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Trash Landings

How Airlines and Airports Can Clean Up Their Recycling Programs

Research Design and Project Coordination

Allen Hershkowitz, Ph.D.
Senior Scientist
Natural Resources Defense Council

Darby Hoover
Senior Resource Specialist
Natural Resources Defense Council

Principal Author

Peter Atkin

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Table of Contents

Executive Summary iv

Introduction: Airport and Airline Waste Management 1
Where Is Airport Waste Generated?
Airport Waste Characteristics

Chapter 1: Methods of Airport Waste Management 3
Decentralized Waste Management May Be Inefficient for Some Airports
Centralized Waste Management Unifies the Process
Industry Trends: What Systems Are Airports Using?

Chapter 2: Findings From NRDC's Airline Recycling Survey 7
How Much Trash?
Current U.S. Airport and Airline Recycling Practices Fall Short
Airport Recycling Protects the Environment
Possible Underreporting of Recycling
Economic Considerations of Airport Recycling
Bringing Airport Recycling Up to Regulatory Standards

Chapter 3: Challenges and Recommendations for Establishing Airport Recycling Programs 16
Challenge: Dealing With Decentralized Waste Management Systems
Challenge: Recovering Airplane Waste for Recycling
Challenge: Developing Financial Incentives to Recycle
Challenge: Educating and Motivating Tenants and Passengers

Chapter 4: More Recommendations for Implementing Airport Recycling Programs 19
Recommendations for Airport Managers
Recommendations for Airline Managers
Recommendations for Retail and Restaurant Concession Tenants
Recommendations for Local Governments and Policy Makers
Recommendations for Air Travel Industry Trade Associations
Recommendations for Recycling Consultants

Conclusion 22

Appendices 23
Appendix A: Airport Recycling Profiles
Appendix B: Parties Responsible for Airport Waste Management Decisions
Appendix C: Project Methodology
Appendix D: Environmental Benefits of Recycling
Appendix E: Benefits of Recycling by Material Type
Appendix F: The Cost of Waste Management
Appendix G: NRDC Survey Forms

Endnotes 44

Executive Summary

The U.S. airline industry discards enough aluminum cans each year to build 58 Boeing 747 airplanes.[1] And aluminum waste is just the tip of the iceberg: The airline industry discarded 9,000 tons of plastic in 2004 and enough newspapers and magazines to fill a football field to a depth of more than 230 feet.

Those are the findings of NRDC's yearlong study of how U.S. airports and passenger airlines dispose of waste. The report shows that the airline industry has a dismal record when it comes to grappling with the amount of waste it generates each year. Although airports are responsible for a huge amount of trash—the 10 airports reporting waste generation data in our survey generated 1.28 pounds of waste per passenger in 2004, about one-third of the total amount of waste Americans generate in an entire day—most of the trash discarded at airports is sent to landfills and incinerators.[2] At this rate of waste generation, the 30 largest airports in the United States generate an amount of waste equal to that of a city the size of Miami.[3,4]

NRDC's study finds that airport and airline recycling systems are largely underdeveloped, with even the best systems achieving recycling rates lower than the national recycling rate of 31 percent. If airports and airlines recycled as much as the average U.S. recycling rate, enough energy would be saved each year to power 20,000 U.S. households, and carbon emissions would be reduced by an amount equal to removing 80,000 cars from the road annually.[5] Airports and airlines could achieve a recycling rate of 31 percent by capturing 70 percent of the discarded aluminum, newspaper, cardboard, magazines, office and mixed paper, PET plastic, and glass.

And they could save money: Four airports with recycling programs studied by NRDC are achieving cost savings of more than $100,000 annually through recycling programs and efficient waste management. Increasingly, our resource-starved world is willing to pay for valuable materials that were previously considered worthless garbage—and pay well.

Moreover, recycling is becoming mandatory at some airports. More than 90 percent of passengers who travel on the five largest U.S. airlines fly to cities with local recycling goals or mandates. Airlines may increasingly be required to accelerate their recycling programs to meet these regional standards.

Fortunately, there is enormous potential for recycling initiatives to capture the majority of airport waste. At the airports studied by NRDC, approximately 75 percent of the waste stream is recyclable or compostable. This report will help guide those interested in establishing recycling initiatives, whether the goal is to meet regional requirements, realize energy savings, or cut operating costs.

Based on the results of our study, NRDC offers the following recommendations to guide airport and airline officials who are interested in establishing recycling programs:

■ **Recycling efforts must begin with airport infrastructure.** In-flight waste is recycled only if there is a system on

the ground that allows it to happen. Airlines can influence the development of recycling infrastructure at the airports they fly to.

■ **Airports should increase aluminum recovery to maximize energy savings and emissions reductions.** Recycling 70 percent of the aluminum cans discarded at airports and by airlines instead of sending them to landfills would save the amount of energy used by 5,000 U.S. households in a year (548,000 mBtu) and reduce carbon emissions by an amount equal to removing 9,000 cars from the road annually (12,300 MTCE). Although aluminum accounts for only 1 percent of the air travel industry's waste stream, the energy and emissions reduction benefits of recycling this material are disproportionately larger. For example, the energy benefits of recycling one ton of aluminum are 11 times that of recycling one ton of newspaper and eight times that of recycling the same amount of PET plastic.

■ **Airports should also focus on recovery of wastepaper to maximize environmental benefits.** Paper is the largest single category of waste generated by the airline industry. Consequently, recycling 70 percent of the paper products discarded at airports and by airlines would save the amount of energy used by 13,500 U.S. households in a year (1,475,000 mBtu) and reduce carbon emissions by an amount equal to removing 68,000 cars from the road annually (91,500 MTCE). Paper products, including cardboard, newspaper, magazines, office paper, and mixed paper, account for about 40 percent of the air travel industry's waste. Focusing on paper recovery can divert the greatest amount of tonnage away from landfills and incinerators.

■ **Airport recycling programs should target the sectors that generate the most waste—airlines and retail and restaurant tenants.** These two sectors combined account for nearly 90 percent of the waste generated at a typical airport.

INTRODUCTION

Airport and Airline Waste Management

Recycling programs need to begin where most airline waste is created: at airports. The can of soda you drink on an airplane makes its way into the airport to be disposed of with general airport waste. When airports lack the infrastructure to recycle—as many do—it doesn't matter whether your aluminum can or newspaper was separated from waste on the airplane. Those already-refined valuable materials will be mixed in with non-recyclable trash and end up in the same place: the incinerator, where they will be burned through a combustion process that releases toxic emissions into the air you breathe, or the landfill, where the materials will lay, wasted, for a century or more and contribute to water and air pollution.

Where Is Airport Waste Generated?

Besides the waste taken off airplanes, airport waste is generated in airport offices, shops, restaurants, restrooms, and flight kitchens; from cargo operations, maintenance areas, and hangars; and from landscaping, construction, and demolition. Each of these areas creates distinct waste streams, making it more complicated to establish an airport-wide recycling program.

This report focuses on three passenger-related waste streams:

1. Terminal public areas and the airport authority's administrative offices (referred to in this report as "terminal public area waste");

2. Terminal retail and restaurant concession tenants (referred to as "retail and restaurant tenant waste" or "terminal tenant waste"); and

3. Airline offices and airplane waste (referred to as "airline waste"). This accounts for about half of the passenger-related waste handled at airports.

Airport authorities oversee airport operations. In some airports, the authority leases space directly to individual restaurant and retail tenants; in others, the authority contracts with a management company to oversee concession operations. Airlines lease space for ticketing counters, offices, and passenger gate areas from the airport authority.

In general, waste management data are poorly maintained by airports and airlines. Inconsistent or, more often, nonexistent data make it difficult to estimate how much waste is generated at U.S. airports and how much funding and other types of resources need to be allocated to manage waste. Ten airports provided NRDC with passenger-related waste generation data, and each uses a different method for tracking and reporting these data. Of the 10, only five airports included information on the three waste streams listed above, four airports included information on only two of them, and one airport reported data on only one.[1] (These 10 airports combined handle 17 percent of U.S. passenger traffic.)

Based on the data provided by these 10 airports, NRDC estimates that airline waste accounts for about 47 percent of the waste stream at a typical airport, retail

and restaurant tenants generate about 41 percent, and terminal public areas contribute about 12 percent.[2]

Airport Waste Characteristics

As just mentioned, there are three streams of passenger-related airport waste: airline waste, retail and restaurant waste, and terminal public area waste.

AIRLINE WASTE

Airline waste includes waste from passenger airplanes, ticketing counters, and gate areas (NRDC did not study waste generated by cargo planes). Airline trash typically includes food and drink containers, uneaten food, newspapers, magazines, computer printouts, and other paper generated at ticketing counters. The characteristics and quantities of waste generated on an airplane vary by length of flight and by carrier.

Low-cost carriers such as Southwest Airlines do not use flight catering services because they do not offer in-flight meals. Because these carriers do not generate in-flight waste associated with meal service, most of their waste comes from beverages and small snacks served by the airline and waste related to items brought onboard by passengers, including food, newspapers, and magazines.[3]

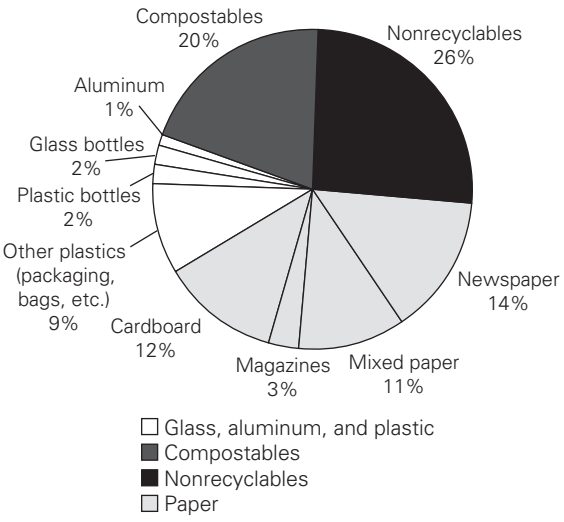
Historically, in-flight meals were provided by large airlines, which are known within the industry as "legacy carriers." However, recent financial pressures on the airline industry have prompted cost-saving measures among legacy carriers, including the elimination of free meal service on most domestic flights. This is changing the characteristics of the waste generated on domestic legacy carrier flights to resemble the waste generated on low-cost carriers.

