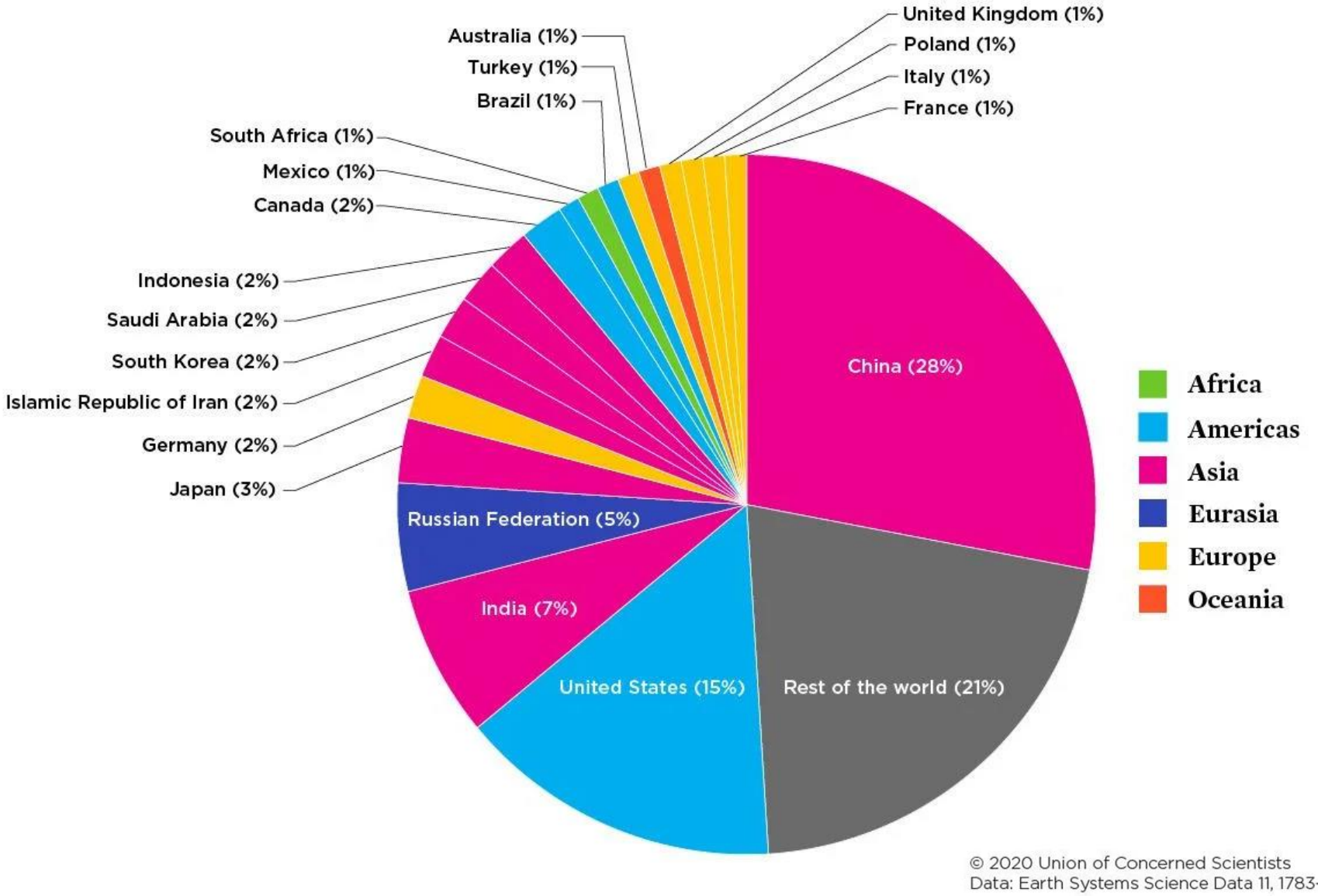
CARBON DIOXIDE OVER 800,000 YEARS



b) Change in global surface temperature (annual average) as **observed** and simulated using **human & natural** and **only natural** factors (both 1850-2020)

