MEMORANDUM

To: Kanti Srikanth, Mark Moran, Dusan Vuksan, and Erin Morrow, TPB Staff

From: Michael Grant, Mike McQueen, and Sam Pournazeri, ICF

Date: June 3, 2022

Re: Clarifications Regarding On-Road Transportation Greenhouse Gas (GHG) Reduction Goals and Strategies

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During the Transportation Planning Board (TPB) Meeting and Working Session on May 18, 2022, TPB members discussed three options for establishing an on-road transportation GHG emissions reduction goal for the region:

- Option A: Aspirational goals identical to the region's overall (non-sector-specific) goals
  - 2030: 50% below 2005 levels
  - 2050: 80% below 2005 levels
- Option B: Ambitious and data-driven goals, with the 2030 goal consistent with the underlying assumptions for the transportation sector from the region's 2030 Climate and Energy Action Plan (CEAP)[1]
  - 2030: 32% below 2005 levels
  - 2050: 80% below 2005 levels
- Option C: Pragmatic goals, based on GHG reduction strategies that appear to be supported by the TPB in the member survey
  - 2030: 23% or 29% below 2005 levels (depending on implementation assumptions)
  - 2050: 80% below 2005 levels

During the discussions, TPB members raised some questions or made statements that seemed worthy of clarification. After the meeting, TPB staff also received a request for clarification, specifically in relation to comparing the goal levels being considered by the TPB with the goals and targets of metropolitan planning organizations (MPOs) in California, as described in a TPB staff memo.[2] This memo attempts to provide clarification on several points to help TPB members put in context the goals being considered. Specifically, it addresses comments related to the following questions:

- Which of the on-road transportation goals being considered by the TPB meets the Metropolitan Washington Council of Governments' (COG) multisector goal to reduce regional GHG emissions by 50% by 2030 (from the 2005 level)? And what strategies would likely be needed to meet these goal levels?
- How do the on-road transportation goals being considered by the TPB compare to the goals and targets of other MPOs?
- Would the on-road transportation goals apply at the local level to individual jurisdictions?
- Do the GHG goals account for upstream emissions associated with vehicle production/manufacturing?

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[1] Metropolitan Washington Council of Governments, "Metropolitan Washington 2030 Climate and Energy Action Plan", 2020. https://www.mwcog.org/documents/2020/11/18/metropolitan-washington-2030-climate-and-energy-action-plan/

[2] Kanti Srikanth et al. to National Capital Region Transportation Planning Board, "Research on Peer MPO On-Road Transportation Greenhouse Gas (GHG) Reduction Targets," Memorandum, April 27, 2022, https://www.mwcog.org/events/2022/5/18/tpb-climate-work-session/

Which of the on-road transportation goals meets COG's regional goal? And what strategies would likely be needed?

During the TPB meeting, there seemed to be some confusion about which on-road transportation goal level would meet COG's regional goal to reduce regional GHG emissions by 50% from the 2005 level. Table 1 below provides a comparison of the three goal options being considered, along with information on transportation strategies that would likely be needed to meet each goal level based on the results of the TPB's Climate Change Mitigation Study of 2021.

Table 1. Comparison of TPB On-Road Goal Options in Relation to COG's 2030 Goal and Strategies Likely Needed

