Blueprint for Transportation Decarbonization

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1. Introduction

I write about the title subject frequently. There are several reasons I do this:

- In spite of my frequent posts on transportation, it is my most popular subject (based on the number of views per post.)
- The transportation sector is the largest source of greenhouse gas emissions in the United States, and another of my major subjects is climate change.
- One of the most important tools we will use to accomplish the title task is to convert this sector to electric energy or clean fuels that are mostly generated using electric energy.
- I post on Energy Central, and implementing the prior bullet will require the greatest changes to the energy sector in its history.

When I discovered that the U.S. Federal Government had released an extremely important document this month (January, as I'm starting to write this). I decided that I needed to create a post summarizing this document, referenced here.[1]

On the first glance the primary reference for this paper appears to be a very broad-ranging document, and I believe that it (and my summary) will provide a unique viewpoint. Of course, given its recent vintage, it should represent the most recent policy position of the federal government regarding the title issue.

2. The Vision

Transportation connects us. It connects people, countries, and cultures, and draws us closer to one another. It is also is a backbone of our economy and critical to supporting the daily needs of all Americans. Our transportation system has been an engine for growth and prosperity over many decades, but that growth has not come without consequences, and that prosperity has not been shared equally. The transportation sector is now the largest source of greenhouse gas emissions in the United States, contributing to the climate crisis that is worsening quality of life in cities, towns, and rural communities throughout America. Emissions from the transportation sector also contribute to poor air quality. In the United States, these effects disproportionately impact underserved and disadvantaged communities.

To address the climate crisis, we must eliminate nearly all greenhouse gas (GHG) emissions from the sector by 2050 and implement a holistic strategy to achieve a future mobility system that is clean, safe, secure, accessible, affordable, and equitable, and provides sustainable transportation options for people and goods.

[1] Lead Author: Matteo Muratori, NREL. For a complete list of Authors and Contributors, see the "Acknowledgements" page near the end of this document. The sponsoring organizations are the following U.S. Departments and Agencies: Energy, Transportation, Environmental Protection, Housing and Urban Development, "The U.S. National Blueprint for Transportation Decarbonization," Jan 2023, https://www.energy.gov/sites/default/files/2023-01/the-us-national-blueprint-for-transportation-decarbonization.pdf

This U.S. National Blueprint for Transportation Decarbonization (Blueprint) is the roadmap for how we can address these issues to provide better transportation options, expand affordable and accessible options to improve efficiency, and transition to zero-emission vehicles and fuels.

This Blueprint offers a whole-of-government approach to transform the transportation sector and sets forth an interagency call to action to coordinate and work effectively together. Achieving our goals will require close cooperation with industry, local, regional, state, and Tribal governments, non-profits, and other stakeholder groups, as well as allies around the world. With bold, coordinated actions, together we can build a transportation system that is clean, safe, secure, accessible, affordable, and equitable, for all Americans to help create a more sustainable future for generations to come.

3. Summary

The transportation sector is the largest source of greenhouse gas emissions in the United States, responsible for one-third of all emissions. To address the growing climate crisis, and to meet the goal of net-zero GHG emissions economy-wide by 2050, it is critical to decarbonize transportation by eliminating nearly all GHG emissions from the sector.[2]

Transportation costs are the second largest household expense for Americans and a well-planned transition to a sustainable transportation future will also result in a more affordable and equitable transportation system, with improved transportation services; more mobility choices; improved air quality and health; greater energy security; better quality of life and accessibility; improved health outcomes; enhanced access to a variety of housing options, services, and amenities; well-paying jobs; and safer, more vibrant and resilient communities throughout the country. A decarbonized transportation system can mobilize a sustainable economy that benefits everyone. As our transportation system and communities are increasingly threatened by worsening climate impacts such as hurricanes, wildfires, flooding, heatwaves, and drought, decarbonizing the sector is essential to addressing this existential crisis…

3.1. Coordination

Implementing a holistic decarbonization strategy will require coordinated actions from federal, regional, state, local, and Tribal governments; nonprofit and philanthropic organizations; and private industries. In recognition of our critical roles, the United States Department of Energy (DOE), the United States Department of Transportation (DOT), the United States Environmental Protection Agency (EPA), and the United States Department of Housing and Urban Development (HUD) signed a joint memorandum of understanding (MOU) in September of 2022 to formalize our commitment to the highest level of collaboration and coordination on transportation decarbonization…