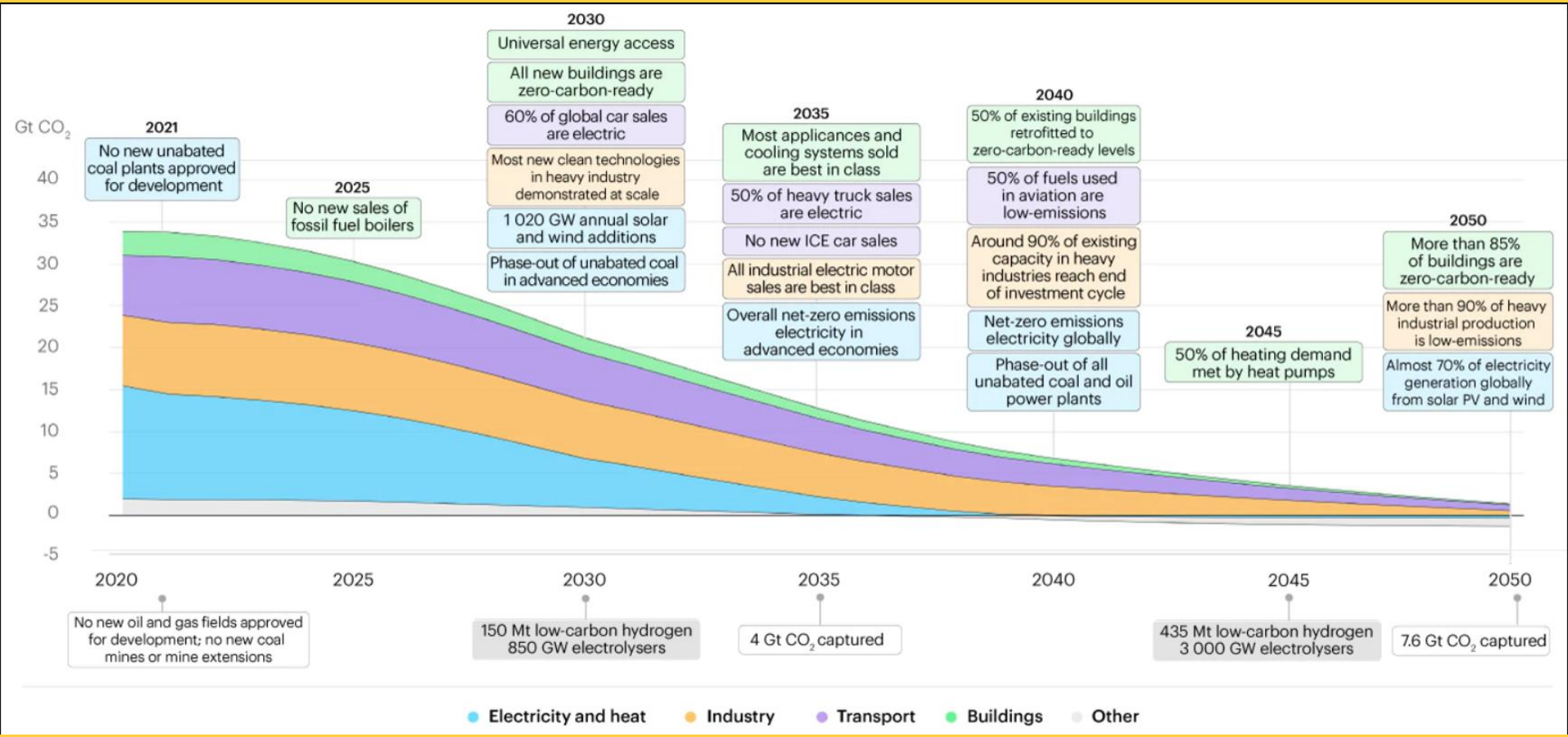


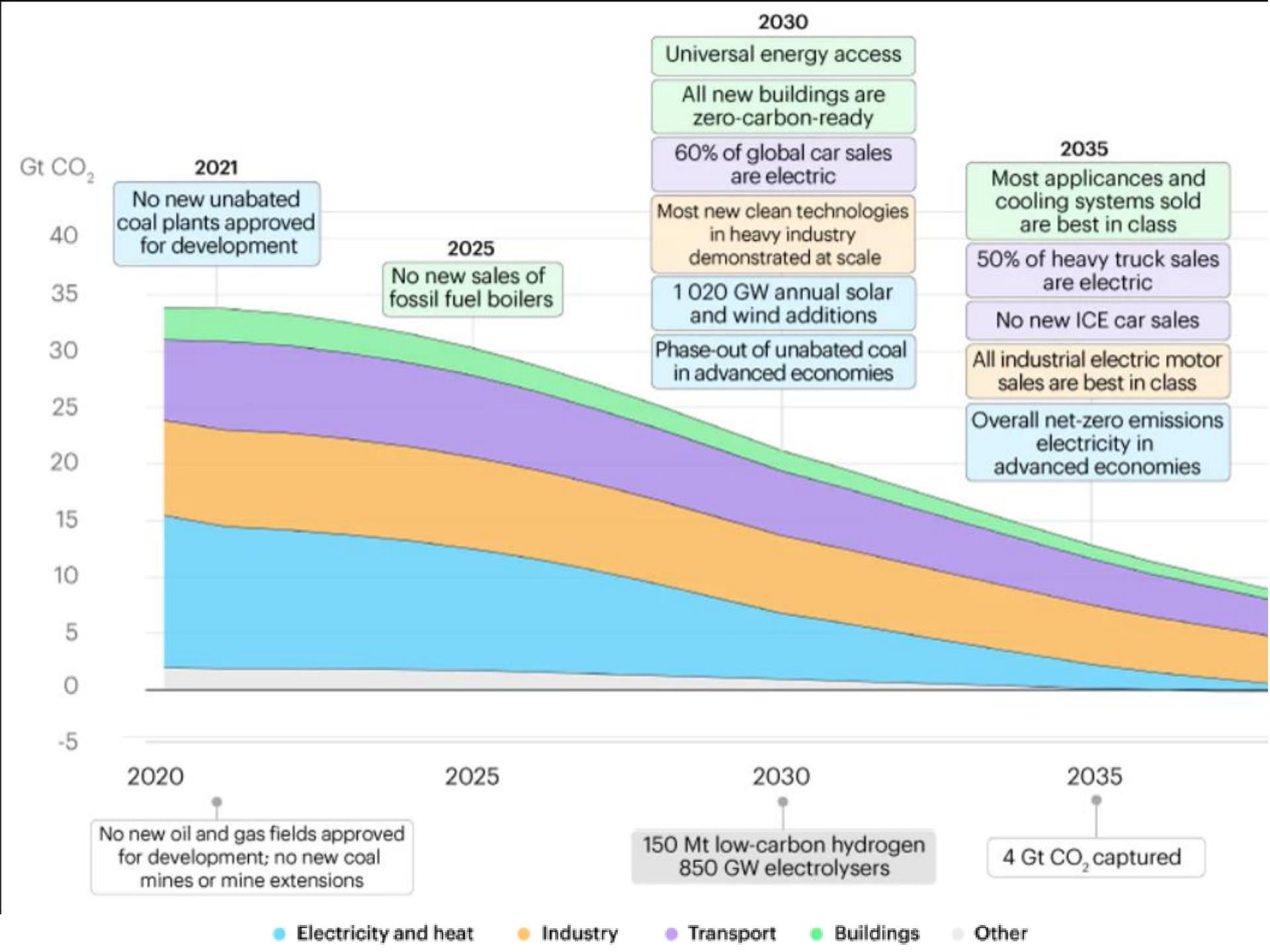
IPCC_AR6_WGI_Full_Report.pdf

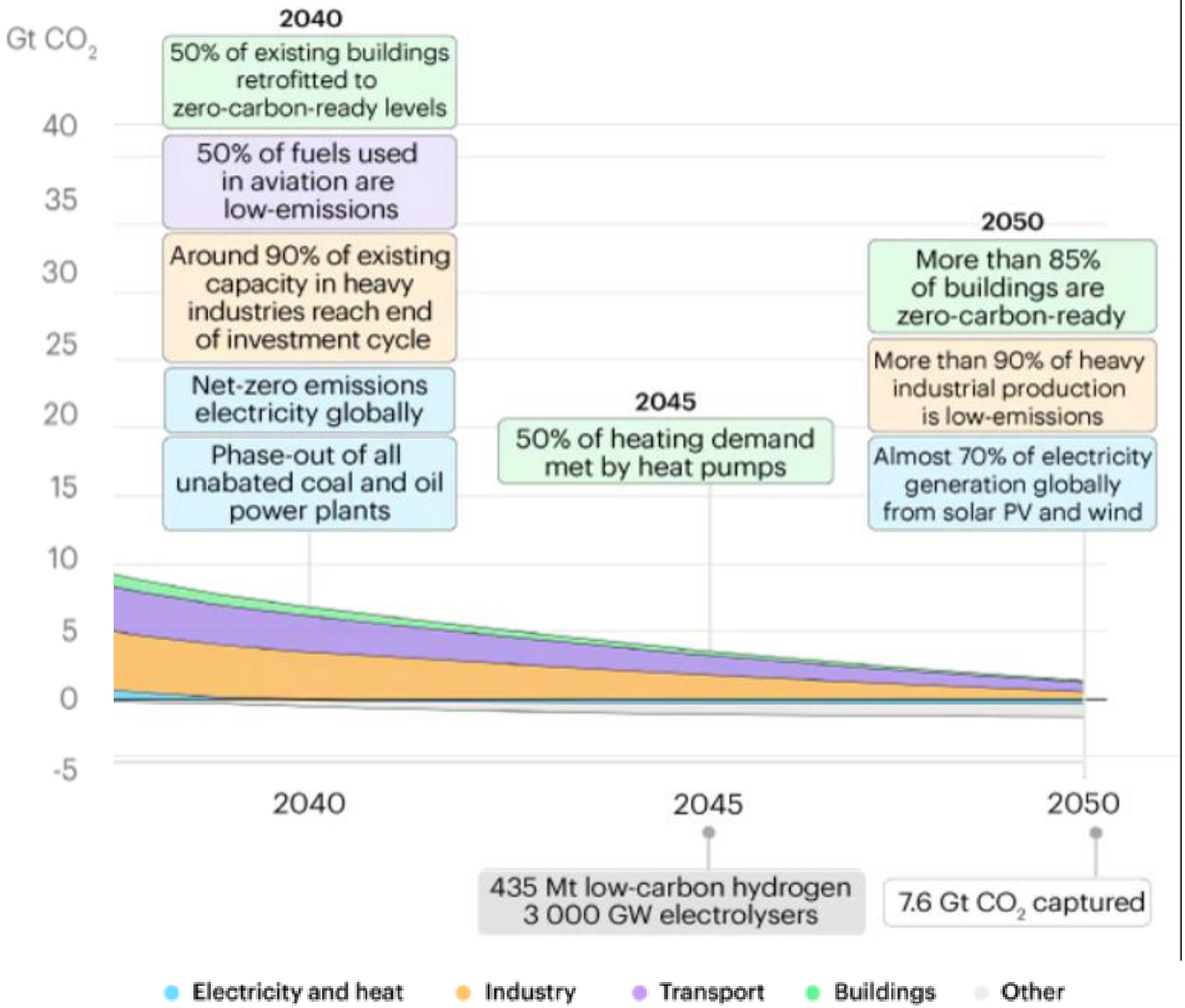


Data: Earth Systems Science Data 11, 1783–1838, 2019

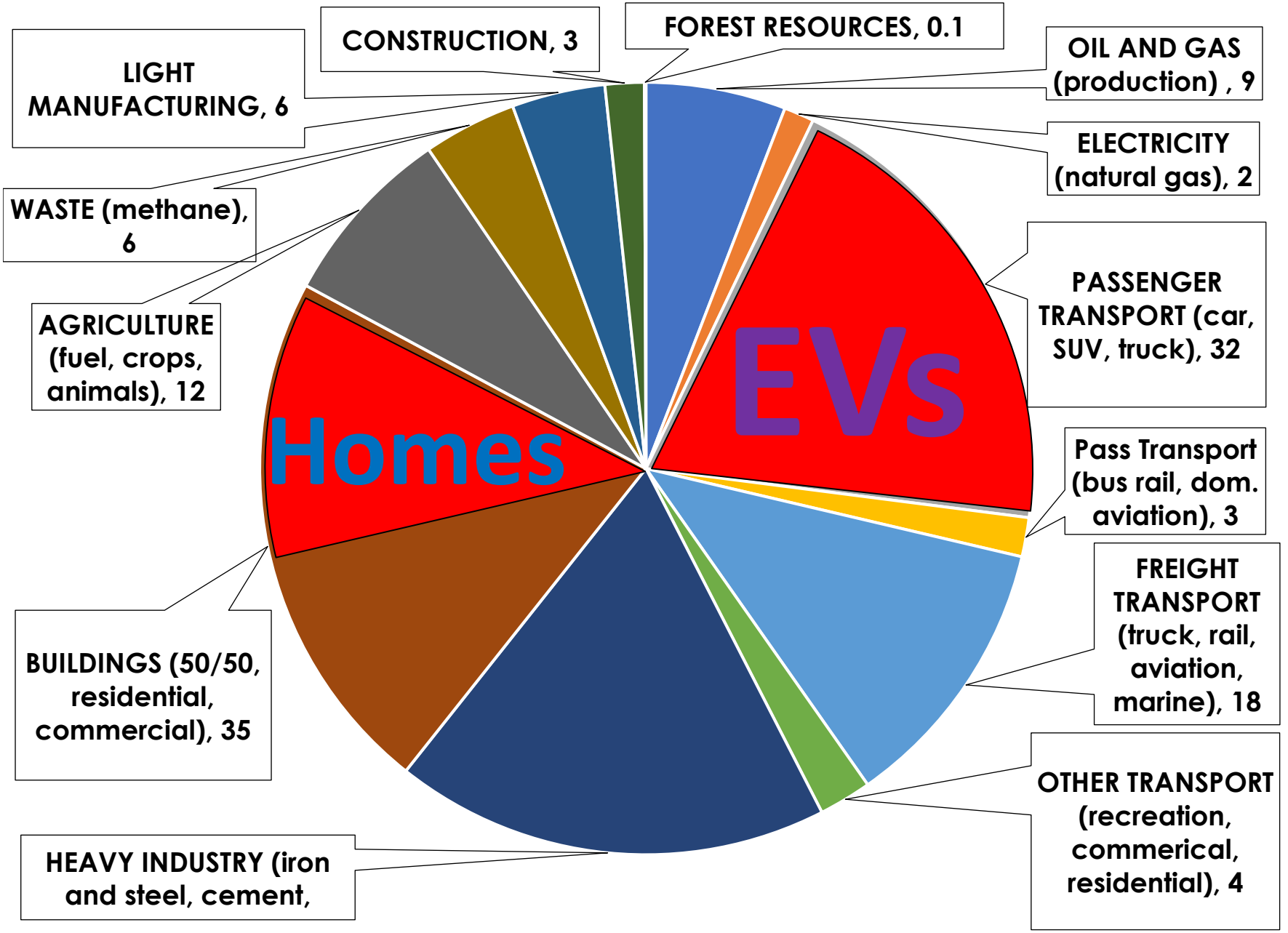
International Energy Agency (IEA)