On-Road Transportation Goal Under Consideration	Meets COG's Regional 50% GHG Reduction by 2030 Goal?	Transportation Strategies that Would be Needed
TPB Goal A: 50% reduction in on-road transportation GHGs by 2030	**YES (assuming other sectors contribute reductions consistent with the CEAP)** – This level of on-road transportation GHG reduction significantly exceeds the level estimated for on-road sources as part of the region's 2030 Climate and Energy Action Plan (CEAP).	**Beyond the Most Aggressive Strategies Analyzed** – None of the scenarios analyzed as part of the Climate Change Mitigation Study (CCMS) of 2021, including the most aggressive combinations of strategies, could achieve close to this goal. The most aggressive scenario analyzed (with levels of EV adoption for 2030 that are likely not feasible) estimated a 38-43% reduction; if VT.1 is assumed to be the most aggressive feasible technology scenario, then the maximum estimate from the scenarios is a 33-36% reduction.[3]
TPB Goal B: 32% reduction in on-road transportation GHGs by 2030	**YES (assuming other sectors contribute reductions consistent with the CEAP)** – This level of on-road transportation GHG reduction meets the level estimated for on-road sources in the 2030 CEAP to achieve the region's 2030 50% reduction goal.	**Very Aggressive Strategies –** Only scenarios with the most aggressive combinations of strategies were estimated to achieve this goal. Significant rapid changes in vehicle technology will be needed (at least 50% of all light-duty vehicles sold would be zero emissions by 2030) combined with significant reductions in VMT associated with the most aggressive mode shift and travel behavior strategies analyzed in the CCMS (those under MS.3, i.e., 40% telework, pricing strategies, free transit, development shifts across the region).
TPB Goal C: 23-29% reduction in on-road transportation GHGs by 2030	**Likely No (but possible if other sectors reduce GHGs further)** – This level of on-road transportation GHG reduction does not meet the level estimated for on-road sources in the 2030 CEAP. Achieving the region's overall goal would require other sectors to reduce GHG emissions further.	**Strategies with Demonstrated TPB Support** (at 23%) to **More Aggressive Strategies** (at 29%) – The low-end of this estimate (23%) assumes implementation of TPB-supported strategies including significant rapid changes in vehicle technology (at least 50% of all light-duty vehicles sold would be zero emissions by 2030) and strategies that reduce VMT. The higher end (29%) assumes even more rapid deployment of EVs (100% of new light-duty vehicle sales as zero emissions in 2030), which may not be feasible; if that is the case, this goal level would additionally require implementation of much more aggressive mode shift strategies.

[3] Note: The Climate Change Mitigation Study (CCMS) of 2021 included estimates of both tailpipe GHG emissions from motor vehicles and GHG emissions associated with the electricity needed to power electric vehicles (EVs).

How do the on-road transportation goals being considered by TPB compare to goals and targets of other MPOs?

TPB staff noted that the Washington, DC region would be the first MPO in the country to set voluntary GHG reduction targets for the transportation sector. During the discussion, comparisons of on-road transportation goals under consideration in the region were made to the GHG targets of MPOs in California, with some suggesting that the TPB goals under consideration appear high compared to California MPOs. After the meeting, there was a request to provide some additional clarification about how the GHG goals under consideration by TPB compare to the GHG reduction targets of California MPOs, given that the goals are defined very differently.

The California MPOs' GHG targets are not directly comparable to the goals under consideration by TPB since the California targets are designed to account for per capita passenger vehicle GHG emissions, accounting for land use and travel behavior strategies addressed at the local/regional level only, without accounting for the benefits anticipated from state vehicle emissions and fuel standards. Since the technology improvements are not counted in these estimates, essentially the California MPOs' targets function as light-duty vehicle miles of travel (VMT) per capita reduction targets.

To establish these targets, the four largest MPOs in California – the Southern California Association of Governments (SCAG), the Metropolitan Transportation Commission/Association of Bay Area Governments (MTC/ABAG), the San Diego Association of Governments (SANDAG), and the Sacramento Area Council of Governments (SACOG)-- voluntarily conducted a hypothetical, less constrained form of scenario planning to determine what kinds of strategies and factors could support maximum feasible VMT reduction targets. Based on these analyses and discussions with their Boards, the four large MPOs in California submitted target recommendations to the California Air Resources Board (CARB) in May 2017 of an 18% reduction in GHG per capita from 2005 levels by 2035.[4] At the same time, CARB staff also conducted additional analysis based on the MPOs' provided information. With these additional analyses, CARB recommended a target of 19% reduction in average GHG emissions per capita in 2035 compared to 2005 levels for each of these MPOs.[5]

