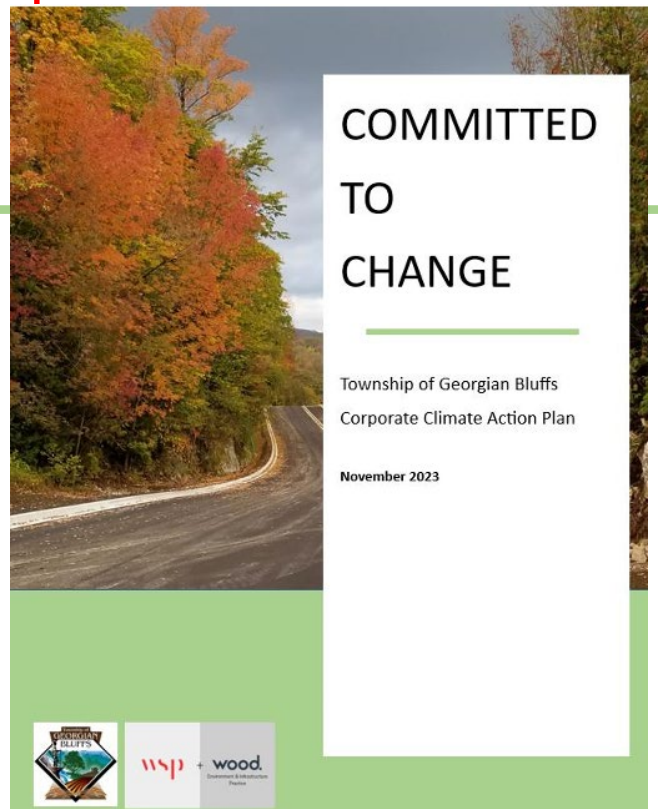
Why a 30 year fleet plan with annual emissions calculator?