2030
Universal energy access
All new buildings are zero-carbon-ready
60% of global car sales are electric
Most new clean technologies in heavy industry demonstrated at scale
1 020 GW annual solar and wind additions
Phase-out of unabated coal in advanced economies
2035
Most applicances and cooling systems sold are best in class
50% of heavy truck sales are electric
No new ICE car sales
All industrial electric motor sales are best in class
Overall net-zero emissions electricity in advanced economies
Gt CO_2
2021
No new unabated coal plants approved for development
2025
No new sales of fossil fuel boilers
40
35
30
25
20
15
10
5
0
-5
2020
2025
2030
2035
No new oil and gas fields approved for development; no new coal mines or mine extensions
150 Mt low-carbon hydrogen
850 GW electrolysers
4 Gt CO_2 captured
Electricity and heat
Industry
Transport
Buildings
Other


Gt CO_2
40
35
30
25
20
15
10
5
0
-5
2040
50% of existing buildings retrofitted to zero-carbon-ready levels
50% of fuels used in aviation are low-emissions
Around 90% of existing capacity in heavy industries reach end of investment cycle
Net-zero emissions electricity globally
Phase-out of all unabated coal and oil power plants
2045
50% of heating demand met by heat pumps
2050
More than 85% of buildings are zero-carbon-ready
More than 90% of heavy industrial production is low-emissions
Almost 70% of electricity generation globally from solar PV and wind
2040
2045
2050
435 Mt low-carbon hydrogen
3 000 GW electrolysers
7.6 Gt CO_2 captured
Electricity and heat
Industry
Transport
Buildings
Other

Electric Vehicles (EVs) are part of reducing GHGs



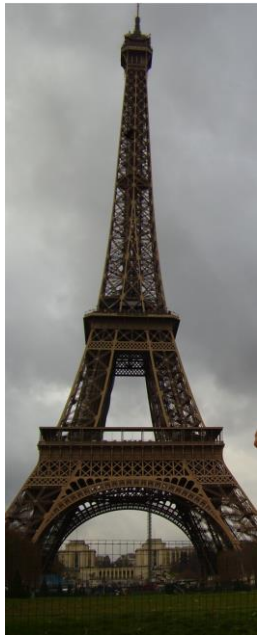
Ontario 2017 159 Mt GHG/year

From 2017 NIR

2 - 6 t GHG/year

*20,000 km/year

4 - 12 t GHG/year



2 t GHG/person

(return)

1 - 3 t GHG/year

(messy)

Total 9 - 23 t GHG/year

Ontario 11.3** t GHG/person/year

** 2017 NIR

Ontario electricity has very low GHG/kWh

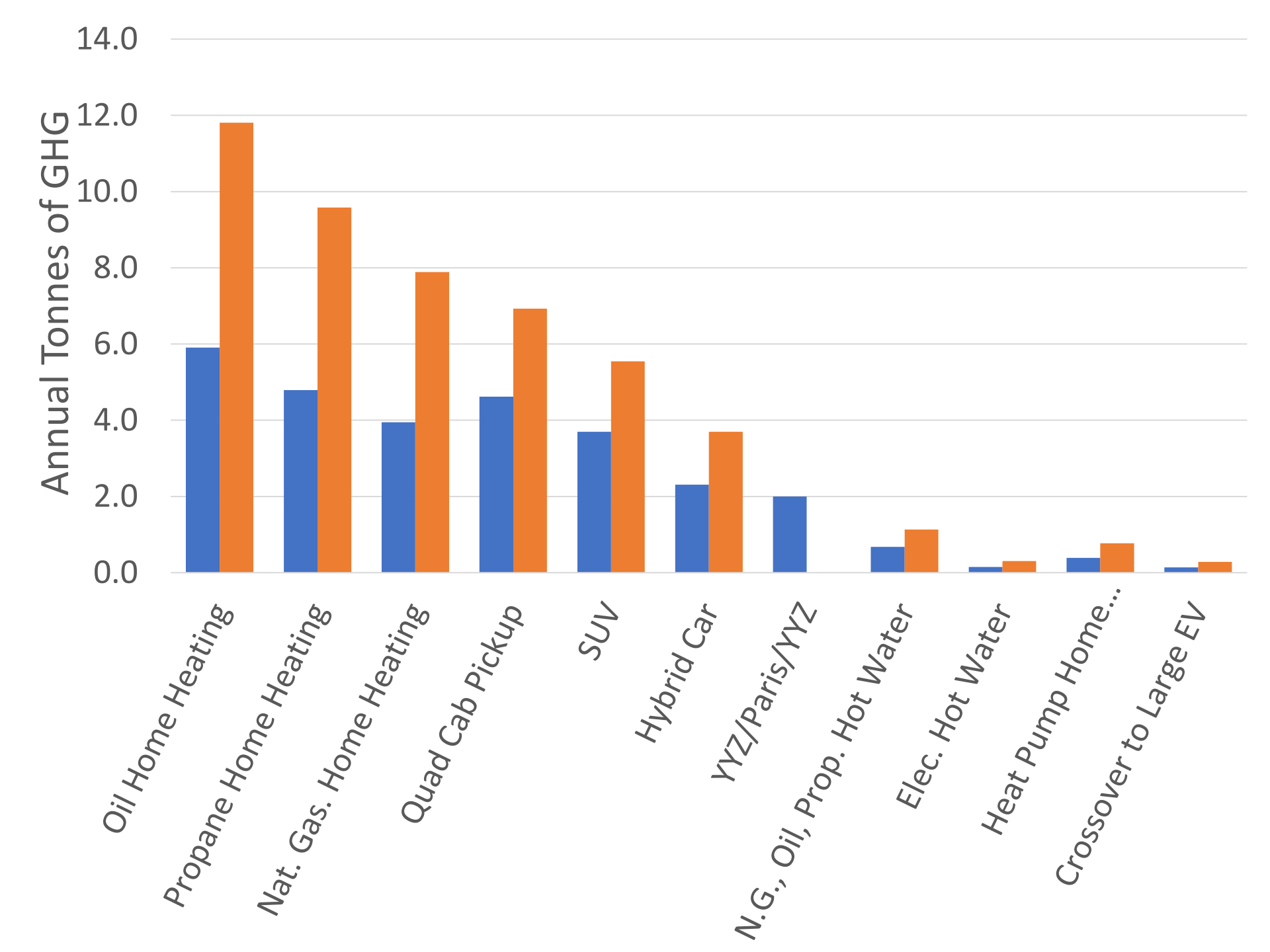
(0.013 to 0.044 kg GHG/kWh avg.*)

