There is an Electric Vehicle in your future!

A talk for students of the Cobourg Collegiate Institute
On behalf of the EV Society – Northumberland Chapter

By: Steve Lapp

Carbontakedown.com

Questions from you!

- Thanks so much for the Google Doc questions, they were super helpful!

45 Minutes:

- GHG Emissions
  - What's happening?
  - COP26
  - What to do?
- Electric Vehicles (EVs)
  - Performance, Range and Charging
  - Mining, Recycling
  - The Electricity Grid
- Your questions!

Our Home


July 17, 1969

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, many activists, scientists and politicians are trying to cooperate – COP26.


50 km

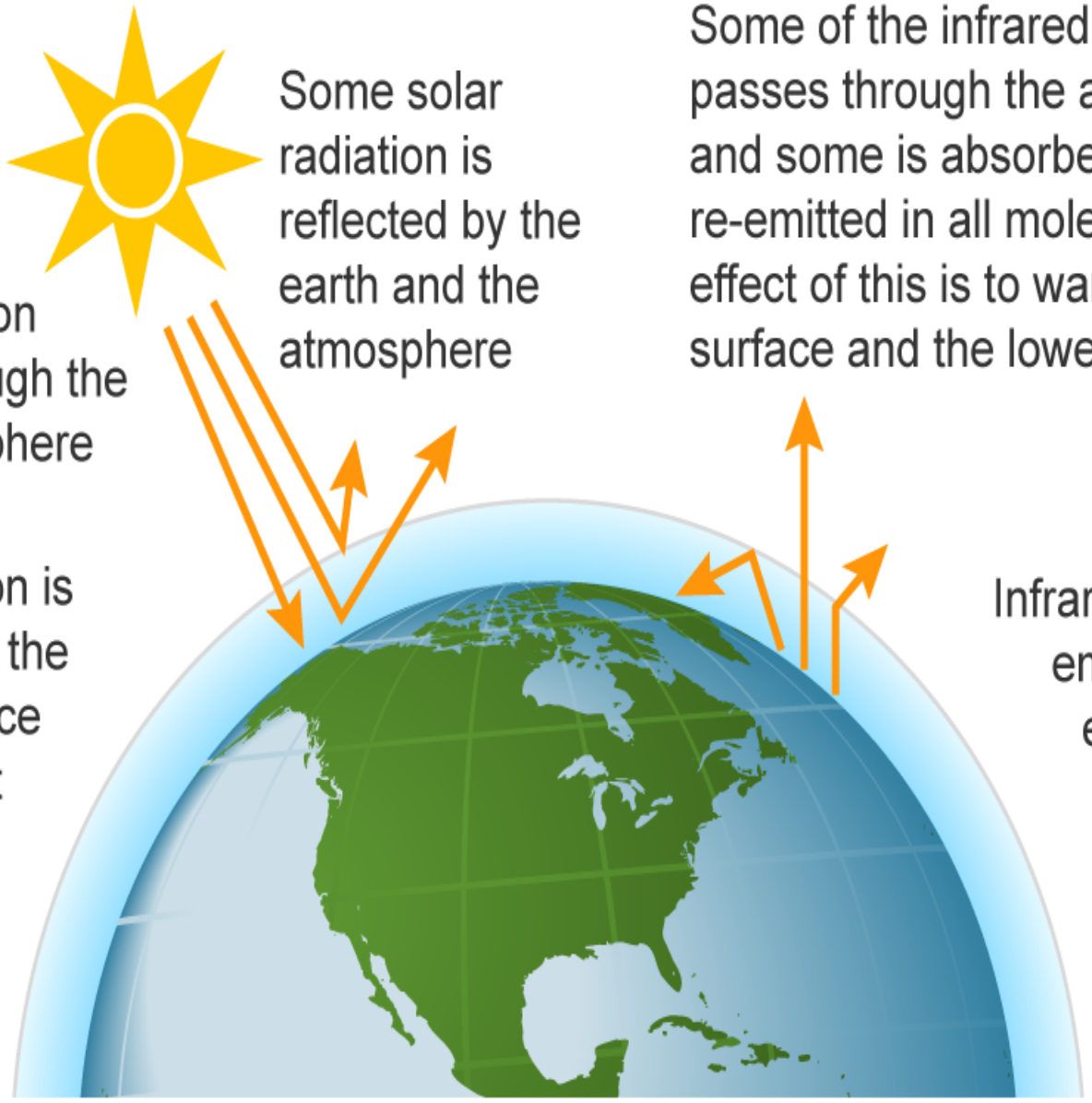
Greenhouse Gases (GHGs) and Global Warming - Climate Change

GHG

"Greenhouse Gas"

a gas that reflects infrared radiation back to earth

The greenhouse effect



US EPA

SMOG

- nitrogen oxides
- sulphuric acid particles
- soot (carbon)
- other particulate matter
- hydrocarbons (unburned fuels)
- volatile chemicals.
- ozone

GHG

- carbon dioxide
- five main others

SMOG ≠ GHG

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

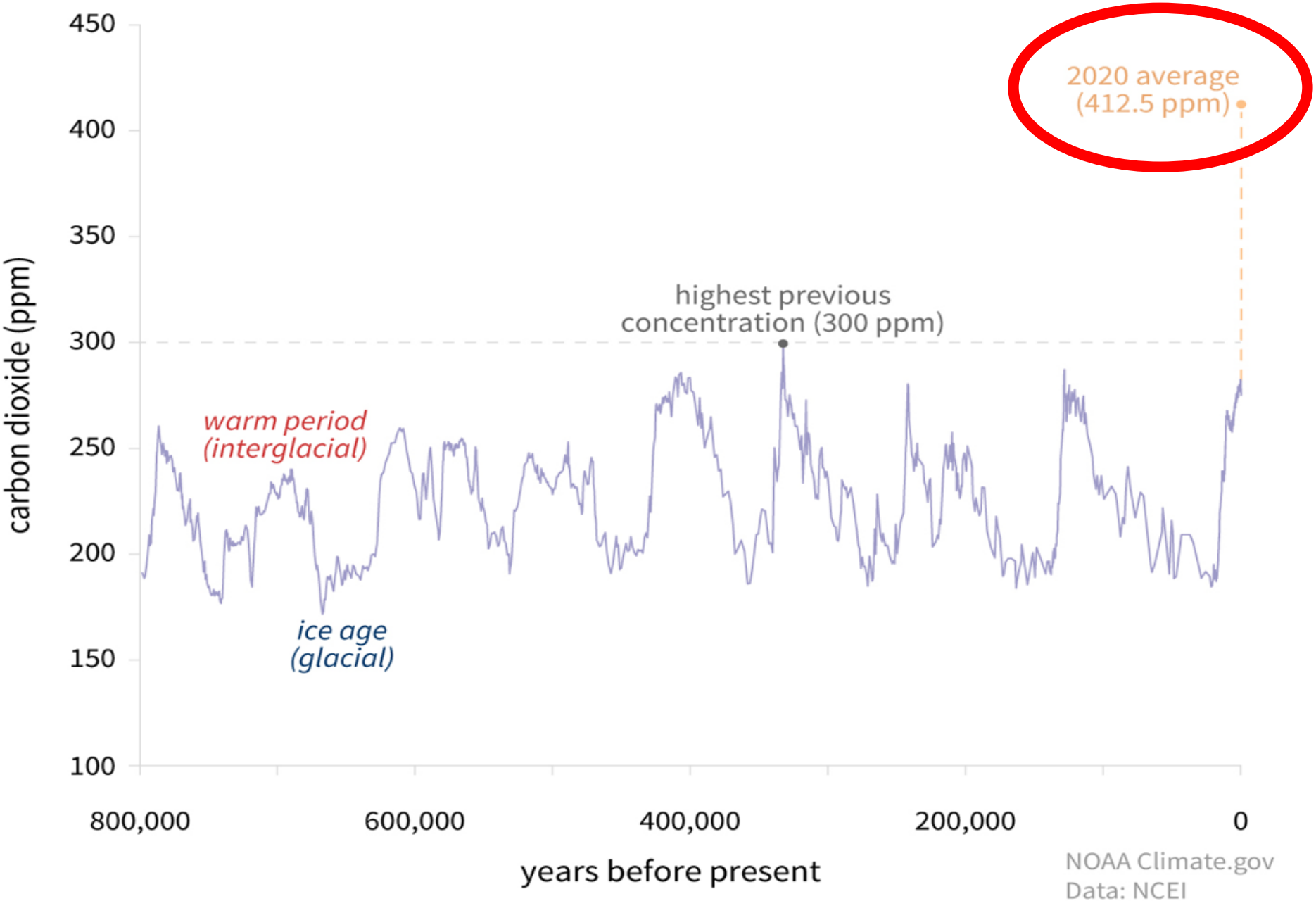
1/ Carbon Dioxide (CO_2)
2/ Methane (CH_4)

