Commercial Aviation in a Carbon Constrained Future

Effective Technological, Operational and Policy Responses

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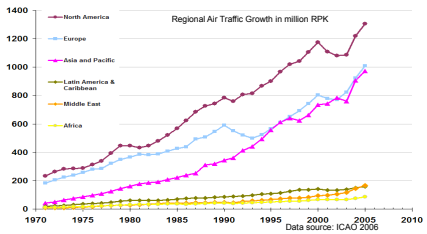
Motivation

Commercial aviation is a strong enabler of the global economy.
It provides medium- and long-haul services that have no substitute by other means of transportation while the demands on land infrastructure are comparatively limited.

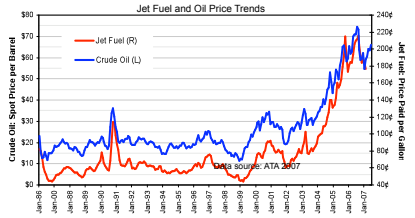
Fast growth rates for both passenger and freight traffic are testimony to this success.

But aviation, an energy intensive sector, is also an emitter of GhG that contribute to climate change.



Aviation's radiative forcing is higher than equivalent ground emitters (contributions of contrails and NOx). It currently is about 3.5% and is expected to grow to 6~12% of total anthropogenic forcing by 2050 (IPCC 1999).

As a result, the European Union will include all flights using EU airports in the carbon emissions trading scheme (ETS) developed to meet the Kyoto protocol requirements by 2011. It is reasonable to expect global measures by 2012.



Tight oil supplies also put pressure on the fuel costs further constraining aviation's availability of a key resource.

Designing effective policies as regulators and competitive strategies as enterprises is not trivial given the multifaceted nature of the air transport system.

Aviation is of special interest to Middle East:

(i) it provides connectivity to major metropolitan centers for business and tourist travelers
(ii) is necessary for diversifying M.E. economies beyond resource extraction to incorporate tourism and industry
(iii) M.E. airlines have been expanding capacity into hubs that connect Europe and N. America to Asia.

Key Questions

What are the long term effects of the policy measures proposed by the EU on the airline ecosystem and on GhG emissions?

Are these effects different if the measures are adopted globally after 2012? What portfolio of measures is more effective?

What are strategies that create competitive advantage for different stakeholders, e.g.:
Is there an enduring competitive advantage to M.E. airlines vis-à-vis carbon constraints? Is there a first mover advantage for efficient aircraft manufacturing? etc
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What are effective strategies for competitive advantage in a carbon constrained market?

Research Methodology

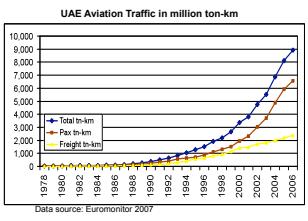
Literature Review on ETS impacts on aviation

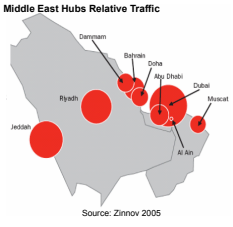
Structured interviews with leaders in various stakeholder organizations including different types of airlines (freight, legacy, low-cost) across the world, government regulators, ICAO, aircraft manufacturers etc. to gauge their perspective in adapting to a carbon constrained world.

Development of a system dynamics model of the air transportation system interactions that combined with other models (e.g. network, economic, cost) as necessary will provide a platform to test different strategies for competitive advantage.

Generation of diverse future scenarios to help test the robustness of the proposed strategies.

Communication of the findings to the relevant stakeholders and generation of discussions on how they reflect on their expectations.



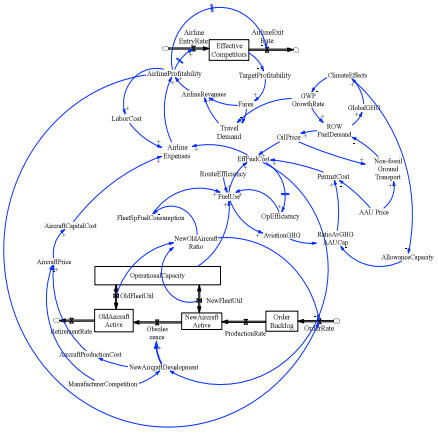


Research

Generation of database for global travel demand and modal choice for both passenger and freight and their related costs and emsissions.

The SD model advances an existing model of the air transportation industries to include more explicitly carbon management methods i.e.:
•Fleet (new aircraft & retrofitting)
•Network and scheduling
•Operations (including Air Traffic Management)
•Fuel

Indicative Causal Loop Diagram for Commercial Aviation Dynamics



System interactions not considered in existing literature:
•Effect of business cycle and carbon mitigation
•Fuel and carbon permit volatility
•Demand changes
•Manufacturer strategies

Challenge

Aviation will continue to grow to serve the increasingly affluent developing world. What are effective options for regulators and entrepreneurs for reducing its effects on the global environment?