Closing the Transportation Emissions Gap with Clean Fuels

Federal and state policy adopted over the past two decades has done a great deal to bend the US transportation emissions curve. However, with 1.6 billion tons of greenhouse gases (GHGs) still projected to come from the transportation sector in 2030, we are a long way from being on track to net-zero emissions by 2050 or reducing transportation-related pollutants like NOx, particulate matter and ozone that disproportionately impact low-income communities and communities of color. To achieve economy-wide net-zero emissions, we find that, in the transportation sector, a portfolio of strategies is the lowest cost and most likely to succeed. While efficiency improvements and vehicle electrification cut transport emissions by up to two-thirds by 2050, low-GHG liquid fuels are needed to fill the gap and achieve net-zero transportation emissions by mid-century.

Emily Wimberger
ewimberger@rhg.com

John Larsen
jwlarsen@rhg.com

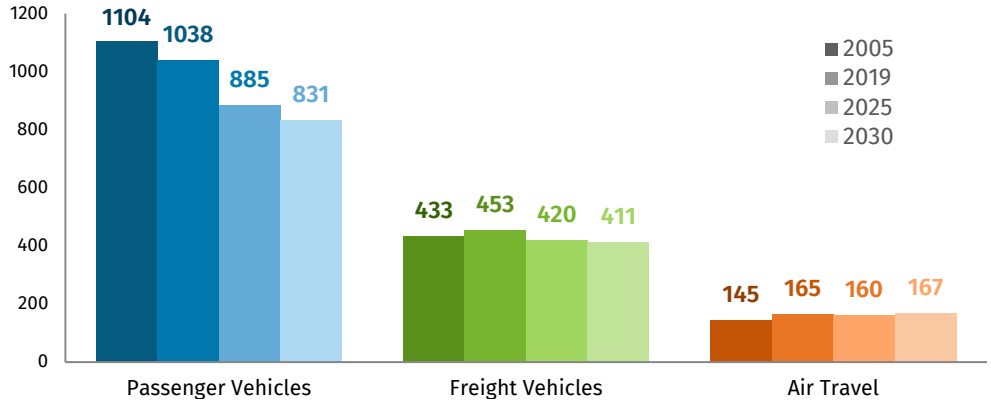
Trevor Houser
tghouser@rhg.com

Without new policy, transportation will continue to be one of the largest sources of US emissions through mid-century

Transportation is the largest source of greenhouse gas (GHG) emissions in the US, accounting for 33% of the economy-wide total in 2019. While transport emissions declined 6% between 2005 and 2019, the majority of reductions have come from the passenger vehicle fleet.

Looking forward, under current policy, passenger vehicle emissions are projected to be 20% lower in 2030 than they were in 2019, due to increased electrification and fuel efficiency improvements. However, freight emissions are projected to decline only by 9% while aviation emissions are anticipated to increase by 1% in 2030 (Figure 1).

FIGURE 1
US transportation emissions by mode, 2005-2030
Million metric tons (MMT) of CO2-equivalent (CO_2e)



Source: Rhodium Group. Projections are from Rhodium Group's Taking Stock 2020, V-shaped economic recovery scenario.

Tel: +1.212.532.1157
Fax: +1.212.532.1162
Web: www.rhg.com

New York
5 Columbus Circle
New York, NY 10019

California
647 4th Street
Oakland, CA 94617

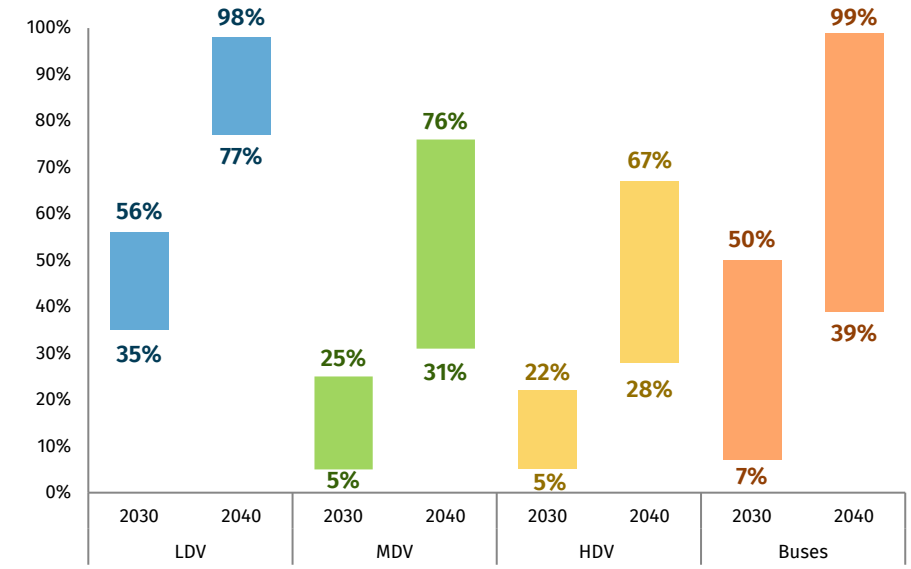
Hong Kong
135 Bonham Strand
Sheung Wan, HK