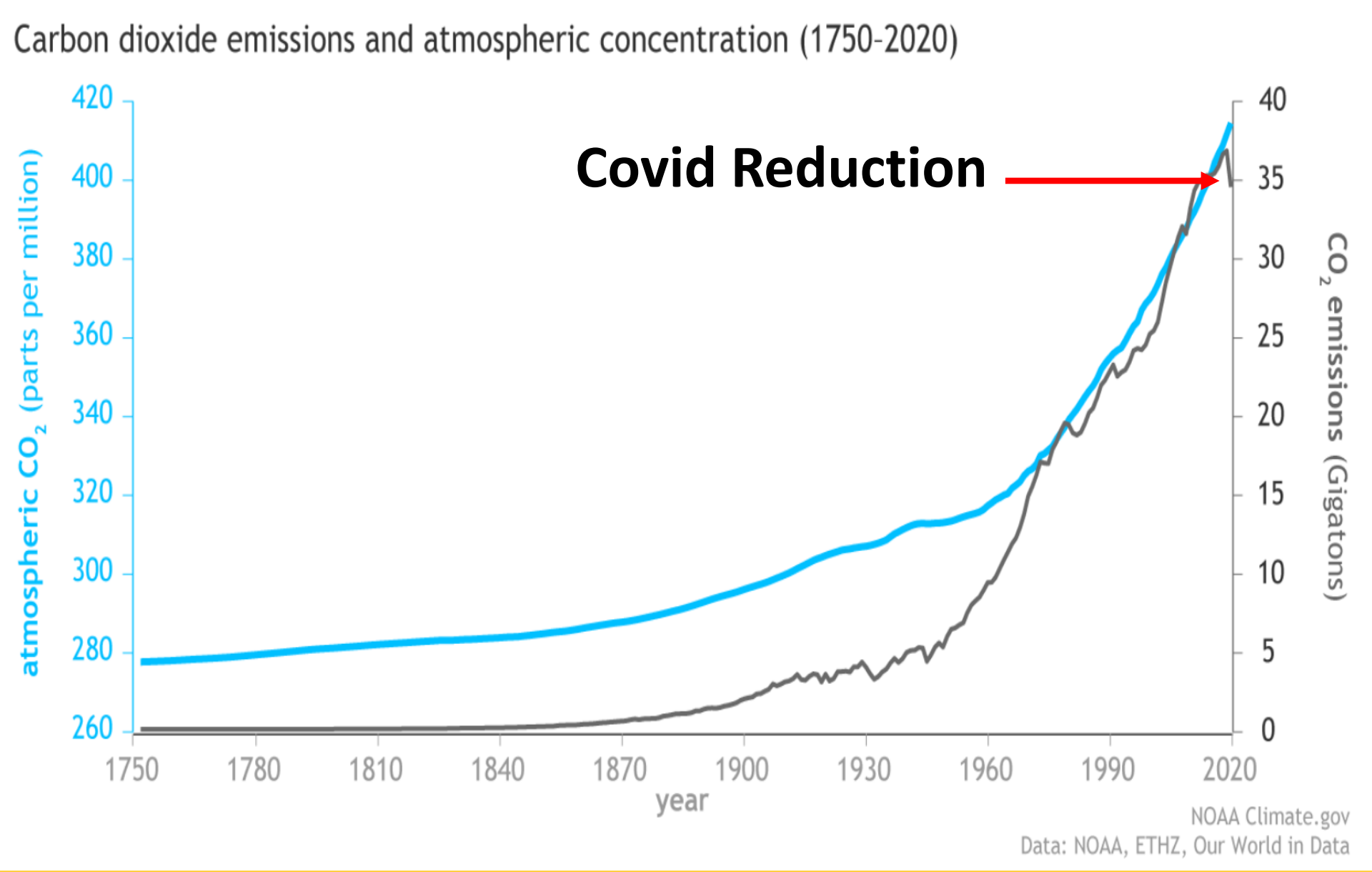
92 %

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

8 %

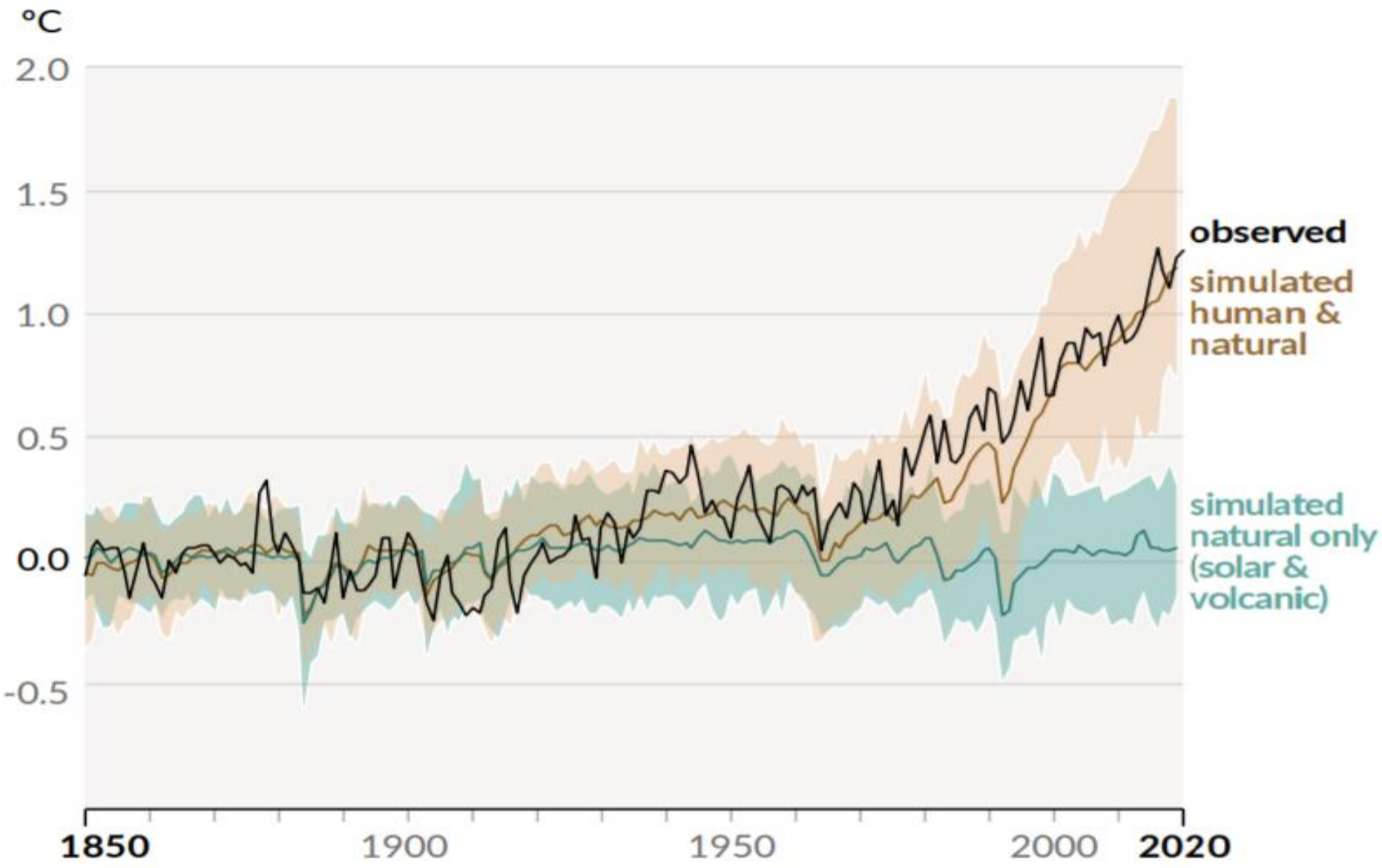
CARBON DIOXIDE OVER 800,000 YEARS





The Industrial Age

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



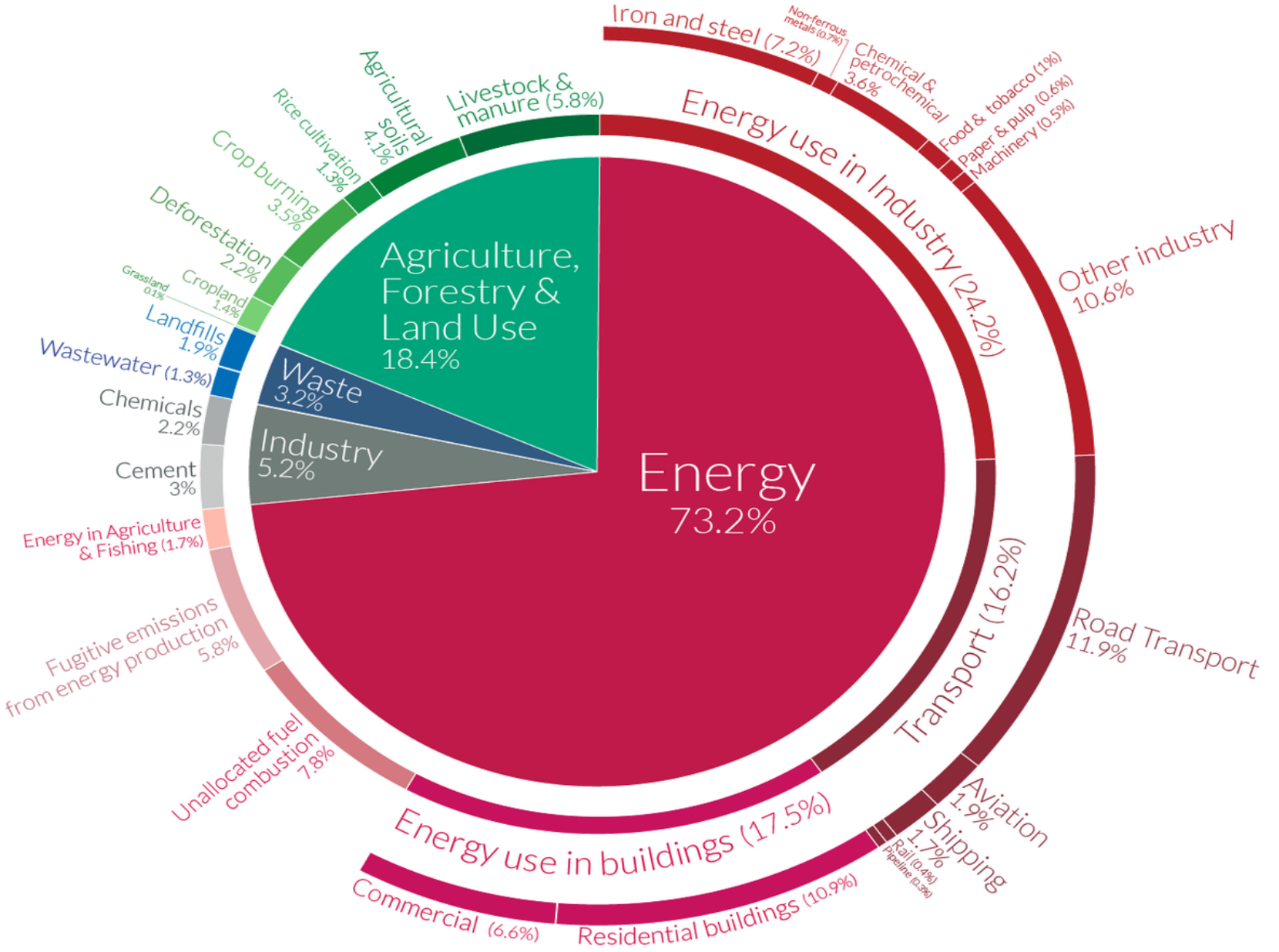
IPCC_AR6_WGI_Full_Report.pdf

What are the activities creating GHGs?

Global greenhouse gas emissions by sector

This is shown for the year 2016 – global greenhouse gas emissions were 49.4 billion tonnes CO_2eq.

Our World in Data



Source: Climate Watch, the World Resources Institute (2020).

COP 26

1. **Secure global net zero by mid-century and keep 1.5 degrees within reach**

Countries are being asked to come forward with ambitious 2030 emissions reductions targets that align with reaching net zero by the middle of the century.

To deliver on these stretching targets, countries will need to:

- accelerate the phase-out of coal
- curtail deforestation
- **speed up the switch to electric vehicles**
- encourage investment in renewables.

