

GREENHOUSE GAS EMISSIONS AND THE RTA *RTA BOARD BRIEFING PAPER*

At the meeting of the RTA board on December 16, 2021, questions were raised by several board members on the impact of transit operations on global warming and the relative importance of electrifying the region’s fixed route public transit fleet. This paper has been developed to answer questions raised at the meeting, specifically:

1. What is the contribution of RTA bus operations to climate change and greenhouse gas emissions? Will a shift from fossil fuel power to battery electric buses really be a significant factor in reducing greenhouse gas emissions?
2. If Battery Electric Buses (BEB) are powered from the grid which is in part powered by fossil fuels, will electric buses really reduce greenhouse gas emissions?
3. Are Pace and CTA making adequate progress to an all-electric bus fleet future?

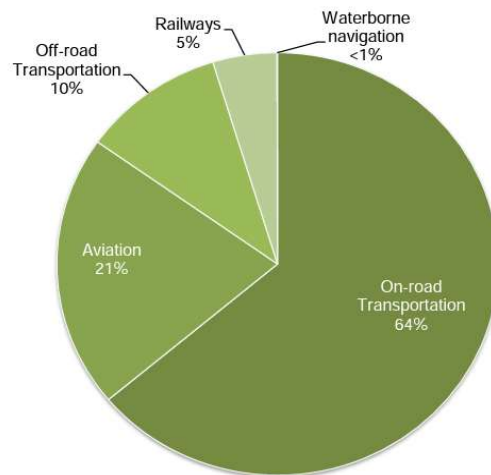
1. RTA Bus Operations and Greenhouse Gas Emissions

For purposes of this paper, we will examine the impact of the CTA fixed route bus fleet and their emissions compared to the total annual greenhouse gas emissions for on road transportation sources within the City of Chicago. The greenhouse gas emissions inventory is provided by the City of Chicago, Dec. 2019 Greenhouse Gas Inventory for Calendar Year 2017 Final Report. This report can be found here:

https://www.chicago.gov/content/dam/city/progs/env/GHG_Inventory/Chicago-2017-GHG-Report_Final.pdf

According to the inventory, 24% of all greenhouse gas emissions annually produced in the City of Chicago are from transportation vehicles. Within the transportation sector, there are railroads, airlines, on road and off-road sources of transportation greenhouse gas emissions:

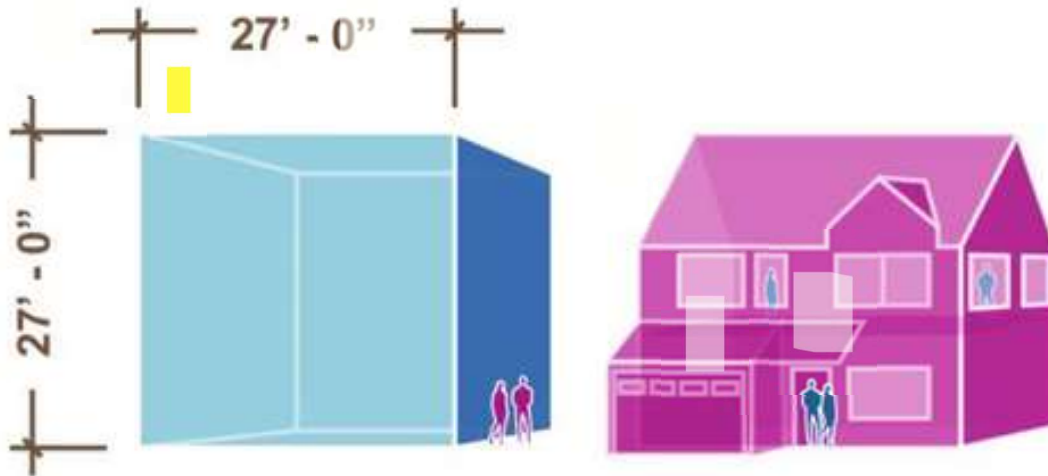
Figure 11 – 2017 GPC BASIC Community GHG Emissions Inventory – Percent of Total Transportation Sector GHG Emissions by Sub-Sector



For On-Road Transportation, the City of Chicago estimated that in 2017 all vehicles in this category emitted 4,795,501 metric tons of CO₂ annually.

For purposes of understanding the units of greenhouse gas emissions, one metric ton of carbon dioxide would fill a cube 27 feet tall. That's the size of a two-story home, totaling more than 1,400 sq. feet.

