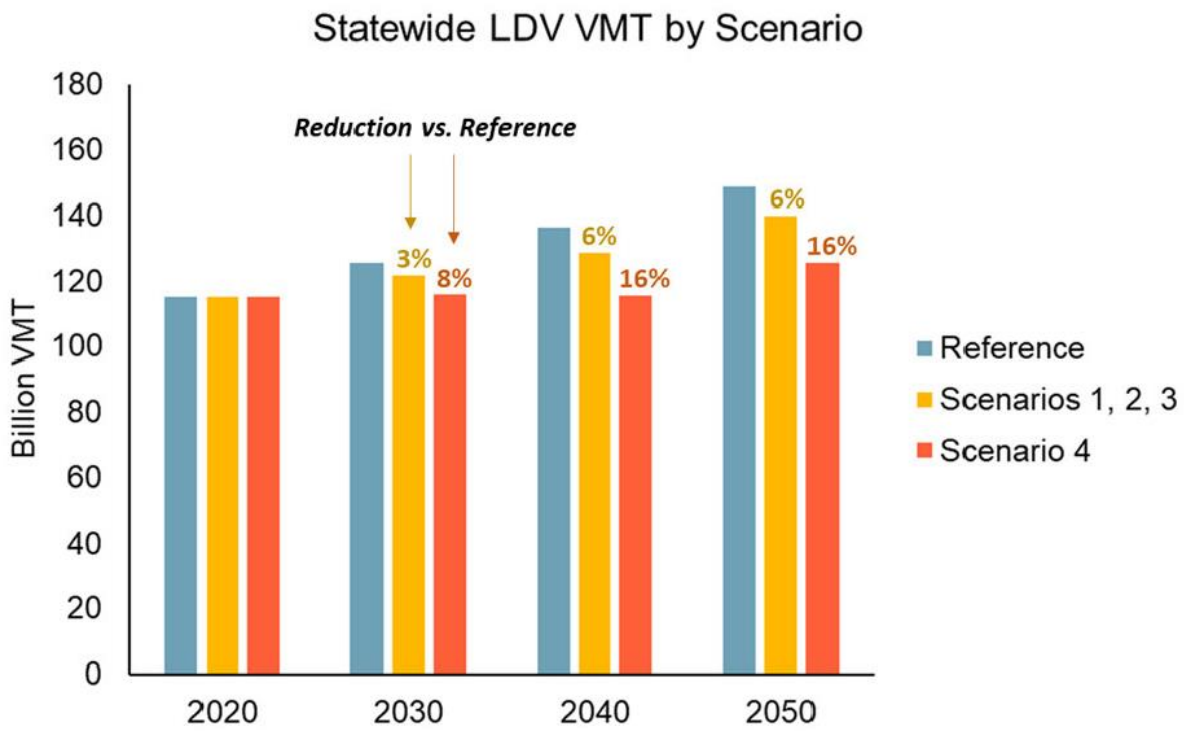
Vehicle ownership and VMT are expected to grow in all scenarios, with the highest growth occurring in the Reference Case. As shown in Figure 25 below, growth in LDV VMT in the Reference scenario, and corresponding increase in energy demand and emissions attributed to transportation, are mitigated somewhat by VMT-reduction measures in all mitigation scenarios. All mitigation scenarios include a key role for VMT reduction using smart growth, expanded public transit, telework and demand management programs. In addition, all scenarios include key role for zero-emission vehicle adoption, electrification of non-road sectors, and targeted low-carbon fuel use. These actions collectively reduce total final energy consumption and GHG emissions within the transportation sector (Figure 26).

Figure 25. Statewide LDV Vehicle Miles Traveled (VMT) by Scenario



All scenarios include a core focus on VMT-reduction due to transit, transportation demand management (TDM), telework, mixed-use development, and complete streets policies. Scenario 4 includes greater ambition in these categories, such as by including congestion pricing and other TDM policies in New York City leveraging data from the 2021 Pathways to Carbon-Neutral NYC report (Carbon Neutral NYC)24, additional ambition in transportation-oriented development where public transit and other low or zero-carbon transportation modes like biking and walking are highly accessible, as well as strategic investments in regional rail to increase ridership and reduce statewide VMT. For more details on VMT Reductions, see Table 9 and Table 10 in Chapter 5.