2. **Adapt to protect communities and natural habitats**

At COP26 we need to work together to enable and encourage countries affected by climate change to:

- protect and restore ecosystems
- build defences, warning systems and resilient infrastructure and agriculture to avoid loss of homes, livelihoods and even lives

COP 26

3. **Mobilize finance**
To deliver on our first two goals, developed countries must make good on their promise to mobilize at least $100bn in climate finance per year by 2020.
International financial institutions must play their part and we need work towards unleashing the trillions in private and public sector finance required to secure global net zero.

4. **Work together to deliver**
We can only rise to the challenges of the climate crisis by working together.
At COP26 we must:

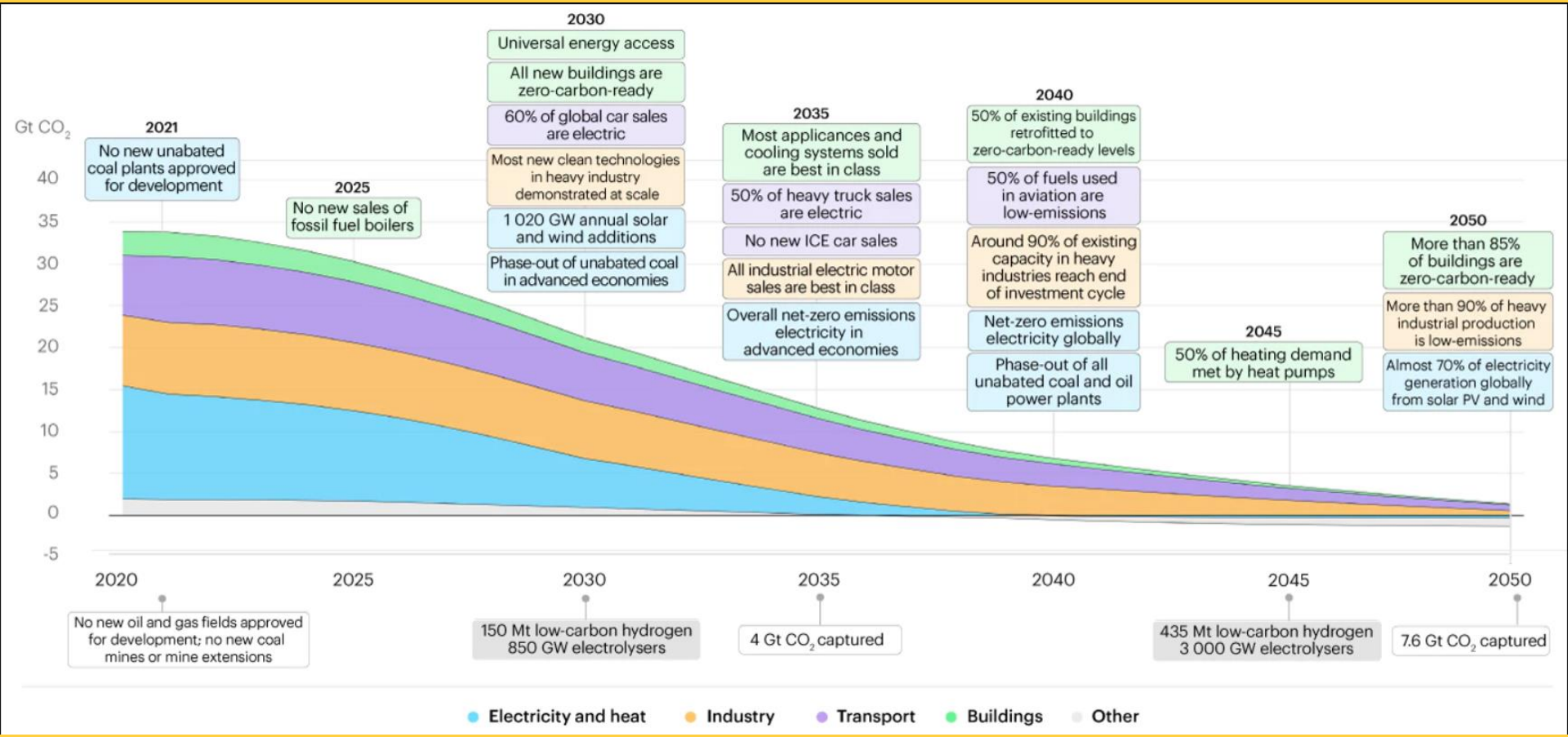
- finalize the Paris Rulebook (the detailed rules that make the Paris Agreement operational)
- accelerate action to tackle the climate crisis through collaboration between governments, businesses and civil society.

