



Partnership for AiR Transportation  
Noise and Emissions Reduction



# Environmental Cost-Benefit Analysis of Ultra Low Sulfur Jet Fuel

## PARTNER Project 27 Final Report

prepared by

Christopher K. Gilmore, Steven R. H. Barrett, Steve H. L. Yim, Lee T. Murray, Stephen R. Kuhn, Amos P. K. Tai, Robert M. Yantosca, Daewon W. Byun, Fong Ngan, Xiangshang Li, Jonathan I. Levy, Akshay Ashok, Jamin Koo, Hsin Min Wong, Olivier Dessens, Sathya Balasubramanian, Gregg G. Fleming, Matthew N. Pearlson, Christoph Wollersheim, Robert Malina,, Sarav Arunachalam, Francis S. Binkowski, Eric M. Leibensperger, Daniel J. Jacob, James I. Hileman, Ian A. Waitz

December 2011

REPORT NO. PARTNER-COE-2011-006

# Environmental Cost-Benefit Analysis of Ultra Low Sulfur Jet Fuel

A report to the U.S. Federal Aviation Administration Office of Environment and Energy

Christopher K. Gilmore<sup>1</sup>, Steven R. H. Barrett<sup>1</sup>, Steve H. L. Yim<sup>1</sup>, Lee T. Murray<sup>2</sup>, Stephen R. Kuhn<sup>1</sup>, Amos P. K. Tai<sup>2</sup>, Robert M. Yantosca<sup>2</sup>, Daewon W. Byun<sup>3</sup>, Fong Ngan<sup>3</sup>, Xiangshang Li<sup>4</sup>, Jonathan I. Levy<sup>5</sup>, Akshay Ashok<sup>1</sup>, Jamin Koo<sup>1</sup>, Hsin Min Wong<sup>1</sup>, Olivier Dessens<sup>6</sup>, Sathya Balasubramanian<sup>7</sup>, Gregg G. Fleming<sup>7</sup>, Matthew N. Pearlson<sup>1</sup>, Christoph Wollersheim<sup>1</sup>, Robert Malina<sup>1,8</sup>, Sarav Arunachalam<sup>9</sup>, Francis S. Binkowski<sup>9</sup>, Eric M. Leibensperger<sup>10</sup>, Daniel J. Jacob<sup>2</sup>, James I. Hileman<sup>1</sup>, and Ian A. Waitz<sup>1</sup>

<sup>1</sup> Department of Aeronautics and Astronautics, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA; <sup>2</sup> School of Engineering and Applied Sciences, Harvard University, Cambridge, Massachusetts, USA; <sup>3</sup> Air Resources Laboratory, National Oceanic and Atmospheric Administration, Silver Spring, Maryland, USA; <sup>4</sup> Department of Earth and Atmospheric Sciences, University of Houston, Houston, Texas, USA; <sup>5</sup> Department of Environmental Health, Boston University School of Public Health, Boston, Massachusetts, USA; <sup>6</sup> Centre for Atmospheric Sciences, University of Cambridge, Cambridge, UK; <sup>7</sup> Volpe National Transportation Systems Center, Cambridge, Massachusetts, USA; <sup>8</sup> Institute of Transport Economics, University of Muenster, Muenster, Germany; <sup>9</sup> Institute for the Environment, University of North Carolina at Chapel Hill, North Carolina, USA; <sup>10</sup> Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, Massachusetts, USA.

Steven R. H. Barrett is the corresponding author. He may be reached at sbarrett@mit.edu

---

Report No. PARTNER-COE-2011-006  
December 2011

---

This work was funded by the U.S. Federal Aviation Administration Office of Environment and Energy, under FAA Cooperative Agreement No. 06-C-NE-MIT, Amendment Nos. 010, 015, 022, and 025 (with U. of Houston Subaward No. 5710002426 and U. of Cambridge Subaward No. 5710002636); and FAA Cooperative Agreement No. 07-C-NE-SU, Amendment No. 002, and FAA Cooperative Agreement No. 09-C-NE-MIT, Amendment Nos. 003 and 010. The project was managed by S. Daniel Jacob. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the FAA, NASA, Transport Canada, the U.S. Department of Defense, or the U.S. Environmental Protection Agency.

The Partnership for AiR Transportation Noise and Emissions Reduction — PARTNER — is a cooperative aviation research organization, and an FAA Center of Excellence sponsored by the FAA, NASA, Transport Canada, the U.S. Department of Defense, and the U.S. Environmental Protection Agency. PARTNER fosters breakthrough technological, operational, policy, and workforce advances for the betterment of mobility, economy, national security, and the environment. The organization's operational headquarters is at the Massachusetts Institute of Technology.

**The Partnership for AiR Transportation Noise and Emissions Reduction  
Massachusetts Institute of Technology, 77 Massachusetts Avenue, 33-240  
Cambridge, MA 02139 USA <http://www.partner.aero>**