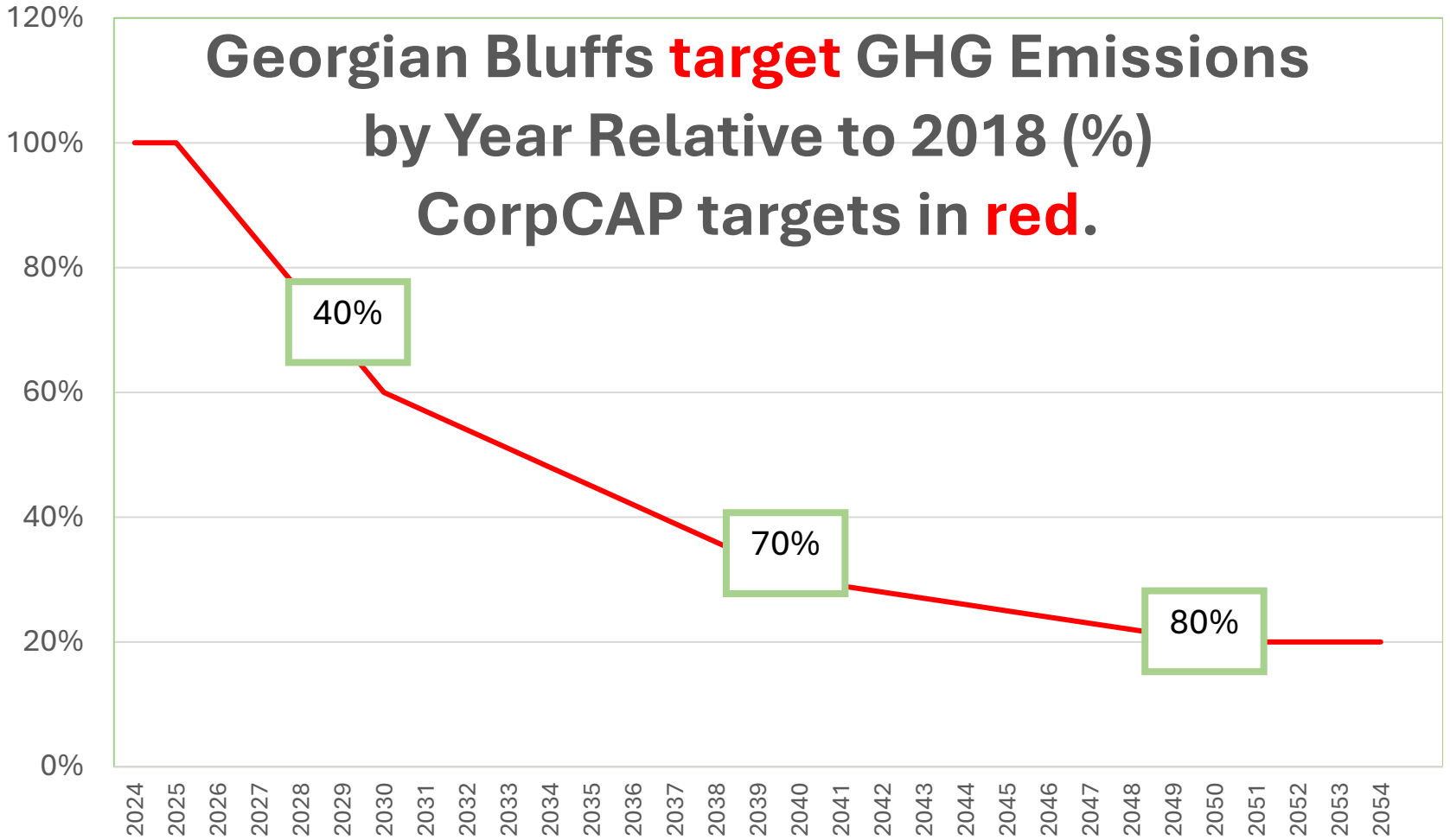
Roger Martin, October 23, 2024


Reason # 1

Reason # 2

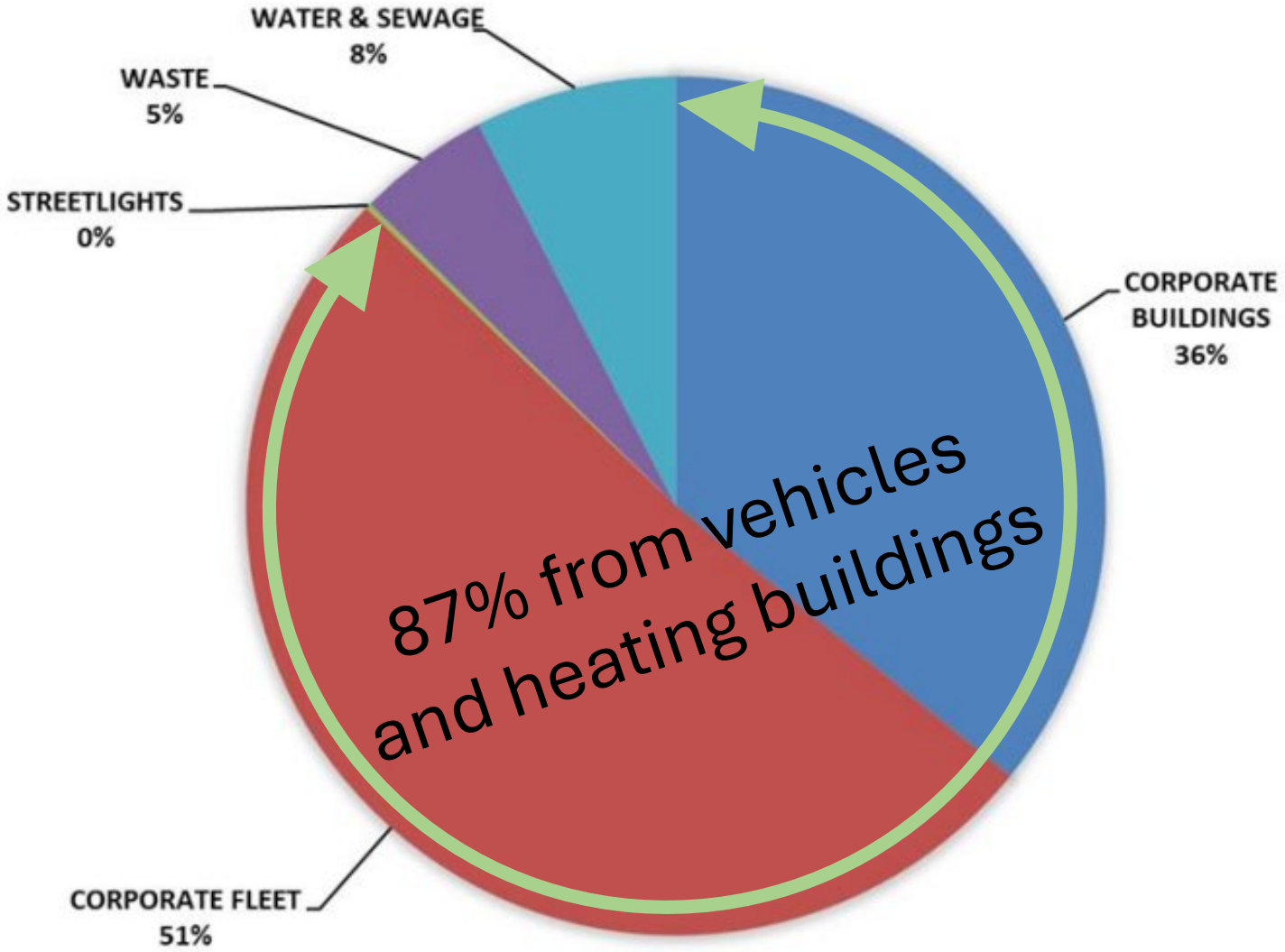
GB Corporate Climate Action Plan (Nov 23), covering municipal operations.





Where do Georgian Bluffs' emissions come from?
Emissions by activity, 2018

(Source: *Committed to Change,* Georgian Bluff's Corporate Climate Action Plan)



Good news:

huge emissions reductions can be achieved by electrification using Ontario's very low carbon grid.

More good news: sample commitments from the global truck manufacturers who make GB's trucks

Volvo truck – "We are committed to the goals of the Paris agreement and have signed up to Science Based Targets. To meet this, by 2050 our rolling population of trucks must be net-zero. That means that from 2040 we aim to be net-zero in our supply chain, since it takes approximately ten years to replace the rolling population"

Daimler truck (Freightliner, Mercedes- Benz) – "By 2039, our ambition is to offer only new vehicles that are CO_2e-neutral in driving operation ("from tank to wheel") in Europe, North America and Japan."

Ford truck - "The company has committed to achieving zero emissions in heavy commercial vehicle production by 2040."

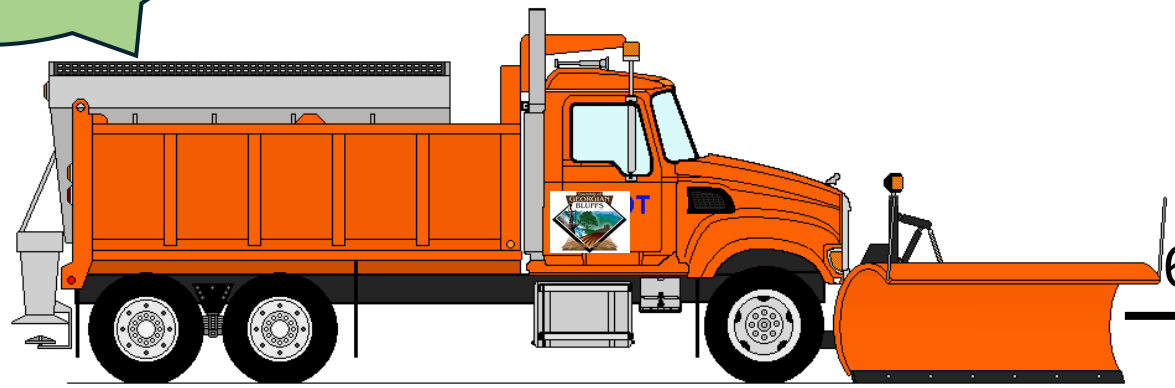
Georgian Bluffs' Current Fleet: emissions and EV availability

Available Now!