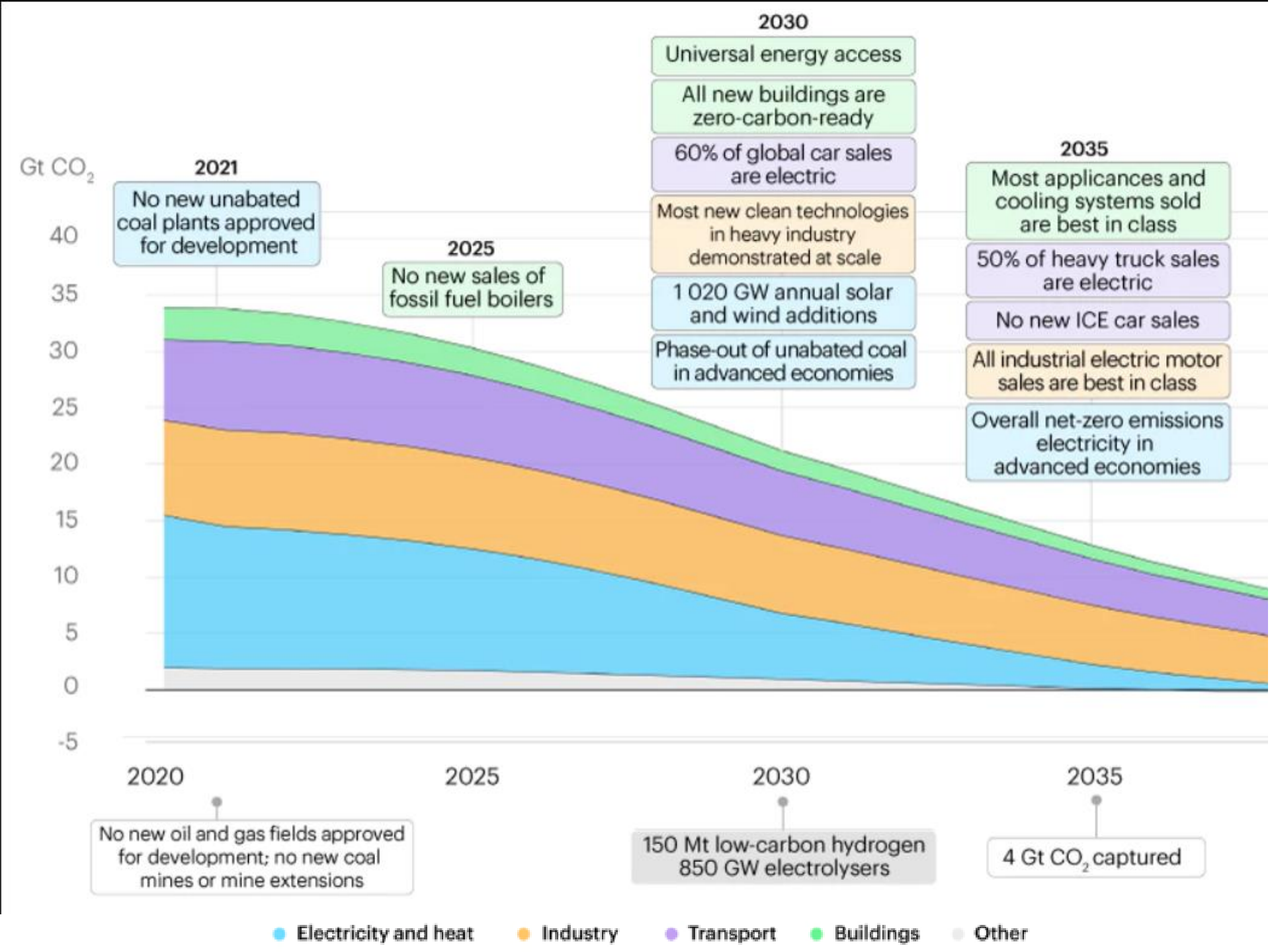
Solutions

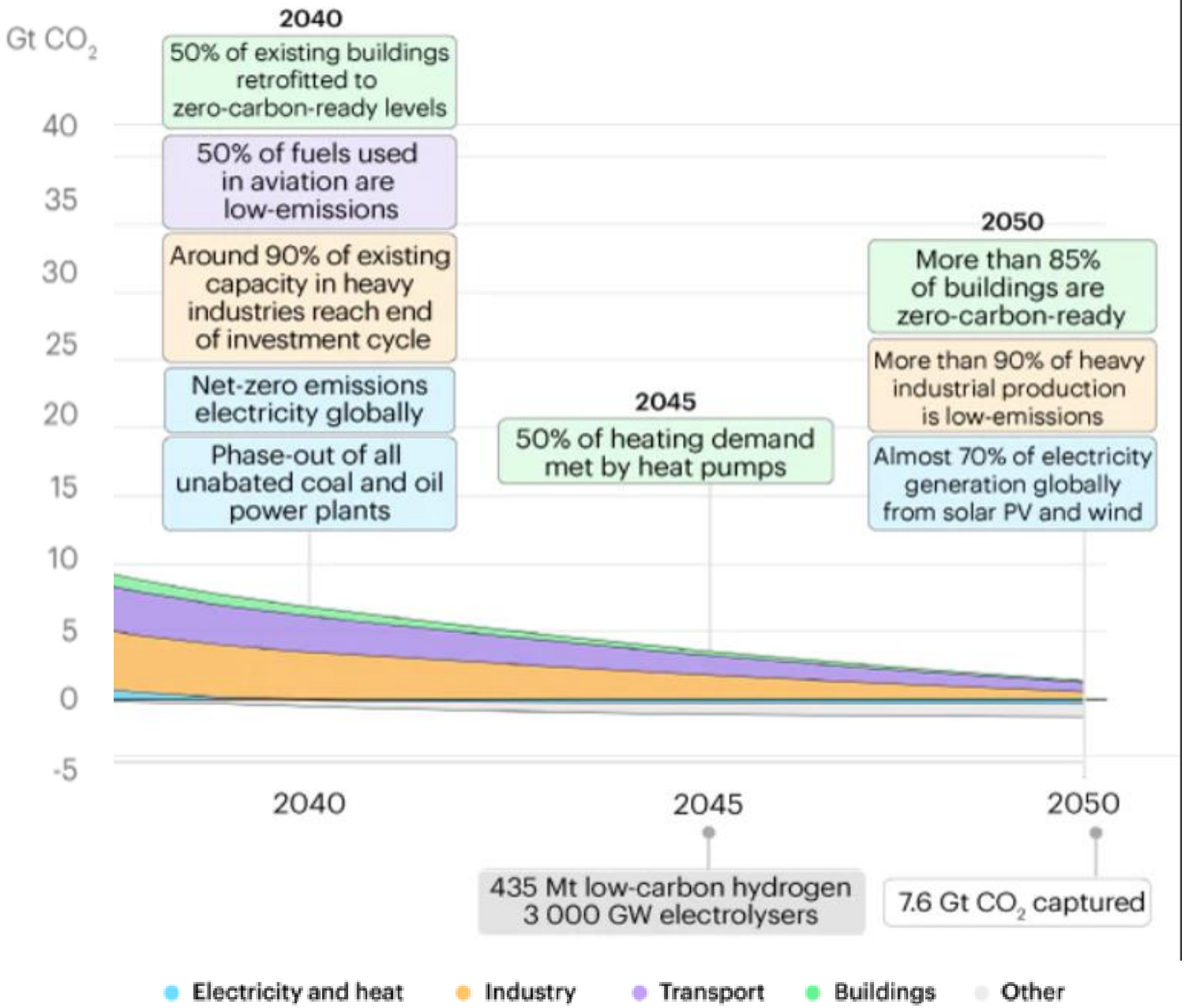
We have most of the technical solutions we require.

What do we need to do, and how do we do it?

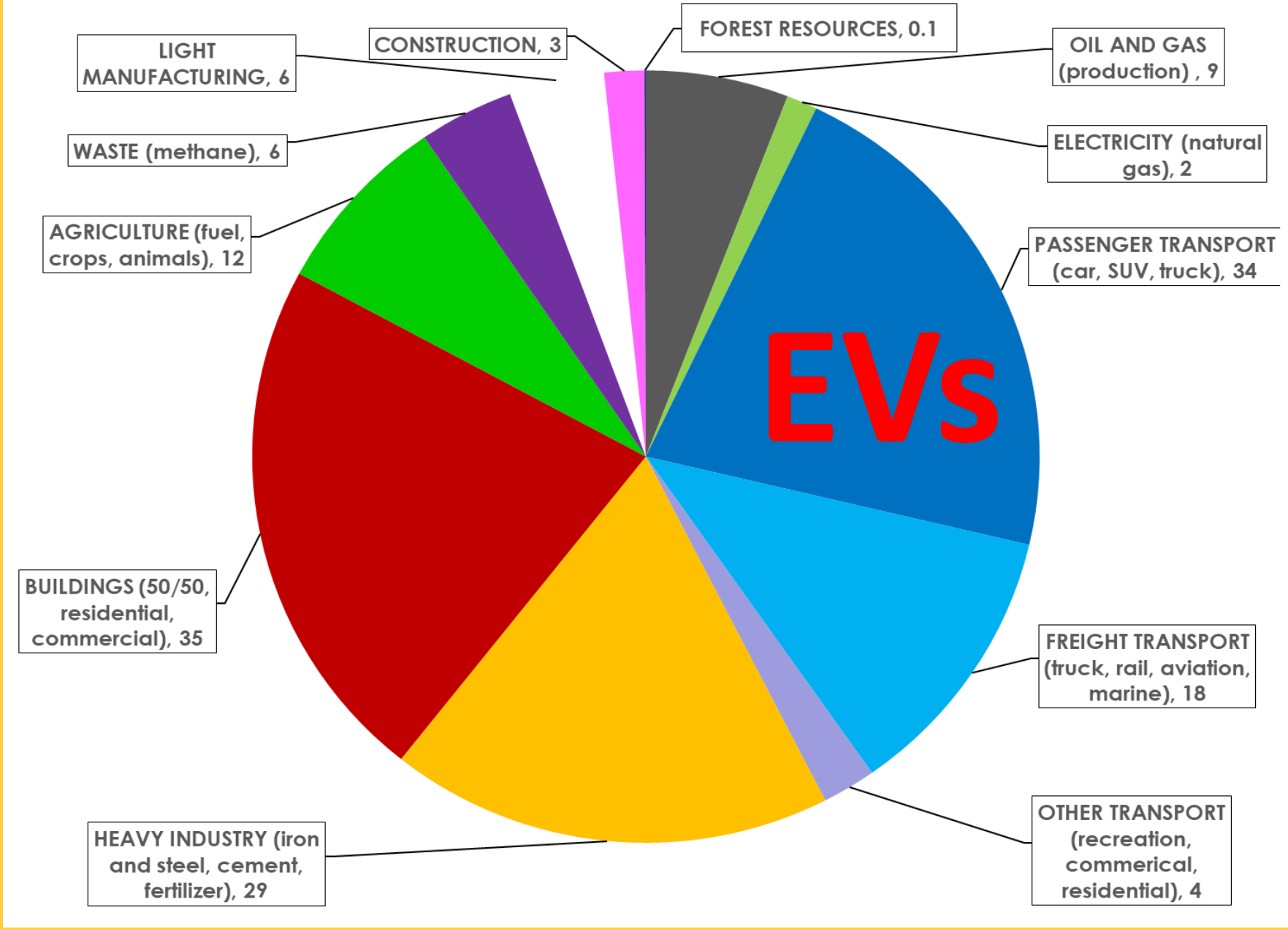
International Energy Agency (IEA)