Legacy carriers operating international flights, on the other hand, have more extensive in-flight services. Consequently, international flights generate more waste. (Waste generated on international flights that land in the United States is subject to the U.S. Department of Agriculture's disposal regulations, which are discussed in Chapter 2.)

RETAIL AND RESTAURANT WASTE

Retail and restaurant waste includes cardboard boxes, paper and plastic packaging, food scraps, and food wrappers disposed of in shops, restaurant kitchens, and airport dining areas. It also includes aluminum, plastic, and glass containers.

Figure 1 Waste Compostion Estimate Based on Data From Five Major Airports[5]



Source: NRDC, 2006.

TERMINAL PUBLIC AREA WASTE

Terminal public area waste includes food and drink containers, food scraps, newspapers, magazines, plastic wrappers, restroom trash, and other trash generated in the public areas of the passenger terminal. In addition, this category includes the copier paper, toner cartridges, and discarded office supplies used in airport authority offices. Terminal public area waste does not include restaurant waste or waste produced at airline passenger gate areas.

Figure 1 is a breakdown of the types of waste generated by airlines, by retail and restaurant tenants, and in terminal public areas at five airports.[4] These five major airports handle 10 percent of U.S. air passengers.

The figure indicates that between two-thirds and three-quarters of the material found in the waste stream of these airports is potentially recyclable or compostable, depending on the markets for discarded plastics. Recyclable or compostable materials include paper products, plastics, aluminum, glass, food waste, and some food-contaminated packaging.

CHAPTER 1

Methods of Airport Waste Management

Waste management systems at airports are centralized, decentralized, or a combination of both. Many airport authorities find that centralized systems are easier to administer financially and in terms of safety.

Decentralized Waste Management May Be Inefficient for Some Airports

In a decentralized system, the airport authority, terminal tenants, airlines, and flight catering companies each deal with their waste management contracts independently. Because dozens of airlines may be operating out of the same airport, there might be numerous waste management contracts. (At one large airport in the United Kingdom, more than 30 waste contractors operate on site.[1])

Decentralization allows an airport authority to minimize its obligations to coordinate among the companies or agencies operating at the airport. It also allows each company operating at the airport to control its own waste management contract. However, decentralization may have several drawbacks:

- It may be less efficient because more Dumpsters than necessary may be used to handle the quantity of waste disposed;
- It introduces the possibility of improper dumping in another airline's Dumpster;
- Quantifying and tracking the amount of waste generated and recycled at an airport is more complicated; and
- Achieving the scale necessary to make recycling more economical for any single tenant is more difficult.

Centralized Waste Management Unifies the Process

Airports that use a centralized waste management system generally have one waste management contract for all terminal and airplane waste. (The exception is flight kitchens, which usually manage their own waste even if an airport relies on a centralized system.)

At airports that use centralized waste management systems, airport authorities provide waste and recycling receptacles for airport tenants and airlines. Under these systems, the costs of waste disposal are either factored into the lease or landing fees that tenants and airlines pay to operate at the airport, or billed as a utility service. Some airports that use a centralized system have devised innovative ways to charge for waste management services to provide incentives to promote waste reduction and recycling. For example, a "pay as you throw" form of billing that financially rewards waste reduction is being tested at Seattle-Tacoma International Airport. (This system and other billing methods are discussed in more detail in Chapter 3.)

Although centralized waste management systems may require more oversight by airport authorities, these

Figure 2 Components of a Decentralized Airport Waste Management System[2]

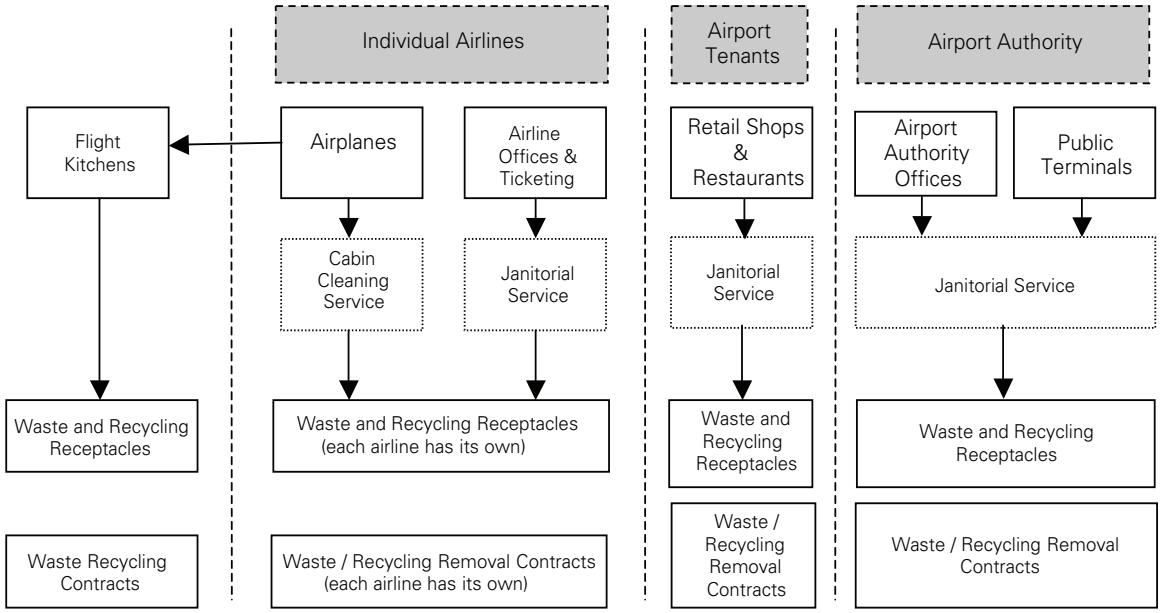
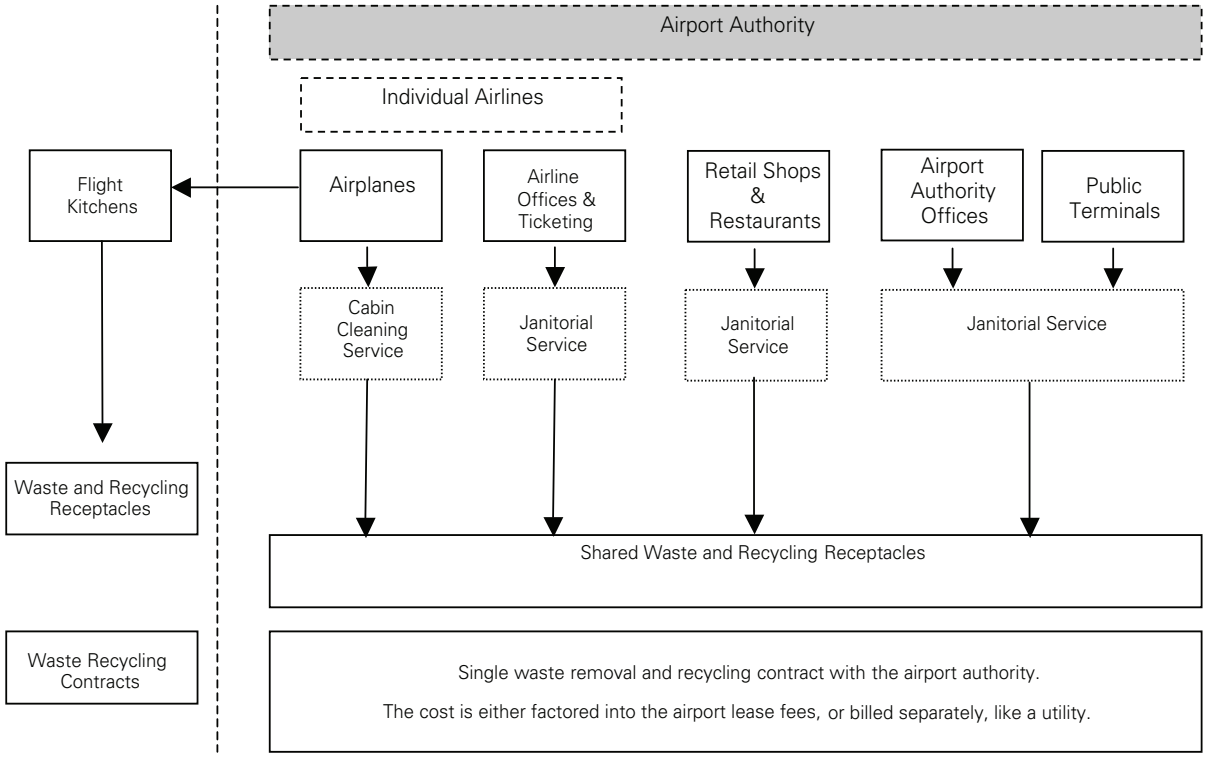


Figure 3 Components of a Centralized Airport Waste Management System[3]



systems may offer several advantages over decentralized systems. Indeed, four out of the five airlines commenting on this issue in NRDC's survey said they prefer a centralized waste management and recycling system. Some airlines reported that they prefer the centralized approach because it offers the potential to more cost-effectively recycle waste at those airports where they have only a small number of flights.