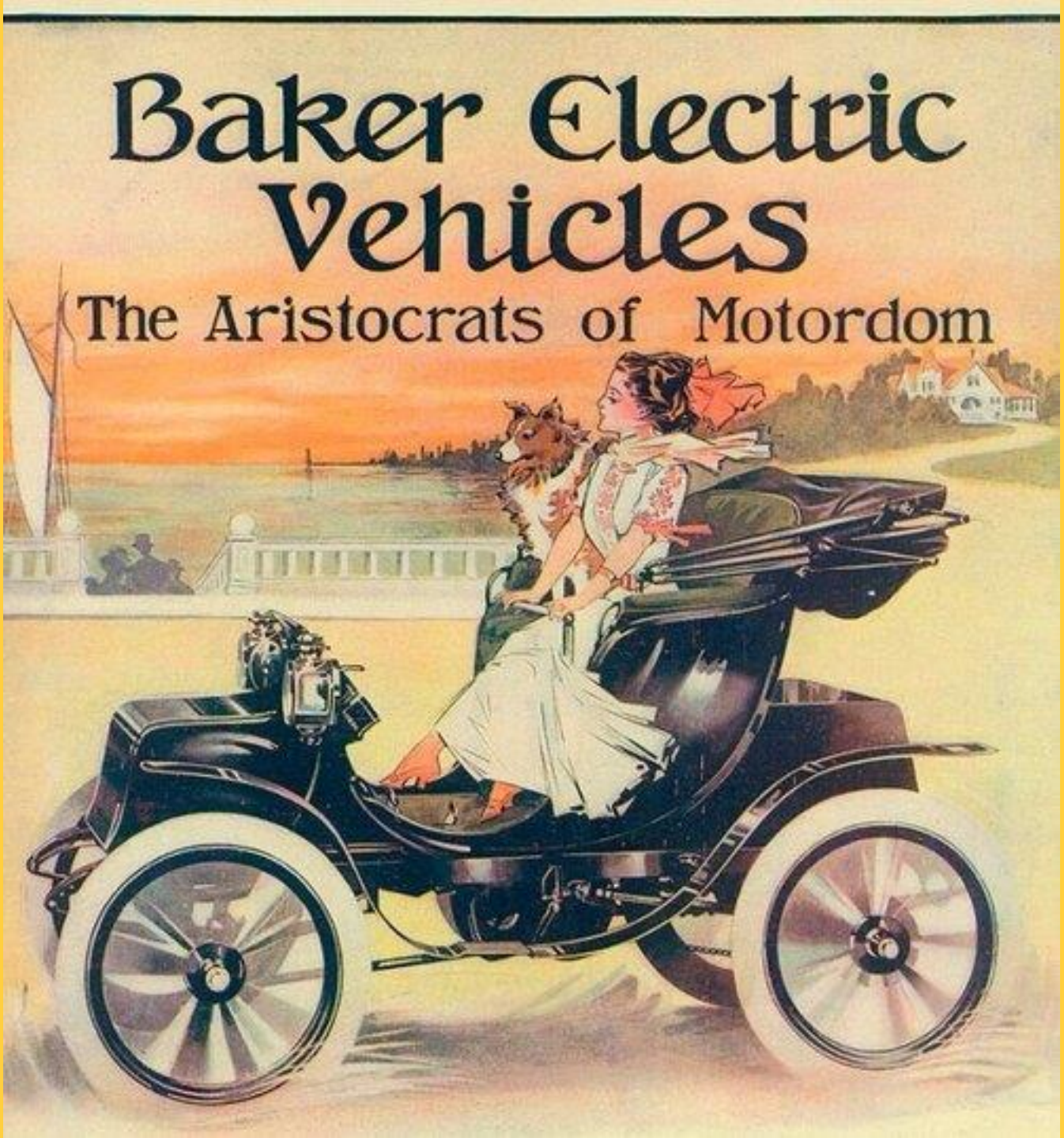
This means the electricity you use to charge your EV has a very, very low upstream GHG impact.

*Toronto Atmospheric Fund 2019

GHG Emissions

Using an EV is a huge GHG emissions reduction for a family! (in Ontario!)


Annual Tonnes of GHG
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Oil Home Heating
Propane Home Heating
Nat. Gas. Home Heating
Quad Cab Pickup
SUV
Hybrid Car
YYZ/Paris/YYZ
N.G., Oil, Prop. Hot Water
Elec. Hot Water
Heat Pump Home...
Crossover to Large EV


Baker Electric
Vehicles
The Aristocrats of Motordom

A 1980 Unique Mobility Electrek

A good effort, not a good car!

Lead acid batteries not up to task in distance or economics.