To yield meaningful comparisons (since the California targets do not incorporate technology improvements and essentially function as light-duty VMT per capita reduction targets), ICF estimated the passenger VMT per capita reductions (accounting for vehicle travel in passenger cars and passenger trucks) that would likely be necessary to achieve each of the three goals being considered by the TPB (50% reduction, 32% reduction, or 23-29% reduction in on-road GHG emissions compared to 2005). Since the Washington, DC region is not under the jurisdiction of one state and does not have the same ability to establish state-level vehicle emissions and fuel standards as California, for this analysis, ICF calculated the level of passenger VMT reduction that would be necessary to meet each of the three goals under the aggressive technology assumptions of the VT.1 scenario (This scenario assumes that 50% of all light-duty vehicles sold in the region would be EVs or similar zero-tailpipe emissions, 30% of new medium/heavy duty truck sales would be zero-tailpipe emissions, and 50% of buses on the road would be zero-tailpipe emissions by 2030), together with the estimated reductions associated with implementation of transportation systems management and operations (TSMO) strategies. Previous comments on the Climate Change Mitigation Study noted that the VT.2 scenario (which assumed that 100% of all light-duty vehicles sold in the region would be EVs or similar zero-tailpipe emissions by 2030, that

[4] Essentially, these targets function as light-duty VMT per capita reduction targets since they focus on light-duty vehicles (not vehicle travel by buses or freight trucks) and technology improvements do not count toward reaching the targets.
[5] California Air Resources Board, "Updated Final Staff Report: Proposed Update to the SB 375 Greenhouse Gas Emission Reduction Targets," February 2018. https://ww2.arb.ca.gov/sites/default/files/2020-06/SB375_Updated_Final_Target_Staff_Report_2018.pdf

50% of new medium/heavy duty truck sales would be electric or zero-tailpipe emissions, and that 100% of buses operating on the roads would be EVs or zero-tailpipe emissions by 2030) are unrealistic, as these assumptions exceed the most aggressive technology plans in California and vehicle manufacturers' plans do not align with such a rapid shift to EV-only sales.

As shown in Table 2, under these technology (VT.1 assumptions) and TSMO strategy effectiveness assumptions, the results suggest that **goal options A and B would require significantly more aggressive levels of VMT per capita reduction than the goals of California's largest MPOs**. Based on our estimates:

- Goal option A would require a 53-57% reduction in light-duty VMT per capita, which would be an unprecedented level of sustained VMT reduction, on the order of magnitude with the levels of VMT reduction during the peak of the pandemic stay-at-home orders in April 2020, when all schools and many businesses were closed or employees were told to say home, and traffic volumes dropped by about 50% temporarily (Note: By July 2020, while most schools and businesses continued to be on-line/remote-only, traffic volumes had recovered to about 80% of pre-pandemic levels).
- Goal option B would require a 20-26% reduction in light-duty VMT per capita by 2030 (depending on electric grid assumptions), compared to a 19% reduction in light-duty VMT per capita by 2035 for the California MPOs, so would involve larger levels of VMT reduction per capita to occur more quickly.
- Goal option C with a 29% reduction in on-road transportation GHG emissions would likely be within the range of the California MPO targets, given that California targets are for 2035, while the TPB is considering targets for 2030. Goal option C with a 23% reduction in on-road transportation GHG emissions would be less aggressive than the California MPOs' targets.

Table 2. Comparison of California MPOs GHG Goals with Estimated VMT per Capita Reductions Required to Meet TPB Goal Options

TPB on-road transportation GHG goal under consideration	Estimated light-duty (passenger vehicle) VMT per capita reduction required to meet TPB goal^
TPB Goal A: 50% reduction in on-road transportation GHGs	53-57% reduction by 2030*
TPB Goal B: 32% reduction in on-road transportation GHGs	20-26% reduction by 2030*
TPB Goal C: 29% reduction in on-road transportation GHGs 23% reduction in on-road transportation GHGs	 14-21% reduction by 2030* 3-10% reduction by 2030*
For comparison: Large California MPOs: SCAG (Los Angeles region), SACOG (Sacramento region), SANDAG (San Diego region), MTC/BAAG (San Francisco region)	19% reduction by 2035 (to achieve GHG reduction targets established by SB 375 and CARB)

^This analysis assumes aggressive clean vehicle adoption similar to the VT.1 scenario of the CCMS, plus implementation of TSMO strategies. If less rapid shifts to EVs occur, VMT reduction required to meet the goal would be higher; if more rapid shifts to EVs occur, VMT reduction per capita required to meet the goal would be lower.