Moreover, although a centralized system requires more coordination among the airport authority, tenants, and airlines, the amount of waste handled under a single centralized contract is larger. By managing a larger amount of waste under a single contract, an airport authority is more likely to realize favorable economies of scale and negotiate lower per-ton disposal and recycling costs with waste haulers.[4]

Airports also cite other benefits provided by a centralized waste management system:

■ Centralized coordination of waste hauling and container maintenance results in less truck traffic on the airfield, less fuel use, and a reduced risk of airfield collisions;

■ Greater control by the airport authority over the type, placement, and maintenance of compactors and Dumpsters saves space and eliminates the need for each airline to have its own containers;

■ Airlines with a small volume of waste can recycle with fewer overhead costs; and

■ By directly billing tenants and airlines for waste management services, the airport authority can develop incentives to promote recycling.

SEATTLE-TACOMA INTERNATIONAL AIRPORT: INCREASING SAFETY BY CENTRALIZING WASTE MANAGEMENT

After centralizing waste management for retail and restaurant tenants, Seattle-Tacoma International Airport (SeaTac) plans to move airlines to a centralized system in which the airport authority will be responsible for waste management.

Although the new system is forecast to provide waste disposal cost savings to the airlines, an important driver for the change is safety.

By coordinating all waste disposal contracts, SeaTac hopes to reduce waste hauler traffic on the airfield and to effectively oversee the maintenance of Dumpsters and compactors. Keeping outdoor waste containers well maintained is important because it reduces the risk that loose paper and plastic will blow onto the runways and become a hazard to airplanes. Birds, which can be attracted by poorly maintained containers, are also a hazard near runways.

PORTLAND INTERNATIONAL AIRPORT: INCLUDING AIRLINES IN AIRPORT RECYCLING

The success of any airport recycling program depends on the participation of passengers, the airlines, and terminal tenants.

To improve its recycling rate, Portland International Airport (PDX) has begun to focus on capturing more recyclables from airplanes. Currently, airlines at PDX participate to varying degrees in the airport recycling program. The airport's waste managers are working with interested airlines to identify opportunities to increase airline recycling, including studying how the waste comes off the airplanes, who handles it, and what Dumpsters or compactors it ends up in.

By doing this, waste managers will be able to work with airline personnel to identify where it would be easiest to sort the recyclables from the rest of the waste. Additionally, a better understanding of the waste flow will allow the airport's waste managers to select an accurate number and proper location of recycling containers to make it easier for the airlines to participate in the program.[a]

a Conversation with Stan Jones, Sheryl Bunn, and Paul Rosenbloom, PDX Waste Team, 05/09/21.

FINANCIAL ADVANTAGES OF CENTRALIZED WASTE MANAGEMENT

Two airports studied by NRDC (Oakland International and Seattle-Tacoma International) recently switched from decentralized to centralized waste management systems, combining several smaller waste management contracts into one larger contract. Consolidating contracts enabled these airports to negotiate a lower per-ton hauling and disposal fee. The operations manager at Oakland International Airport (OAK) noted that since implementing centralized waste management and recycling systems, the monthly waste management costs incurred by at least two airlines operating at the airport have dropped by more than 50 percent.[5]

Airports may also apply this strategy to their recycling contracts. A single contract covering a higher volume of recyclables is likely to be more attractive to a recycling contractor than numerous smaller separate contracts, and the contractor may offer a more favorable hauling and processing contract to the airport. A more favorable contract might include a lower—or even waived—hauling cost for the recyclables or a

higher percentage of the revenue received from the sale of recyclables.[6]

Industry Trends: What Systems Are Airports Using?

The 30 airports responding to NRDC's survey tend to prefer centralized waste management systems.

■ Nineteen airports have fully centralized systems in which the airport authority manages the waste for both the terminal tenants and the airlines.[7]

■ Three airports have a fully decentralized system in which the tenants and the airlines manage their own waste.[8]

■ Five airports have a partially centralized system in which the airport authority manages the waste for the terminal tenants, but not for the airlines.[9]

■ One airport has a partially centralized system in which the airport authority manages the waste for the airlines, but not for the terminal tenants.[10]

■ One airport has a centralized system in which an independent company manages the waste for the airport authority, the retail tenants, and the airlines, but not for the restaurant tenants.[11]

■ One airport responded that it uses a combination of centralized and decentralized systems throughout the airport but did not provide details.[12]

PLANNING FOR RECYCLING DURING CONSTRUCTION

Modern airport terminals resemble shopping malls, with public areas, shops, and restaurants. Like shopping center recycling programs, airport terminal programs can benefit from foresight when a new terminal is being designed. For example, Minnesota's Mall of America was designed with recycling in mind. An innovative chute and cart system, designed before construction began, moves trash and recyclables through the mall. Mall officials estimate that it saves $200,000 per year in waste management labor costs.[a]

The U.S. Environmental Protection Agency says about shopping mall design that "architects who plan for recycling can include space for recyclables storage, space and appropriate electrical service for balers or compactors, and easy access for vendors." Forethought about terminal design would also improve recycling at airports.

a U.S. EPA, "America's Marketplace Recycles: A Guide to Waste Reduction at Shopping Centers," EPA530-R-04-031, 2004, p 11.

Recycling by airlines and terminal tenants is stymied or enabled by airport facilities. Unless the airport provides sorting facilities on the ground, airplane waste must be sorted in-flight. However, because airplane waste is not always sorted in flight, even airports providing a recycling infrastructure to the airlines sometimes have difficulty capturing recyclables from the in-flight waste stream. The success of recycling efforts depends on a partnership between airports and the airlines and tenants whose waste feeds the airport's recycling infrastructure.

CHAPTER 2

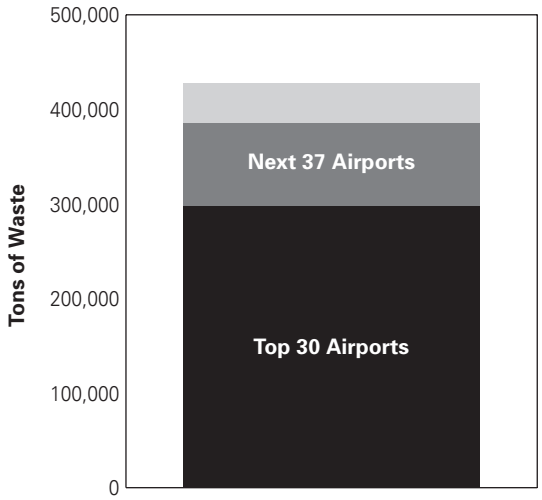
Findings From NRDC's Airline Recycling Survey

How Much Trash?

Airports produce a lot of waste. At the five airports that reported waste disposal data for terminal public areas, retail and restaurant tenants, and airlines, the average amount of waste generated was 1.28 pounds per passenger departure. Despite the relatively short amount of time passengers spend moving through an airport, this is about one-third of the total amount of waste the average American produces in an entire day. Nationwide, this translates into about 425,000 tons of waste generated at U.S. airports in 2004. Airline waste accounts for about half of the total.[1]

Waste generated at an airport obviously correlates to the number of passengers visiting it.[2] Although there are more than 500 commercial airports in the United States, the largest 30 airports account for 70 percent of all passenger air traffic; 37 medium-sized airports account for an additional 20 percent.[3] Assuming 1.28 pounds of waste generated per passenger, the 30 largest U.S. airports combined generated about 300,000 tons of waste in 2004—or as much as a city of 360,000 people (e.g., Minneapolis or Miami).[4]

Figure 4 Waste Generated at U.S. Airports



Current U.S. Airport and Airline Recycling Practices Fall Short

While many airports and airlines have implemented some recycling efforts, our survey results and interviews with airport managers suggest that the overall airline and airport industry-wide recycling rate is low, perhaps even less than 20 percent. (The national recycling rate in the United States is 31 percent—not high, but still more than 50 percent higher than the rate achieved by U.S. airports.)[5]

Of the 30 airports responding to NRDC's survey, 27 indicated that they have some form of recycling program in place.[6] Twelve airports provided data on how much they recycle, but only four of those airports reported data on all three passenger-related waste streams. For those four airports, the recycling rate for those waste streams was about

17 percent. Because these four airports are considered by airport professionals to be industry leaders in recycling efforts, the overall industry recycling rate at airports is probably lower than the 17 percent that these airports achieve.

Only four of the 30 airports surveyed have recycling programs in place that target terminal public areas, retail and restaurant tenants, and airline waste.[7] Some of the other airports reported that they were unable to provide waste management data because their waste management systems do not include a method of tracking the amount of waste and recyclables generated. Two other notable findings indicate that airline recycling is stymied by the absence of recycling programs at airports:

■ Eleven of 27 airports with recycling programs have targeted only small portions of the waste stream (e.g., administrative offices or selected public areas) and do not provide recycling services to retail and restaurant tenants or to the airlines.[8]

■ Ten of the airports studied have recycling programs that include terminal public areas and retail and restaurant tenants, but do not include the airlines.[9]

Although airline waste and retail and restaurant tenant waste account for nearly 90 percent of the waste generated at a typical airport, many airports are not targeting these waste streams. Of the airports responding to NRDC's survey, more allocate resources to public area recycling programs than to airline recycling programs, even though public areas produce only about 12 percent of an airport's waste, while airlines account for nearly half.

The eight airports reporting the highest recycling rates (over 10 percent) achieved these rates by committing resources to recycling, including hiring a recycling coordinator. However, even these airports reported challenges in capturing airplane waste for recycling. Because airline waste (most of which is airplane waste) accounts for almost half of an airport's waste, it is impossible to achieve a high recycling rate without recovering airplane waste.

Only one airport, Fort Lauderdale International (FLL), reported achieving a recycling rate of more than 25 percent, estimating a recycling rate of 30 percent.[10] FLL attributes its better-than-average recycling rate to the fact that it has an on-site waste-sorting facility and to its targeting of the waste from terminal public areas, and retail tenants, as well as from the airlines.