Paris
33 Avenue du Maine
75015 Paris

Electric vehicles alone will not get the US to net-zero by 2050

In identifying transportation pathways to net-zero emissions, we adopt a range of EV sales projections that are more aggressive than the most optimistic current market forecasts, but within the realm of technical possibility (Figure 2). In the most optimistic case for light-duty vehicles (LDVs), we model EV sales shares as high as 55% in 2030, 88% in 2035, 98% in 2040 and 100% from 2045 onward (Figure 4). Electrification is occurring more slowly in the medium-duty vehicle (MDV) and heavy-duty vehicle (HDV) segments. For MDVs we assume between 5 and 19% of all sales are electric by 2030 and between 35 and 67% by 2040. For HDVs we assume between 5 and 14% of all sales are electric by 2030, and between 30 and 57% by 2040. We expect transit buses will be easier to electrify, and in our modeling assume 10 to 50% of all sales are electric in 2030, growing to 67 to 99% by 2040 (Figure 2).

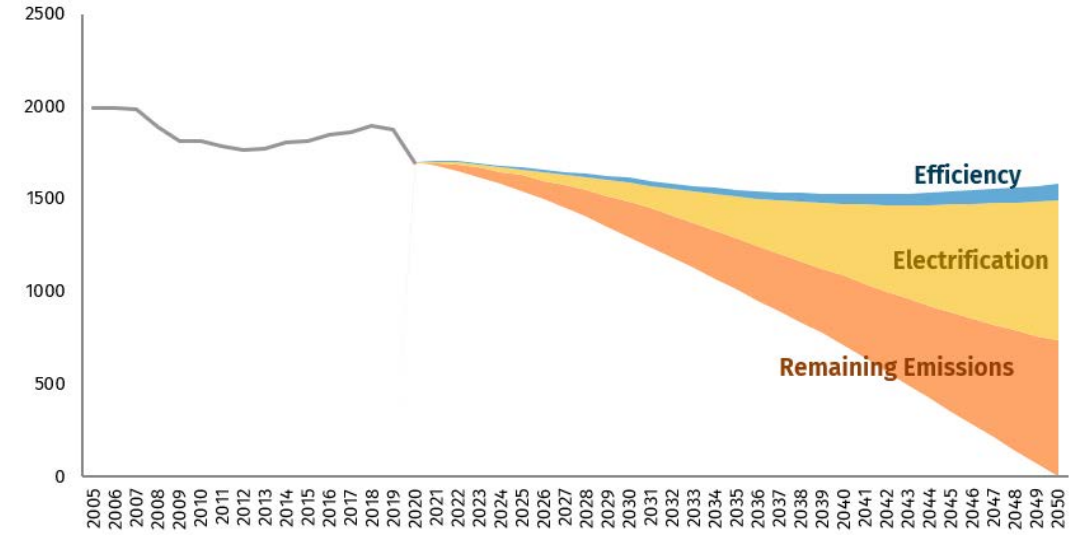
FIGURE 2
US electric vehicle sales as a share of total sales
Percent