3.2. Immediate Actions

Implementing immediate strategies that achieve meaningful emissions reductions this decade is essential to reaching our nation's 2030 emissions reduction goals in line with the president's commitment and the U.S. Nationally Determined Contribution under the Paris Agreement. We must work concurrently to develop solutions that will result in full economy-wide decarbonization by midcentury. This Blueprint provides a comprehensive,

[2] This Blueprint uses the term "decarbonization" to refer to reducing or eliminating all greenhouse gas emissions.

system-level perspective of the entire transportation system across all passenger and freight travel modes and fuels, and lays out three key strategies to achieve decarbonization.

1. *Increase convenience by supporting community design and land-use planning at the local and regional levels that ensure that job centers, shopping, schools, entertainment, and essential services are strategically located near where people live to reduce commute burdens, improve walk-ability and bike-ability, and improve quality of life...*

   Because every hour we don't spend sitting in traffic is an hour we can spend focused on the things and the people we love, all while reducing GHG emissions.

2. *Improve efficiency by expanding affordable, accessible, efficient, and reliable options like public transportation and rail, and improving the efficiency of all vehicles...*

   Because everyone deserves efficient transportation options that will allow them to move around affordably and safely, and because consuming less energy as we move saves money, strengthens our national security, and reduces GHG emissions.

3. *Transition to clean options by deploying zero-emission vehicles and fuels for cars, commercial trucks, transit, boats, airplanes, and more...*

   Because no one should be exposed to air pollution in their community or on their ride to school or work and eliminating GHG emissions from transportation is imperative to tackle the climate crisis.

While the first two strategies—increasing convenience and improving efficiency— will contribute to reducing GHG emissions, transitioning to clean options is expected to drive the majority of emissions reductions (see the chart below).

1 icon represents limited long-term opportunity
2 icons represents large long-term opportunity
3 icons represents greatest long-term opportunity

	BATTERY/ELECTRIC	HYDROGEN	SUSTAINABLE LIQUID FUELS
Light Duty Vehicles (49%)*	●●●	–	TBD
Medium, Short-Haul Heavy Trucks & Buses (~14%)	●●	●	●
Long-Haul Heavy Trucks (~7%)	●	●●●	●●
Off-road (10%)	●●	●	●
Rail (2%)	●●	●●	●●
Maritime (3%)	●	●†	●●●
Aviation (11%)	●	●	●●●
Pipelines (4%)	●●	TBD	TBD
Additional Opportunities	• Stationary battery use • Grid support (managed EV charging)	• Heavy industries • Grid support • Feedstock for chemicals and fuels	• Decarbonize plastics/chemicals • Bio-products
RD&D Priorities	• National battery strategy • Charging infrastructure • Grid integration • Battery recycling	• Electrolyzer costs • Fuel cell durability and cost • Clean hydrogen infrastructure	• Multiple cost-effective drop-in sustainable fuels • Reduce ethanol carbon intensity • Bioenergy scale-up

* All emissions shares are for 2019

† Includes hydrogen for ammonia and methanol

4. Timeline

The Blueprint divided future actions into three periods as described in the following subsections.

4.1. Before 2030

The following actions will maximize the impact of the historic BIL/IRA[3] investments and catalyze collaboration and private investments.