Airport Recycling Protects the Environment

Recycling conserves energy, cuts greenhouse gas emissions, and reduces the need for landfilling and incineration (see Appendix D for a more complete accounting of the environmental benefits associated with recycling). NRDC met with the recycling coordinators from eight airports to determine how successful their recycling programs were at realizing these environmental benefits. Tables 1–4 quantify some of the energy and greenhouse gas emission reductions achieved by recycling programs at four of these airports. (The methodology underlying these calculations is explained in Appendix D.) The other four airports whose recycling coordinators we met with have recycling programs but do not keep track of how much they recover, so we could not calculate their environmental benefits.

Some notable findings stand out about the recycling programs at the four airports profiled below:

■ **Los Angeles International Airport** saved enough energy through recycling in 2004 to power 502 households and reduced greenhouse gas emissions by an amount equal to removing 2,228 passenger cars from the road for a year.

■ **Fort Lauderdale International Airport** saved enough energy through recycling in 2004 to power 180 households and reduced greenhouse gas emissions by an amount equal to removing 596 passenger cars from the road for a year.

■ **Seattle-Tacoma International Airport** saved enough energy through recycling in 2004 to power 149 households and reduced greenhouse gas emissions by an amount equal to removing 485 passenger cars from the road for a year.

■ **Portland International Airport** saved enough energy through recycling in 2004 to power 42 households and reduced greenhouse gas emissions by an amount equal to removing 290 passenger cars from the road for a year.

The recycling and energy data in Tables 1–4 pertain to metals, paper, glass, plastics, and food waste. Some airports recycle additional materials outside the scope of this study (including batteries, toner cartridges, fluorescent light bulbs, and construction waste).

NRDC's waste composition estimate suggests that 1 percent of an airport's waste stream is aluminum and 40 percent is paper. Thus, an airport generating 20,000 tons of waste per year could expect approximately 200

Table 1 Portland International Airport (PDX)
Annual passenger departures: 6.5 million
Total waste generation: 2,800 tons
Waste per passenger: 0.86 pounds

Material	Amount recycled (tons)	Amount recycled as % of total waste	Energy savings, mBtu (Equivalent number of households' annual energy use)[a]	Greenhouse gas emission reductions, metric tonnes (Equivalent number of cars removed from road annually)[b]
Cardboard	222	8%	2,872 (26)	175 (130)
Glass/tin	44	2%	93 (1)	4 (3)
Paper	175	6%	1,350 (12)	137 (101)
Plastic	10	0.4%	223 (2)	4 (3)
Food waste	87	3%	— —	71 (53)
Total recycled	**538**	**19%**	**4,538 (42)**	**391 (290)**

Note: All data are for 2004. PDX does not track aluminum recycling separately, though it is tracked as part of mixed material totals. Aluminum beverage can waste at PDX is generated mostly on airplanes, and PDX is not currently capturing most airplane recyclables, although some airlines recycle aluminum independently. (Source: Conversation with Stan Jones, Portland International Airport's waste and remediation manager, March 6, 2006.)

a The average U.S. household consumed 108.7 mBtu of primary electricity in 2001. Primary electricity includes the actual energy used by a household along with all the energy wastes in the generation and distribution process. (Source: Energy Information Administration, "Residential Energy Consumption Survey," 2001.)

b The average U.S. passenger car emitted 1.35 MTCE in 2004. This is based on the 2004 average fleet mileage of 22.4 miles per gallon for passenger cars, and an average of 12,500 miles traveled per car. (Source: Bureau of Transportation Statistics, "National Transportation Statistics 2005," December 2005. Table 4-23 and Table 4-11). Emissions per gallon of gasoline are 2.41 kg of Carbon Equivalent (Energy Information Administration, "Fuel and Energy Source Codes and Emission Coefficients," http://www.eia.doe.gov/oiaf/1605/coefficients.html).
Calculation: (2.41 kg CE per gallon)/1000 * 12,500 miles * (1/22.4 mpg) * = 1.35 MTCE

Table 2 Fort Lauderdale International Airport (FLL)
Annual passenger departures: 10 million
Total waste generation: 3,312 tons
Waste per passenger: 0.67 pounds

Material	Amount recycled (tons)	Amount recycled as % of total waste	Energy savings, mBtu (Equivalent number of households' annual energy use)[a]	Greenhouse gas emission reductions, metric tonnes (Equivalent number of cars removed from road annually)
Aluminum cans	45	1.4%	8,312 (76)	186 (138)
Cardboard	163	4.9%	2,106 (19)	129 (95)
Newspaper	424	12.8%	7,030 (65)	314 (232)
Magazines	207	6.2%	141 (1)	128 (95)
Office/mixed paper	2	0.1%	18 —	2 (1)
Plastics	39	1.2%	859 (8)	17 (12)
Glass	58	1.8%	123 (1)	5 (4)
Steel	46	1.4%	909 (8)	23 (17)
Total recycled	**983**	**30%[b]**	**19,500 (179)**	**803 (595)**

Note: All data are for 2004. Data include waste from terminal public areas, retail shops, and airlines. Terminal restaurant waste is not included.

a FLL's reported waste generation does not include terminal restaurant waste.

b FLL's reported recycling rate was 34 percent if wood pallets are included.

Table 3 Seattle-Tacoma International Airport (SEA)

Annual domestic passenger departures: 14 million
Total waste generation: 5,000 tons
Waste per passenger: 0.69 pounds

Material	Amount recycled (tons)	Amount recycled as % of total waste	Energy savings, mBtu (Equivalent number of households' annual energy use)[a]	Greenhouse gas emission reductions, metric tonnes (Equivalent number of cars removed from road annually)
Mixed paper and cardboard	456	9%	5,899 (54)	360 (267)
Glass	43	1%	91 (1)	4 (3)
Plastic	18	0.36%	401 (4)	8 (6)
Scrap metal	124	2%	9,796 (90)	248 (184)
Food waste	42	1%	— —	34 (26)
Total	**683**	**14%**	**16,187 (149)**	**654 (485)**

A small amount of aluminum cans are commingled with the paper, cardboard, glass, and plastic, but the airport does not track aluminum recycling. Aluminum waste is usually generated by terminal concessions or airplanes. At SeaTac, very few aluminum cans are sold by terminal concessions, and the airport does not manage airplane waste. (Source: Conversation with Dan Roloff, Corporate Recycling Services, February 7, 2006.)

Note: All data are for 2004.

a SEA's reported waste generation does not include airline waste.

Table 4 Los Angeles International Airport (LAX)

Annual passenger departures: 29 million
Total waste generation: 19,000 tons
Waste per passenger: 1.313 pounds

Material	Amount recycled (tons)	Amount recycled as % of total waste	Energy savings mBtu (Equivalent number of households' annual energy use)	Greenhouse gas emission reductions, metric tonnes (Equivalent number of cars removed from road annually)
Aluminum	12	0.06%	2,210 (20)	49 (37)
Cardboard	2,021	11%	26,144 (241)	1,597 (1,183)
Newspaper	89	0.47%	1,477 (14)	66 (49)
Office paper	527	3%	5,341 (49)	685 (507)
Glass	17	0.09%	36 ()	2 (1)
Plastic beverage containers	9	0.05%	201 (2)	4 (3)
Plastic films[a]	913	5%	19,173 (176)	383 (284)
Food waste	271	1%	- -	222 (165)
Total	**3,859**	**20%[b]**	**54,581 (502)**	**3,008 (2,228)**

Note: All data are for 2004.

a Plastic film can refer to different types of plastic; NRDC used the U.S. EPA's energy and emissions calculations for "mixed plastic." (Source: Headley Pratt Consulting, "Understanding Plastic Film: Its Uses, Benefits, and Waste Management Options," 1996.)

b Including construction waste, scrap metal, wood pallets, and other materials such as batteries and oil filters, LAX reported a recycling rate of 55 percent. Because the focus of this study is on passenger-related wastes, these waste categories have not been included in the data.

tons of discarded aluminum and 8,000 tons of wastepaper. An airport producing 4,000 tons of waste per year could expect approximately 40 tons of discarded aluminum and 1,600 tons of wastepaper.

Clearly, U.S. airports and airlines could achieve more energy and environmental benefits from recycling. Even the airports profiled by NRDC that are considered above average by industry standards, are falling short. Given the large ecological footprint of this industry, especially its enormous use of energy and its greenhouse gas emissions, the airport industry's dismal recycling rate must be improved.

Possible Underreporting of Recycling

It is possible that airports are recycling more than they are reporting. Most airports, if they track recycling practices at all, generally do not separately track the amount of each material recycled. Aluminum recycling rates may be underreported at some airports, for example, because some airlines recycle aluminum cans recovered from in-flight service but do not keep track of the amount they recycle. Other airlines may be recycling aluminum cans but not reporting it to the airport recycling coordinator (if one exists).

THE POTENTIAL FOR LARGE-SCALE ENVIRONMENTAL BENEFITS FROM AIRPORT RECYCLING

Airports and airlines can do more to save energy, reduce global warming pollution, and divert waste from landfills and incinerators. Because the environmental benefits of recycling differ according to material, we would need to know the percentage of each material being recycled in order to quantify the environmental benefits currently achieved through recycling. Below, we estimate the potential benefits available if 25 percent, 50 percent, or 70 percent of the materials most frequently recycled were recovered at all airports.

Assuming that the U.S. air travel industry generates 425,000 tons of waste per year,[11] by recycling 70 percent of the materials listed in the table and figures below, U.S. airports and airlines could save energy equal to that consumed by 20,000 households in a year and reduce greenhouse gas emissions by an amount equal to removing 80,000 passenger cars from the road each year. Based on NRDC's waste composition estimate, recycling 70 percent of these materials would result in an industry-wide recycling rate of 31 percent, which is equal to the current national average.