Figure 4 – How Large is One Metric Ton of CO₂?



In the FY 22 CTA Budget, CTA reports that they operate a 1502 fixed route bus fleet (maximum) daily. This figure is less than the total fleet size of CTA because the total CTA fleet size include spare buses that are used when buses are removed from service for maintenance, or mechanical failures. From a CTA 2008 press release, CTA estimates that each bus operates approximately 40,000 miles a year:

<https://www.transitchicago.com/cta-details-efforts-to-mitigate-rising-fuel-costs/>

These 1502 buses operating daily therefore operate a total of 60,080,000 vehicle miles annually. The 2017 City of Chicago inventory of vehicle miles for public transit buses within the City of Chicago estimated that for that year, the vehicle miles operated by fixed route transit buses are 64,822,866. Since this is very close to the derived figure, it is assumed that the 2017 City of Chicago inventory is a credible source for public transit bus annual vehicle mileage for CTA.

Vehicle miles driven annually by CTA buses represent 0.6% of vehicle miles driven on-road in Chicago. The relevant statistics for 2017 for on-road transportation vehicle activity and emissions from the City of Chicago report is summarized in this table:

2017 Chicago On Road Transportation Inventory of Activity and Emissions by Vehicle Type

Vehicle Type	2017 vehicle miles traveled	Percent of Total VMT traveled	CO2 Emission Factor (g/mile)	Annual GHG Emissions (MT CO2)	Percent of GHG Emissions
Motorcycle	150,979,313	1.42%	368.51	55,637	1.14%
Passenger Car	6,657,165,927	62.76%	365.67	2,434,313	49.94%
Passenger Truck	2,999,681,432	28.28%	461.66	1,384,846	28.41%
Light Commercial Truck	239,951,105	2.26%	461.66	110,777	2.27%
Transit Bus	64,822,866	0.61%	2,212.00	143,388	2.94%
Single Unit Short-haul Truck	221,332,445	2.09%	1,129.23	249,936	5.13%
Combination Short-haul Truck	257,114,045	2.42%	1,814.48	466,528	9.57%
Combination Long-haul Truck	16,120,859	0.15%	1,814.48	29,251	0.60%
TOTAL	10,607,167,992	100.00%		4,874,676	100.00%

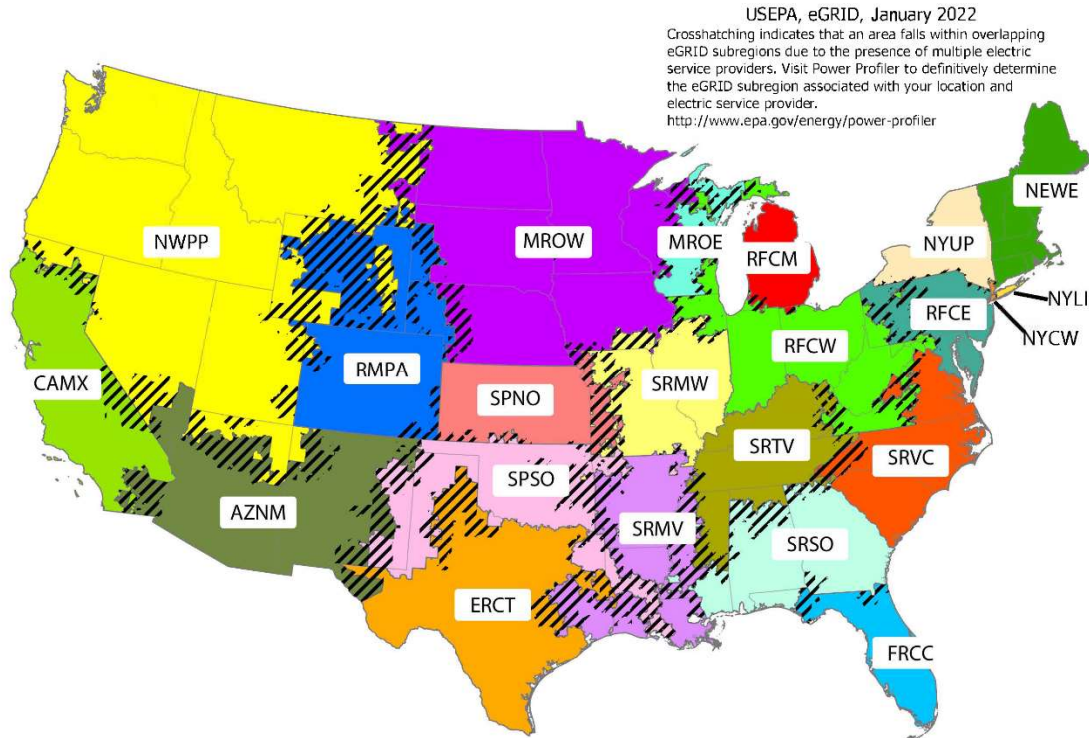
The City of Chicago inventory used an erroneous figure for CO2 emissions for a diesel transit bus. This has been corrected, and the figure of 2,212 grams of CO2 per mile was used which is the grams of greenhouse gas per mile emissions from a diesel hybrid bus. Making this correction increases the on-road total emissions by 1.7% to 4,874,676 MT CO2 annually. The increased mileage driven annually by a bus compared to a passenger car is a factor in increasing the contribution of a transit bus fleet to total GHG emissions. The 143,388 MT CO2 emissions annually by CTA buses is equal to 2.94% of all GHG emissions for Chicago on-road transportation vehicle emissions in 2017.