40% GHG →

Diesel	Gas
27 t CO_{2e}	64 t CO_{2e}
12%	28%

Available by 2040



60% GHG →

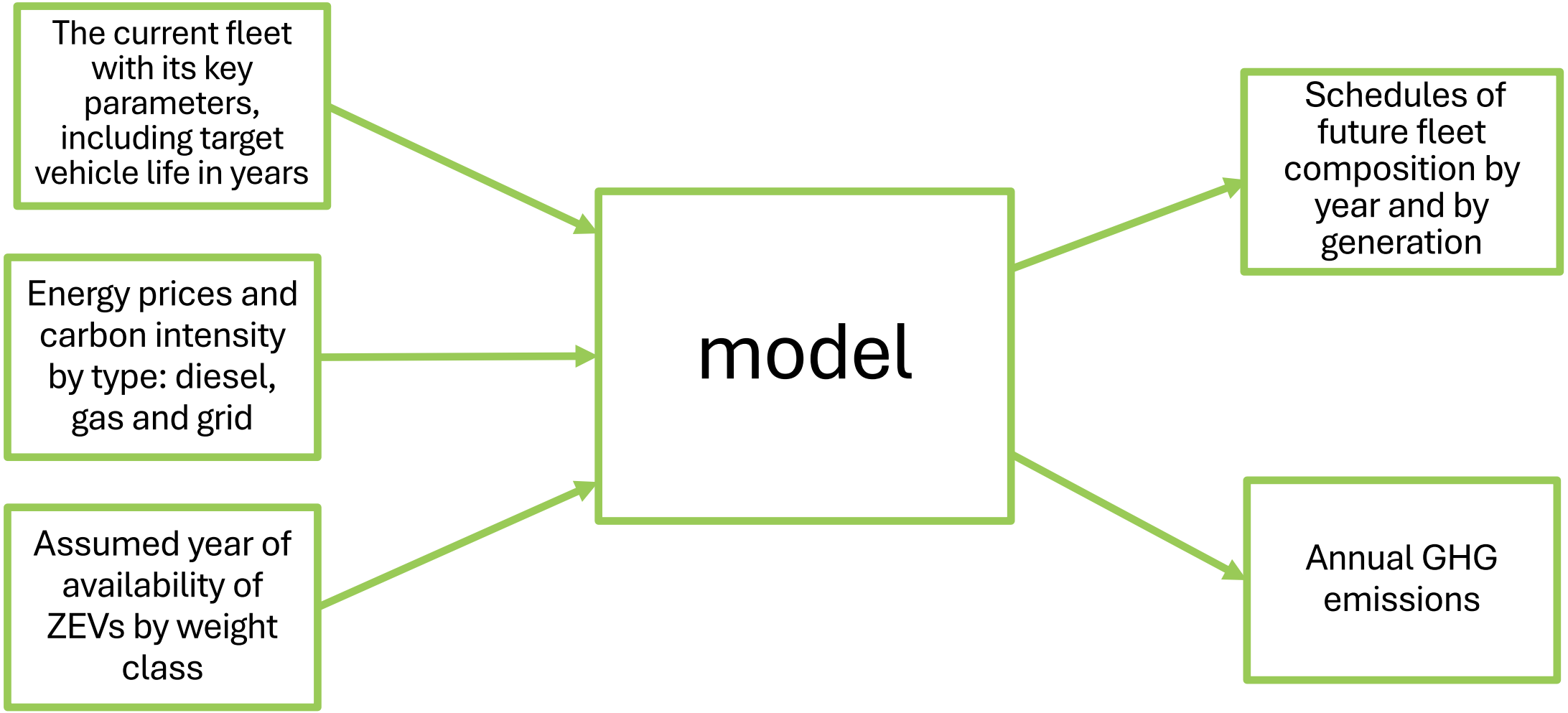
137 t CO_{2e}	0 t CO_{2e}
60%	0%

What are the premises of the 30 year fleet plan?