Airport recycling coordinators should prioritize their recycling programs to focus on achieving the greatest environmental benefits. The potential environmental benefits data in Table 5 assume that an equal amount of aluminum, paper products, plastic, and glass are recycled. However, the environmental benefits associated with recycling any particular material are not proportionate to the percentage of that material found in the waste stream. For example, although aluminum accounts for only 1 percent by weight of the air travel industry's waste stream, the energy and emissions reduction benefits of recycling that material are disproportionately larger. The energy benefits of recycling one ton of aluminum are 11 times that of recycling one ton of newspaper and eight times that of recycling PET plastic. In Table 5, the benefits of recycling aluminum represents 25 percent of the total potential energy benefits listed

Table 5 Potential Air Travel Industry Environmental Benefits of Recycling

Estimated benefits of recycling aluminum, newspaper, cardboard, magazines, office and mixed paper, PET plastic, and glass.[a]

Benefits	Potential recycling rates:[b]		
	25%	50%	70%
Energy savings (mBtu)	774,005	1,548,009	2,167,213
Equivalent number of households' annual energy use	7,121	14,241	19,938
Greenhouse gas emission reductions (metric tonnes)	38,165	76,330	106,862
Equivalent number of cars removed from road annually	28,270	56,541	79,157
Contribution to overall recycling rate at U.S. airports[c]	11%	23%	31%

a These materials are estimated to make up 45 percent of airport waste (~200,000 tons).

b The potential recycling rate is the potential percentage of each of the listed materials (aluminum, paper, glass, and PET plastic) captured for recycling. For example, a 25 percent potential recycling rate means that 25 percent of the aluminum, paper, glass, and plastic discards at U.S. airports are captured for recycling.

c The contribution to overall recycling rate is the amount of total discards that are recycled. Because the listed recyclable materials included in this table are estimated to make up 45 percent of the industry's total waste stream, this rate is calculated as 45 percent of the potential recycling rate.

at each recycling rate. Figures 5 and 6 illustrate the energy savings and greenhouse gas emissions reductions associated with recycling one ton of aluminum, paper, PET plastic, and glass. (A description of the environmental benefits of recycling and calculation methods used throughout this report can be found in Appendix D. See Appendix E for more detail on environmental benefits by material type.)

Figures 7 and 8 illustrate the relative environmental benefits associated with recycling 70 percent of the aluminum, paper, PET plastic, and glass discarded by the air travel industry. Even though recycling aluminum results

Figure 5 Energy Savings From Recycling One Ton of Material[12]

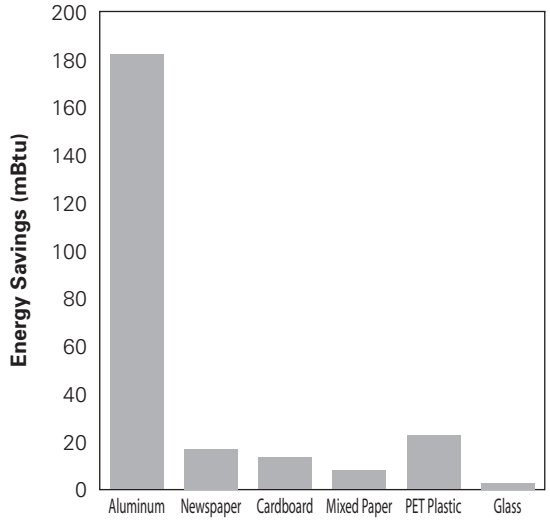


Figure 6 Greenhouse Gas Emission Reduction From Recycling One Ton of Material[13]

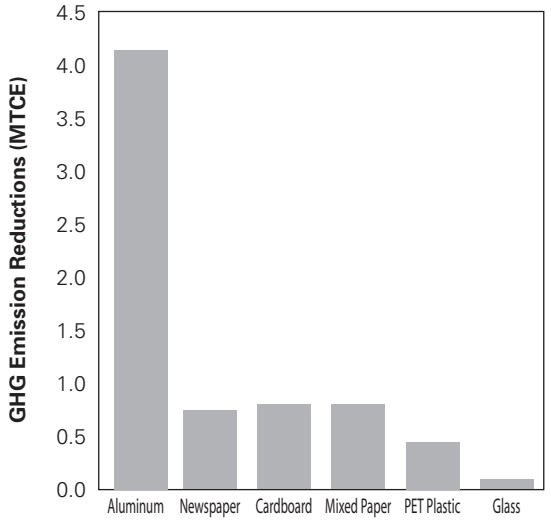


Figure 7 Potential Airline Industry Energy Savings by Material Type at 70% Recycling Rate

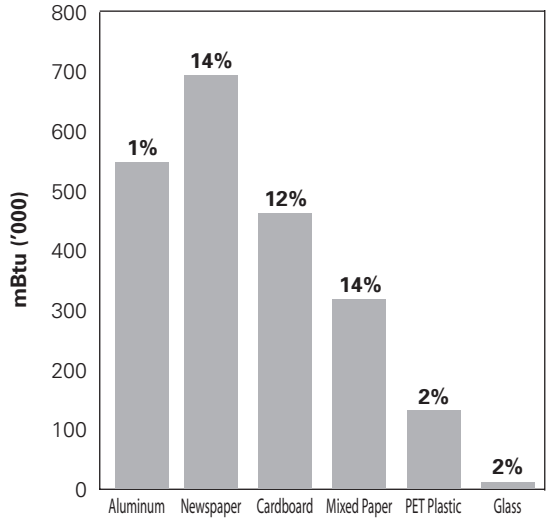
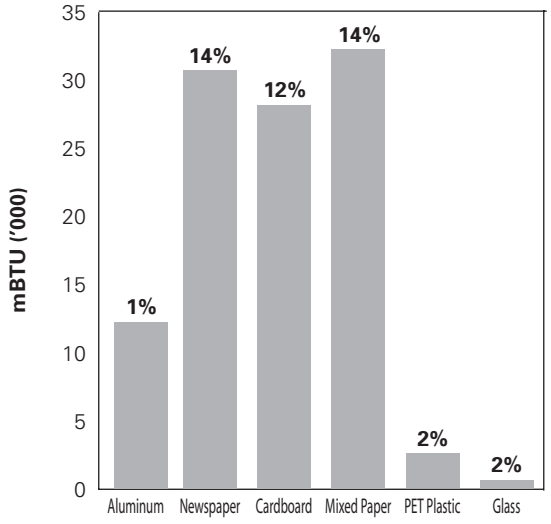


Figure 8 Potential Airline Industry Greenhouse Gas Emissions Reductions by Material Type at 70% Recycling Rate



Note: Total benefits are derived by multiplying the per-ton benefits of recycling each material by the percentage of that material in the airport waste stream. (Percentages are noted for each material; for example, aluminum is 1 percent of the airport waste stream).

in the greatest energy savings and emissions reductions on a per-ton basis, the higher proportion of paper in airport waste means that recycling 70 percent of wastepaper would result in greater overall energy and emissions benefits than recycling 70 percent of the aluminum.

These data point to two airport recycling strategies:

■ **Airports should increase aluminum recovery to maximize energy savings and emissions reductions from recycling.** An estimated 4,250 tons of aluminum cans were discarded by the U.S. airline industry in 2004. This is enough aluminum to build 58 Boeing 747 airplanes.[14] Recycling 70 percent of the aluminum cans discarded by the air travel industry would save the amount of energy used by 5,000 U.S. households in a year (548,000 mBtu) and reduce carbon emissions associated with processing virgin bauxite ore into aluminum by an amount equal to removing 9,000 cars from the road annually (12,300 MTCE).

■ **Airports should also focus on recovering wastepaper to maximize the environmental benefits and tonnage diverted to recycling.** Recycling 70 percent of the paper products discarded by the air travel industry (about 40 percent of the waste stream) would save the amount of energy used by 13,500 U.S. households in a year (1,475,000 mBtu) and reduce carbon emissions associated with processing virgin timber into paper by an amount equal to removing 68,000 cars from the road annually (91,500 MTCE). It would also help some of the many endangered forests now being cut down to make disposable paper products.

Economic Considerations of Airport Recycling

Waste management can cost a large airport more than a million dollars per year. This cost includes the purchase or rental of equipment, hauling and disposal costs, and program management costs. Recycling programs can reduce some of these costs (e.g., disposal costs), but may increase other costs (e.g., program management, equipment, labor). If, over the lifetime of the program, avoided costs and revenue from the marketing of recyclables are greater than added costs, the program will be financially cost-competitive as well as ecologically intelligent.

HOW MUCH DO AIRPORTS SPEND ON WASTE MANAGEMENT?

Airport waste management costs vary based on the tipping fees at the landfills or incinerators they rely on and an airport's fixed and variable costs, including transportation costs. (See Appendix F for a more detailed assessment of costs associated with airport waste management.) Tipping fees at landfills or incinerators near medium and large airports range from less than $20 per ton (near San Antonio, Texas[15] and Reno, Nevada[16]) to more than $100 per ton (near Fort Lauderdale, Florida[17]). The average tipping fee for landfills or incinerators near large and medium airports was $43 per ton in 2004.[18]

Of the 19 airports with centralized waste management systems responding to NRDC's survey, seven airports provided cost data. For these seven airports, the average annual cost of waste management per passenger was six cents.[19] The costs ranged from a low of three cents per passenger at one airport to a high of 10 cents per passenger at another (the variation is largely due to differences in tipping fees). The seven airports providing cost data to NRDC represent 9 percent of U.S. passenger traffic.

WHEN DOES RECYCLING SAVE MONEY?