For 2017, according to the Illinois Secretary of State office, there were 1,433,299 on road vehicles (passenger cars, motorcycles, trucks, buses, etc.) registered within the City of Chicago. The 1502 operating CTA buses therefore represents just 0.1% of all vehicles registered within the City of Chicago but are causing 2.94% of all Greenhouse gas emissions in Chicago. Thus, CTA buses have 29.4 times more of an impact on a per vehicle basis to greenhouse gas emissions compared to the average of all vehicles registered in Chicago.

Fixed route bus service, even if it is fossil fuel powered, is a key means to reduce the number of cars on the road contributing to global warming. But there is a further responsibility on the part of RTA to operate bus transit to maximize greenhouse gas emission savings and minimize operating costs. Operating an electric bus instead of a diesel bus fleet will not affect ridership. But electric bus operation will lower greenhouse gas emissions even further and be achieved at a large savings in operating costs of \$30,000 annually per bus due to fuel and maintenance savings. Assuming the same ridership for 1502 battery electric buses, CTA can remove an additional 70,000-90,000 MT of CO2 annually and save \$45 million in operating costs annually.

2. Impact on Grid on BEB Emissions

At the December 16 RTA Board meeting, Director J.D. Ross questioned whether there are significant savings of greenhouse gas emissions if electric buses are powered from the grid, and the grid is in part powered by fossil fuels. For the Chicago area, virtually the entire RTA area is powered by the RFCW grid, as shown in this map below from the US EPA.



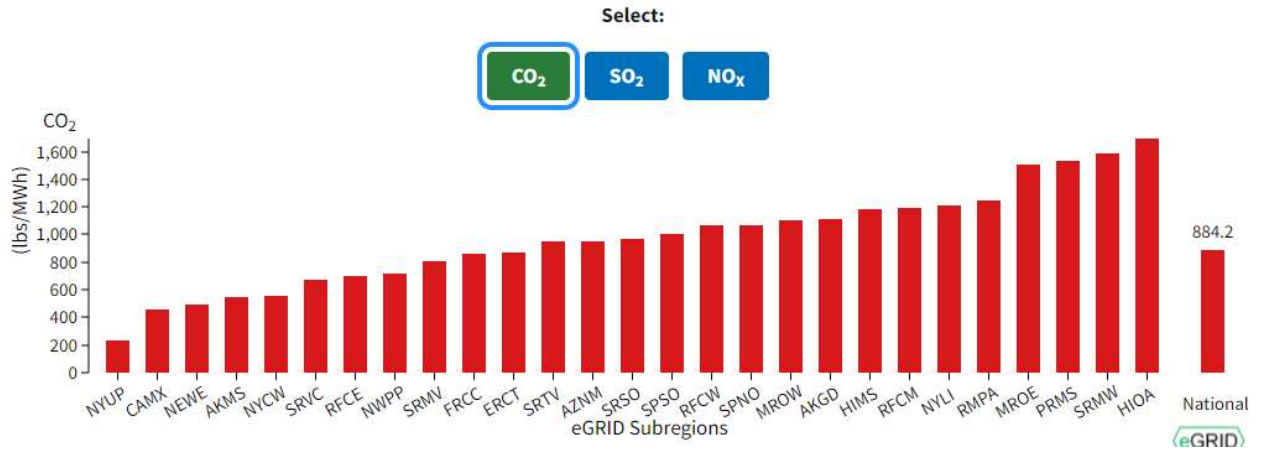
In 2018, the RFCW Grid was powered by the following sources:

