Aviation and the Environment

Our Commitment to a Better Future

March 2008

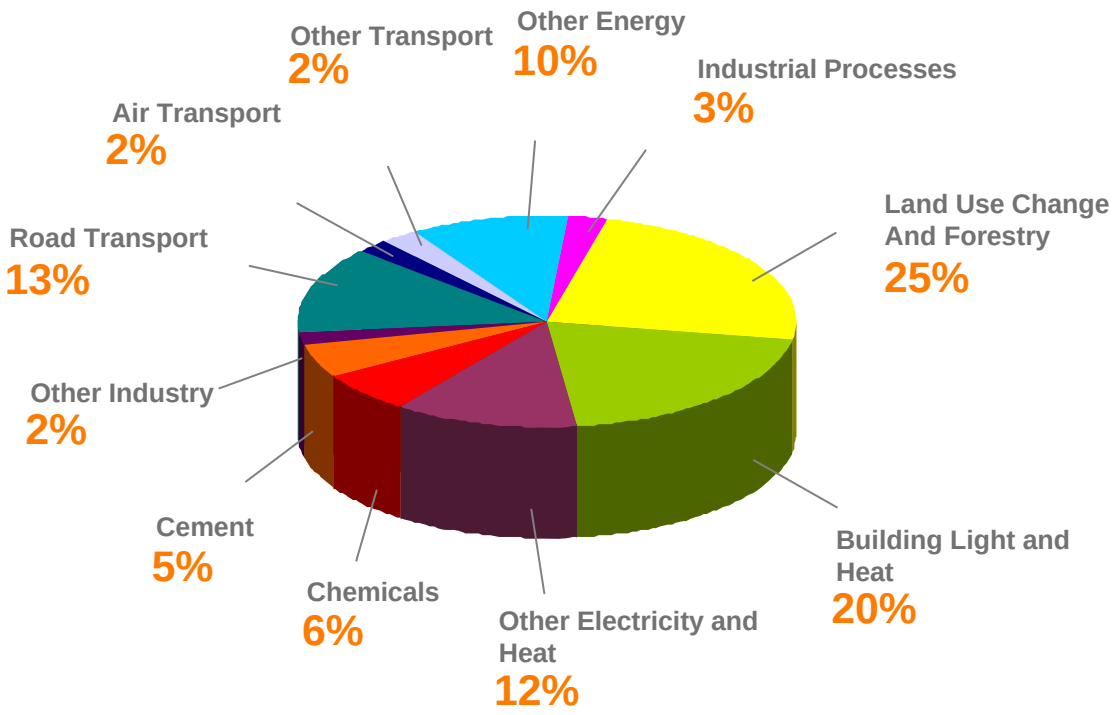
Sources of human-produced CO_2

Emissions from human activities are increasing concentrations of greenhouse gases that lead to climate change.

Of the greenhouse gases, CO_2 has the longest-lasting, global effects.

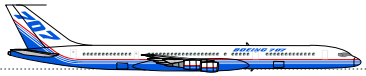
Data based on World Research Institute (WRI) report.

Global man-made CO_2



2000 IATA/WRI data

Aviation has made steady, significant progress



Early Jet Airplanes

MORE FUEL

Relative fuel use

LESS FUEL

EVEN LESS

HIGHER DECIBELS

Noise dB

LOWER DECIBELS

EVEN LOWER

90% Reduction in Noise Footprint

70% Fuel Improvement and Reduced CO_2

New Generation Jet Airplanes

1950s → 1990s

Noise footprint based on 85 dBa.

The challenge

How can we most effectively minimize aviation's impact on the environment – specifically CO_2 emissions?

Our strategy for creating a better future

1 Focusing on a Clear Vision

- Technology unlocks the future
- CO_2 and fuel are the priority
- System efficiency is essential
- A global approach involves and benefits everyone

2 Achieving Specific Metrics and Milestones

- Pioneer new technologies
- Relentlessly pursue manufacturing and life cycle improvements
- Create progressive new products and services
- Improve performance of worldwide fleet operations

3 Delivering Global Aviation Industry Leadership

- Continually work together with the industry to promote effective global public policies and best practices – for a better future

Plan and commitments

Pioneer new technologies	Relentlessly pursue manufacturing and life cycle improvements	Deliver progressive new products and services	Improve performance of worldwide fleet operations
75%	**100%**	**15%**	**25%**
Focus on improving fuel and CO_2 efficiency, reducing noise footprints and developing low carbon alternative fuels. More than **75%** of R&D will benefit environmental performance.	Develop ISO 14001 certification plan for **100%** of BCA manufacturing sites. Use Lean+ practices to reduce impact. Maximize recycling initiatives, including metals and composites.	Each new airplane generation will deliver at least **15%** improvement in CO_2 and fuel efficiency. Continue our dedication to design innovation.	Focus on achieving **25%** efficiency improvements in worldwide fleet fuel use and CO_2 emissions by 2020. Partner with customers to achieve performance.