Recycling saves money when the cost of implementing and managing a recycling program totals less than avoided disposal costs plus revenue from the sale of recyclable materials. Otherwise, recycling is a cost-increasing or cost-neutral measure. Of course, whether or not a recycling program is cost-competitive in any specific location does not affect the positive ecological value of the recycling program.

Small-scale airport recycling programs may decrease waste disposal costs only marginally or not at all because of the small amount of material being recycled and because the airport may not receive any meaningful revenue for the recyclables.

However, when a larger quantity of materials is recycled, then some garbage containers can be removed, reducing the costs related to disposal. Revenue can also be generated from the sale of recyclables such as paper, aluminum, and some plastics.

Four out of the 30 airport survey respondents cited cost as a barrier to implementing recycling programs. But four other airports that have already established recycling programs reported cost savings from these programs. These four airports are profiled below.

Fort Lauderdale International Airport (FLL)

FLL has an on-site waste sorting facility operated by Airport Recycling Specialists (ARS), a local waste management and recycling company. ARS has an agreement with the airport authority and the airlines operating at FLL

to accept all the waste generated at the airport except for kitchen-related food waste. This on-site sorting system increases the amount of waste that can be recycled, redirecting approximately 30 percent of the airport's total waste that would otherwise go to landfills or incinerators.

Since Airport Recycling Specialists opened its sorting facility at FLL in 1989, the local landfill tipping fee has increased by 300 percent; the airport's passenger traffic has increased by 300 percent as well. Due to the airport's high recycling rate, however, the waste-management costs paid by the airport have increased by only 43 percent since 1989. The tipping fee paid on nonrecycled waste sent to the local landfill is now more than $100 per ton.[20]

Seattle-Tacoma International Airport (SeaTac)

The SeaTac airport authority manages waste disposal for the terminal tenants and public areas. Currently, SeaTac's recycling rate is 14 percent, and the airport authority claims to be saving approximately $178,000 a year by recycling—an amount that has increased every year since a renewed emphasis was placed on recycling in 2001.[21]

For nonrecycled waste, a combination of high transport costs and a tipping fee of roughly $80 per ton brings SeaTac's cost of waste disposal to approximately $110 per ton.[22] Recycling not only avoids the cost of waste disposal, but generates revenues for the airport authority. SeaTac's commingled recyclables generate revenues of $30 per ton, and separated scrap metals yield $40 per ton. Composting coffee grounds costs the airport just $20 per ton, compared with the $80 per ton it would cost to landfill the coffee grounds.

According to SeaTac's recycling consultants, the airport has saved money because Corporate Recycling Services (CRS) has implemented more efficient waste hauling schedules. By scheduling container pick-ups to occur only when the containers are full and by removing unnecessary containers from service, CRS estimates that a large airport like SeaTac can save approximately 10 percent on waste disposal costs.[23]

Baltimore-Washington International Airport (BWI)

BWI has a centralized waste management system whereby the airport authority manages all waste generated on the airport grounds. BWI's current recycling rate of 20 percent reduces the amount of materials the airport sends to local landfills, where the tipping fee is $43 per ton. By increasing recycling efforts and developing more efficient hauling schedules, BWI claims to have achieved a cost savings of approximately $15,000 per month.[24]

BALTIMORE-WASHINGTON AIRPORT: A FOCUS ON CARDBOARD

By focusing on cardboard, BWI airport has succeeded in increasing its recycling rate from less than 8 percent in 2003 to more than 20 percent by the end of 2005. This has brought the airport into compliance with Maryland's 20 percent recycling diversion mandate, and it saves the airport significant amounts of money by avoiding the local $43 per ton tipping fee and generating revenue from the sale of the cardboard. To encourage participation in the recycling program, BWI staff discuss recycling issues at monthly meetings with airport tenant and airline managers.[a]

a Source: Conversation with Richard Keller, Maryland Environmental Services, November 3, 2005.

Oakland International Airport (OAK)

OAK recently changed from a decentralized waste management system to a centralized system. The airport authority purchased one 30-yard compactor for waste and another compactor for recyclables, both for use by the airlines. By putting all the airline waste up for bid under one contract and by increasing its recycling efforts, the airport authority has been able to negotiate lower waste management fees for the airlines. According to the operations manager at OAK, waste management costs have decreased for one airline from $7,700 per month to $2,500, and another airline's monthly costs have dropped from $2,300 to $1,000.[25]

Bringing Airline Recycling Up to Regulatory Requirements

DOMESTIC REGULATIONS

Airports

Unlike Europe and Japan, there are no federal recycling requirements in the United States. However, nine airports in our survey cited state, county, or city regulations that require them to implement recycling programs.

Sixty-two of the 67 large and medium airports in the United States are located in states or cities with some kind of recycling target, goal, or mandate.[26] Not all require commercial recycling. However, since the U.S. EPA estimates that commercial solid waste accounts for 35 percent to 45 percent of the entire municipal solid waste stream,[27] states, cities, or counties with a commitment to recycling frequently target commercial institutions to increase their region's recycling rate.

Airlines

States, counties, and cities that adopt enforceable recycling regulations should require airlines to comply.

For example, in July 2001 Portland, Oregon—a city with a recycling ordinance—sent a letter warning the airlines operating at the city's international airport that they were not complying with the regulation that all businesses must separate and recycle 50 percent of their waste.[28]

Because airlines have preestablished routes for their regular flights, it is possible to estimate how much passenger traffic (and airplane waste) will be concentrated in states with recycling goals or regulations. Table 6 shows the percentage of passenger traffic of the five largest domestic airlines arriving in states (or regions) with recycling goals.

At least 90 percent of the passenger traffic for each of the airlines represented in Table 6 arrives at airports located in states with a recycling goal or mandate. Despite this, none of the airlines responding to NRDC's survey maintain complete data about their recycling rates, and many airlines do not participate in airport recycling programs at all.

WASTE FROM INTERNATIONAL FLIGHTS

Waste generated on international flights is regulated by the U.S. Department of Agriculture (USDA).[29] The USDA Manual for Agricultural Clearance states that aluminum cans, glass, and plastic containers may be recycled by airlines as long as they have never held milk or other dairy products and are stored separately from food waste. The containers must be separated at the point of collection, and neither separation nor sorting is allowed once the materials are off the aircraft.[30]

However, the USDA regulation is interpreted differently by different airlines and airports. Most airport and airline officials responding to NRDC's inquiries interpret these regulations to mean that all international waste must be incinerated, even though the regulations do not say this and in fact indicate that high-value aluminum can be recycled if it is sorted in-flight.

About 70 million international passengers arrived in the United States in 2004.[31] Based on a conservative estimate of one aluminum can for every arriving international air passenger, recycling of cans on international flights could yield as much as 133,810 mBtu of energy savings—the equivalent of taking 2,217 cars off the road each year.[32]

PORT COLUMBUS INTERNATIONAL AIRPORT: RECYCLING ASSISTANCE FROM WASTE DISPOSAL PARTNERS

Port Columbus International Airport (PCIA) is located in a region with no commercial recycling regulations. Nevertheless, the airport has a successful recycling program. The Solid Waste Association of Central Ohio (SWACO) offered the airport a grant in 2001 to perform a full waste audit. Because part of SWACO's mission is to minimize the amount of waste sent to the landfill in its region, the association targeted large public facilities, including the airport, as potential places to increase recycling.[a]

Once the waste audit was complete, SWACO provided an additional grant to the airport to develop the infrastructure required to establish a recycling program. SWACO also helped airport officials set up a tracking and reporting system to monitor the success of the program.[b]

Port Columbus International Airport went from no recycling program to a reported recycling rate of 6 percent in 2004. According to the airport's director of facilities, the recycling program has not increased costs.

a Source: Conversation with Irm Shubert, Solid Waste Association of Central Ohio, April 20, 2005.

b Source: Conversation with Ron Newland, director of facilities, Port Columbus International Airport, July 15, 2005.

Table 6 State Recycling Regulations and Airplane Traffic

Airline	Ranking by number number of 2004 passengers[a]	Percentage of airline's traffic arriving at airports in states with recycling goals or targets[b]
American	1	97
Delta	2	94
Southwest	3	90
United	4	97
Northwest	5	95

Note: Airline routes are subject to change. The data in this table reflect 2004 airline traffic patterns.

a Air Transport Association, *2005 Economic Report,* 2005, p. 25.

b Bureau of Transportation Statistics, DOT T100 Segment Database, 2004.

Table 7 Aluminum Cans on International Flights Arriving in the United States Annually
Estimated amount of aluminum: 1,038 tons

Benefits	Potential recycling rates 25%	50%	70%
Energy savings (mBtu)	47,789	95,578	133,810
(Equivalent no. of households' annual energy use)	440	879	1,231
Greenhouse gas emission reductions (metric tonnes)	1,069	2,138	2,994
(Equivalent no. of cars removed from road annually)	792	1,584	2,217

CHAPTER 3

Challenges and Recommendations for Establishing Airport Recycling Programs

A number of challenges can discourage airports from implementing comprehensive recycling programs, but none are insurmountable. What follows are some recommendations to help airports develop recycling programs.

Barriers to implementing airport recycling programs can be divided into four categories:

1) Dealing with decentralized airport waste management systems;
2) Recovering airplane waste for recycling;
3) Developing financial incentives to recycle; and
4) Educating and motivating tenants and passengers to recycle.

Challenge: Dealing With Decentralized Waste Management Systems

As mentioned earlier, a decentralized airport waste management system is one in which the airport authority, the tenants, and the airlines each manage their own waste. A centralized system, by contrast, is one in which the airport authority manages waste for all tenants and airlines. In a decentralized system, even though each tenant or airline may have direct cost incentives to recycle because it pays its own waste management bills, the volume of waste generated by each individual tenant is lower than that produced by the airport overall. Because of this, the per-ton economics of recycling tends to be less cost-competitive.