April 2014 – 3 models











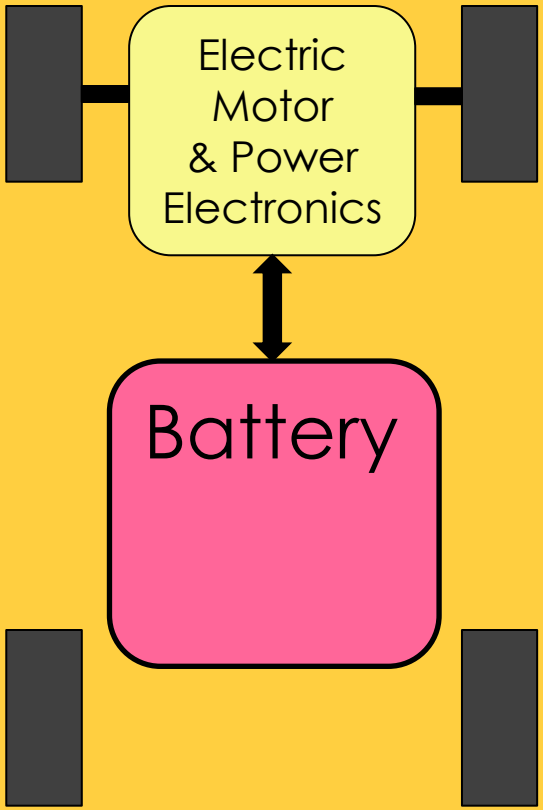




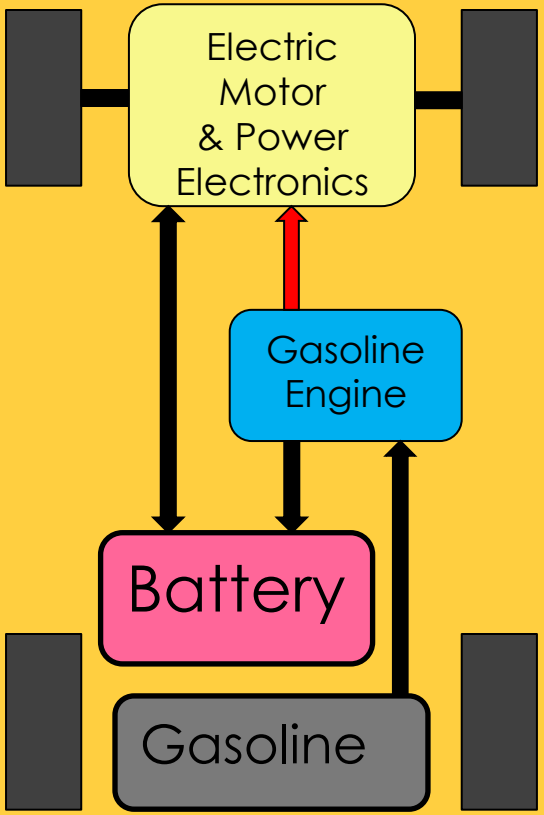


2021 BEV
40+ models

6,000,000 Sold Worldwide



EV



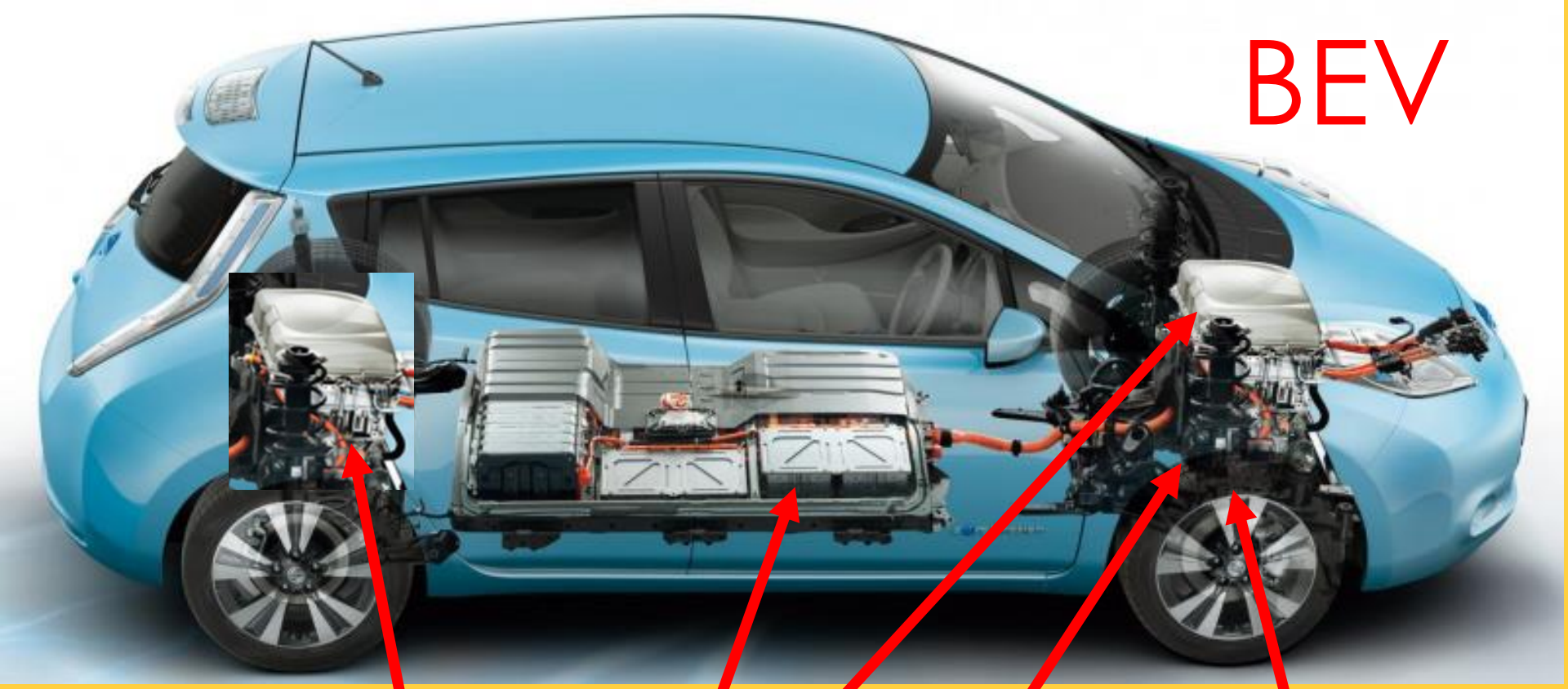
BEV

Battery Electric Vehicle

PHEV

Plug-In Hybrid Electric Vehicle

BEV



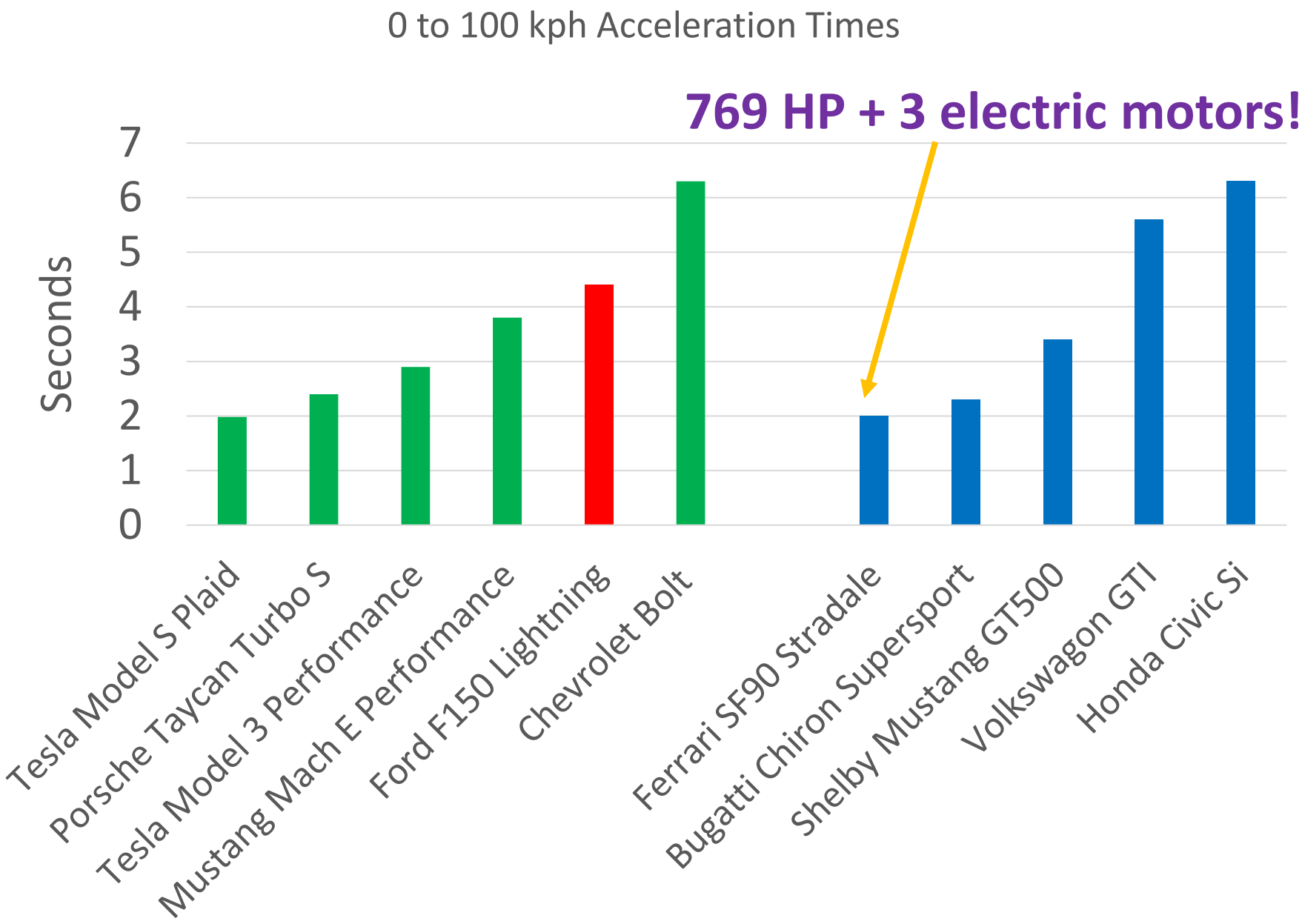
Battery

Inverter

Electric Motor

Reducing gears and differential

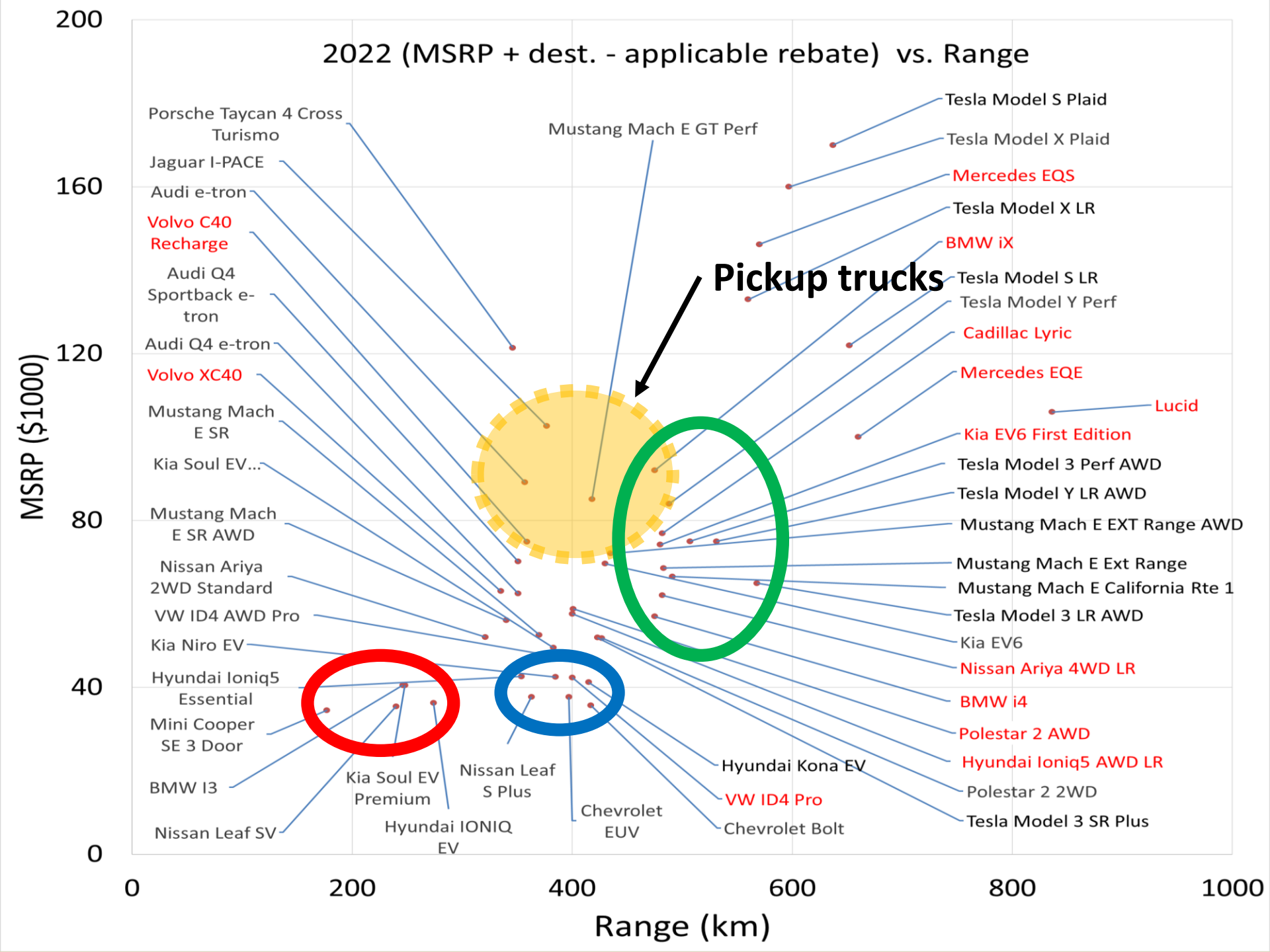
4 Wheel Drive – add a motor

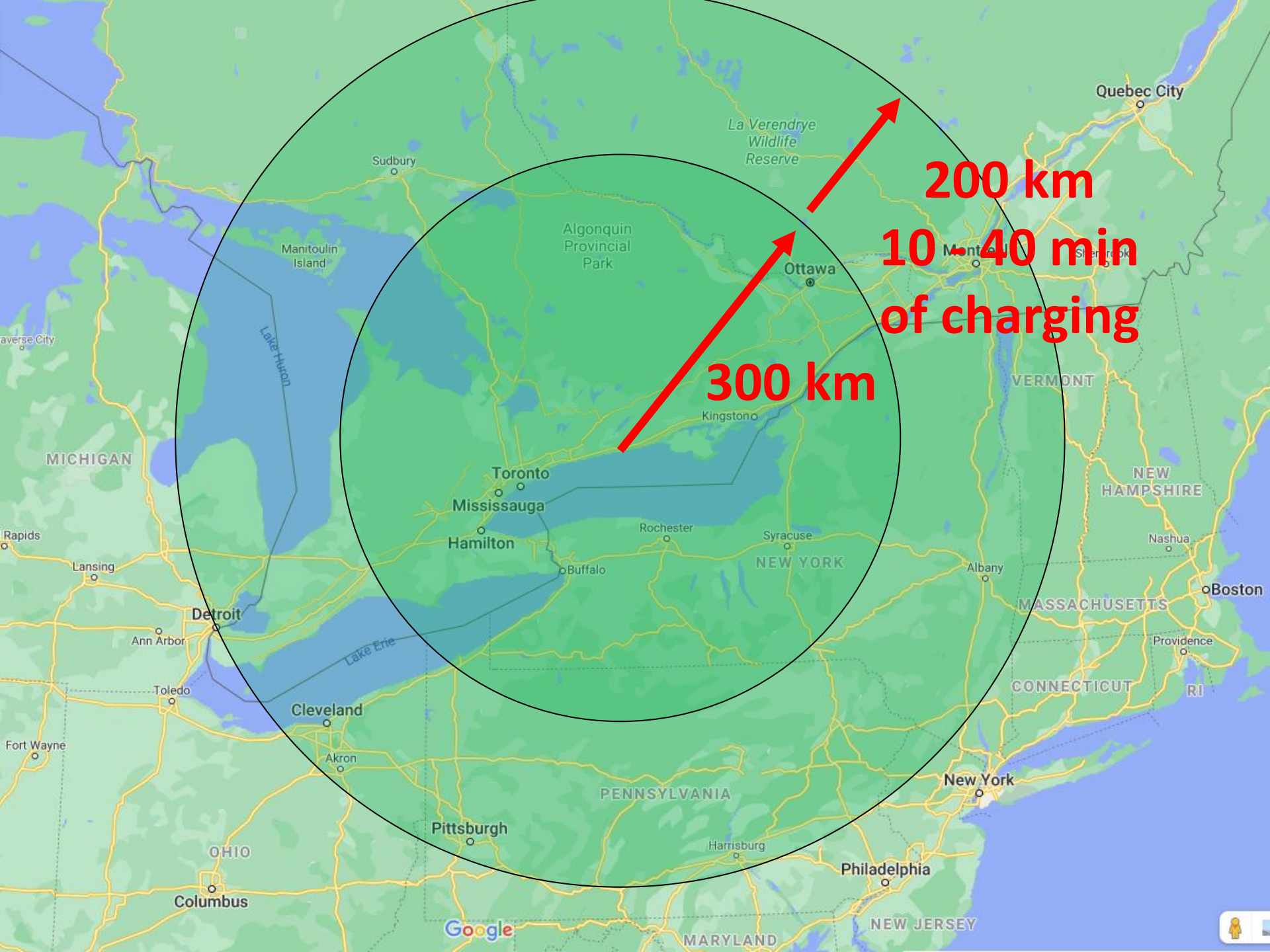

0 to 100 kph Acceleration Times
769 HP + 3 electric motors!
Seconds
0
1
2
3
4
5
6
7
Tesla Model S Plaid
Porsche Taycan Turbo S
Tesla Model 3 Performance
Mustang Mach E Performance
Ford F150 Lightning
Chevrolet Bolt
Ferrari SF90 Stradale
Bugatti Chiron Supersport
Shelby Mustang GT500
Volkswagon GTI
Honda Civic Si

Range and Price

2022 BEV (100% Electric) 49 +/- Models

100% Battery Electric Vehicles	Range (km)	Price in $1000's inc. del.	MSRP (plugndrive) 1000s includes del.
Lucid	836	106.0	$106,000
Mercedes EQE	660	100.0	$100,000
Tesla Model S LR	652	122.0	$121,990
Tesla Model S Plaid	637	170.0	$169,990
Tesla Model X Plaid	597	160.0	$159,990
Mercedes EQS	570	146.2	$146,200
Tesla Model 3 LR AWD	568	65.0	$64,990
Tesla Model X LR	560	133.0	$132,990
Tesla Model Y LR AWD	531	75.0	$74,990
Tesla Model 3 Perf AWD	507	75.0	$74,990
Mustang Mach E California Rte 1	491	66.6	$66,590
Tesla Model Y Perf	488	84.0	$83,990
Mustang Mach E Ext Range	483	68.6	$68,590
Nissan Ariya 4WD LR	482	62.1	$62,050
Cadillac Lyric	482	77.0	$76,950
Kia EV6 First Edition	480	74.2	$74,200
BMW i4	475	57.0	$56,990
BMW iX	475	92.0	$91,990
Mustang Mach E EXT Range AWD	435	72.1	$72,090
Kia EV6	430	69.7	$69,654
Polestar 2 2WD	427	51.8	$51,800
Tesla Model 3 SR Plus	423	52.0	$56,380
Mustang Mach E GT Perf	418	85.1	$85,090
Chevrolet Bolt	417	35.7	$40,098
Hyundai Kona EV	415	41.2	$45,651
Polestar 2 AWD	401	58.8	$58,800
Hyundai Ioniq5 AWD LR	400	57.6	$62,049
VW ID4 Pro	400	42.4	$46,780
Chevrolet EUV	397	37.7	$42,098
VW ID4 AWD Pro	386	47.4	$51,780
Kia Niro EV	385	42.5	$46,929
Kia Soul EV Limited	383	49.5	$53,929
Jaguar I-PACE (CO)	377	102.6	$102,626
Mustang Mach E SR	370	52.6	$52,590
Nissan Leaf S Plus	363	37.7	$42,174
Volvo C40 Recharge	359	74.9	$74,900
Audi e-tron	357	89.2	$89,150