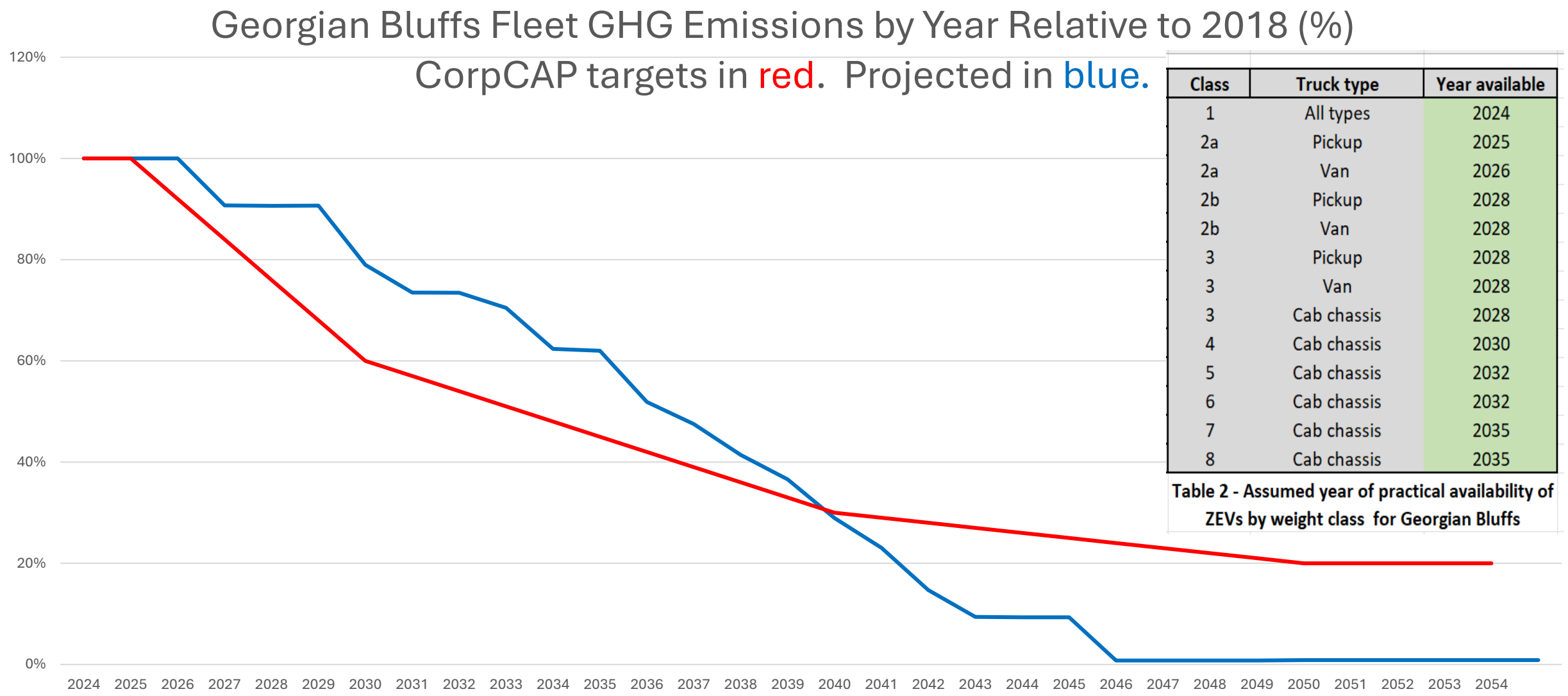
1. GB will purchase a new vehicle only after the current vehicle doing a particular job has reached end of life

2. GB will replace an internal combustion engine vehicle (ICE) with a zero emission vehicle (ZEV) only if there is a commercially practical ZEV to do the job, both in terms of performance and expected total cost of ownership (TOC)

Inputs and outputs of the planning model



Sample output – expected fleet GHG emissions by year with ZEV year-of-availability assumptions



Class	Truck type	Year available
1	All types	2024
2a	Pickup	2025
2a	Van	2026
2b	Pickup	2028
2b	Van	2028
3	Pickup	2028
3	Van	2028
3	Cab chassis	2028
4	Cab chassis	2030
5	Cab chassis	2032
6	Cab chassis	2032
7	Cab chassis	2035
8	Cab chassis	2035

Table 2 - Assumed year of practical availability of ZEVs by weight class for Georgian Bluffs

Conclusion: how this model can help now and in the future

NOW: We can play with it and get a sense of how different purchase decisions will affect our fleet GHG emissions. We can explore how the timing of the future availability of heavy-duty ZEVs will affect our emissions. We can compare expected lifetime fuel costs, ICE vs. EV. We can specify charging infrastructure needed for EV trucks based on daily range requirements. And more.

IN THE FUTURE: As the input variables to the model change, as they inevitably will – fuel and vehicle prices, actual carbon intensities, actual availability of ZEVs – we can just put the new variables into the model and see what it says to us.

End of presentation

Questions?