Source: Rhodium Group and EER

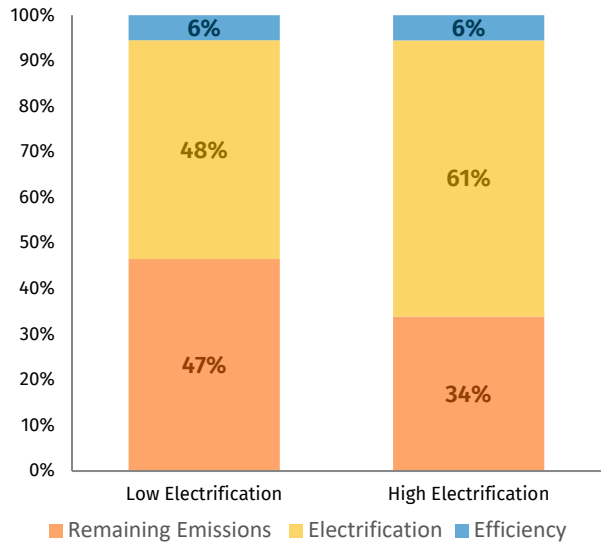
Assuming modest electrification of light-duty vehicles, we project 735 million metric tons of emissions remaining in 2050 from fuels that need to be decarbonized or displaced through mobility strategies that reduce vehicle usage (Figure 3). Even with aggressive electrification (high electrification in Figure 4), where more than half of all LDV sales nationally are electric by 2030 and nearly 90% by 2035, there are still 525 million tons of GHGs remaining in the transportation sector in 2050 and 37% of reductions will need to come from fuel decarbonization or mobility solutions. Increasing mobility will reduce vehicle miles traveled but cannot decarbonize the remaining emissions from the transportation sector. Clean fuels will be needed to close the transportation emissions gap.

FIGURE 3
US transportation emissions with decarbonization strategies under a low electrification scenario
Million metric tons CO2e



Source: Rhodium Group and EER

FIGURE 4
Transportation emissions fuel gap in 2050 under varying levels of electric penetration
Percentage in million metric tons CO2e



Source: Rhodium Group and EER

A portfolio of clean fuels is needed to address the remaining emissions gap

Achieving net-zero emissions in 2050 will require aggressive federal action to deploy a portfolio of clean fuels. We find in our modeling that after accounting for electrification, a combination of advanced biofuels, electrofuels and carbon-neutral fossil fuels can successfully close the transportation emissions gap and get the sector to net-zero by 2050.

TABLE 1
Clean fuel categories

Biofuels	Conventional and advanced fuels made from biomass (plant-based) feedstock
Electrofuels	Drop in liquid replacement fuels made from electricity, carbon, and hydrogen
Carbon neutral fossil fuels	Petroleum fuels whose emissions are offset with negative emissions technology

The optimal portfolio of clean fuels will depend on technology cost and feedstock availability and will vary regionally based on local air quality issues, availability of high-quality wind and solar resources, and characteristics of the local agricultural economy. Federal climate policy advancing the research, development, and wide-scale deployment of clean fuels will be needed to ensure the availability of a wide portfolio of fuels and achieve net-zero emissions by 2050.

Federal policies will drive clean fuel deployment

Achieving net-zero emissions in 2050 will require aggressive federal action to reduce transportation demand, electrify vehicles, and develop and deploy clean fuels. A portfolio of policies can drive emissions reductions across transportation modes and amplify reductions from policies enacted at the state and local level. The federal government plays a large role in determining the US fuel mix. Research funding, fiscal incentives, market-based policies, and GHG and air quality targets all shape the portfolio of fuel consumed across the country. Transportation fuel demand can be filled with petroleum, or the federal government can take action to accelerate the deployment and market penetration of the clean fuels needed to achieve net-zero emissions by 2050.

Research and development | The majority of clean fuel technologies have not yet reached commercialization and there is a significant need for continued federal support in the research and development of advanced technology fuels. In addition to direct funding of clean fuel technologies, the federal government should prioritize investments in training a diverse cohort of scientists and engineers through university grants and federal internships. Reinvigorating investments in science and human capital can drive innovation in breakthrough technologies.

Deployment and validation | Beyond research, the federal government can accelerate the development and deployment of clean fuels through fiscal incentives and procurement requirements. Fiscal incentives targeting fuel manufacturers can increase the supply of clean fuels by providing tax credits and loan guarantees to accelerate innovation and reduce costs related to feedstocks and processing of clean fuels. Production incentives can drive deployment of clean fuels and increase market penetration and improve transport and storage of clean fuels.

Deep market penetration | Deploying clean fuels in the volumes required to achieve net-zero emissions by 2050 will also require a durable price signal and a robust federal policy framework. The federal government could provide this through modification of the Renewable Fuel Standard (RFS), the current framework for federal fuel policy. The RFS could be structured to include electricity from qualifying renewable fuels or "eRINs". Other advocates suggest that federal policymakers create a Clean Fuel Standard (CFS), leveraging successful design elements from existing state LCFS programs to drive investment in clean fuel production and to support ZEV penetration through electricity and hydrogen fuel pathways.

Disclosure Appendix

This nonpartisan, independent research was with support from Breakthrough Energy. The results presented in this report reflect the views of the authors and not necessarily those of the supporting organization.

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