Fuel	Percentage
Gas	26.5%
Coal	37.4%
Nuclear	29.0%
Wind	4.4%
Hydro	1.0%
Oil	0.2%
Other Fossil Fuels	0.7%

The RFCW grid emissions are higher than the national average for carbon dioxide emission rates per Megawatt hour produced. In 2018, RFCW emissions were 1,067 lbs CO₂/MWh which were 20.8% higher than the national average of 884.2 lbs CO₂/ MWh.

Emission Rates

This chart compares the average emission rates in pounds per MWh in all eGRID subregions to the national average emission rates for carbon dioxide (CO₂), sulfur dioxide (SO₂), and nitrogen oxide (NO_x).



The Union of Concerned Scientists analyzed the reduction in greenhouse gas emissions for an electric transit bus being powered by a particular subgrid in 2018: <https://blog.ucsusa.org/jimmy-odea/electric-vs-diesel-vs-natural-gas-which-bus-is-best-for-the-climate/>

Life cycle global warming emissions from battery electric buses in different grid regions across the United States

eGRID subregion name	Battery electric bus grams CO ₂ e/mile ^a	Battery electric bus emissions-equivalent MPG diesel ^b	Battery electric bus grams CO ₂ e/mile relative to diesel ^d	Battery electric bus grams CO ₂ e/mile relative to natural gas ^e
ASCC Alaska Grid (AKGD)	1,209	10.7 (2.22x)	-55%	-49%
ASCC Miscellaneous (AKMS)	590	21.9 (4.54x)	-78%	-75%
ERCOT All (ERCT)	1,108	11.7 (2.42x)	-59%	-53%
FRCC All (FRCC)	1,132	11.4 (2.37x)	-58%	-52%
HICC Miscellaneous (HIMS)	1,353	9.5 (1.98x)	-50%	-43%
HICC Oahu (HIOA)	1,901	6.8 (1.41x)	-29%	-19%
MRO East (MROE)	1,748	7.4 (1.53x)	-35%	-26%
MRO West (MROW)	1,289	10.0 (2.08x)	-52%	-45%
NPCC Long Island (NYLI)	1,320	9.8 (2.03x)	-51%	-44%
NPCC New England (NEWE)	652	19.8 (4.11x)	-76%	-72%
NPCC NYC/Westchester (NYCW)	740	17.5 (3.62x)	-72%	-69%
NPCC Upstate NY (NYUP)	347	37.3 (7.73x)	-87%	-85%
RFC East (RFCE)	837	15.4 (3.20x)	-69%	-65%
RFC Michigan (RFCM)	1,356	9.5 (1.98x)	-49%	-43%
RFC West (RFCW)	1,311	9.9 (2.04x)	-51%	-44%
SERC Midwest (SRMW)	1,676	7.7 (1.60x)	-37%	-29%
SERC Mississippi Valley (SRMV)	949	13.6 (2.82x)	-65%	-60%
SERC South (SRSO)	1,186	10.9 (2.26x)	-56%	-50%
SERC Tennessee Valley (SRTV)	1,257	10.3 (2.13x)	-53%	-47%
SERC Virginia/Carolina (SRVC)	878	14.7 (3.05x)	-67%	-63%
SPP North (SPNO)	1,468	8.8 (1.83x)	-45%	-38%
SPP South (SPSO)	1,338	9.7 (2.00x)	-50%	-43%
WECC California (CAMX)	609	21.2 (4.40x)	-77%	-74%
WECC Northwest (NWPP)	690	18.7 (3.88x)	-74%	-71%
WECC Rockies (RMPA)	1,429	9.0 (1.88x)	-47%	-39%
WECC Southwest (AZNM)	1,124	11.5 (2.38x)	-58%	-52%