*Range depends on the electric grid assumptions. Specifically, under the "clean grid" assumption, less VMT must be reduced than under the "reference grid" assumption. The higher end of the range represents the "reference grid" assumption, which assumes significant improvements in carbon intensity of the electric grid compared to today based on existing power sector policies and plans.

For comparison purposes, the National Capital Region baseline forecast (Visualize 2045 assumptions) is for approximately an 8% reduction in passenger VMT per capita by 2030 compared to 2005 (accounting for travel in passenger cars and trucks). See the Appendix, at the end of this memo, for more information.

For the California MPOs, while the 19% GHG emissions per capita reduction targets were based on a bottom-up analysis conducted by CARB and MPOs, California also conducted a top-down analysis, as part of its 2017 Scoping Plan Update,[6] demonstrating that to achieve overall 2030 California GHG reductions goals,[7] there is a need for 25% reduction in light-duty VMT per capita from 2005 levels by 2035 statewide.[8] Earlier in 2022, California released its 2022 Scoping Plan Update, charting the pathway for California to reach carbon neutrality no later than 2045.[9] In this new plan, California acknowledged that the state is not on track to achieve the VMT reduction called for in the 2017 Scoping Plan, in large part due to entrenched transportation, land use, and housing policies and practices. In fact, light-duty VMT per capita in California increased from 2005 to 2019.[10] The new plan also presents a new top-down analysis demonstrating that achieving carbon neutrality goals in California will require light-duty VMT per capita reduction of 12% below the 2019 level by 2030 and 22% below the 2019 level by 2045, which are less aggressive targets than in the previous plan.

Table 3. California's VMT per Capita Reduction Targets

California Planning Documents	VMT per Capita Reduction Targets
2018 SB 375 Greenhouse Gas Emission Reduction Targets	19% reduction in light-duty VMT per capita from 2005 levels by 2035
2017 Scoping Plan Update	25% reduction in light-duty VMT per capita from 2005 levels by 2035
2022 Scoping Plan Update	VMT per capita reduction of 12% below 2019 levels by 2030 and 22% below 2019 levels by 2045*

*Note: 2019 passenger VMT per capita exceeded 2005 passenger VMT per capita in California

Finally, regardless of the goal option that is ultimately chosen, it is important to note that TPB's goals could be considered ambitious relative to peer MPOs given that staff research showed that 1) many peer MPOs do not have any on-road transportation sector GHG reduction goals, and 2) TPB would be the first MPO adopting these types of goals without a state mandate.

[6] California Air Resources Board, "2017 Scoping Plan-Identified VMT Reductions and Relationship to State Climate Goals", January 2019. https://ww2.arb.ca.gov/sites/default/files/2019-01/2017_sp_vmt_reductions_jan19.pdf

[7] 40% GHG reduction below 1990 levels

[8] Please note that the 19% GHG per capita reduction is the target that is established as part of the SB375. During the 2017 Scoping Plan, CARB noted that to achieve 2030 goals, a higher level of VMT reductions (i.e., 25%) would be needed statewide. However, that higher target was not included in the SB375 targets for the MPOs.

[9] California Air Resources Board, "Draft 2022 Scoping Plan Update", May 10, 2022. https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp.pdf

[10] California Air Resources Board, "2018 Progress Report: California's Sustainable Communities and Climate Protection Act", November 2018. https://ww2.arb.ca.gov/sites/default/files/2018-11/Final2018Report_SB150_112618_02_Report.pdf

Would the on-road transportation goals apply at the local level to individual jurisdictions?

Several TPB members expressed concern that relatively limited transit within their jurisdictions would constrain their ability to meet aggressive on-road transportation goals. It is important to note that whatever goal is adopted, the percentage reduction would be a regional goal, not locality specific. Individual jurisdictions would not all be expected to achieve the same percentage reductions.

