Tough to Decarbonize Transportation

THE CHALLENGE FOR AVIATION, SHIPPING, AND TRUCKING

- Aviation, maritime shipping, and trucking are the backbone of the global economy—connecting people to economic opportunity and enabling long-range movement of goods we rely on.
- Aviation also connects the world culturally and socially—enabling us to learn from other cultures, innovate through exchange, and maintain ties with friends and family.
- All three modes of transportation are tough to decarbonize. There are currently no viable plans to achieve zero CO_2 emissions, other than plans that rely on large-scale offsets or reductions in use.
- These transportation modes also pose major air pollution challenges, which current plans do not address.

A better future for the world achieves net zero CO_2 for tough-to-decarbonize transportation (T2DT), does not create other environmental damage, and enables ever greater parts of the global community to benefit from social, cultural, and economic connectedness provided by aviation, shipping, and trucking.

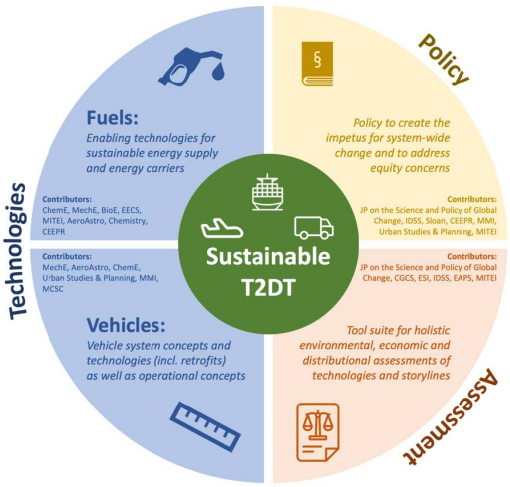
We aim to chart a course to net zero CO_2 emissions for aviation, shipping, and trucking by 2050 that:

- Makes the world more connected and more equitable and avoids climate policy–related inequality growth.
- Does not rely on fossil fuels or offsets from other sectors. Given that we must achieve worldwide net zero, the capacity for offsets will become limited over time.
- Achieves net zero climate impact, including non-CO_2 impacts such as contrails from aviation.
- Approaches zero air pollution–related deaths, compared to the 400,000 deaths currently caused each year by emissions from T2DT

- Is broadly sustainable, politically viable, and applicable to different regions in the world – drawing upon globally agreed UN Sustainable Development Goals

RESEARCH PLAN

- Our team will pursue four focus areas: fuels, vehicles, policy, and assessment.
- Efforts draw broadly upon existing initiatives, labs, departments, and centers across MIT – aiming to amplify these rather than create a new formal structure.
- Researchers focused on fuels will develop efficient production technologies for a range of high energy density drop-in and zero-CO_2 fuels. These need to be suitable for different modes, times, and places, with solutions characterized based on lifecycle emissions, costs, and infrastructure requirements.
- Integrated design and optimization of vehicles, fuels, propulsion systems, emissions controls, and operational practices will ensure efficient resource use and broaden access to T2DT services.
- Researchers focused on policy will develop new policy options and resolve institutional and political roadblocks.
- The assessment group will ensure that our solutions achieve zero climate forcing from T2DT and quantify each solution's overall sustainability, including net and distributional impacts on climate, economic output, air pollution, and water availability.



PATHWAY TO IMPACT

The key to our success is collaboration and coordination.

- Our research will be conducted by groups across MIT but organized by our T2DT leadership team, including a full-time project director and the steering committee.
- In addition to coordinating within MIT, we will set up a stakeholder coalition: the members of the T2DT industry, think tanks, and NGOs who will be directly affected by and contribute to the changing nature of a sustainable T2DT system. Five companies have already formally signaled their support in writing, and we will continue to approach others to represent the value chain for T2DT as a whole.

RESOURCES

- We will identify a strategic portfolio of policy and technology solutions where MIT can make the greatest difference through research, engagement, and education.
- We will work with external collaborators to advance quickly from lab to real-world testing and policy formulation.

THE TEAM

Steven Barrett (MIT Aeronautics and Astronautics) and **Bill Green** (MIT Chemical Engineering) are leading a team that includes 39 MIT faculty members and senior researchers. The team spans four of the five schools at MIT (with planned expansion) and the College of Computing, and 14 departments/units across MIT. In addition, a Steering Committee of 10 faculty members and senior researchers from across the schools provides multidisciplinary leadership.