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

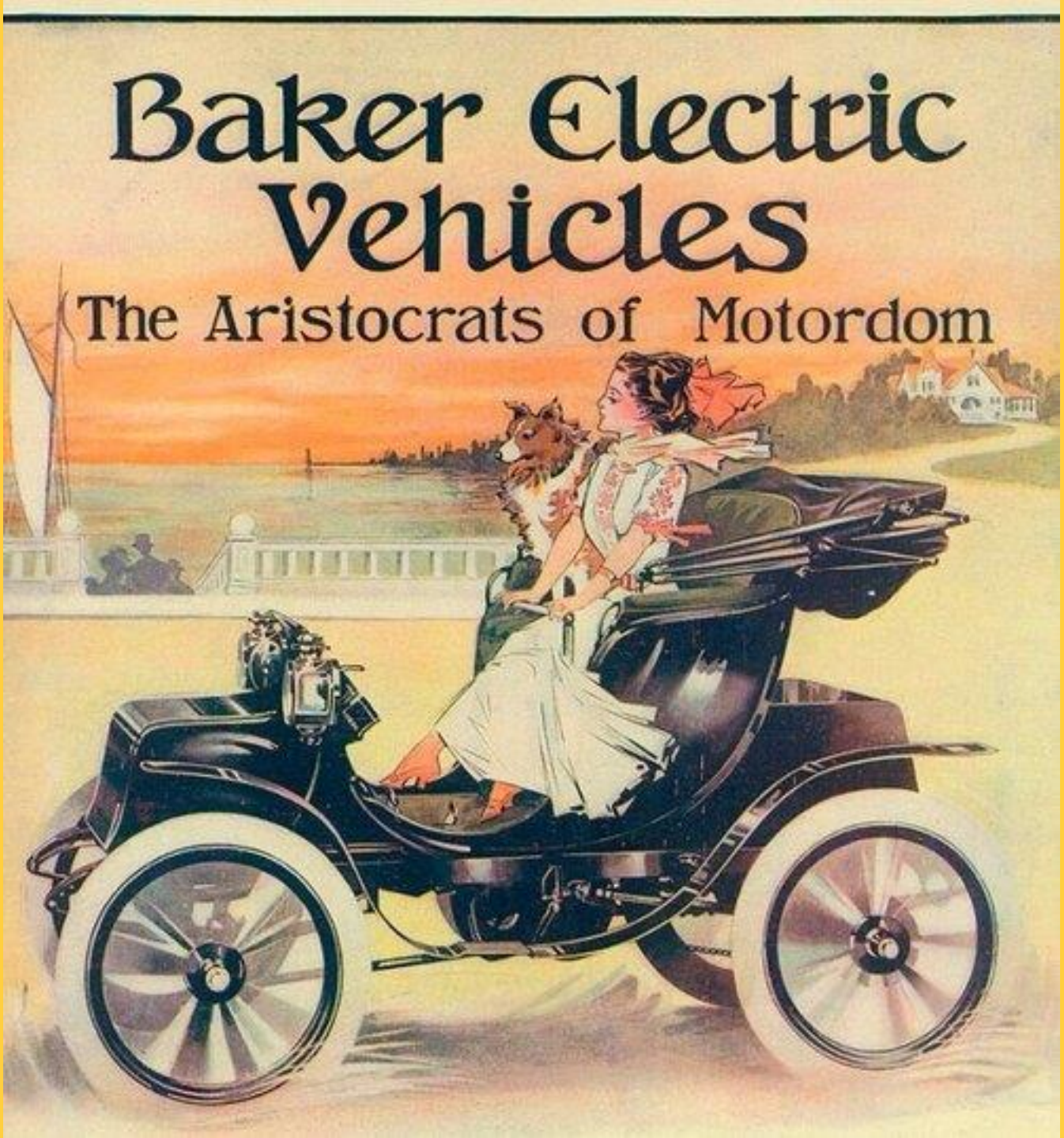

Gt CO_2
40
35
30
25
20
15
10
5
0
-5
2040
50% of existing buildings retrofitted to zero-carbon-ready levels
50% of fuels used in aviation are low-emissions
Around 90% of existing capacity in heavy industries reach end of investment cycle
Net-zero emissions electricity globally
Phase-out of all unabated 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


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









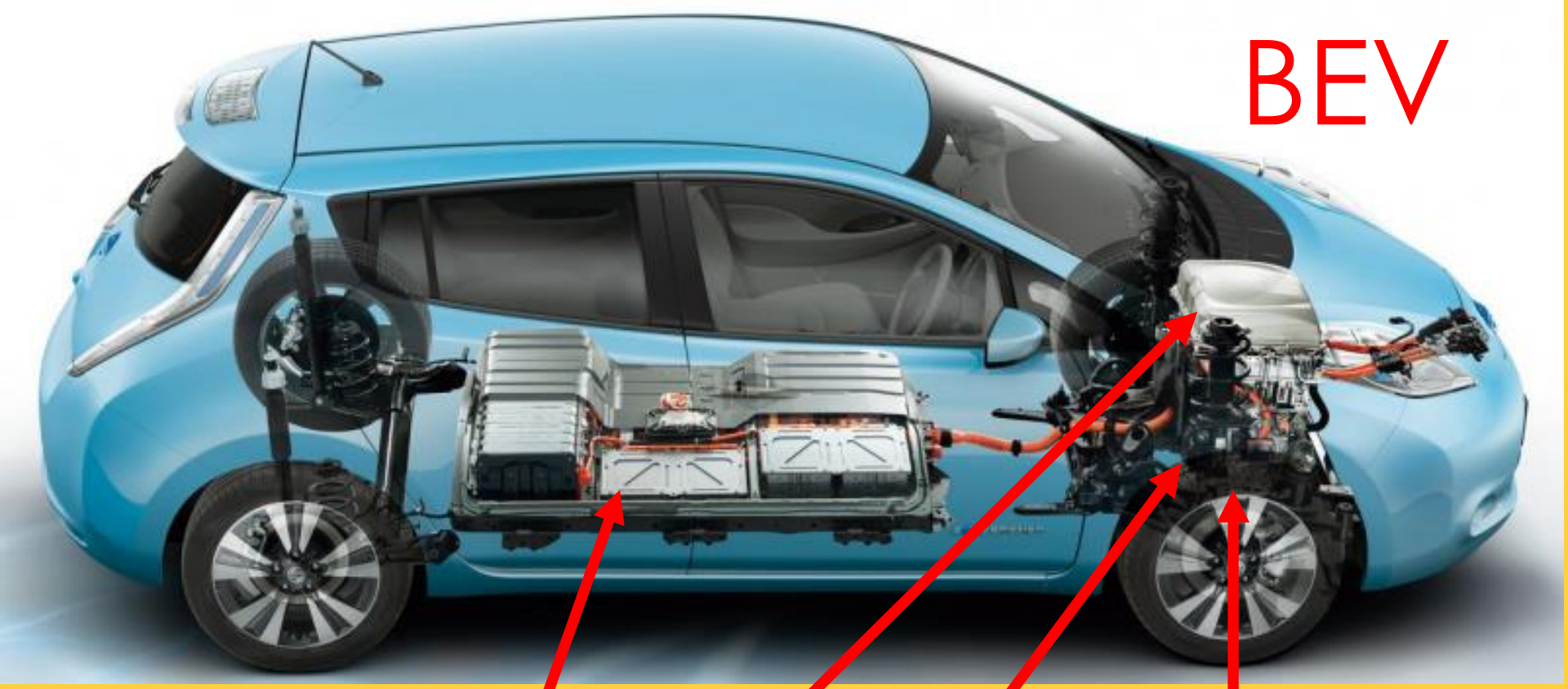








BEV



- Battery
- Inverter
- Electric Motor
- Reducing gears and differential

GHG Emissions

Using an EVs is likely the single biggest GHG emissions reduction a family can make! (in Ontario!)