Slides 13 to 24, following, provide further information for those interested

Table of Contents for Supplementary Slides

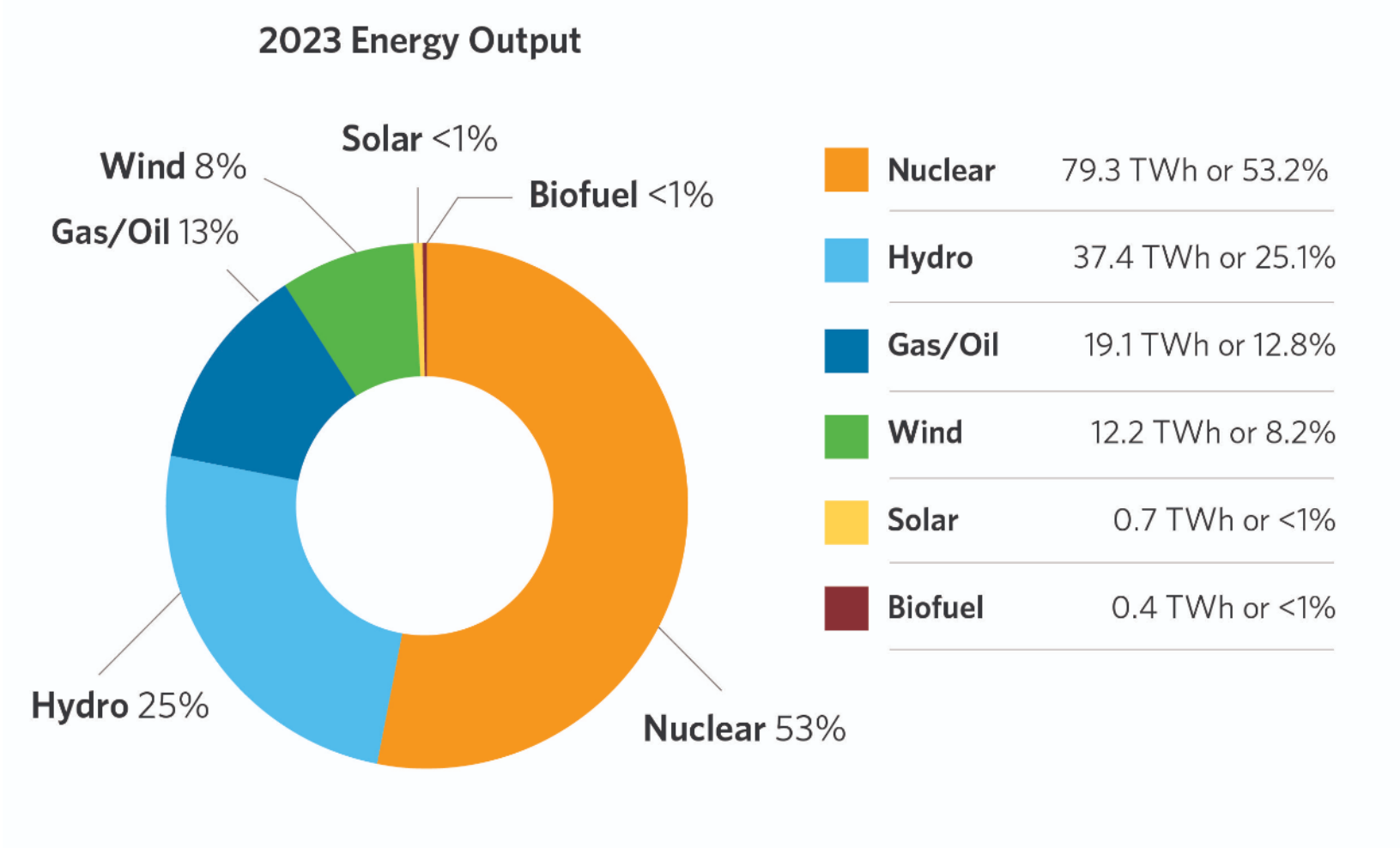
Georgian Bluffs' GHG Reduction Targets and those of Other Jurisdictions

	2030	2035	2050
Canada, 2015 Paris Accord commitment	30% below 2005		Net Zero
Canada, 2021 Paris Accord commitment	40-45% below 2005	all grids net zero	Net Zero
Ontario, 2018 commitment, renewed 2024	30% below 2005		
Grey County Corporate	40% below 2018		Net Zero
Grey County Community	30% below 2018		Net Zero
Owen Sound Corporate	35% below 2018	50% below 2018	Net Zero
Owen Sound Community	30% below 2018	50% below 2018	Net Zero
Georgian Bluffs Corporate	40% below 2018	55% below 2018	80% below 2018
North Bruce Peninsula	30% below 2018		Net Zero
Huron Kinloss	30% below 2018		Net Zero

Energy Inputs to Ontario's Grid, 2023

We already have a low-carbon grid!

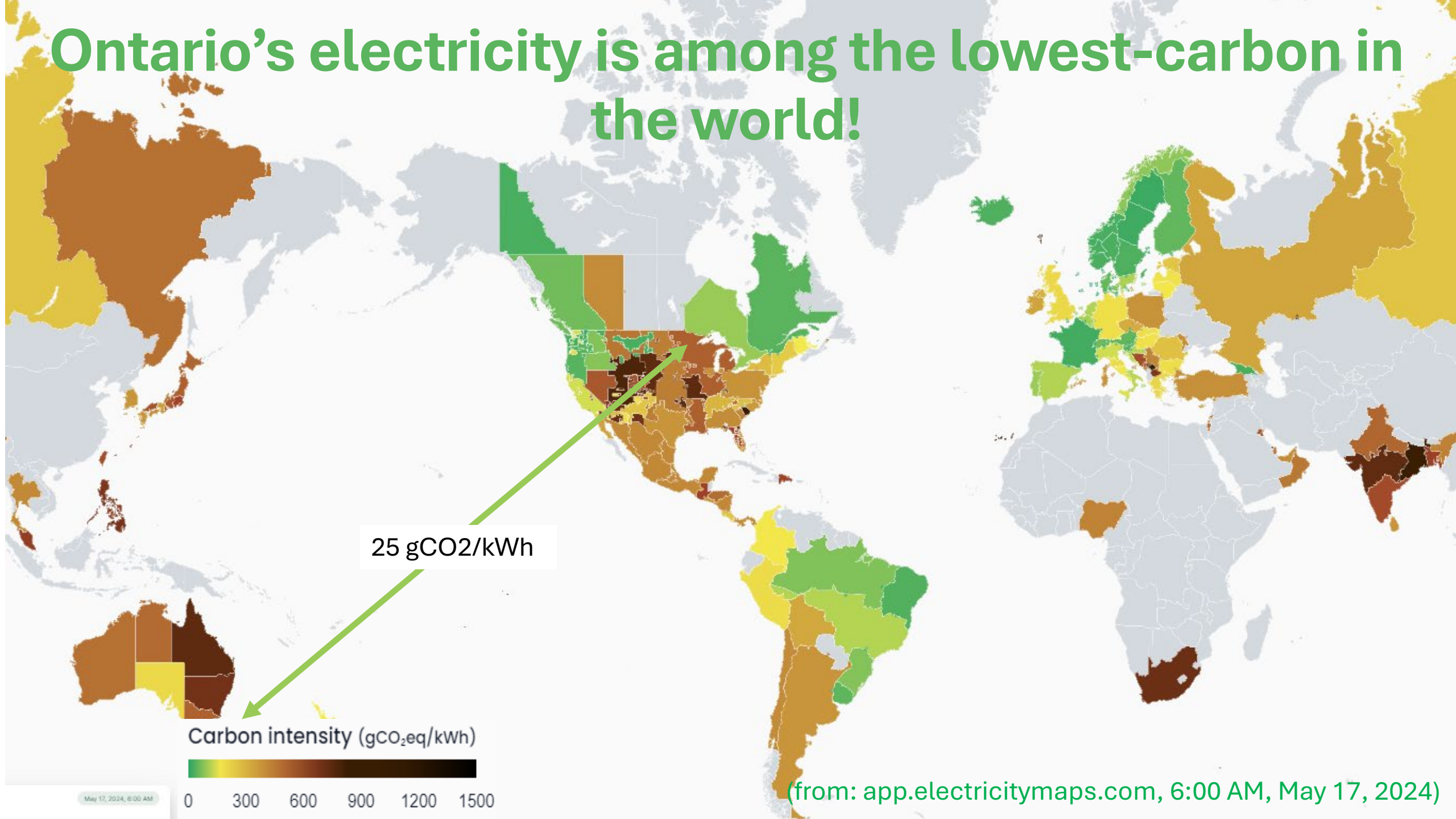
(Among the lowest in the world)



