Methodology: Minnesotans would save up to $91 billion from climate-smart transportation

VMT Analysis:

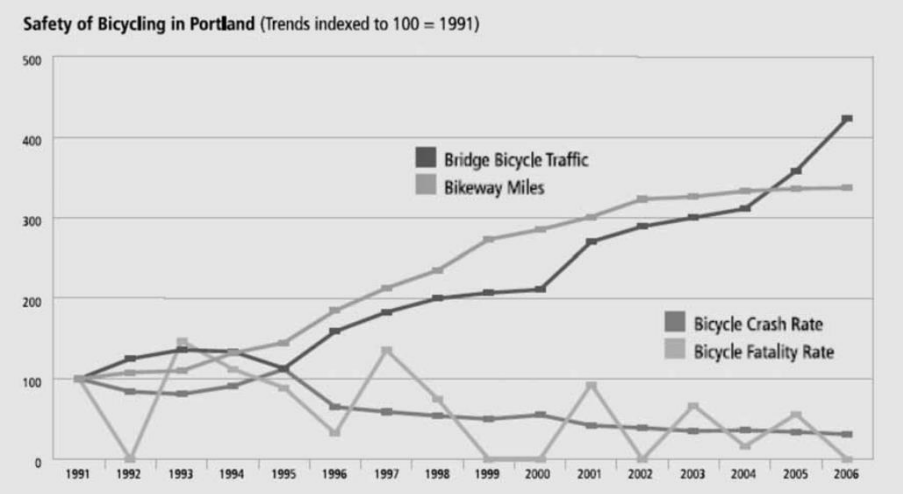
The RMI team conducted a spreadsheet analysis comparing two MnDOT identified Vehicle Miles Traveled scenarios from MnDOT's 2022 "Promoting Transportation Options & Measuring with a VMT Target" report prepared by the MnDOT Planning Director of Transportation.

Both scenarios use a 2019 VMT baseline, consistent with the state's voluntary VMT reduction target baseline. The first scenario represents MnDOT's "business-as-usual" case and projects that Minnesota's VMT will increase gradually to 69.7 billion miles by 2050. The second scenario represents MnDOT meeting its 20% per capita VMT reduction target of 56.0 billion miles by 2050 in the increments described in the report. The subsequent cost savings are calculated from the difference in VMT between these two scenarios.

1) Crash Fatality and Injury Savings:

To estimate the cost savings from avoided automobile crash fatalities and injuries, crashes are assumed to be reduced in proportion to VMT reduction. Average million vehicle-mile crash rates are used from Fatality Analysis Reporting System (FARS) fatality data from 2000-2009 and injury rates reported by the Bureau of Transportation Statistics (BTS) in National Transportation Statistics (Table 2-17: "Motor Vehicle Safety Data"). The latest 2021 U.S. DOT guidance for the statistical value of life is used to monetize the cost of traffic fatalities, while injuries are valued using data from 2021 official Federal Transit Administration reporting templates.

Presumably, reduced light duty vehicle (LDV) VMT represents shorter trips, avoided trips, or trips shifted to other modes. For this analysis, we assume that increased ridership of other modes will not lead to increased fatalities. According to the National Safety Council, the US fatality rates on busses and trains are ten and seventeen times smaller, respectively, than the LDV fatality rate per *passenger* mile. The literature also describes a "safety in numbers" effect in which increases in biking and walking are associated with no change or decreases in the fatality rate per person mile traveled (PMT). For example, according to a study, the city of Portland saw a three-fold increase in biking PMT between 1991 and 2006. In the same time period, the number of bike-related fatalities and crashes decreased in total.



We therefore assume that Minnesota would see neither an increase or decrease in pedestrian and bicyclist fatality events, although we acknowledge that this outcome would be most likely when mode shift is paired with increased investments in safety infrastructure.