- *Partner with local communities to develop and demonstrate effective, equitable, and scalable local or regional land-use and planning solutions to increase convenience and reduce emissions by making it possible for people to take fewer or shorter trips. Provide best practices, data, tools, and technical assistance on system-level design solutions to increase convenience and reduce emissions.*
- *Work with public and private sector partners to identify and advance solutions for a more equitable and healthier transportation system including support for transit-oriented development.*
- *Support land-use, street design, and development policies that make walking and biking easier, safer, and more convenient.*
- *Reduce national transportation cost burden by at least 5% by 2030.[4]*
- *Invest in rail, public transportation, and active transportation infrastructure to provide the option to use more affordable and energy-efficient forms of transportation.*
- *Provide incentives to support greater use of efficient travel modes and vehicles and reduce the transportation cost burden on disadvantaged communities. Continue to strengthen standards to improve vehicle efficiency.*
- *Set clear, ambitious but achievable targets across all travel modes (e.g., sales shares of zero-emission vehicles, volumes of sustainable fuels, emissions reduction targets).*
- *Work with international partners to define targets, infrastructure standards, and implementation plans to encourage international shipping and aviation to rapidly decarbonize.*
- *Invest in research and innovation to further develop and demonstrate clean technologies (e.g., achieve battery, hydrogen electrolysis, and sustainable fuel cost targets) and enable seamless integration with energy systems.*
- *Continue and expand funding and market incentives to accelerate the uptake of low- or zero-emission vehicles and invest in supporting infrastructure (e.g., vehicle rebates and EV charging infrastructure), especially in low-income and overburdened communities*
- *Develop a robust workforce including by engaging residents and businesses in disadvantaged communities and secure domestic and international supply chain solutions to ensure the U.S. can manufacture enough clean vehicles and fuels to meet rapidly growing demand*

[3] Bipartisan Infrastructure Law / Inflation Reduction Act

[4] See U.S Department of Transportation Strategic Plan, FY 2022 to 2026, https://www.transportation.gov/sites/dot.gov/files/2022-04/US_DOT_FY2022-26_Strategic_Plan.pdf

4.2. 2030-2040 – Accelerating Change

Scaling Up Deployment of Clean Solutions: *Adapt strategies and implementation plans in response to global events, consumer response, and technology progress.*

- *Continue to implement land-use and planning solutions and policies at the appropriate scale while ensuring transportation infrastructure is equitable and resilient to a changing climate.*
- *Administer forward-looking policy to maximize the positive impact of transformative technologies, like automation, in terms of quality of life and emissions*
- *Continue to invest in and encourage greater use of efficient travel modes for passenger and freight to optimize travel and freight logistics and improve fuel economy*
- *Leverage technologies and innovative business models to enable multimodal and shared travel Continue to strengthen standards to further improve vehicle efficiency*
- *Transition all new vehicles sales to zero-emission technologies and scale up production and use of sustainable fuels*
- *Ensure infrastructure needed to support clean technologies is in place (e.g., EV charging, clean hydrogen and sustainable fuel refueling) and is fully integrated in the energy systems*
- *Continue to build resilient supply chains, expand infrastructure, and implement a robust workforce development strategy to enable a full transition to zero-emission solutions*

4.3. 2040-2050 – Completing the Transition

A Sustainable and Equitable Future: *Ensure that no one is left behind and do our part to achieve a net-zero-emissions economy:*

- *Continue to support the implementation of equitable regional or local land-use and planning solutions and policies to reduce emissions and achieve net-zero-emissions goals*
- *Fully leverage the system-wide potential for efficient travel modes like rail, transit, and shared multimodal mobility and maximize vehicle efficiency*
- *Support fleet turnover to fully replace legacy vehicles and petroleum infrastructure with clean zero-emission solutions*
- *Fully integrate the clean transportation and clean energy systems to ensure reliable operations of mobility, freight, and energy supply and delivery networks*

4.4. Transportation Modes

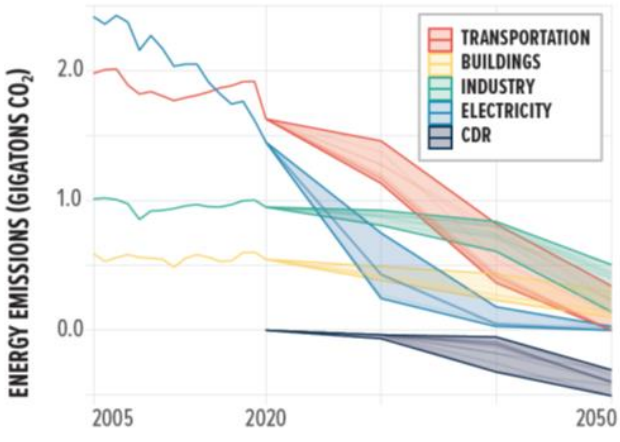
The following are plans for each transportation mode.