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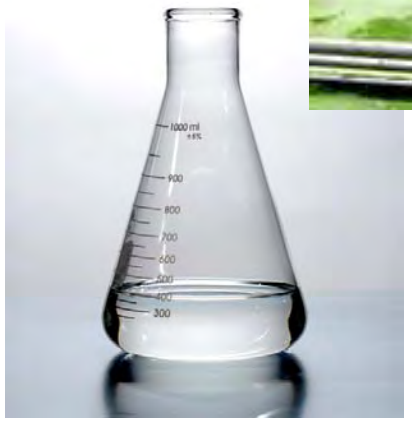
Priority technology research for alternative fuels

Demonstrating alternative, low-carbon life cycle fuels

Conducting the first biofuel demonstration on a commercial airplane

Researching potential of future environmentally progressive fuels

Plants, including algae, could supply fuel for the world's airplane fleet while absorbing CO_2 from the atmosphere



Accelerating deployment of viable sustainable alternative low carbon life cycle fuels

Initiated industry working group to facilitate alternative fuel research

Priority technology research for alternative fuels

Boeing and Virgin Atlantic to work on biofuels for aircraft

Posted Apr 25th 2007 2:49PM by Sam Abuelsamid
Filed under: Emerging Technologies

Boeing and Virgin Atlantic yesterday announced a deal for the airline to purchase 15 of the new 787-9 aircraft and form a new environmental partnership. The first 787 is expected to start final assembly in the next few weeks and will take to the skies for the first time later this year. It has been the fastest selling new airliner ever at least in part because of a twenty percent improvement in the fuel efficiency compared to existing aircraft.

The environmental work between the two companies will focus on developing biofuels that can be used as commercial jet fuel. The first demonstration is scheduled for next year using one of Virgin's Boeing

Priority technology research for alternative fuels

Friday, March 14, 2008 - Page updated at 12:00 AM

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Boeing and Continental Airlines will test a plane that runs on biofuel

By Ángel González
Seattle Times business reporter

Continental Airlines wants to fuel its jetliners with something more palatable than Texas Tea.

The Houston-based airline is teaming up with Boeing and engine maker GE Aviation to test a plane powered by a new generation of renewable fuels, the companies said Thursday.

The agreement makes Continental the first major U.S. airline to formally dabble in alternative

enlarge DAVID J. PHILLIP / AP

"Exploring sustainable biofuels is a logical and exciting new step in our environmental commitment," says Continental

More Boeing/aerospace

UPDATE - 01:53 PM
Boeing 787 structural design changes will delay jet further, says ILFC chief Hazy

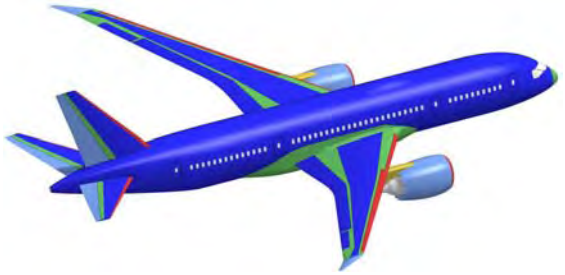
Boeing likely to face "uphill battle"

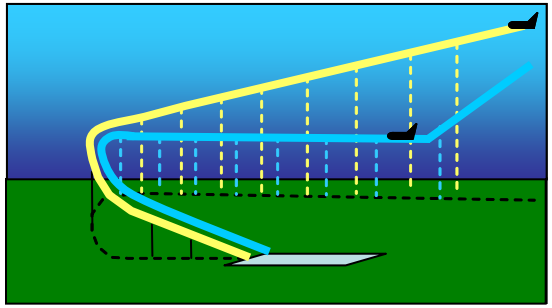
Tanker fight now has Web petitions

Boeing CEO pay dropped to $19 million last year

Boeing and Continental Airlines will test a plane that runs on biofuel

Priority technology research for fuel efficiency, emissions and noise





Researching next generation materials

Example: Next generation composites

Result: Reduces weight, which reduces fuel use and emissions

Designing aerodynamic improvements

Example: Advanced wing design, raked wing tip

Result: Reduces drag which reduces fuel use and emissions

Researching improved propulsion systems

Example: Integrating new, more efficient engines

Result: Reduces fuel consumption and emissions and lowers noise

Researching less energy-intensive electric systems

Example: Reducing pneumatic systems

Result: Improving electrical efficiency improves fuel efficiency

Advancing more efficient operations and air traffic management

Example: Advanced Arrivals

Result: Reduces fuel consumption and emissions and lowers noise

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Continue our dedication to design innovation.

Improve performance of worldwide fleet operations

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Focus on achieving **25%** efficiency improvements in worldwide fleet fuel use and CO_2 emissions by 2020.