2) Active Transportation Benefits:

Active transportation health benefits are calculated based on two key assumptions. First, we assume that for every mile of reduced VMT, 5% shifts to biking PMT and 10% shifts to walking PMT. Second, we use the medium rate of avoided fatalities per PMT from biking and walking active transportation health benefits as measured in a 2020 Harvard study evaluating the impacts of mode shift in 12 U.S. states. From the data provided, we calculate total annual averted fatalities. These averted fatalities are *not* included in the direct monetized cost savings for the state, since the magnitude of averted fatalities could be quite large but this impact is indirect and thus more uncertain than the other health benefits which we monetized.

3) Air Quality Fatality Cost Savings:

The air quality averted fatalities were calculated using data retrieved from the EPA's Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool (COBRA) for the Energy Policy Simulator (EPS). Avoided all-cause mortality from $PM_{2.5}$, NO_x, and SO_2 in Minnesota's transportation sector were normalized for the approximate share resulting from LDVs, and assumed to be reduced in proportion to the share of reduced VMT that comes from ICE vehicles. The proportion of ICE to EV vehicles for each annual reduced VMT sum was assumed to be proportional to the fleet's overall composition that year. The annual ICE/EV fleet composition was found using projections from the EPS for Minnesota and the NDC-aligned vehicle stock scenario. The latest 2021 U.S. DOT guidance for the statistical value of life is used to calculate savings from averted deaths.

The avoided fatalities cost savings exclude the potential additional benefits from reducing non-exhaust pollution from automobiles. In addition, this approach assumes an ambitious EV adoption rate corresponding to the EPS "Nationally Determined Contribution" (NDC) scenario — a slower adoption rate of EV's would represent additional air quality savings benefits for every VMT reduced. A final limitation of this approach is that it simplified the VMT reduction target to

assume that all the avoided VMT corresponds to LDVs, which represent the vast majority of VMT.

4) Fuel and Operating Cost Savings:

The RMI team calculated Minnesota fuel and maintenance costs in 2020 dollars for both ICE vehicles and EV vehicles using EIA and Kelly Blue Book data. The annual ICE/EV fleet composition was found using projections from the EPS for Minnesota, NDC-aligned vehicle stock scenario. Reductions in VMT were applied in proportion to the ICE/EV fleet composition, and cost savings from avoided VMT were calculated by vehicle type. These assumptions exclude any benefits of families reducing vehicle ownership in response to decreased trips or improved access to alternative transportation options.

To calculate savings to each LDV owner, RMI assumed that registered private vehicles in Minnesota would grow in proportion to Minnesota population growth through 2050. RMI assumed that private vehicles each drove an equal share of Minnesota LDV VMT, which the Federal Highway Administration estimates is about 90% of the state's total VMT, and divided costs to each automobile appropriately.

Social Cost of Carbon Analysis:

The RMI team conducted a spreadsheet analysis comparing two MnDOT identified surface transportation emission scenarios from MnDOT's 2019 "Pathways to Decarbonizing Transportation in Minnesota" report, prepared by the MnDOT in collaboration with the Minnesota Environmental Quality Board.

Both scenarios use a 2020 emissions baseline. The first scenario, reference, represents MnDOT's "business-as-usual" case. In this scenario, MnDOT incorporated the impact of all contemporary 2019 policies and assumed that the federal fuel economy standard would be weakened starting in model year 2021. The second scenario, 100x50, achieved net zero surface transportation emissions using a combination of strategies that MnDOT suggested may be achievable. The subsequent social cost of carbon savings were calculated from the difference in CO2e emissions between these two scenarios. An additional scenario was considered where Minnesota achieved zero carbon surface emissions by 2040.

The social cost of carbon is valued at $190 per metric ton of CO2 using a 2% near-term Ramsey discount rate, based on the latest federal EPA guidance released in September 2022. The state of Minnesota legally adopted this value and discount rate as the state's social cost of carbon in February, 2023 with the passage of Senate File 4. The true value of the SCC may be higher, as EPA has yet to incorporate several forms of climate damages into its evaluation, including damages to supply chains, national security, and extreme weather.