To decarbonize the remaining transportation energy services demand, zero-emissions vehicles have a central role in all scenarios, with a rapid increase in customer adoption of battery electric and hydrogen fuel cell vehicles. As shown in Figure 26, the electricity share of final energy demand increases from

approximately 1% in 2020 to 51%-60% by 2050 for Scenarios 2-4. Across all scenarios, sales of internal combustion engine vehicles are phased out by 2035 for light-duty vehicles and by 2045 for medium and heavy-duty vehicles. Scenario 2 includes significant vehicle electrification and a greater focus on low-carbon fuels, in particular advanced renewable diesel and renewable jet kerosene that are utilized to decarbonize trucking and aviation, respectively. Scenario 3 includes accelerated vehicle electrification relative to Scenario 2 with some early retirements of the oldest vehicles on the road. This greater pace of electrification goes in hand with greater pace of charging infrastructure investments needed to ensure New Yorkers can charge vehicles at home, at work, and using public charging points as needed. Scenario 4 includes a greater level of vehicle electrification consistent with Scenario 3, and goes further in tackling non-road emissions by including an innovation perspective on the use of electric and hydrogen aviation; Scenario 4 leverages analysis from the Transportation Roadmap which suggests feasibility of including a small role for electric aviation in decarbonizing short distance flights by 2050, and hydrogen aviation to decarbonize medium distance flights; together, hydrogen and electric aviation displace 47% of remaining aviation fuel demand in Scenario 4. Detailed annual final energy demand and GHG emissions for all scenarios are reported in Annex 2, while base year vehicle characteristics and vehicle populations are detailed in Annex 1.

Transportation (Section I page 93)

The transportation sector includes a representation of on-road vehicles (e.g., passenger cars) and non-road transportation (e.g. aviation). For most on-road vehicle categories, E3 applied a stock rollover approach, but for non-road vehicle categories a total energy approach was used.

The unit of energy service demand for vehicle categories simulated with a stock rollover approach in transportation (Light Duty Autos, Light Duty Trucks, Medium Duty Trucks, Heavy Duty Trucks, and Buses) is VMT. The underlying future VMT growth in the Reference scenario was estimated using Vision Eval-State, a disaggregate demand/aggregate supply travel demand model, combining the rich demographic and socioeconomic detail of simulated households with aggregate treatments of travel calibrated for New York State.54 Modeled VMT reduction measures fall into three broad categories: enhanced transit & mobility, telework & transportation demand management (TDM), and smart growth & biking/walking mode shifting. In all scenarios, we assume a targeted effort to expand programs and policies in the 2020s and 2030s, with continuous investment to maintain levels of reductions beyond 2035 through mid-century. VMT reductions are high-level estimates meant to represent ambitious action in reducing VMT relative to a Reference scenario. The following is a brief description of the VMT reduction measures attributed to each scenario, while Table 9 and Table 10 show impacts of the VMT reductions by measure achieved by 2050.

Enhanced Transit & Mobility:

- Low VMT (Scenarios 1-3): Expansion in bus transit service statewide, enhanced transit service taken from Carbon Neutral NYC report.
- Very Low VMT (Scenario 4): Incremental reductions from enhanced in-state rail aligning with 125 MPH alternative detailed in Empire Corridor Tier 1 Draft EIS

Telework & TDM:

- Low VMT (Scenarios 1-3): Additional promotion and informational TDM programs and modest increase in teleworking reduces a small amount of VMT, while in NYC additional programs like congestion pricing and other measures modeled in Carbon Neutral NYC further reduce VMT, although we do not include full Carbon Neutral NYC impacts in this case
- Very Low VMT (Scenario 4): Further ambition statewide reduce LDV VMT and full adoption of congestion pricing and other policies in Carbon Neutral NYC reduce NYC VMT. Similarly to the