Partner with customers to achieve performance.

Key frameworks that drive our manufacturing and life cycle improvements

An internationally recognized ISO 14001 standard to implement or improve environmental management systems

- Promotes environmental stewardship
- Continual improvement
- Emphasis on prevention

Lean

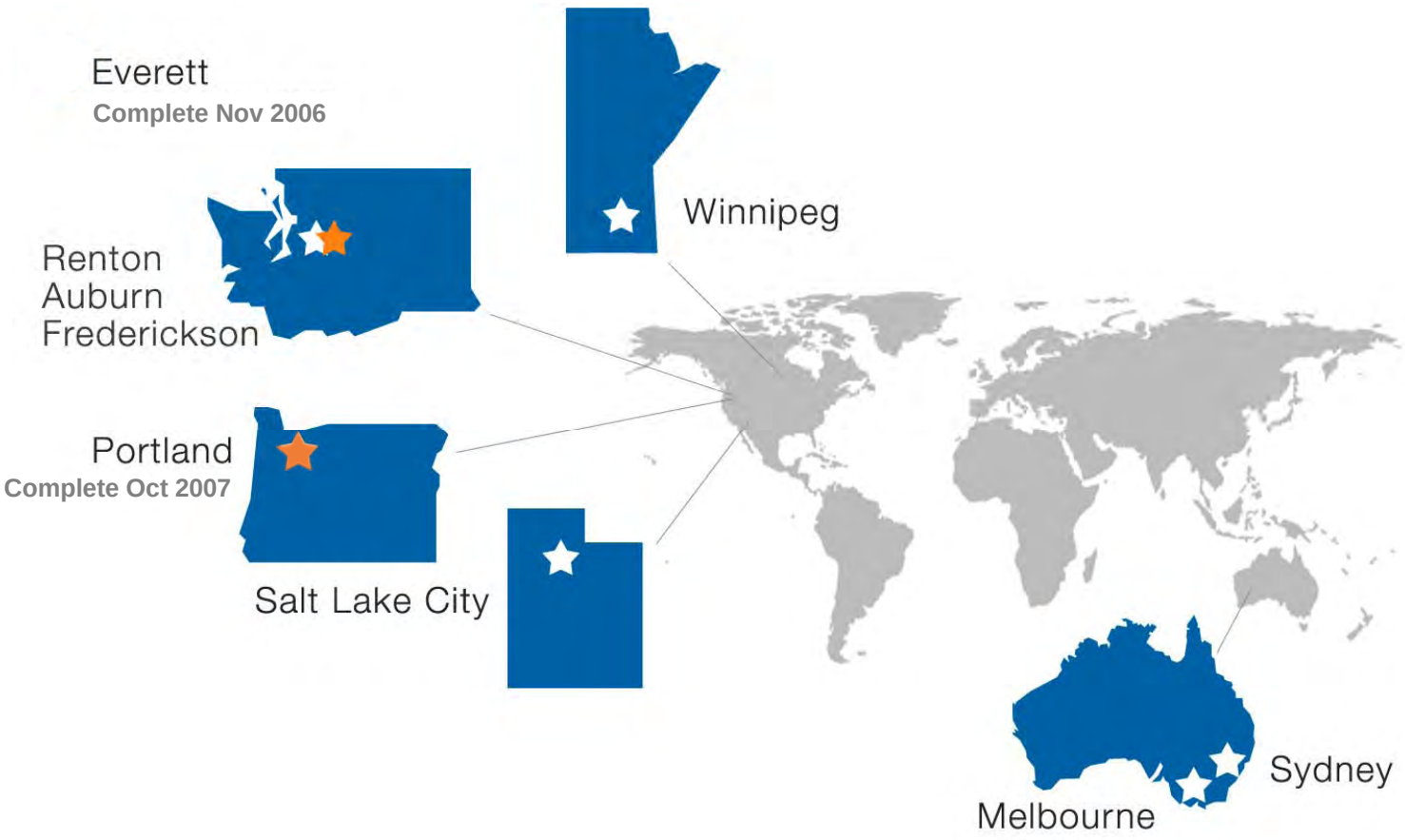
A set of progressive manufacturing principles and practices to reduce environmental impact

- Increases operating efficiency
- Minimizes waste
- Emphasis on conservation of resources

A commitment to recycling during all phases of the life cycle

- Ensures airplane materials, including metals and composites, are recycled for high-value industrial uses
- Identifies environmentally progressive end-of-service solutions
- Promotes best practices