Total Electricity Output by Source in 2023 (Source: Year End Data)

And, Ontario's Independent Electricity Systems Operator (IESO) plans to make our grid bigger and even cleaner over the next 25 years.

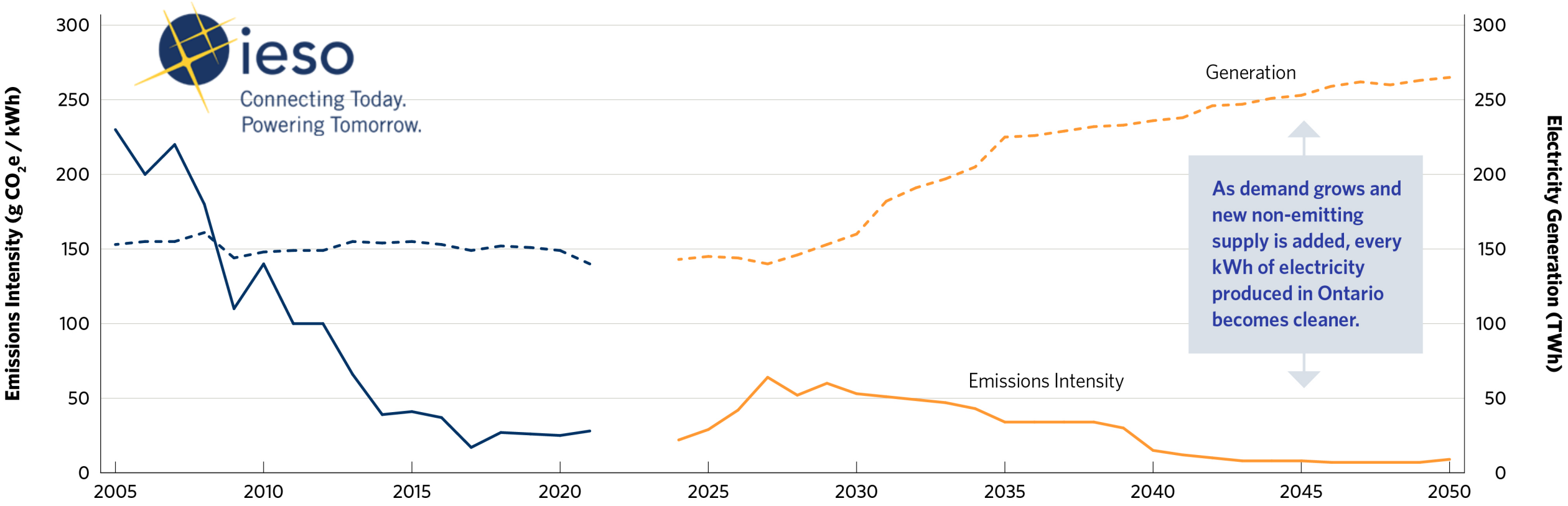
Ontario's electricity is among the lowest-carbon in the world!



(from: app.electricitymaps.com, 6:00 AM, May 17, 2024)

To enable clean electrification of transportation and heating, Ontario's Independent Electricity Systems Operator (IESO) plans to make our grid bigger and cleaner over the next 25 years.

Carbon Emissions Intensity



Source: IESO Submission on ECCC's Clean Electricity Regulations: Public Update

Why is an EV's GHG emissions so much lower than an ICE's?

We need to look at two variables:

"carbon intensity"

"energy conversion efficiency"

Carbon Intensity: gCO_2e / kWh

Grams of carbon dioxide equivalent per kilowatt-hour of energy generated

What are the carbon intensity numbers for the Georgian Bluffs fleet?

Energy source	Carbon intensity (gCO2e/kWh)
Diesel	245
Gasoline	255
Ontario grid energy now	25
Ontario grid energy 2045	10

And what is the energy conversion efficiency for the Georgian Bluffs fleet?

Drivetrain type	Energy "in"	Energy "out"	"out"/"in" (%)
Internal combustion (ICE)	Diesel or gasoline	Traction at wheels	21%
Electric (EV)	Ontario grid	Traction at wheels	76%

These numbers will vary from vehicle to vehicle and depend on driving conditions, notably outside temperatures, but:

the rough ratio of 3:1 of EV efficiency to ICE efficiency is valid.

How do these two variables work together?

