

# Green Airspace Design

Gene C. Lin, Ph.D.

703.983.3427 • [gclin@mitre.org](mailto:gclin@mitre.org)

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## Environmental Issues May Constrain Future Aviation

### ■ Global Warming

- Aviation directly accounts for 0.5% of economy but 2% of greenhouse gas emissions; impacts may be higher
- Regulatory trends and (some) public opinion favor more regulation.

### ■ Engine combustion emits several chemical pollutants

- Carbon dioxide: a greenhouse gas
- Nitrogen oxides (NO<sub>x</sub>): a precursor for smog and acid rain
- Sulfur oxides (SO<sub>x</sub>): a precursor for acid rain
- Particulate matter (TSP / PM<sub>10</sub>): implicated in lung ailments.

**Fuel use is an uncontroversial first step for various environmental and economic endpoints.**

# Background



- **Criteria Pollutants (specified by Clean Air Act)**
  - Minimum legal limits still not reached in many metro areas
  - Understanding of health effects continues to evolve.
- **Near large airports, the flight paths (arrival and departure procedures) are defined by the FAA.**
- **Mission of the Air Traffic Control (ATC) system is the “safe, orderly, and efficient flow of traffic”**
  - To date, “efficient” means “maximizing capacity”
  - If “efficient” comes to mean “clean”, how might operations change?

***“...I ask this Congress to send me legislation that places a market-based cap on carbon pollution...”***

**President Barack Obama, 24 February 2009**

# Objective



- **Look for Airspace Design Ideas to Reduce Fuel.**
- **Assess**
  - **Potential fuel savings**
  - **Operational impacts.**

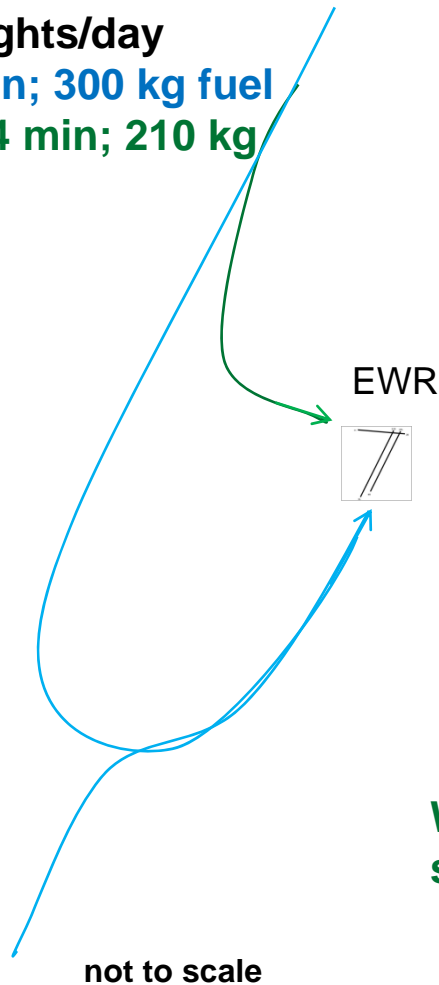
# Activities: Ideas to Assess



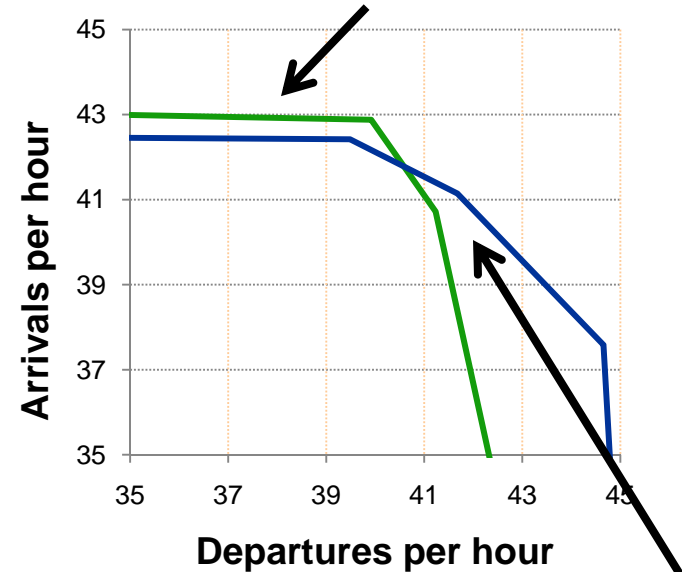
- **Shorten arrival paths**
  - **Newark Liberty Airport (EWR): increase use of Runway 11 in Northeast Configuration.**
  
- **Fuel-optimal arrival and departure profiles**
  - **Dallas Fort Worth International Airport (DFW): eastern complex in North Configuration.**

# Highlight: Shorter Flight Paths

60 flights/day  
20 min; 300 kg fuel  
vs. 14 min; 210 kg



Adding arrivals to Runway 11...

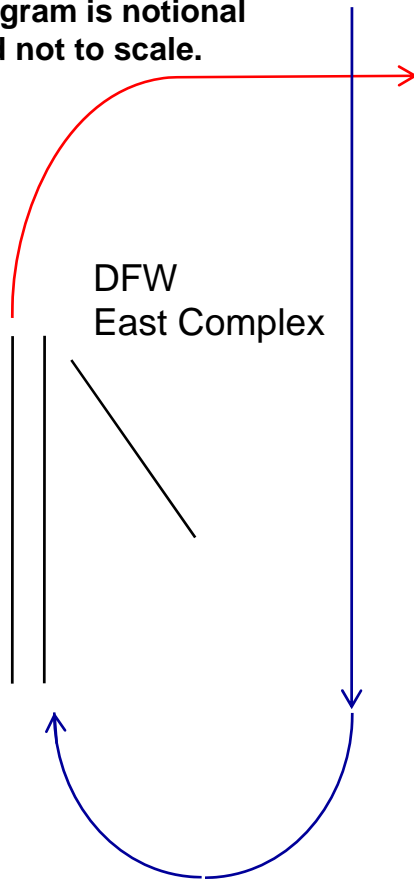


... costs some departure capacity

Where is the optimum point for environmentally-sensitive operation of the airport?

# Highlight: Optimize Profiles

Diagram is notional  
and not to scale.



- Upon entry to terminal area, northern arrivals to DFW-east fly level for 20 NMI until downwind
  - Departures stay below until they pass arrivals.
- If arrivals were cleared higher on a different descent profile, departures might be able to climb with minimal restrictions.
  - What is the optimal tradeoff for fuel?

# Impacts



- **Assist FAA in systematically considering the environmental implications of changes in airspace.**
- **Enable better engagement with academia and industry within the aviation environmental community**
  - **Improve understanding of air traffic considerations.**

# Future Plans



- Complete analysis for DFW and EWR.
- **Next Step** – application to larger airspace design project.  
**Study questions:**
  - What tradeoffs are inside a practical decision-space?
  - How do other environmental metrics (e.g., global warming potential, smog) change the decision space?
  - How much analysis has to be done to get to those alternatives?