Target for ISO 14001 certification at all BCA manufacturing sites—December 2008



Waste reductions and energy conservation achieved through Lean manufacturing

Lean

42% reduction in hazardous waste

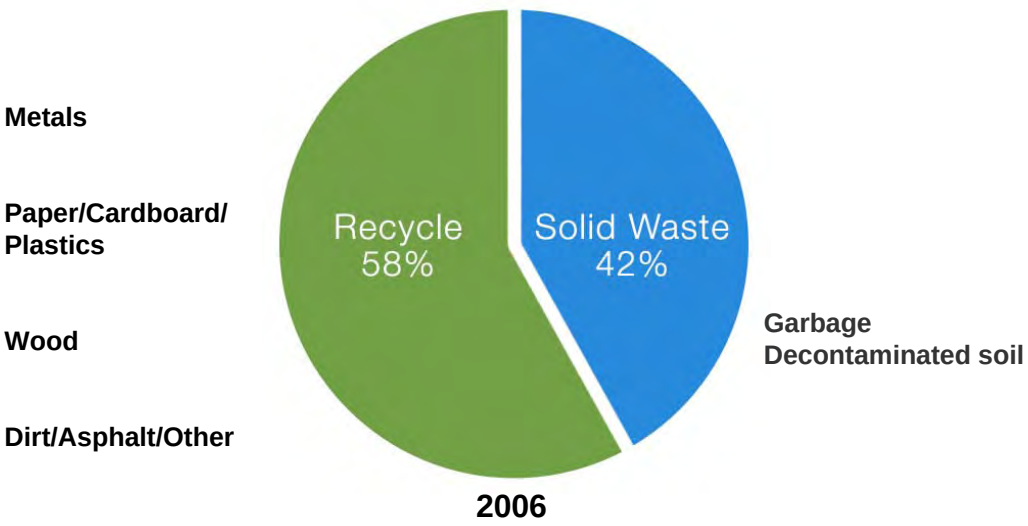
21% total reduction in electricity use

19% reduction in water use

Source: 2001 - 2005 data

Promoting recycling is a priority

58% of Generated Waste is Recycled



Recycling is part of our culture

- Moving lines conserve energy and resources
- Pursuing additional opportunities through ISO 14001

AFRA
Aircraft Fleet Recycling Association
RECYCLE
RE-SALE
RETIRE

Leading the first comprehensive airplane recycling program

- Provides environmental progressive end-of-service solutions
- Contains audit program to assure and promote best practices

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The 787 Dreamliner is cleaner, quieter and more efficient

The 787 Dreamliner delivers:

- 20%* Reduction in fuel and CO_2
- 28% Below 2008 industry limits for NOx
- 60%* Smaller noise footprint

*Relative to the 767

The 747-8 is cleaner, quieter and more efficient

The 747-8 delivers:

- 16%* Reduction in fuel and CO_2
- 28% Below 2008 industry limits for NO_x
- 30%* Smaller noise footprint

*Relative to the 747-400

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Improving the performance of worldwide fleet operations

Opportunities to Reduce Emissions, Fuel and Noise

Airplane Improvements

Offer airplane hardware and software modifications to improve life cycle performance

Lowers operating costs and reduces fuel use, emissions and noise

Efficient Airline Operations

Work with airlines to develop and implement best practices and operational procedures

Reduces fuel use, emissions and noise

Airspace Efficiency

Work with Air Traffic Management providers to optimize airspace navigation and efficiency around the world

Reduces fuel use, emissions and noise

Airplane performance improvements are part of ongoing programs

737 Improvements

- Engine improvements lowering emissions
- Automated throttle control reduces takeoff noise footprint
- Increased precision navigation for operational efficiency
- Blended winglets for 3-5% aerodynamic efficiency
- Lighter weight carbon brakes
- Flight deck noise reduction

777 Improvements

- Wing modified to reduce drag
- Wing systems revision reduces drag
- New raked wingtip for improved aerodynamic efficiency
- Wing control surface tailoring reduces drag
- Engine inlet treatment for noise reduction
- Maneuver load alleviation for lower empty weight

Air traffic modernization will maximize aircraft efficiency improvements

Air traffic improvements can benefit the environment by –

- Reducing inefficiencies in the current system
  Current flight paths, departures & arrivals are not optimized for full efficiency
- Relieving system congestion and delays
  The worse the congestion gets, the more waste (emissions) is created
- Integrating airplane and ATM capabilities
  Current aircraft capabilities are not fully utilized for maximum efficiency

"ATM improvements could reduce emissions by up to 12%." (IPCC)

"Cutting flight times by a minute per flight on a global basis would save 4.8 million tons of CO_2 every year." (IATA)

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UW/WSU/Boeing Environmental Collaboration Workshop

- Environmental collaboration workshop recently held with the University of Washington and Washington State University
- Identified areas of collaborative research
  - Alternative Fuels
  - Fuel Cells
  - Lifecycle assessment
  - Next generation materials
- Research proposal being developed based on recent white paper down select
- Contract awards expected by end of 2Q 2008

We are committed to a better future

THANK YOU