Low VMT case, maximum reductions are achieved in the mid-2030s and maintained through 2050

Smart Growth & Biking/Walking Modeshifting:

- Low VMT (Scenarios 1-3): Focus on transportation-oriented development for new construction leads to reduced LDV VMT, with VMT impacts estimated using methodology from Growing Cooler report
- Very Low VMT (Scenario 4): Assume incremental ambition in smart growth development in collocating residential and commercial development, and incremental ambition in biking/walking infrastructure investments, all which lead to greater reductions.

Table 9. 2050 VMT Reduction Measures in Scenarios 1-3

Measure	State Total (million VMT)	Reduction vs Reference (%)	Sources[55]
2050 Reference	140,400	N/A	N/A
VMT Reductions:			
Enhanced Transit and Mobility	3,700	3%	Carbon Neutral NYC, E3 Internal Analysis
Telework and TDM	2,300	2%	Carbon Neutral NYC, UCR COVID Impacts Study, FHWA Integrating TDM into the Transportation Planning Process
Smart Growth and Biking/Walking/Modeshifting	2,900	2%	Carbon Neutral NYC, Growing Cooler: The Evidence on Urban Development and Climate Change
Total Reductions	**8,800**	**6%**	

55 Carbon Neutral NYC: https://www1.nyc.gov/assets/sustainability/downloads/pdf/publications/Carbon-Neutral-NYC.pdf, accessed November 2021
UCR Covid Impacts Study: https://ucreconomicforecast.org/wpcontent/uploads/2020/08/Mobility_Emissions_COVID19_CEFD_White_Paper_August_2020.pdf, accessed November 2021
FHWA Integrating TDM Into the Transportation Planning Process: https://ops.fhwa.dot.gov/publications/fhwahop12035/chap10.htm, accessed November 2021
Growing Cooler: The Evidence on Urban Development and Climate Change: https://www.nrdc.org/sites/default/files/cit_07092401a.pdf, accessed November 2021

Table 10. 2050 VMT Reduction Measures in Scenario 4

Measure	State Total (million VMT)	Reduction vs Reference (%)	Sources[56]
2050 Reference	140,400	N/A	N/A
VMT Reductions:			
Enhanced Transit and Mobility	3,700	3%	Carbon Neutral NYC, E3 Internal Analysis
Telework and TDM	7,200	5%	Carbon Neutral NYC, UCR COVID Impacts Study, FHWA Integrating TDM into the Transportation Planning Process
Smart Growth and Biking/Walking/Modeshifting	10,800	8%	Carbon Neutral NYC, Growing Cooler: The Evidence on Urban Development and Climate Change
Total Reductions	**21,700**	**16%**	

As E3 used a total energy approach for calculating energy demand and associated GHG emissions in the non-stock vehicle categories (e.g. aviation, marine), there is no fundamental energy service demand driver which is separate from energy demand for these non-stock vehicle categories.

Scenario 4 includes greater ambition in on-road transportation reductions (from greater VMT reductions and aggressive electrification levels) as well as greater levels of non-road ambition (such as increased rail, electric and hydrogen aviation); we include estimates for costs associated with this greater ambition, as summarized in Table 11.

Table 11. Transportation-related Incremental Costs Associated with Scenario 4

Measure	Per-Unit Cost	Units	Sources[57]
VMT Reductions[58]	$.0309/mile	14 billion LDV miles reduced relative to Scenarios 2/3 in 2050	$/mile reduction costs based on Moving Cooler estimates
Rail Improvements	$6/mile	200 million LDV miles reduced relative to Scenarios 2/3 in 2050	Empire Corridor Draft 1 Tier EIS
Electric and Hydrogen Aviation Infrastructure	$30/MMBtu	60 Tbtu in 2050 [47% of all aviation energy consumption in 2050]	E3 analysis of white paper on hydrogen fueling infrastructure in EU