Hyundai Ioniq5 Essential	354	42.6	$47,049
Audi Q4 e-tron	351	62.5	$62,500
Audi Q4 Sportback e-tron	351	70.2	$70,150
Porsche Taycan 4 Cross Turismo	346	121.4	$121,400
Mustang Mach E SR AWD	340	56.1	$56,090
Volvo XC40	335	63.1	$63,070
Porsche Taycan S Cross Turismo	325	219.5	$219,500
Nissan Ariya 2WD Standard	321	52.1	$52,050
Hyundai IONIQ EV	274	36.3	$40,726
Kia Soul EV Premium	248	40.5	$44,929
BMW I3	246	40.5	$44,950
Nissan Leaf SV	240	35.4	$39,874
Mini Cooper SE 3 Door	177	34.5	$38,956


2022 (MSRP + dest. - applicable rebate) vs. Range
MSRP ($1000)
Range (km)
0
40
80
120
160
200
0
200
400
600
800
1000
Pickup trucks
Porsche Taycan 4 Cross Turismo
Jaguar I-PACE
Audi e-tron
Volvo C40 Recharge
Audi Q4 Sportback e-tron
Audi Q4 e-tron
Volvo XC40
Mustang Mach E SR
Kia Soul EV...
Mustang Mach E SR AWD
Nissan Ariya 2WD Standard
VW ID4 AWD Pro
Kia Niro EV
Hyundai Ioniq5 Essential
Mini Cooper SE 3 Door
BMW I3
Nissan Leaf SV
Kia Soul EV Premium
Hyundai IONIQ EV
Nissan Leaf S Plus
Chevrolet EUV
Mustang Mach E GT Perf
Hyundai Kona EV
VW ID4 Pro
Chevrolet Bolt
Tesla Model S Plaid
Tesla Model X Plaid
Mercedes EQS
Tesla Model X LR
BMW iX
Tesla Model S LR
Tesla Model Y Perf
Cadillac Lyric
Mercedes EQE
Lucid
Kia EV6 First Edition
Tesla Model 3 Perf AWD
Tesla Model Y LR AWD
Mustang Mach E EXT Range AWD
Mustang Mach E Ext Range
Mustang Mach E California Rte 1
Tesla Model 3 LR AWD
Kia EV6
Nissan Ariya 4WD LR
BMW i4
Polestar 2 AWD
Hyundai Ioniq5 AWD LR
Polestar 2 2WD
Tesla Model 3 SR Plus


200 km
10 - 40 min
of charging
300 km
Quebec City
La Verendrye
Wildlife
Reserve
Sudbury
Algonquin
Provincial
Park
Manitoulin
Island
Ottawa
Lake Huron
VERMONT
Kingston
MICHIGAN
Toronto
Mississauga
Hamilton
NEW
HAMPSHIRE
Rochester
Syracuse
Nashua
Rapids
Lansing
Buffalo
NEW YORK
Albany
Boston
Detroit
MASSACHUSETTS
Ann Arbor
Providence
Lake Erie
Toledo
CONNECTICUT
RI
Cleveland
Fort Wayne
Akron
New York
PENNSYLVANIA
Pittsburgh
Harrisburg
OHIO
Philadelphia
Columbus
Google
NEW JERSEY
MARYLAND

Seasonal Range Change

- Energy consumption increases with speed^2
- COLD!! - cold grease in bearings, harder rubber tires, dense air and lowered battery temperature plus heating impacts the range
- Worst winter day (-25°C, snow) range at 100 kph could be 40 - 50% reduced.