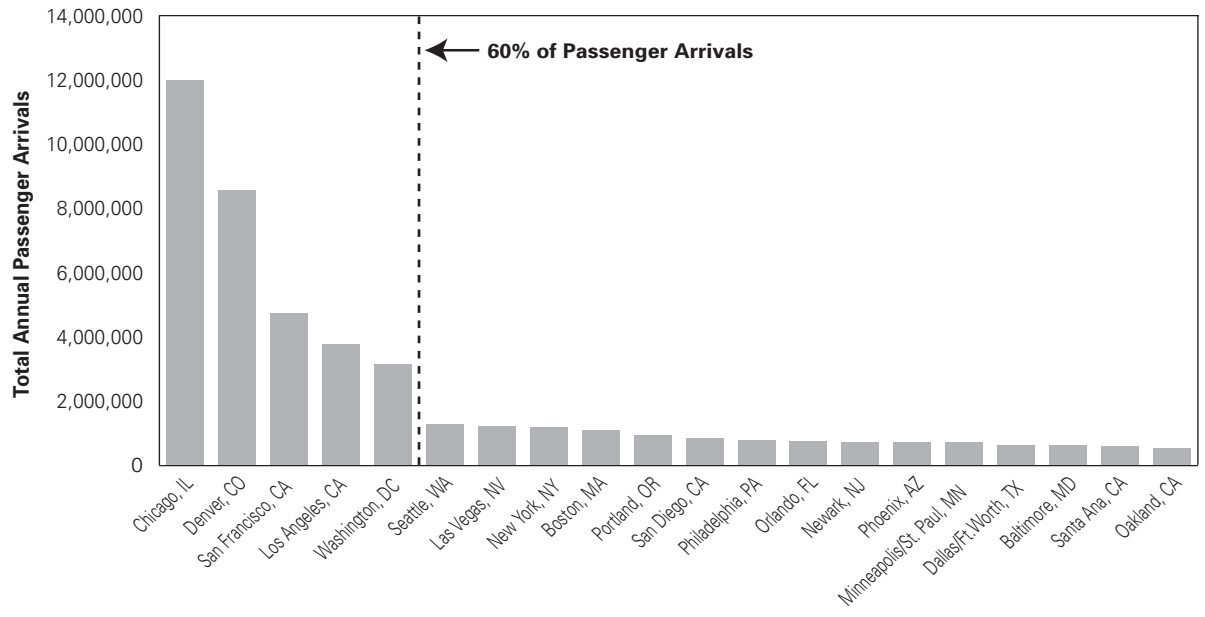
One of the reasons that decentralized waste management systems may impair recycling is because the costs for an airline company are typically distributed unequally among the airports at which the airline operates. Most large airlines in the United States operate on a "hub and spoke" system, which concentrates the bulk of passenger traffic at only a few airports. Since the amount of airline waste—including recyclable materials—correlates with the amount of passenger traffic in a given location, hub and spoke airlines generate larger amounts of waste at their hub airports because these facilities serve the majority of their passengers. At the outlying "spoke" airports, airlines may not generate enough recyclable materials to make recycling programs economical unless they become part of a larger waste management system at that airport.[1] If waste management systems at these spoke airports are decentralized, airlines must pay to implement their own recycling programs, and many airlines find that the amount of recyclable materials being diverted does not save them enough money in avoided disposal costs, or generate enough revenue from the sale of recyclables, to justify the costs of the program.

For example, nearly 60 percent of United Airlines' domestic traffic is located at only five airports, but the airline generates in-flight waste at dozens of airports. Most domestic airlines have similar traffic—and waste generation—patterns.

SOLUTIONS

Centralized waste management can assist recycling at airports. Some airports, such as Oakland International Airport, have found it cost-effective to change from a

Figure 9 United Airlines' Domestic Passenger Traffic Distribution by Airport, 2004[2]



decentralized waste management system to a centralized system. Oakland's change was motivated by its desire to enhance airfield safety, improve general sanitation, and reduce costs. Under Oakland's new, centralized system, not only is recycling available to the airlines and airport tenants, but, according to airport personnel, the savings from adopting a larger waste disposal and recycling contract are so substantial that airlines have seen their monthly waste disposal bills drop by more than 50 percent.[3] Similarly, San Francisco Airport took over waste management responsibilities for its terminal tenants, although not for its airlines, in 2004.[4] And Seattle-Tacoma International Airport is evaluating the benefits of moving from a system where each airline manages its own waste to one controlled by the airport authority, while still trying to retain financial incentives to recycle.[5]

Airlines can take the initiative and establish recycling programs for airplane waste at their primary hubs. Given that airline waste (most of which is airplane waste) accounts for about 50 percent of the waste in terminal areas, an effective airline recycling program could help reduce waste management costs and generate revenues from the sale of recyclables. Airlines might be wise to encourage airports to provide a centralized recycling infrastructure where the airlines do not have enough volume to justify their own recycling programs.

Challenge: Recovering Airplane Waste for Recycling

In-flight waste creates an added management issue for many airport recycling coordinators because they have little control over how waste is managed on the airplane. With the exception of waste from airplanes that land at the few airports with sorting systems, airplane waste that does not get sorted in-flight does not usually get recycled on the ground.[6]

Challenges related to recycling airplane waste include:

- Lack of space at gates for recycling containers;
- Lack of access to secured areas of the airport for recycling collection;
- Limited space to store segregated materials on the airplane;
- Limited time to separate waste on short flights;
- Limited time for cabin cleaners to collect recyclable waste separately;
- Lack of knowledge about which airports provide recycling programs to their tenants; and
- Low volume of recyclables at airports where airlines have low traffic.

All waste management programs pose challenges, and capturing airplane waste for recycling is no exception. But

the existence of thousands of successful recycling programs throughout the world attests to the fact that if there is a desire to develop a recycling program, it can be effectively done. At airports, establishing a centralized recycling program is one helpful way to address space constraints and provide equal access for recycling contractors.

SOLUTIONS

Create more space-efficient in-flight recycling systems. A commonly cited barrier to recycling on airplanes is space constraints. However, some onboard storage systems are designed so that collecting recyclables does not require additional space. For example, by using bags of different colors for recyclables and storing the bags in the same container used for garbage bags on the plane, no extra space is needed. The recyclables can then be separated into recycling Dumpsters when the plane lands.

Inform airlines about the recycling systems at the airports they use. Flight attendants report that they often do not know whether a recycling infrastructure exists at the destination airport. This can be frustrating for flight attendants who go through the effort of separating recyclables in-flight, only to see them mixed with garbage when the plane lands. This problem can be solved by having a standard recycling method at all airports or by informing airline personnel (including flight attendants) about the recycling opportunities available at each airport.

Provide incentives for in-flight recycling. Some airlines offer incentives to encourage recycling efforts by flight attendants or the cabin cleaners who collect waste. For example, Southwest Airlines allocates the funds earned from the sale of recyclables at each airport to support charity programs and extra benefits for their employees.[7]

Challenge: Developing Financial Incentives to Recycle

Without a financial incentive to recycle, airlines and other airport tenants may be reluctant to participate. Despite the environmental benefits, businesses will often not adopt recycling programs unless there is a cost advantage. At most airports with centralized waste management systems, the costs are passed on to the tenants as part of their lease fees. However, this approach to billing may prevent tenants from receiving any financial benefits that the recycling program might provide. This can stymie participation.

SOLUTIONS

Bill tenants and airlines directly for waste management. By making these costs known, an airport authority can encourage tenants to consider waste reduction options and take a more active role in recycling their waste.

Institute a "pay-as-you-throw" system. A pay-as-you-throw system charges each tenant for the amount of waste it produces. This approach is being tested at Seattle-Tacoma International Airport, coupled with a recycling incentive: Tenants pay for waste they dispose of in the garbage compactors, but disposing of separated recyclables is free.[8]

Write recycling requirements into tenant leases. Airport managers should incorporate recycling requirements into their lease agreements with tenants, especially in locations with recycling regulations. This would mandate participation by tenants in an airport's recycling program.

Challenge: Educating and Motivating Tenants and Passengers

Because all tenants contribute to an airport's waste stream, and because tenancy and tenant employees change over time, there is an ongoing need to reinforce information about recycling. With thousands of employees at each airport, this is no small challenge.

SOLUTIONS

Hire a dedicated recycling coordinator. All recycling programs benefit from the attention of a dedicated recycling coordinator. Recycling coordinators can oversee program implementation and employee training and can provide tenant managers with the necessary tools to train their own employees. Recycling coordinators can use meetings with tenants to address ongoing challenges, contamination rates, and other pertinent issues. They can also solicit feedback and ideas from tenants, passengers, and custodial staff.

Clearly label recycling receptacles and place them in visible locations to make it easy to recycle. In locations where passengers or tenant employees speak different languages, signs should be printed in as many languages as necessary.

CHAPTER 4

More Recommendations for Implementing Airport Recycling Programs

It's not only airport managers, airline officials, and terminal tenants that can make a difference when it comes to improving airline and airport recycling. Trade associations and flight attendants can also help advance recycling programs. The following recommendations suggest how the key parties can be involved in implementing recycling programs.

Recommendations for Airport Managers

■ **Centralize airport waste management programs and hire a recycling coordinator.** The potential to achieve cost savings by centralizing waste management and recycling programs justifies appointing a recycling coordinator. The coordinator can help ensure participation in the recycling program and can help determine appropriate financial incentives for the program's participants. The recycling coordinator can also communicate with airport tenants and airline personnel and provide tenant and airline station managers with educational materials for their employees.

■ **Airports with recycling programs should coordinate with one another to streamline procedures for dealing with airplane waste.** Airline employees would undoubtedly find it easier to participate in recycling programs if the different airports used by that airline had similar recycling systems. Airport recycling coordinators should work with property managers to ensure that tenant leases require participation in an airport's recycling program.