While local jurisdictions play an essential role in taking action, there are different conditions that will affect the ability of individual jurisdictions to reduce on-road transportation emissions. The largest factors that will influence on-road transportation emissions reductions at a local level are likely to be population and employment growth, land development decisions, and clean vehicle (such as EV) adoption. Transit is one of many factors that will influence the ability to reduce on-road transportation GHG emissions.

Do the GHG goals account for upstream emissions associated with vehicle production/manufacturing?

A comment was made during the meeting that the term "zero emissions vehicles" (ZEVs) is misleading since even if the vehicles do not emit GHGs and the electric grid is carbon free, there are upstream emissions associated with the manufacturing and maintenance of the vehicles. This is correct that the manufacturing of vehicles generates GHG emissions, which are not included within this regional analysis.

Typically, regional emissions inventories do not include upstream or downstream emissions associated with the manufacture of products outside of the region, and if manufactured in the region would be counted as industrial-related emissions. (Similarly, the regional inventory does not include emissions associated with the production of goods used by residents in the region, such as clothing, furniture, toys, or other products purchased by residents, if they are manufactured outside of the region.)

From a full life-cycle perspective, there are GHG emissions associated with the manufacture, repair, and disposal of electric vehicles, as well as roadway maintenance, which are not considered in this analysis. It should be noted that upstream GHG emissions are also produced for transit. For instance, GHG emissions are generated as part of the construction, maintenance, and operations of rail stations and railcars (for light-rail, Metrorail, and commuter rail), as well as for bus manufacturing, maintenance, and refurbishment.

It should be noted that the Climate Change Mitigation Study (CCMS) of 2021 included estimates of both tailpipe GHG emissions from motor vehicles and GHG emissions associated with the electricity needed to power electric vehicles (EVs). By contrast, many other studies and GHG reduction plans for on-road transportation sources account for only tailpipe emissions from motor vehicles.

A 2021 study made a global comparison of life cycle GHG emissions of motor vehicles, estimated in Europe, the United States, China, and India for two years (2021 and 2030).[11] That study included the following aspects of GHG emissions from motor vehicles:

- fuel/electrical production,
- fuel consumption,
- vehicle maintenance,

[11] Georg Bieker, "A Global Comparison of the Life-Cycle Greenhouse Gas Emissions of Combustion Engine and Electric Passenger Cars," White Paper (Berlin, Germany: International Council on Clean Transportation, July 2021), https://theicct.org/publications/global-LCA-passenger-cars-jul2021

- battery manufacture, and
- vehicle manufacture.

That study found that, in all cases, the estimated life cycle GHG emissions from battery electric vehicles (BEVs) are lower than the comparable GHG emissions from internal combustion engine vehicles (ICEVs), as shown in Figure 1 below. Additionally, as the electricity mix and manufacturing processes decarbonize further, the amount of emissions will decline further.

Figure 1. Life-cycle GHG emissions of average medium-size gasoline internal combustion engine vehicles (ICEVs) and battery electric vehicles (BEVs) registered in Europe, the United States, China, and India in 2021 and projected to be registered in 2030