Transportation Mode	Share of Current Transportation Emissions	Federal GHG Emissions Reduction Goals
 Light-Duty Vehicles	49%	• Achieve 50% of new vehicle sales being zero-emission by 2030 supporting a pathway for full adoption, and ensure that new internal combustion engine vehicles are as efficient as possible • Deploy 500,000 EV chargers by 2030 REF • Ensure 100% federal fleet procurement be zero-emission by 2027 REF
 Medium and Heavy-Duty Trucks and Buses	21%	• Aim to have 30% of new vehicle sales be zero-emission by 2030 and 100% by 2040 REF • Ensure 100% federal fleet procurement is zero-emission by 2035 REF
 Off-road	10%	• Work to establish specific targets • Focus resources to develop technology pathways and set efficiency and zero-emissions vehicle and equipment targets
 Rail	2%	• Work to establish specific targets • Focus resources to develop technology pathways and set efficiency and zero-emissions vehicle targets • Encourage greater use for passenger and freight travel to reduce emissions from road vehicles
 Maritime	3%	• Continue to support the Zero-Emission Shipping Mission (ZESM) goals to ensure that 5% of the global deep-sea fleet are capable of using zero-emission fuels by 2030, at least 200 of these ships primarily use these fuels across the main deep sea shipping route, and 10 large trade ports covering at least three continents can supply zero-emissior fuels by 2030 REF • Support the U.S. domestic maritime sector by performing more RD&D into sustainable fuels and technologies and incentivize U.S. commercial vessel operators to move towards lower GHG emissions • Work with countries in the International Maritime Organization to adopt a goal of achieving zero emissions from international shipping by 2050 REF
 Aviation	11%	• Reduce aviation emissions by 20% by 2030 when compared to a business-as-usual scenario • Achieve net-zero GHG emissions from the U.S. aviation sector by 2050 • Catalyze the production of at least three billion gallons of SAF per year by 2030 and ~35 billion gallons by 2050, enough to supply the entire sector REF

Pipelines	4%	• Work to establish specific targets • By 2036, repair or replace 1,000 miles of high-risk, leak-prone, community-owned legacy gas distribution pipeline infrastructure, as well as an estimated reduction of 1,000 metric tons of methane emissions REF • Eliminate leakages and enable use of pipelines for clean sustainable fuels
Total Sector	100%	• 80–100% Emissions Reductions by 2050 (**in line with the U.S. LTS**)

4.5. The Long-Term Strategy of the United States (LTS)

"*In the United States and around the world, we are already feeling the impacts of a changing climate. Here at home, in 2021 alone we have seen historic droughts and wildfires in the West, unprecedented storms and flooding in the Southeast, and record heatwaves across the country. We see the same devastating evidence around the world in places like the fire ravaged Amazon, the sweltering urban center of Delhi, and the shrinking coastlines of island nations like Tuvalu. The science is clear: we are headed toward climate disaster unless we achieve net-zero global emissions by midcentury. We also know this crisis presents vast opportunities to build a better economy, create millions of good-paying jobs, clean our waters and air, and ensure all Americans can live healthier, safer, stronger lives.*"[5]



The path to economy-wide decarbonization entails electricity emissions and emissions from transportation, buildings, and industry falling dramatically in all scenarios, with the greatest reductions coming from electricity, followed by transportation, and growth in non-land sink carbon dioxide removals (Source: LTS). Note, in the above chart, CDR is carbon dioxide removal.

In November 2021, the Biden-Harris administration published The Long-Term Strategy (LTS) of the United States, a visionary climate strategy that outlines a plan to tackle the growing climate crisis by decarbonizing our national economy. The LTS established a goal of net-zero GHG emissions by no later than 2050 with an interim, near-term milestone of a 50–52% reduction from 2005 levels in economy-wide net GHGs by 2030. Addressing the climate crisis is critical for the long-term health and well-being of every resident of the United States and will require rapid, widespread, and major transformations of many complex systems that are closely intertwined with our economy and way of life. Achieving a net-zero-emissions economy by 2050 involves aggressive curbing of emissions from all sectors (see Figure), including transportation, which is now the largest source of U.S. GHGs—about a third of all domestic emissions. In the LTS, transportation emissions are projected to reduce by 80–100% by 2050.

[5] The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050, Nov, 2021, https://www.whitehouse.gov/wp-content/uploads/2021/10/US-Long-Term-Strategy.pdf