^a Battery electric bus generation-weighted average: 1.078 grams CO₂e/mile

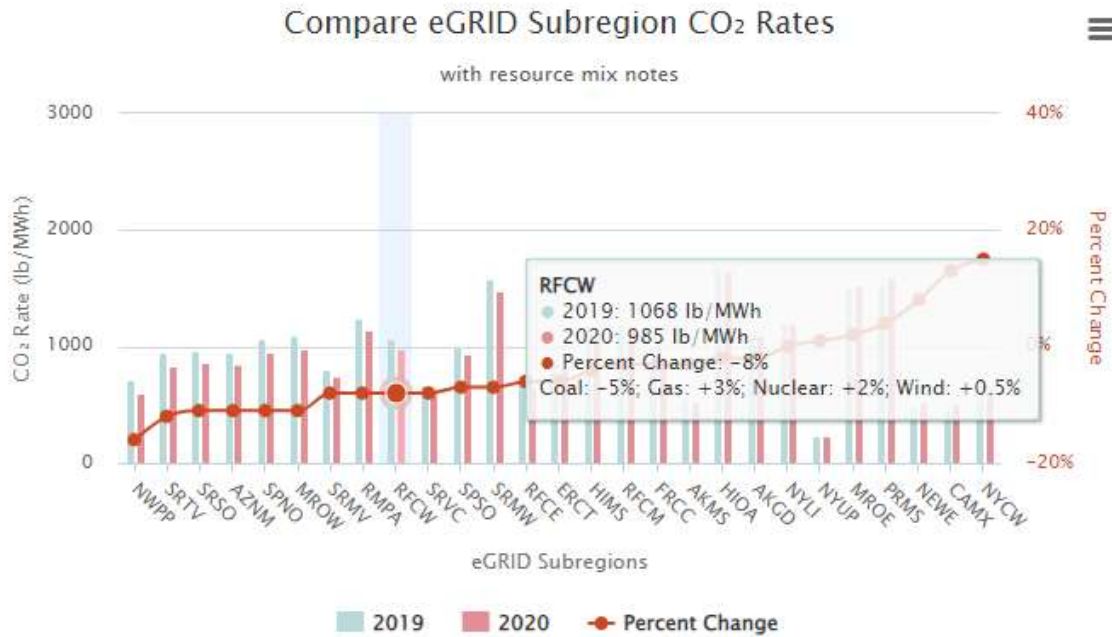
^b Battery electric bus emissions-equivalent generation-weighted average: 12.0 MPG

^c Diesel bus: 2,680 grams CO₂e/mile

^d Natural gas bus: 2,364 grams CO₂e/mile

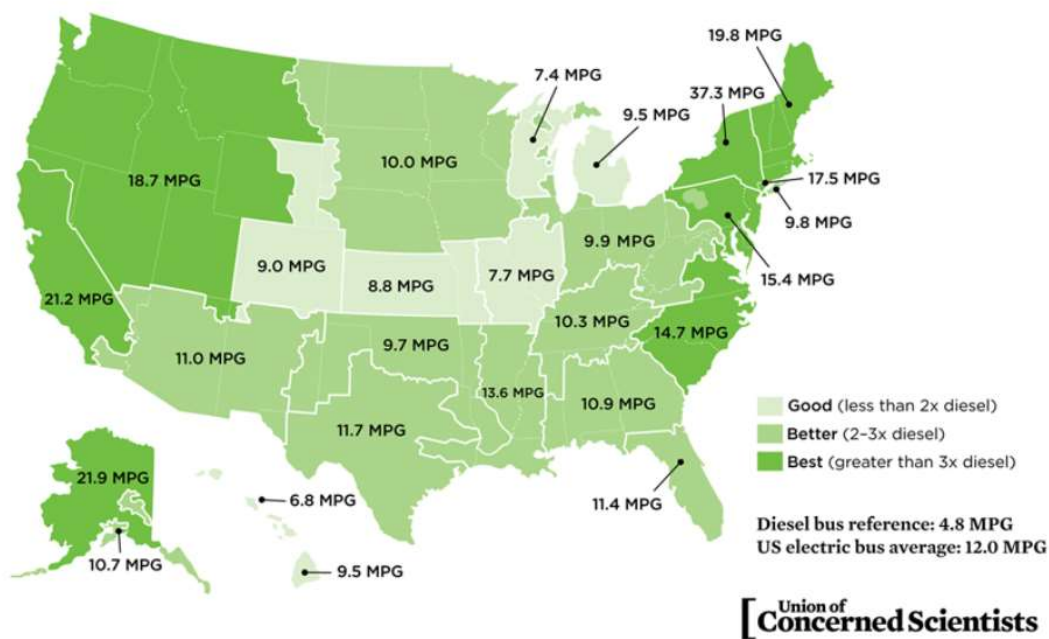
Good (less than 2x diesel)
 Better (2-3x diesel)
 Best (greater than 3x diesel)