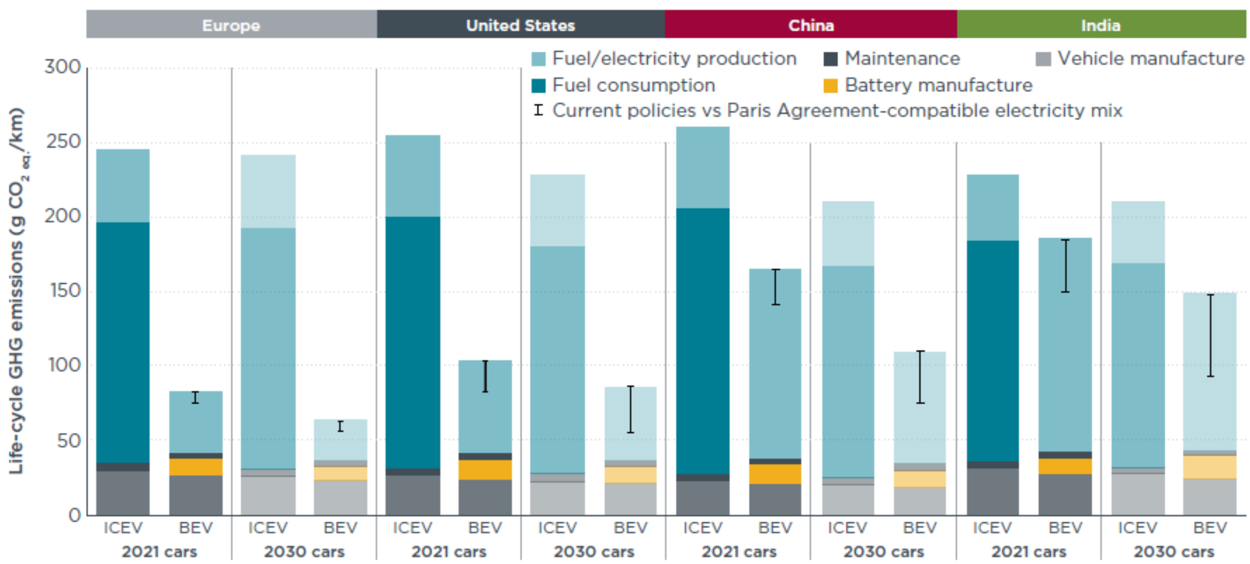

Figure ES.1. Life-cycle GHG emissions of average medium-size gasoline internal combustion engine (ICEVs) and battery electric vehicles (BEVs) registered in Europe, the United States, China, and India in 2021 and projected to be registered in 2030. The error bars indicate the difference between the development of the electricity mix according to stated policies (the higher values) and what is required to align with the Paris Agreement.

Source: Page ii, Bieker, Georg. "A Global Comparison of the Life-Cycle Greenhouse Gas Emissions of Combustion Engine and Electric Passenger Cars." White Paper. Berlin, Germany: International Council on Clean Transportation, July 2021. https://theicct.org/publications/global-LCA-passenger-cars-jul2021.

APPENDIX: Calculations for Comparison with California MPO Goals

This appendix provides some additional detail on the calculation of estimating VMT per capita reductions associated with different goal levels.

2005 Baseline Passenger VMT (mi) = 35.04 B

2030 Baseline Passenger VMT (mi) = 42.23 B

2005 Population estimate = 4.758 M

2030 Baseline Population estimate = 6.249 M (note: this analysis uses the baseline forecast, and does not account for an increase in population associated with adding additional households to the region)

2005 Daily Passenger VMT per capita = 20.17 mi

Table A1. Reference Grid Case, 2030 with VT.1 and TSMO Assumptions

Goal level: Percent GHG reduction compared to 2005:	50%	32%	29%	23%
Passenger VMT required to meet goal (mi):	19.6 B	34.04 B	36.45 B	41.26 B
Reduction in passenger VMT compared to baseline 2030:	54%	19%	14%	2%
Reduction in passenger VMT compared to baseline 2005:	44%	3%	-4%	-18%
Daily passenger VMT per capita (mi):	8.59	14.93	15.98	18.09
Reduction in daily passenger VMT per capita compared to baseline 2005:	57%	26%	21%	10%

Table A2. Clean Grid Case, 2030 with VT.1 and TSMO Assumptions

Goal level: Percent GHG reduction compared to 2005:	50%	32%	29%	23%
Passenger VMT required to meet goal (mi):	21.57 B	36.94 B	39.51 B	44.63 B
Reduction in passenger VMT compared to baseline 2030:	49%	13%	6%	-6%
Reduction in passenger VMT compared to baseline 2005:	38%	-5%	-13%	-27%
Daily passenger VMT per capita (mi):	9.46	16.20	17.32	19.57
Reduction in daily passenger VMT per capita compared to baseline 2005:	53%	20%	14%	3%