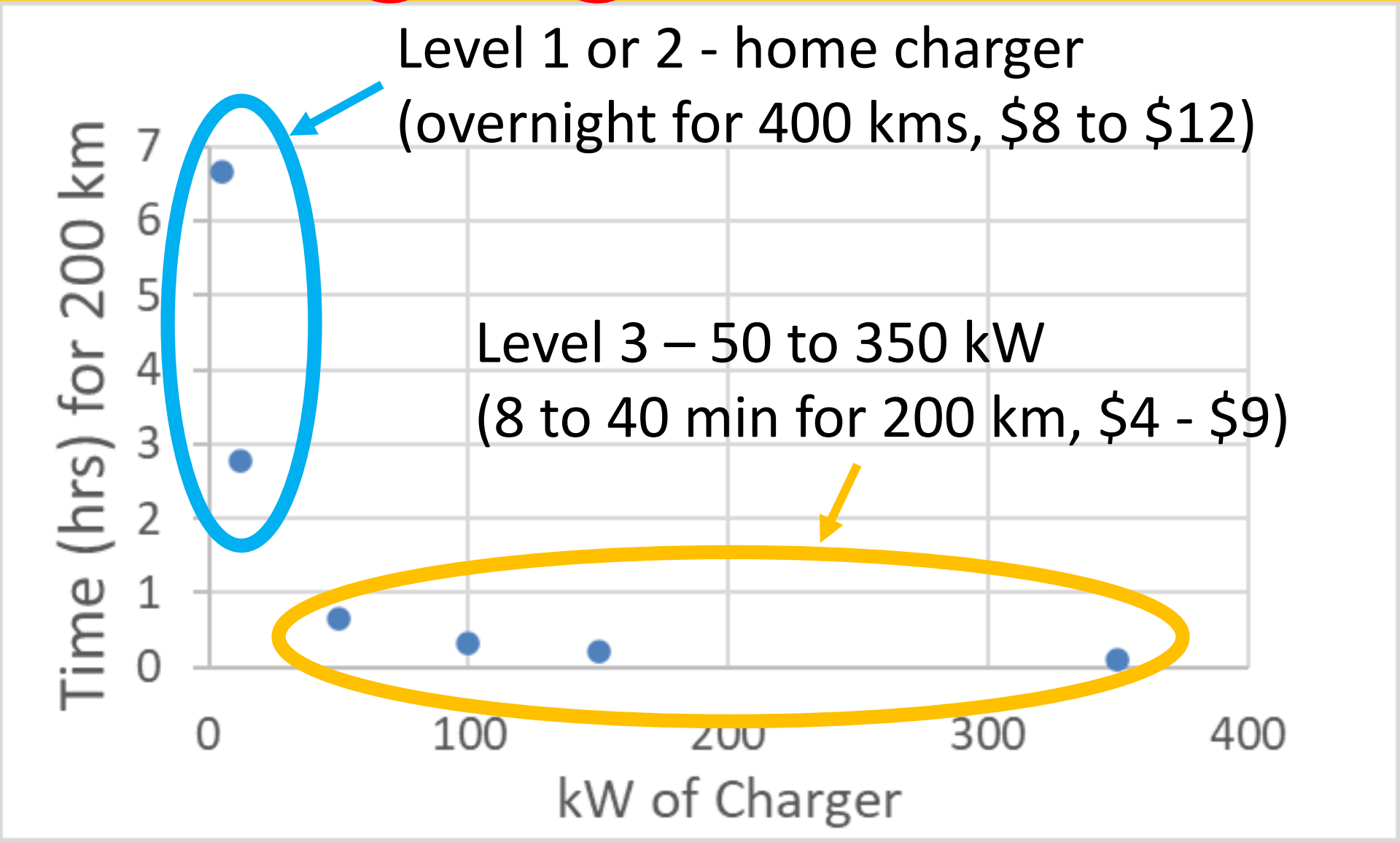
Charging

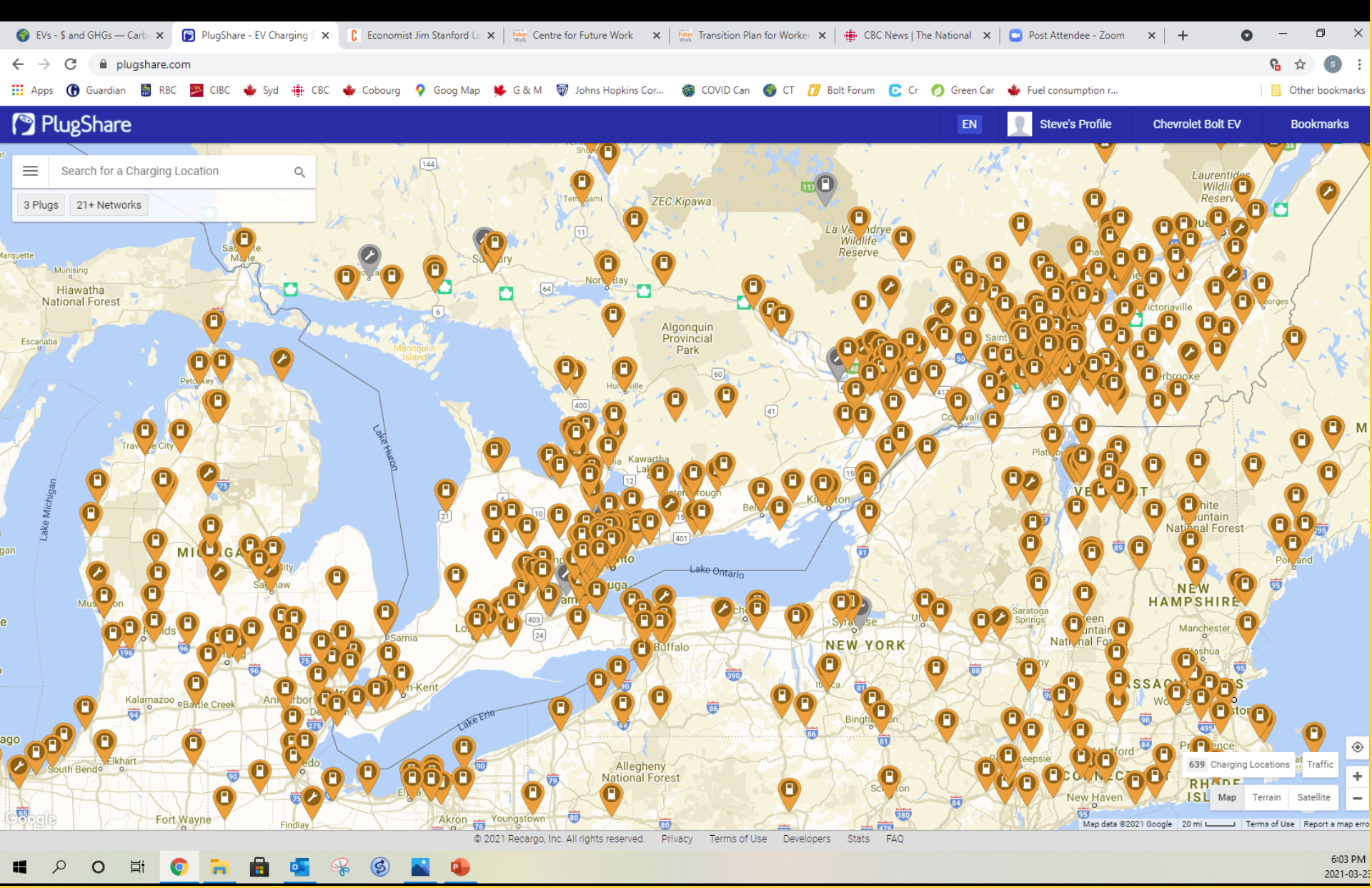
Level 3 High Power

Level 1 and 2 at home or away, J1772

Cobourg's **LEVEL 3** Petro Canada Chargers

Charging time/km/$





Level 3 “Plugshare.com” screen grab

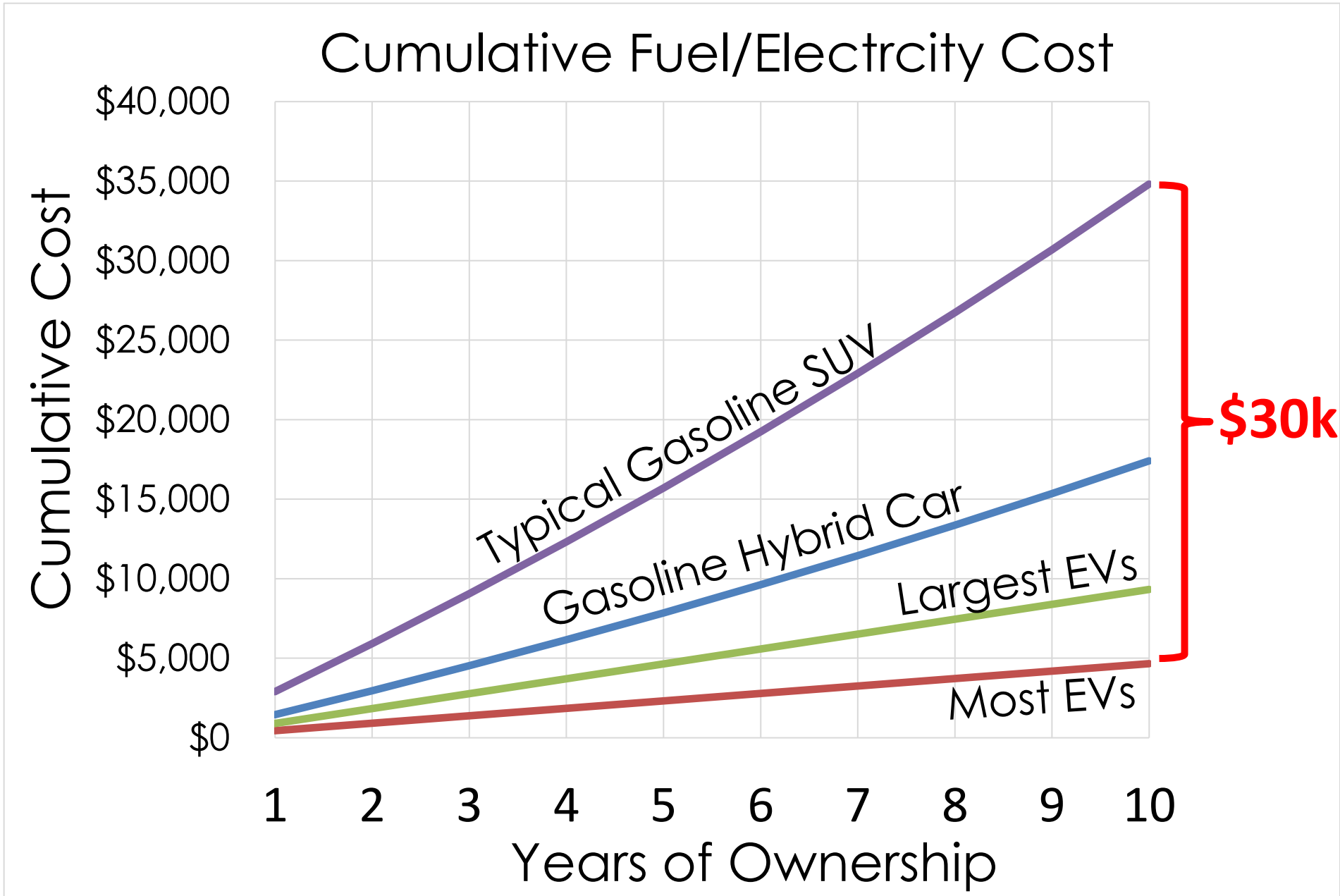
Impact of EVs on the Ontario Electricity Grid

1,000,000 EVs each going 20,000 km/year would create a

2.5%

increase in Ontario's total 137 TWh of electricity generation

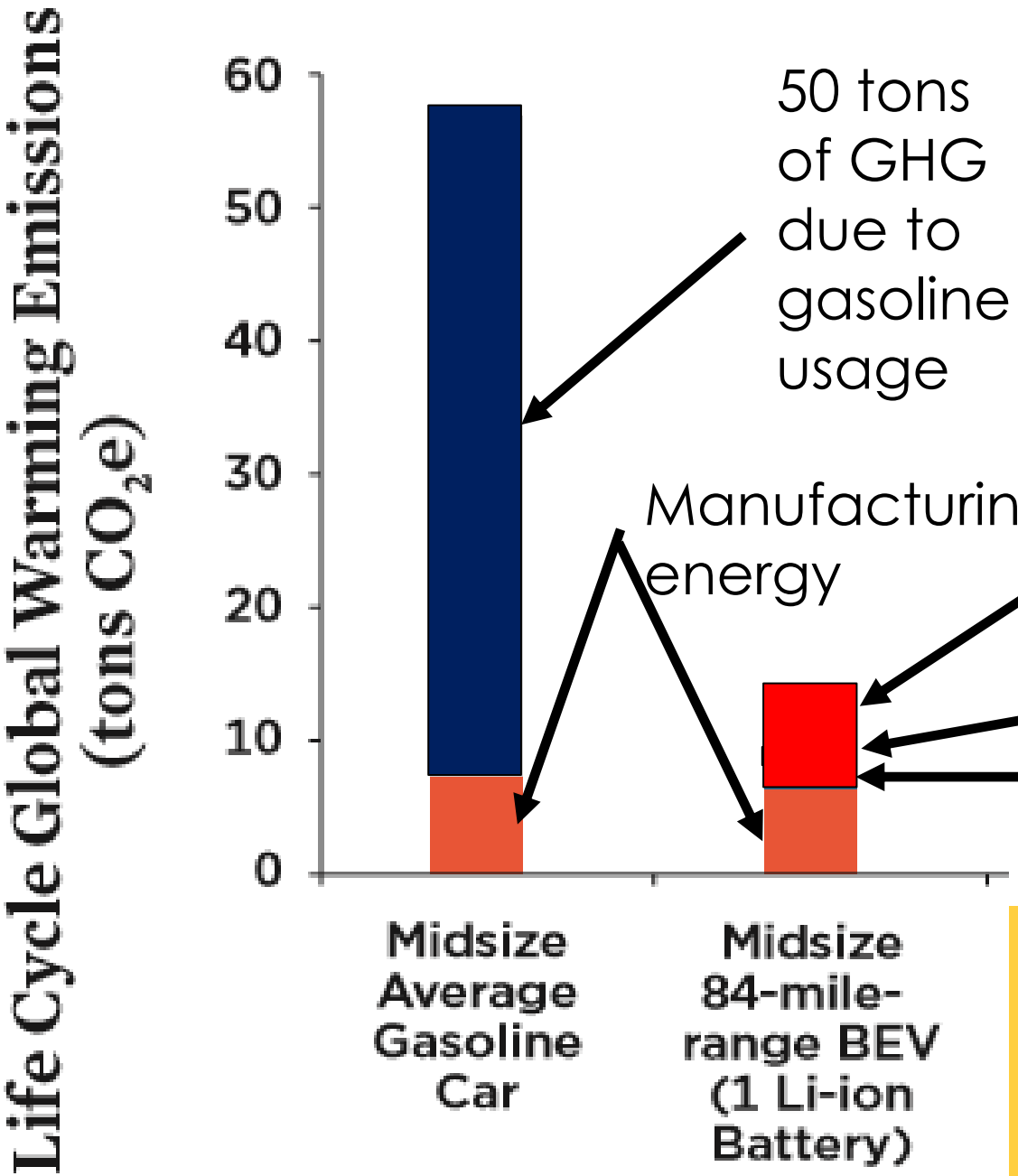
Operating Costs



($1.45/litre, $0.15/kWh, 20,000 km/year, 4% infl.)

The Bigger Picture

Mining & Manufacturing



- 220,000 km vehicle life

Base data from 2015

Union of Concerned Scientists – Cradle to Grave, includes upstream fuel production emissions

Battery Materials

- 10 kg Lithium per EV = 5.3 billion batteries (1.3 B pass. vehicles world)*
- Other battery chemistries are in use, some require no conflict (Cobalt) minerals

Human Rights / Environmental Impact

- Fossil fuel extraction/use has climate change plus large scale human rights and environmental impacts
- Mining of battery minerals has negative impacts and they can be addressed with policy, laws and through activist pressure and corporate action – all happening
