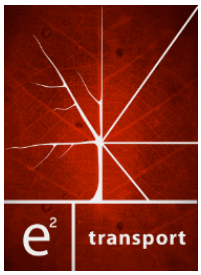


e² transport — Aviation: The Limited Sky

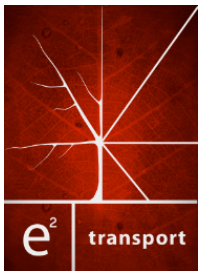
While the aviation industry accounts for roughly 5% of greenhouse gas emissions today, it is the fastest growing sector of CO_2 emitters, at a growth rate of 5% per year, which has many experts concerned. Because fuel costs amount to 30-50% of the operating costs for a typical airline, there is a built-in incentive to reduce fuel use. The airline industry is taking steps to address its growth with a focus on reducing CO_2 emissions, but there is much debate about which strategy or strategies will yield the best long-term results.

In the video, Jos Dings, Director of the European Federation for Transport and Environment, gives insight into how the industry can increase fuel efficiency and lower CO_2 emissions. However, he states that in order to make real inroads in addressing the global climate problem, consumers will have to make sacrifices in terms of speed and cost of travel. Today, airlines try to maximize passenger miles per aircraft, so they design planes to be as fast as possible. If they shifted their focus to maximizing passenger miles per liter of jet fuel, they could design a plane that is10% slower but 20% more fuel-efficient.

We hear from William Glover, the Environmental Strategy Director for Boeing Commercial Airplanes, about specific innovations that are being made in aircraft design. The fuselage and wings of the new Boeing 787 Dreamliner are made primarily of composite material, making it a lighter plane that requires less thrust to fly. The difference in weight allows for a reduction in engine size. These and other features result in a 20% reduction in CO_2 emissions.

While newly designed aircraft can be part of the solution, it is important to improve the fuel efficiency of the current fleet of airplanes as well. Improvements in the planning and procedures of air traffic control can help get planes to the gates more quickly or provide more direct routes, though in some cases that would require opening up air space that is currently restricted. Many airports have already implemented continuous descent approach, which is essentially a smooth glide from the cruising altitude to the airport at reduced engine power. This provides a quieter and more fuel-efficient landing. While these ideas and others, like tugging aircraft out to the starting point, can help, they could be hard to implement given the rate of growth in the industry.

While fuel efficiency-based approaches are important, some believe the fuel itself is the problem to be fixed. While developing an anti-malarial compound, Amyris Biotechnologies discovered a way to produce hydrocarbons from a plant. Hydrocarbons, which are contained in fossil fuels, are the world's main source of energy. While most biofuels today, like ethanol, are alcohol-based and contain 27-30% less energy than



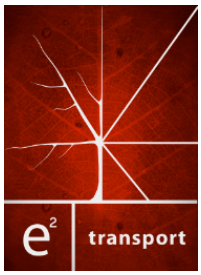
gasoline, the fuel that Amyris creates is comparable to gasoline. It is not a compromise for consumers and could be easily integrated into the current infrastructure of pipelines and vehicles.

Other strategies that the aviation industry has started to develop range from selling carbon offsets to consumers to the reinvention of the airship. A blimp, which is most commonly seen hovering above a sporting event, is one example of an airship, but others can move at higher speeds and even make overseas flights. A combination of approaches will likely be employed to reduce CO_2 emissions, but the question remains, at what cost?

To find out more about Amyris Biotechnologies, visit www.amyrisbiotech.com

To find out more about the skycat airship, visit www.worldskycat.com

To find out more about Boeing, visit www.boeing.com or to find out more about the 787 Dreamliner, visit www.boeing.com/commercial/787family/background.html



e² transport — Aviation: The Limited Sky

PRE-VIEWING QUESTIONS

1) Have you heard of climate change? If so, can you list some of the causes of climate change? Do airplanes contribute to climate change? If so, explain how.

2) What is the difference between renewable resources and non-renewable resources? List examples of each type.

3) What are biofuels? Can you give an example of a biofuel that you have heard of? Where is it used and for what purpose? Why are biofuels commonly believed to be better for the environment? What are the benefits and drawbacks of biofuels?

4) In late 2008, some airlines started charging passengers for checked baggage. Why do you think they made that decision? How does excess baggage affect the airline's costs?

5) What other types of aircraft exist besides the jumbo jets that most commercial airlines use? Could any of these other types of aircraft be used commercially? Why or why not?

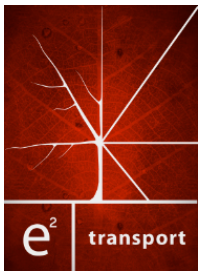
POST-VIEWING QUESTIONS

1) In the episode, several different approaches to reducing the aviation industry's consumption of oil are presented. Which solution or solutions do you think will be the most effective? Which do you believe will be the least effective? Why? Support your answer with details from the video.

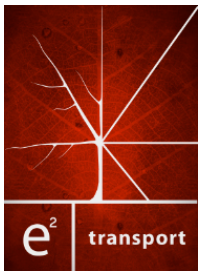
2) What are the environmental benefits of creating a hydrocarbon-based biofuel? What are the drawbacks? What challenges does Amyris Biotechnologies face as they try to move forward with their biofuel?

3) Would you be willing to pay for carbon offsets when buying an airline ticket? Why or why not? Do you think carbon offsets are an effective way of reducing CO_2 emissions? Why or why not? Support your answer with details from the video.

4) In the video, Jos Dings, Director of the European Federation for Transport and Environment, suggests that fuel suppliers should be paid for carbon savings rather



than liters of fuel provided. Do you think the approach is feasible? Why or why not?



NATIONAL STANDARDS FROM MCREL STANDARD

Engineering Education
Standard 5.6: Knows renewable and non-renewable sources of energy (e.g., fossil, wind, nuclear, solar)

Standard 14.4: Understands how societal interests, economics, ergonomics, and environmental considerations influence a solution.

Family/Consumer Sciences

Standard 4.3 - Knows methods used to conserve, preserve, and recycle resources.

Science

Standard 6.2 - Knows how the amount of life an environment can support is limited by the availability of matter and energy and the ability of the ecosystem to recycle materials

Technology

Standard 4.5 - Knows that since there is no such thing as a perfect design, trade-offs of one criterion for another must occur to find an optimized solution.

Standard 4.6 - Knows that a design involves different design factors (e.g., ergonomics, maintenance and repair, environmental concerns) and design principles (e.g., flexibility, proportion, function).

Standard 6.8 - Knows different requirements for structural design (e.g., strength, maintenance, appearance) and that these structures require maintenance.