This table shows that for the RFCW grid in 2018, an electric bus will reduce by 51% greenhouse gas emissions compared to a diesel bus. This reduction includes the impact of emission of greenhouse gases from the grid to power up the electric battery bus. Data available from the EPA shows that the RFCW grid continues to improve. In 2020, greenhouse gas emissions dropped 8% largely due to less coal being used to power the grid. It should be expected that as the grid improves, the advantage of using electric battery buses to reduce greenhouse gases also increases.



The Union of Concerned Scientists also produced a map showing what the equivalent miles per gallon of diesel fueled buses would have to be to equal the lowered emissions of electric buses. In the RFCW region, the grid is better than most areas of the country, where electric buses are 2 to 3 times better in terms of greenhouse gas emissions compared to diesel buses. CTA's currently averages approximately 3.3 miles per gallon for its diesel bus fleet, so CTA's fuel efficiency would have to triple to meet the greenhouse gas emission efficiency of battery electric buses.

Battery electric buses have lower global warming emissions than diesel (and natural gas) buses everywhere in the country.



Note: The MPG (miles per gallon, diesel) value listed is the fuel efficiency a diesel bus would need to have the same life cycle global warming emissions as a battery electric bus in each region. Regional global warming emissions ratings are based on 2016 power plant data in the EPA's eGRID database (the most recent version). Argonne National Laboratory's GREET 2017 model was used to estimate emissions from diesel and electricity fuel production.

2. Are Pace and CTA Making Adequate Progress for a BEB Future?

With the adoption of the FY 2022 5 year plan, Pace has joined CTA in adopting a 2040 deadline for operating a 100% fixed route no emission bus fleet. The 2040 deadline means that there can be no fossil fuel bus programmed in the final year of the recently adopted RTA 5 year capital plan (FY2026). A bus programmed in a capital program in a particular capital year will typically have a contract awarded the following year. So, for example, any bus awarded in FY2022, the solicitation for a bid will not be done until after the Illinois legislature approves the capital program. We can therefore expect that a contract will likely be signed in 2023. Depending on the size of the order, many of the buses are not delivered and put into service until the following year (2024). Federal funding of transit buses requires that a bus be utilized for a minimum of 12 years. A bus programmed in this FY2022 Capital budget will therefore operate through the year 2036. A fossil fuel bus therefore cannot be programmed in the FY 2026 Capital Program because that would require that a fossil fuel bus would have to operate in the 2040 year.

If Pace and CTA wait until 2026 to order electric buses (beyond the 70 that CTA has programmed and the 52 that Pace has programmed in the current plan), there will be only 13 years to program funding of these buses. CTA will have to program 138 buses a year

between 2026 and 2039 to ensure that they meet the 2040 deadline. Pace would have to program 56 electric buses a year starting in 2026.

CTA has five electric en-route charging stations located at Navy Pier, the Chicago Avenue garage, and the Chicago/Austin bus turnaround points. These overhead chargers give 75-125 miles per charge and work so bus service won't need to be paused or interrupted for charging. However, a complete strategic plan for equipping the entire fleet with the right proportion of depot charging (at garages) and en-route charging is a high priority. CTA has seven bus garages. To meet the 2040 goal, they must immediately begin engineering to equip these garages with the necessary charging infrastructure, and coordinate with ComEd.

Pace will be developing a plan for the Waukegan garage where the first electric buses will be going, but Pace has stated that the initial service of 6 electric buses at Waukegan is a demonstration project. Pace waiting to develop planning and engineering on the remainder of the system is unwise. With electric buses streaming into other garages after the Waukegan buses are delivered would require a complete plan for all of Pace garages, so adequate depot and en-route charging facilities can be built. This planning should start now.