Drivetrain type	Carbon intensity "in"	Conversion efficiency	Carbon intensity "out"	% of ICE GHGs
ICE	245	21%	1167	100%
EV	25	76%	33	3%

charging from the current Ontario grid:

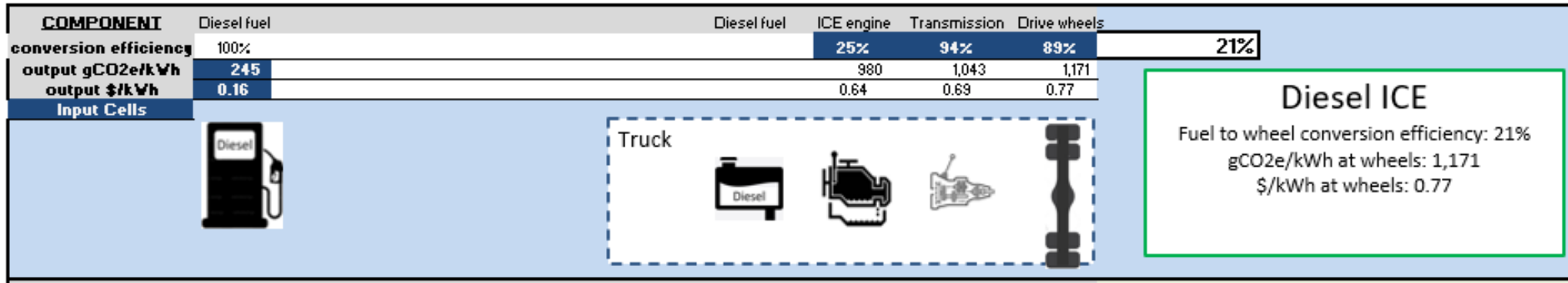
an EV will emit between 3% and 5% of the GHGs of an equivalent ICE…!!

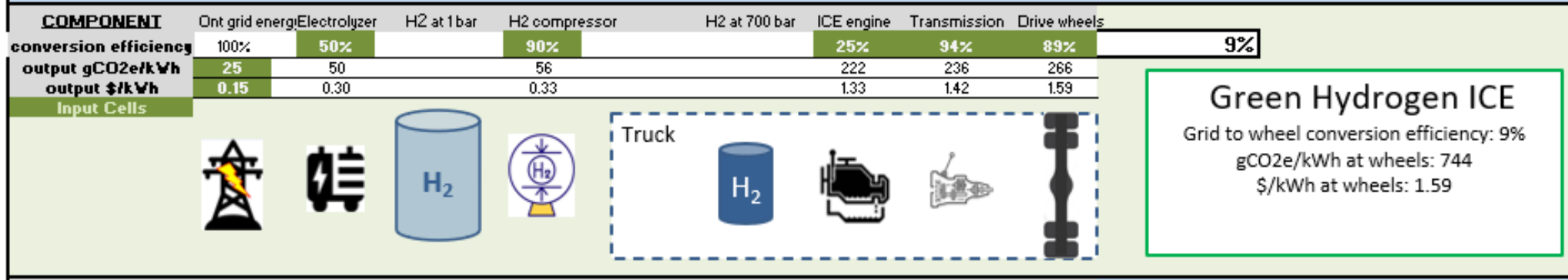
This will drop to about 1% once IESO achieves its carbon intensity goals.

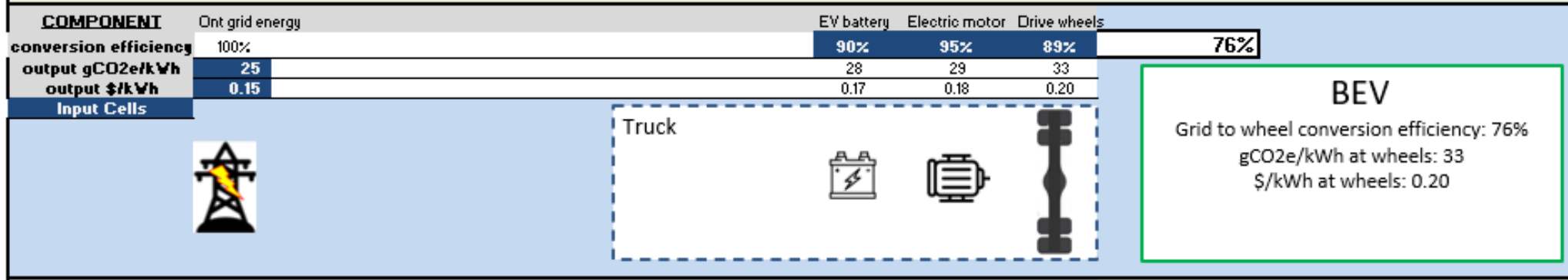
Currently, there are no EVs in the fleet. In the next turnover of vehicles, "Gen 2" below, 9 of 21 vehicles are EVs. By "Gen 3", which starts in 2033 and ends in 2047, all vehicles are EVs.