Gasoline Vehicle*: 2 - 6 t GHG/year

House: N.G.: 4 - 10 t GHG/year

Flying: YYZ/Paris: 2 t GHG/person

Total 8 - 18 t GHG/year

(Ontario 11.3 t GHG/person/year)**

**Ontario data 2017

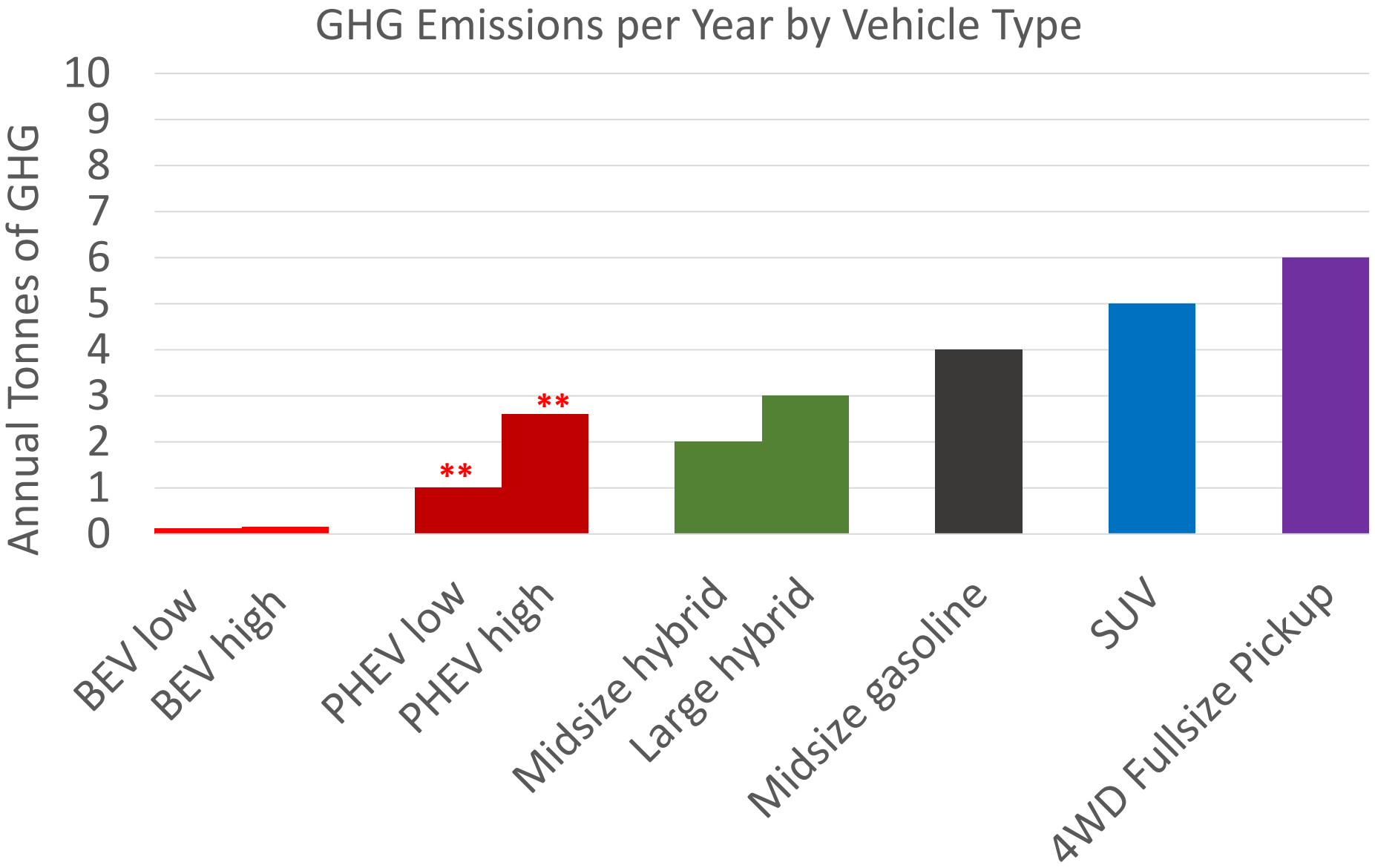
*20,000 km/year

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



20,000 km per year

* 0.04 kg CO_2e Ontario grid emissions

** depends on ratio of EV to gas operation

Gasoline Vehicle*: 2 - 6 t GHG/year

House: N.G.: 4 - 10 t GHG/year

Flying: YYZ/Paris: 2 t GHG/person

Total 8 - 18 t GHG/year

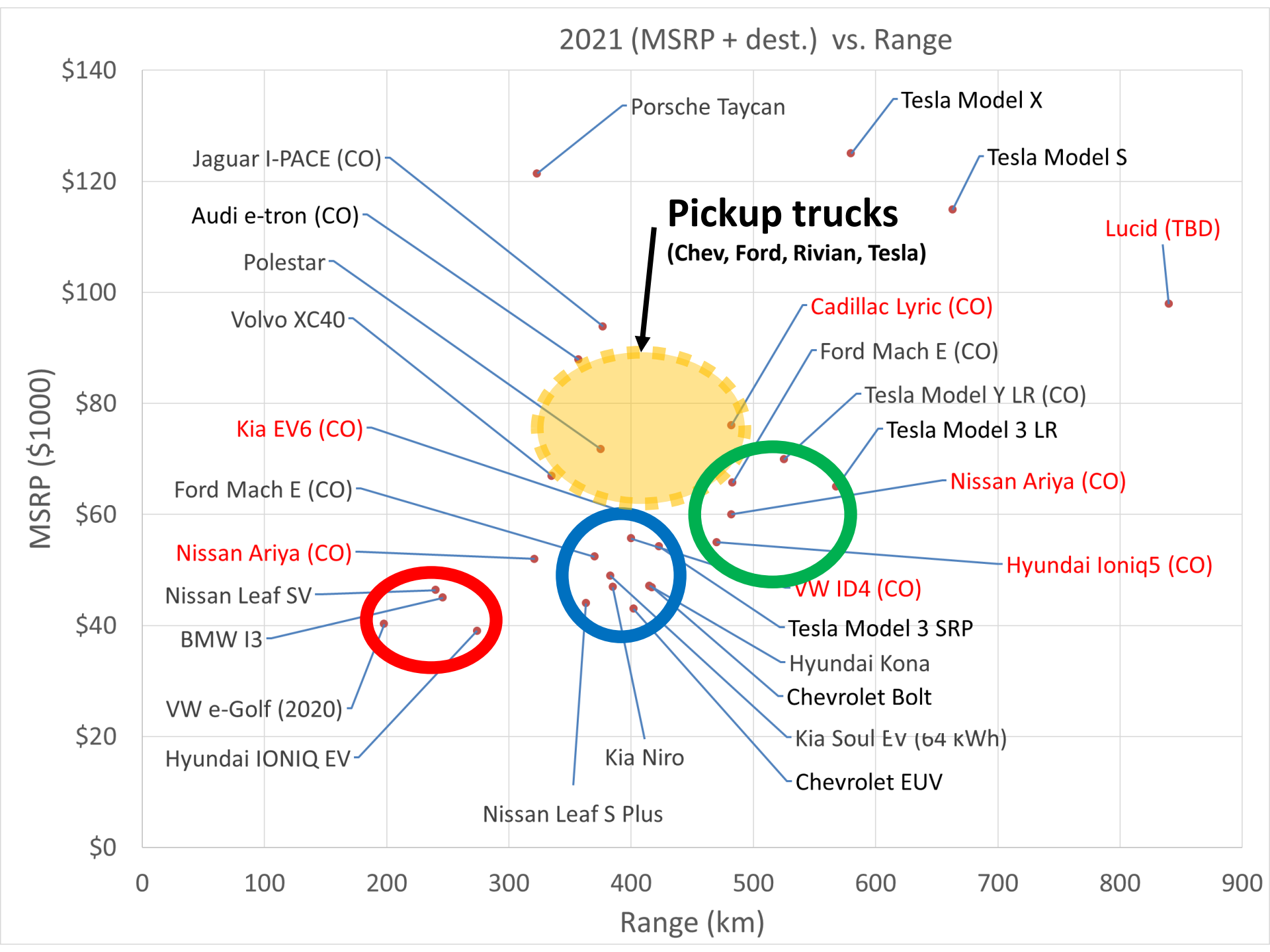
EV: 0.07 t GHG/year

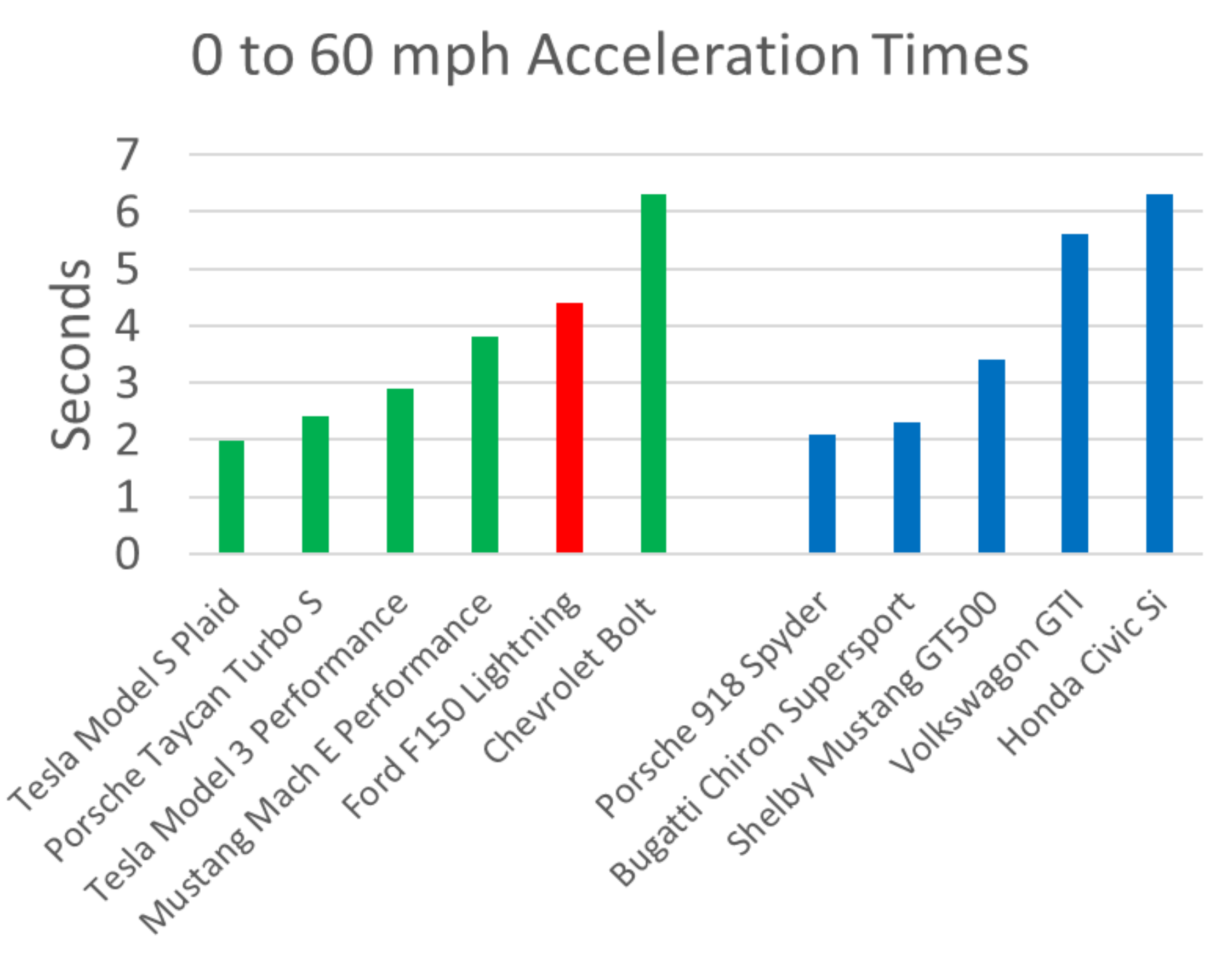
(Ontario 11.3 t GHG/person/year)**

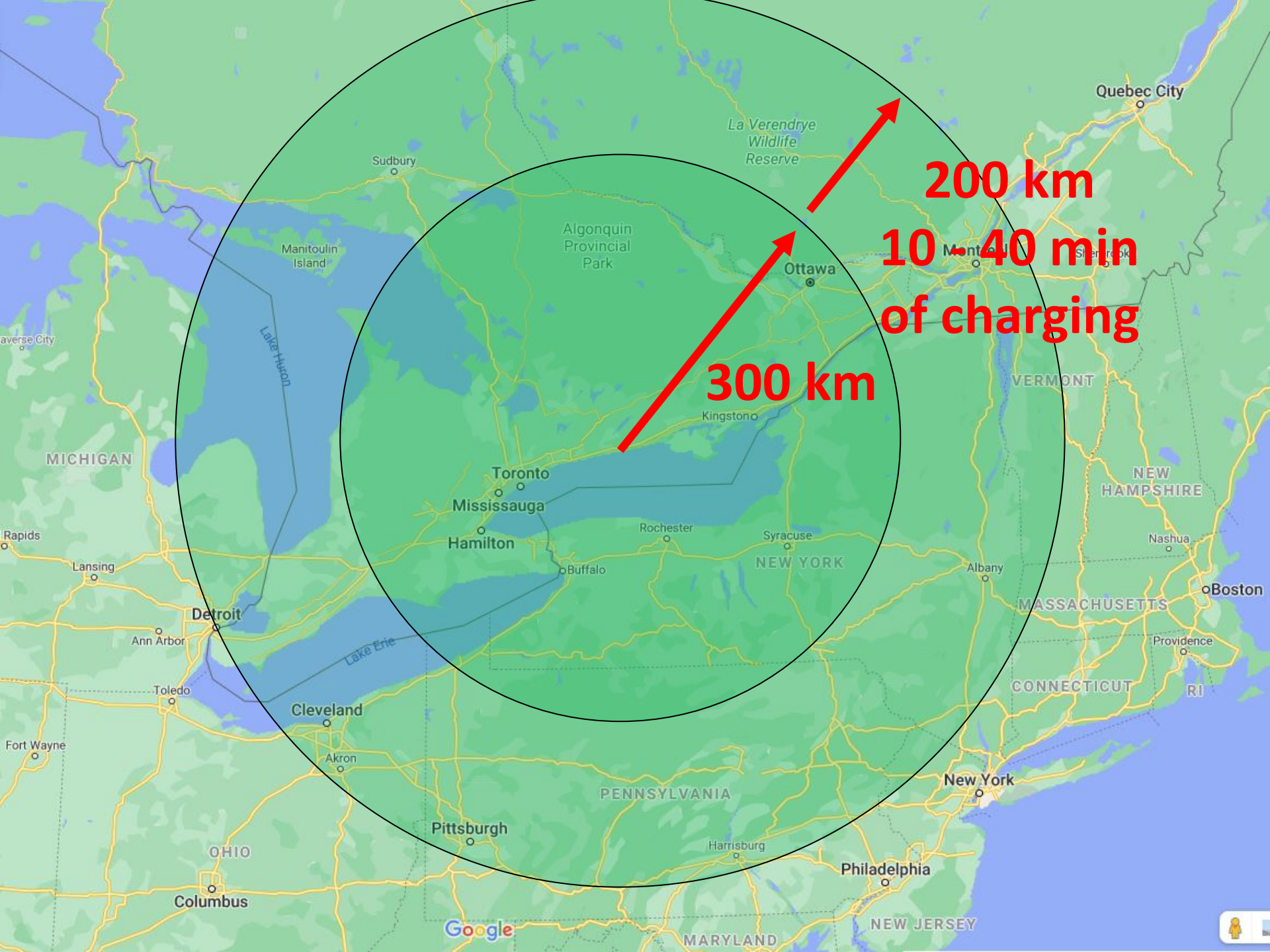
**Ontario data 2017

*20,000 km/year

Range and Price


2021 (MSRP + dest.) vs. Range
MSRP ($1000)
Range (km)
$0
$20
$40
$60
$80
$100
$120
$140
0
100
200
300
400
500
600
700
800
900
Porsche Taycan
Tesla Model X
Tesla Model S
Lucid (TBD)
Jaguar I-PACE (CO)
Audi e-tron (CO)
Polestar
Volvo XC40
Pickup trucks
(Chev, Ford, Rivian, Tesla)
Cadillac Lyric (CO)
Ford Mach E (CO)
Tesla Model Y LR (CO)
Tesla Model 3 LR
Kia EV6 (CO)
Nissan Ariya (CO)
Ford Mach E (CO)
Nissan Ariya (CO)
Hyundai Ioniq5 (CO)
VW ID4 (CO)
Nissan Leaf SV
BMW I3
Tesla Model 3 SRP
Hyundai Kona
Chevrolet Bolt
VW e-Golf (2020)
Kia Soul EV (64 kWh)
Hyundai IONIQ EV
Kia Niro
Chevrolet EUV
Nissan Leaf S Plus


0 to 60 mph Acceleration Times
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
Porsche 918 Spyder
Bugatti Chiron Supersport
Shelby Mustang GT500
Volkswagon GTI
Honda Civic Si


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.