Unfortunately, Pace is still insisting on building a new Northwest Division Garage in Wheeling to house over 128 CNG buses. Pace went out to bid last summer with \$43 million programmed for the garage but discovered that bids came in tens of millions of dollars above the \$43 million funding. Pace just went out to bid again on February 10, 2022 for a CNG garage that should not be built. Because electric buses have fewer moving parts and no requirements for heavy engine maintenance, electric bus garages require far less sq. feet in maintenance areas and are far less costly to build and operate. Pace programmed 88 new fossil fuel Compressed Natural Gas (CNG) buses in the FY22 Capital Plan and is going forward with a bid to manufacture 40 CNG buses this year. CNG buses emit more greenhouse gases than diesel buses when accounting for the production, transmission and tailpipe emissions. Significant methane gas is emitted during the production phase of CNG, and methane gas has more than 80 times the warming power of carbon dioxide after it reaches the atmosphere. Any bus programmed in the capital budget now will be operating well into the decade of the 2030's and contributing to global warming. Rather than focusing on continuing to build a new CNG bus garage, Pace should be using the Northwest Division garage as their first all new built electric bus garage so that Pace would not be stuck with a fossil fuel powered facility that will be obsolete within the next decade.

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Feb. 11. 2022

February 14, 2022

RTA Administrative Offices
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Chicago, IL 60604

RTA Board of Directors:

We are writing to express our strong concern with the Regional Transportation Authority's (RTA) strategic planning process. Our organizations have been invited to participate in the development of this plan, but over the past year we still have not seen any serious effort to address the existing and imminent challenges facing our transit system. This plan, and the process to develop it, needs to meet the needs of this historic moment and, to date, it has not.

On January 26, RTA convened over a hundred stakeholders for a "Strategic Plan Workshop." Many of those present have vast expertise, experience, and history dealing with serious financial and public policy issues surrounding public transit. Instead of using their valuable time to elicit meaningful reaction to serious policy choices, participants were treated as little more than a focus group to test marketing messages around transit. Indeed, asking participants (or, previously, the public via survey) to choose between a transit system that is fiscally stable and one that addresses climate change, for example, is a false choice and a wasted opportunity.

There was also a clear lack racial diversity in the group and among staff and facilitators. There were no ground rules for the meeting and most slides were difficult to understand and not helpful. When the agency's recent survey came up, there was no discussion of the methodology and whose views the responses represent - and those who are not represented. The proposed vision statement lacks an equity lens and the language is so broad, nondescript, and void of local context that it lacks meaning. The same applies to the proposed principles, which are now being used to form subgroups. The phrase "open to change" was used repeatedly, which is incredibly troubling considering the major crisis Chicago area transit is facing and the urgent need to change in order for transit to survive.

The pandemic has hit mass transit hard. Systemwide ridership is just 60 percent of pre-pandemic levels on a good day. Yet transit is more necessary than it ever has been, especially for communities of color and those who rely on transit as their primary mode of transportation. CTA, Metra, and Pace have largely been able to meet transit riders' needs during the pandemic, but this was only possible because of federal emergency funding. This emergency funding will expire and we need a plan to address that uncertain and serious future.

Nine months into the planning process, stakeholders should be discussing real and difficult decisions, including how to plan transit services given long term ridership uncertainty; choices over farebox and tax revenues to support transit; what equity measures should guide our regional investments; and governance of our disparate

transit services. RTA's incremental, status quo planning process lacks the awareness of the unprecedented, compounding crises communities have faced over the last two years. And it will leave the transit system more vulnerable given looming threats. After more than a year hearing from elected officials, groups like ours, RTA board members, and the public, the RTA has not yet developed any proposals that address this obvious and predictable crisis. Transformational ideas may be controversial, but that is not an excuse to avoid them. We cannot allow bureaucratic anxiety to lock the region's transit system into doomsday scenarios of emergency service shutdowns, financial fights between the service boards, and uncertainty for millions of people and businesses.

RTA's plan must be radically different. **A stronger plan starts with serious engagement from RTA with the public and the communities that depend on transit the most.** We urge RTA to review recent policy planning models like those used by the City of Chicago's Equitable Transit Oriented Development (ETOD) Working Group and by CMAP's ongoing COVID Mobility Recovery Steering Committee. To date, the engagement around your plan has been lacking and when it has happened, it has concentrated only on high-level platitudes regarding transit. The public already agrees transit is essential to the City's well-being, is an important part of our fight against climate change, and necessary for businesses and economic growth. What we need now are serious and specific proposals to maintain those foundational roles transit plays.

Signed,

Active Transportation Alliance

Center for Neighborhood Technology

Elevated Chicago

Environmental Law & Policy Center

High Speed Rail Alliance

Metropolitan Planning Council

Shared-Use Mobility Center