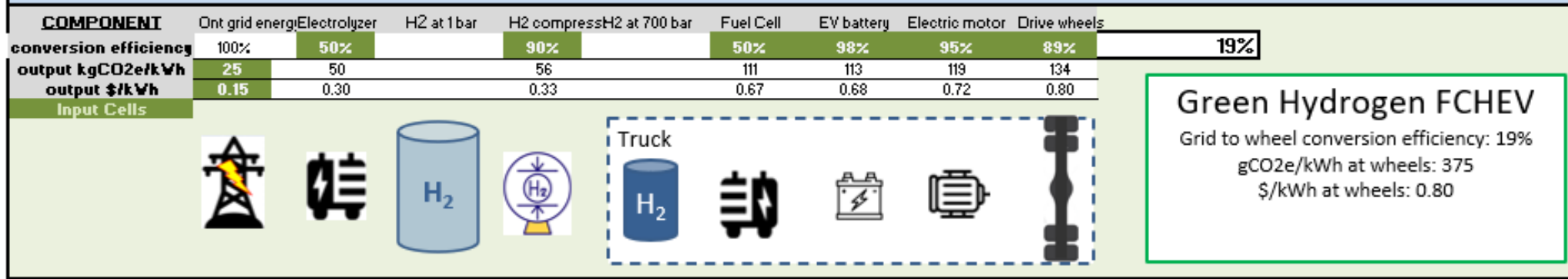
Heavy Duty							Target Repl		Target Repl		Target Repl	
Year	Type (gen 1)	Fuel Type	Dept	Description	Class	Target Life	Gen 2	Fuel Type	Gen 3	Fuel Type	Gen 4	Fuel Typ
						(yr)	(calendar yr)		(calendar yr)		(calendar yr)	
2008	White International Plow Truck	Dsl	Road	Single Axle Plow Truck	7	12	2024	Dsl	2036	EV	2048	EV
2009	Volvo Tandem	Dsl	Road	Tandem Axle Plow Truck	8	12	2025	Dsl	2037	EV	2049	EV
2010	Volvo Plow	Dsl	Road	Single Axle Plow Truck	8	12	2026	Dsl	2038	EV	2050	EV
2012	International Tandem	Dsl	Road	Tandem Axle Plow Truck	8	12	2027	Dsl	2039	EV	2051	EV
2013	International Plow	Dsl	Road	Single Axle Plow Truck	7	12	2028	Dsl	2040	EV	2052	EV
2015	International Tandem	Dsl	Road	Tandem Axle Plow Truck	8	12	2029	Dsl	2041	EV	2053	EV
2017	International Plow	Dsl	Road	Single Axle Plow Truck	7	12	2030	Dsl	2042	EV	2054	EV
2021	Western Star	Dsl	Road	Single Axle Plow Truck	7	12	2033	Dsl	2045	EV	2057	EV
2023	Frieghtliner	Dsl	Road	Single Axle Plow Truck	7	12	2035	EV	2047	EV	2059	EV
Light Duty												
2007	2007 Chevy Silverado 3500 Crew	Dsl	Road	One Ton - Crew Cab	3	10	2025	Dsl	2035	EV	2045	EV
2015	2015 Chev Silverado WT150 Crew	Gas	Road	1/2 Ton Pickup - Crew Cab	2a	7	2026	EV	2033	EV	2040	EV
2017	2017 GMC Sierra 1500	Gas	Road	1/2 Ton Pickup - Crew Cab	2a	7	2026	EV	2033	EV	2040	EV
2019	2019 Ford F250	Dsl	Road	3/4 Ton Pickup - 2 Seats	3	7	2026	Dsl	2033	EV	2040	EV
2020	2020 Dodge Ram 4500	Gas	Road	3 Ton - Crew Cab	3	10	2030	EV	2040	EV	2050	EV
2022	2022 Chevrolet Silverado 1500	Gas	Road	1/2 Ton Pickup - Crew Cab	2a	7	2029	EV	2036	EV	2043	EV
2018	2018 Dodge Ram 2500	Dsl	Parks	3/4 Ton Pickup - Reg Cab	3	7	2025	Dsl	2032	EV	2039	EV
2019	2021 Dodge Ram 2500	Dsl	Parks	3/4 Ton Pickup - Crew Cab	3	7	2026	Dsl	2033	EV	2040	EV
2015	2015 Hyundai Tucson	Gas	Shared	Office Vehicle	1	7	2026	EV	2033	EV	2040	EV
2022	2022 Dodge Ram 1500	Gas	Building	1/2 Ton Pickup - Crew Cab	2a	7	2029	EV	2036	EV	2043	EV
2022	2022 Dodge Ram 1500	Gas	Bylaw	1/2 Ton Pickup - Crew Cab	2a	7	2029	EV	2036	EV	2043	EV
2022	2022 Ford F150	Gas	Operations	1/2 Ton Pickup - Crew Cab	2a	7	2029	EV	2036	EV	2043	EV

The figure to the right shows the relative delivered energy costs at the wheels, in dollars and in GHG emissions, of different drive trains, based only on the primary energy cost and carbon intensity and the conversion efficiencies of the elements of the “primary energy to wheels” chain. The BEV is the clear winner by these measures.









For trucks that use a lot of energy in a day, such as GB's highway plows, energy storage is critically important. Hydrogen stores more energy per kg than diesel (see green ellipse below) but when tank weight and conversion efficiency are factored in stores only about one third of diesel fuel per kg, as can be seen by the numbers in the red ellipse below. Both are far better on effective energy density than current batteries. This is why the truck manufacturers are still researching and developing hydrogen drive systems for large trucks despite the big conversion efficiency advantage of BEVs shown on the previous slide.

Energy Density Comparison for Fuels for a Long Haul Truck

	Diesel	Hydrogen	Tesla Model 3 Battery
Tank Capacity	120 gallons	56 kg	N/A
Tank or "rest of pack" weight	250 lbs	982 kg	180
Fuel or cell weight	852 lbs	56 kg	300 kg
Total weight	1102 lbs	1,038 kg	480 kg
Energy stored	4,880 kWh	1,848 kWh	75 kWh
Fuel or cell energy density	13 kWh/kg	33 kWh/kg	0.27 kWh/kg
Full tank or pack energy density	10 kWh/kg	1.8 kWh/kg	0.16 kWh/kg
Fuel to wheel energy conversion efficiency	21%	41%	76%
Density of energy delivered at wheels	2.04 kWh/kg	0.74 kWh/kg	0.12 kWh/kg
As % of Diesel ICE delivered energy density	100%	36%	6%

The same calculations used in Slide 20 to compare GHG emissions between an ICE and an EV can be used to compare GHG emissions between a natural gas furnace and a heat pump

Heater type	Carbon intensity "in"	Conversion efficiency	Carbon intensity "out"	% of NGF GHGs
Natural gas furnace (NGF)	181	95%	191	100%
Heat pump	25	300%	8.3	4.4%

Powered by the current Ontario grid:

a heat pump with a COP of 3 will emit just over 4% of the GHGs of an equivalent natural gas furnace!

This will drop to under 2% once IESO achieves its carbon intensity goals.