- Virtually every EV maker has ethical supply chain policies
- Recycling being developed in many places

*U.S. Geological Survey, Mineral Commodity Summaries, January 2018

Finally

- EVs are a key technology to address Greenhouse Gas Emissions and the climate crisis
- Most EVs have great acceleration!
- EVs in Ontario lower your family's GHG emissions significantly
- Basic EVs have similar ownership cost to equivalent fossil fuel cars
- Long distance travel entirely feasible
- Better to cycle or walk if you can!

Thank you for your attention.

Questions?

lappstve@kos.net

Carbontakedown.com

5 Year Net Vehicle Cost

	Kona Gas	Prius	Kona EV	Chevy Bolt EV
MSRP+Dest.	$ 26,154	$ 31,071	$ 45,651	$ 40,098
Tax	$ 3,400	$ 4,039	$ 5,935	$ 5,213
Federal rebate	$ -	$ -	$ 5,000	$ 5,000
Energy (Gasoline or Electricity)				
1st Year	$ 2,212	$ 1,260	$ 513	$ 513
2nd "	$ 2,300	$ 1,310	$ 533	$ 533
3rd "	$ 2,392	$ 1,363	$ 555	$ 555
4th "	$ 2,488	$ 1,417	$ 577	$ 577
5th "	$ 2,588	$ 1,474	$ 600	$ 600
5 year insurance	$ 4,000	$ 4,000	$ 5,000	$ 5,000
5 year maintenance	$ 5,000	$ 5,000	$ 2,500	$ 2,500
Trade in Value	$ 13,299	$ 15,800	$ 21,374	$ 16,251
Net Expense	$37,236	$35,135	$36,402	$30,140
5 Year GHG tonnes Emitted	18.2	10.4	0.68	0.68

Plus $1000 to $1500 one time $ for a charger at home