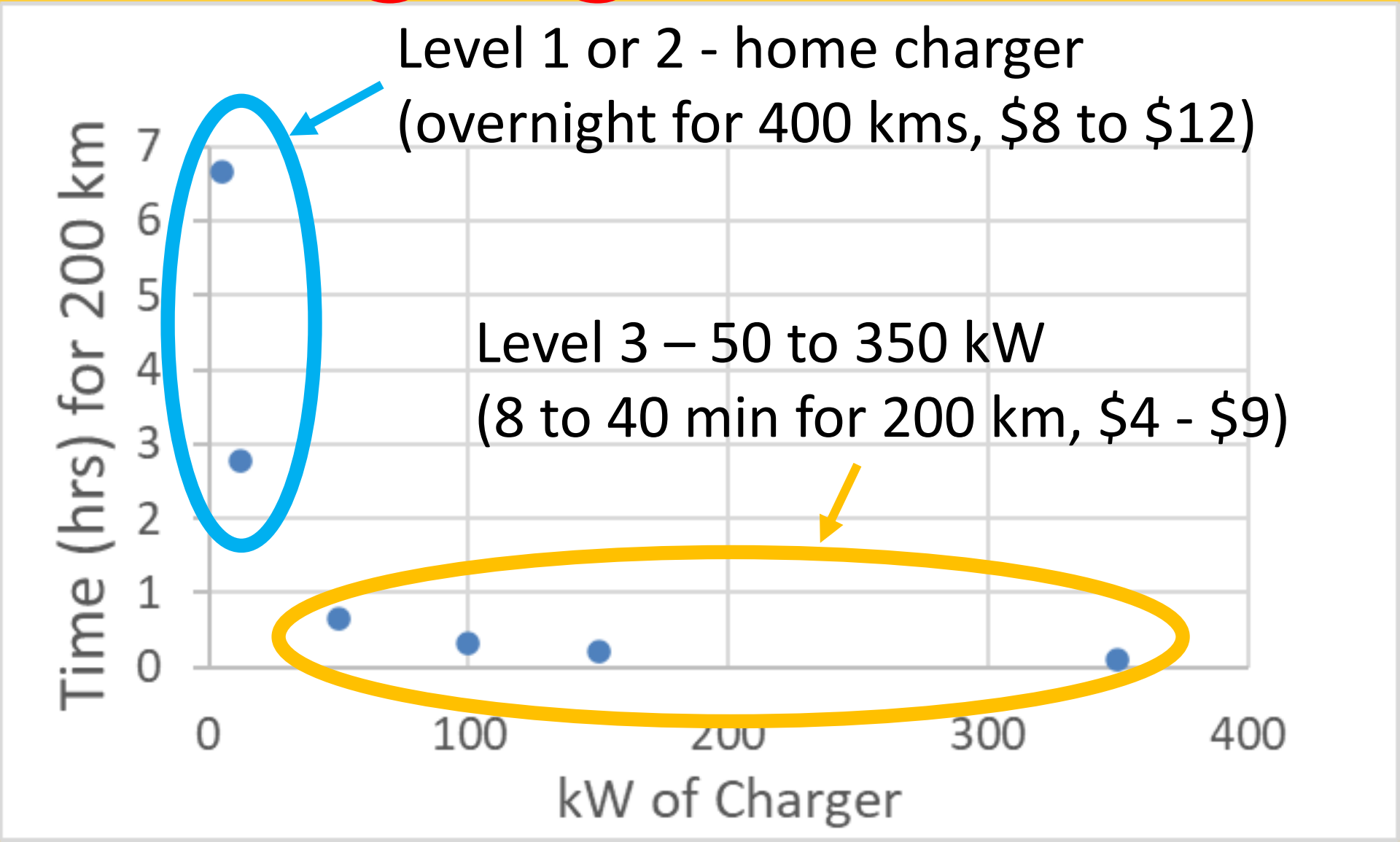
Charging

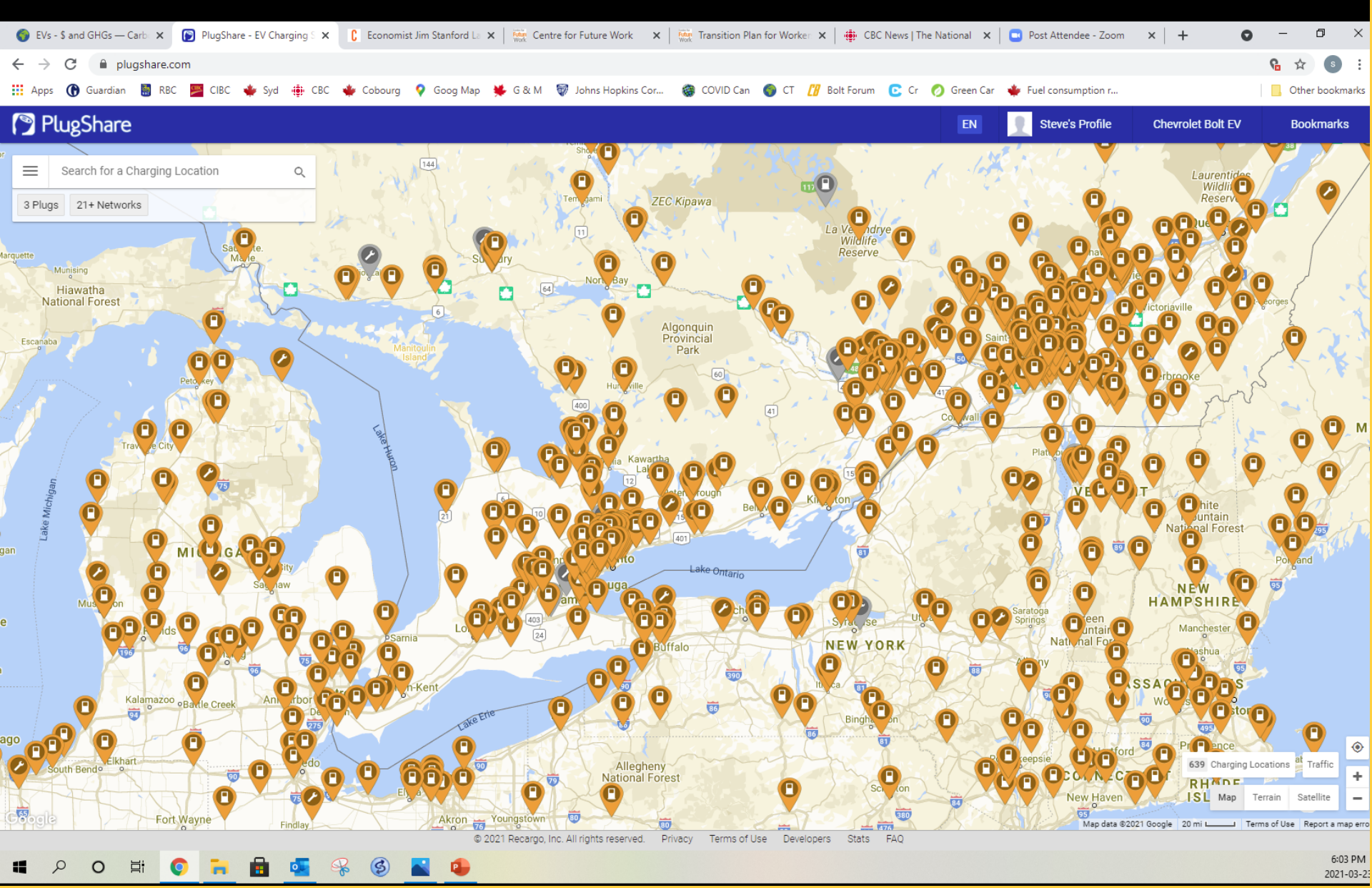
Level 3 High Power

Level 1 and 2 at home or away, J1772

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

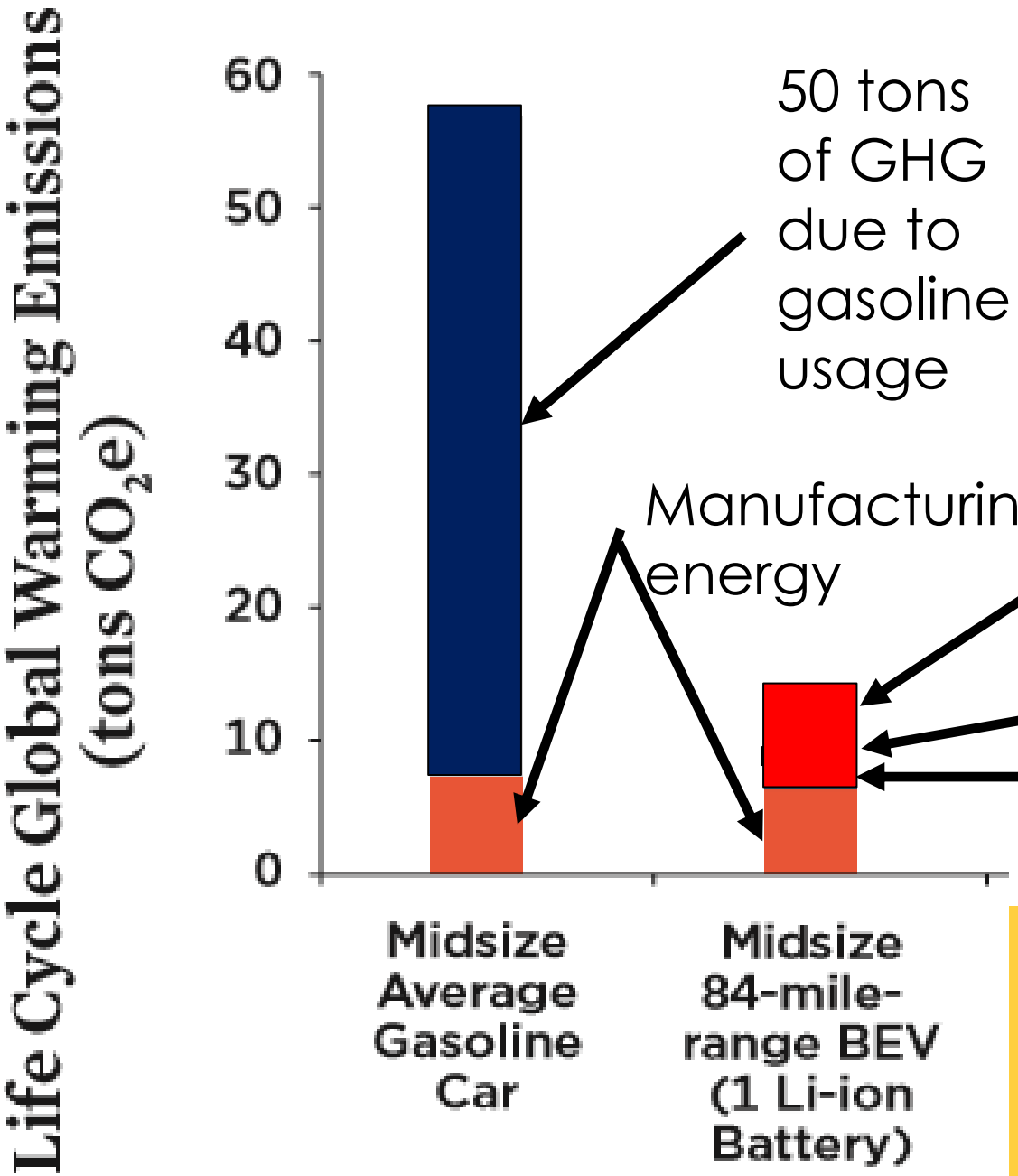
Charging time/km/$





Level 3 “Plugshare.com” screen grab

Climate Change 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

Not to be ignored

- Mining has negative impacts and they can be addressed with policy, laws and through activist pressure – all happening
- Most Critical - We must reduce GHGs

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

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

Economics

	Hyundai Kona	Kona EV	Bolt
new vehicle before tax	**26,154**	**46,301**	**40,098**
tax @13%	**3,400**	**6,019**	**5,213**
Federal rebate	**0**	**5,000**	**5,000**
distance km/year	**20,000**	**20,000**	**20,000**
gasoline $/litre	**1.4**	**n/a**	**n/a**
fuel economy l/100km	**7.9**	**6.5 km/kWh**	**6.5 km/kWh**
kWh electricity		**3419**	**3419**
$/year electricity		**513**	**513**
Capital Cost	$29,554	$48,246	$36,113
Insurance/year	$800	$1,000	$1,000
2021 annual energy cost	$2,212	$513	$513
2022 annual energy cost	$2,278	$528	$528
2023 annual energy cost	$2,347	$544	$544
2024 annual energy cost	$2,417	$560	$560
2025 annual energy cost	$2,490	$577	$577
5 year energy cost	11744	2723	2723
5 year insurance cost	4000	5000	5000
5 years maintenance	5000	2500	2500
Resale	15368	25088	18779
Total 5 years cash	**$34,930**	**$33,381**	**$27,557**
5 years GHG (tonnes)	**18**	**0.7**	**0.7**

Finally

- EVs in Ontario lower your family's GHG emissions significantly – address Climate Change!!!!!
- Basic EVs have similar ownership cost to equivalent fossil fuel cars
- Long distance travel entirely feasible
- EVs are a key technology to address the climate crisis.
- But better to cycle or walk if you can!

Thank you for your attention.

Questions?

lappstve@kos.net

Carbontakedown.com

The End