■ **Establish financial incentives to recycle for airport tenants.** Even with a centralized waste management system, airports should establish financial incentives to encourage tenant and airline participation in recycling programs. A pay-as-you-throw system can allow tenants to save money while increasing their recycling rate.

■ **Plan ahead before implementing or expanding a recycling program.** A successful recycling program must be carefully planned to ensure that the program is easy to use and convenient for airport tenants and airline personnel, as well as for passengers.

Managers should determine which materials are the most cost-effective and easy to recycle, and begin their recycling program by targeting those materials. Targeting high-volume recyclables such as cardboard packaging and high-value recyclables such as aluminum could achieve cost savings quickly and create a foundation for a more comprehensive recycling program.

■ **Start early: Consider waste management and recycling in terminal design and during construction.** A common impediment to implementing a recycling program cited by respondents to NRDC's airport recycling survey is space constraints for recycling Dumpsters and compactors. Considering in advance the space requirements for recycling in any terminal construction or renovation can simplify implementation in the future.

As an example of how poor design can adversely affect recycling, at one of the airports visited by NRDC, a chute was installed in an external wall allowing garbage to be transferred from inside the terminal to a garbage Dumpster

outside the terminal, but there is no chute for the adjacent recycling Dumpster. A special security clearance is required to access the outside of the terminal, so while any employee can dispose of garbage through the chute, only employees with a special security clearance can access the recycling container. Had a similar chute for the recycling Dumpster been installed during construction when the garbage chute was installed, it would be just as easy for tenant employees to recycle as it is to dispose of garbage. The inconvenience of not having a chute to the recycling container means that recyclable materials often end up getting tossed out as garbage.

■ **Measure progress of recycling systems.** It is easier to manage what we can measure. By consistently tracking the amount of materials recycled and disposed, airport managers can assess their recycling programs. Tracking waste diversion and tenant participation will also help management identify problems or opportunities in their recycling programs.

Maintaining accurate data is also essential for estimating a program's environmental benefits, and communicating information about these environmental benefits can motivate participation.

■ **Publicize recycling achievements to the greater community.** Airport managers should publicize their recycling efforts and successes to passengers and the surrounding community. With nearly 700 million passengers per year, the U.S. air travel industry is in a unique position to help educate the public about the value of recycling. By labeling recycling containers, posting signs about the environmental and economic benefits of recycling, and including articles about the industry's recycling programs in in-flight magazines, the air travel industry might help educate hundreds of millions of people about the benefits of recycling. Given the number of businesspeople who travel, this type of educational outreach could also inspire more recycling programs in the business sector.

Recommendations for Airline Managers

■ **Separate waste in-flight.** Keeping recyclables separate from trash in-flight can greatly assist ground crews in recycling materials collected from airplanes.

■ **Collaborate financially with state and local governments.** At least 90 percent of air passenger traffic for most major U.S. airlines occurs in regions with recycling goals or mandates. Airlines should investigate whether government assistance is available for implementing recycling programs and partner with local government to meet recycling standards. If financial support doesn't exist, airport authority officals should work with state, local, and regional governments to develop it. In light of the financial pressures on airlines, this type of financial support could be of great value. Cities and counties with recycling goals should be reminded that airports can produce the same amount of waste as thousands of households. For example, in 1999, the amount of waste generated at San Francisco International Airport (including all tenant, cargo, and construction waste) accounted for more than 43 percent of all the waste generated in San Mateo County, where the airport is located.[1] State and local governments should offer recycling assistance to airports.

■ **Encourage airports to provide centralized waste management.** Centralizing airport waste management is likely to save airlines money and help them recycle. Airlines should encourage centralized systems in the airports where they fly.

■ **Encourage standardized waste management and recycling practices at all airports.** Recycling is challenging for airline personnel because waste management systems vary from airport to airport. This means that flight crews may need to handle waste differently on each flight. If all large and medium-sized airports had the same system for capturing airplane recyclables, flight attendants could handle waste more uniformly, which could simplify and increase participation in recycling.

■ **Provide incentives to flight attendants and cabin cleaners to recycle.** Providing incentives to the employees who handle the sorting and disposal of recyclables can motivate them to support a recycling program. For example, Southwest Airlines allows the local staff at Oakland International Airport to keep the revenues generated from the sale of recyclables to fund employee barbecues, special events, and a discretionary "rainy day" fund for employee assistance.[2] The airline saves money by avoiding waste disposal fees, and the employees benefit as well. The employees recycle as much as they can because they personally realize tangible benefits from participating. This type of incentive system could be used throughout the air travel industry.

Recommendations for Retail and Restaurant Concession Tenants

■ **Encourage airports to provide centralized waste management and share any cost savings from recycling.** As mentioned before, airport tenants can save money if a centralized waste management system is put in place. To ensure that tenant participation in a recycling program is rewarded, tenants should ask their airport authority to share cost savings from recycling programs in their lease agreements.

■ **Standardize purchasing to make recycling easier.** Airport tenants can adopt an environmentally preferable purchasing policy to ensure that more materials in the airport waste stream are recyclable. Tenants can also adopt waste reduction measures to increase cost savings.

Recommendations for Local Governments and Policy Makers

■ **Offer assistance to local airport recycling programs.** Airports serve as the gateway to cities, giving many visitors their first impression of a city. Bearing this in mind, local governments should promote the environmental sentiments and goals of their community at airports.

Cities and counties with recycling goals should be reminded that airports can produce the same amount of waste as thousands of households. For example, in 1999, the amount of waste generated at San Francisco International Airport (including all tenant, cargo, and construction waste) accounted for over 43 percent of all the waste generated in San Mateo County, where the airport is located.[3] State and local governments should offer recycling assistance to airports.

Recommendations for Air Travel Industry Trade Associations

■ **Share knowledge about successful recycling programs throughout the industry.** Airport waste management coordinators cite similar challenges in establishing recycling programs. By including workshops on airport recycling at industry conferences and facilitating information exchange, trade associations could help disseminate useful information about successful programs. Trade groups could also help establish standard methods to deal with airplane recyclables.

■ **Establish awards and recognition programs.** The International Council of Shopping Centers (ICSC) in collaboration with the U.S. EPA has established an award program to recognize superior shopping center recycling programs. Similarly, the American Association of Airport Executives or the Airports Council International could work with the U.S. EPA to establish a program for airports. Recognition of successful recycling efforts is an incentive that could encourage airport managers to take their recycling programs more seriously. The Airport Revenue Network has an awards program that recognizes achievements of airport concessions, and an award for recycling might be incorporated into this existing program.

Recommendations for Recycling Consultants

■ **Propose shared-savings service agreements.** The large volume of waste generated by airports can represent a valuable business opportunity for recycling consultants. Recycling service agreements wherein contractors agree to manage the recycling program in exchange for a percentage of the savings can be profitable for recycling consultants. Seattle-Tacoma International Airport has a shared-savings agreement with the consultants that manage its recycling program, which provides a strong financial motive for the consultants to continually improve the recycling program and increase recycling rates.

Conclusion

Businesses all over the world are increasingly acknowledging their responsibility for slowing the pace of global warming. The air travel industry, with its extraordinarily heavy reliance on fossil fuels, should exploit any opportunity to reduce its ecological footprint, especially its energy consumption. Recycling programs offer one way to mitigate the industry's environmental impacts.

Recycling is fundamental to every vision of sustainable development, and it is an important step toward improving both the environmental performance of airports and airlines and the public's image of the industry. Recycling by airlines and at airports will become even more important as more Americans rely on air travel. The U.S. air travel industry is forecast to grow 4.5 percent per year, serving more than a billion passengers annually in 2015, compared with 738.6 million in 2005.[1] Waste generation will increase with the number of passengers, and as much as 650,000 tons of waste per year will be generated in U.S. airports by 2015.[2]

Increasing passenger traffic means that airports will be expanding. One estimate anticipates that about $1.9 billion will be spent on airport terminal construction between 2005 and 2009.[3] This creates opportunities for airports to design new terminal space with recycling in mind, and to recycle waste generated by new construction.

Currently, airport and airline recycling programs are underdeveloped and achieve minimal environmental benefits. The potential for the airline industry to have more of an impact on our collective environmental health is substantial: If recycling was implemented at all U.S. airports, the reductions in emissions could equal the removal annually of 80,000 cars from the road.

In addition to providing environmental and economic benefits, adopting recycling programs tends to boost employee morale and improves relations with local governments and the media. Recovery of materials for recycling should be combined with procurement policies that give priority to buying products made from recycled materials to help strengthen recycling markets. And along with recycling, waste reduction efforts should be adopted.

APPENDIX A

Airport Recycling Profiles

Portland International Airport (PDX)

Portland International Airport (PDX) is the nation's 34th busiest airport and has one of the highest recycling rates of any U.S. airport NRDC studied. Through efforts on the part of the Port of Portland and Community Environmental Services,[1] numerous waste audits have been conducted at the airport to determine not only what types of materials are in the waste stream, but also which areas of the airport generate the waste.

CURRENT RECYCLING PRACTICES

Portland Airport's waste management and recycling programs are administered by a remediation and waste project manager. This manager's mandate is to reduce the amount of waste the airport sends to the landfill, a task for which he contracts for assistance from a team of student consultants from Portland State University's Community Environmental Services (CES).[1] CES has four consultants working on the PDX project whose combined contributions represent the equivalent of about one and a half full-time employees. This team meets regularly with the remediation and waste project manager to oversee the day-to-day management of the recycling program, improve tenant training programs, and devise new methods to divert the airport's waste from the landfill. CES assists with planning, implementation, and evaluation of the recycling program.

LOGISTICS OF PDX WASTE MANAGEMENT

PDX has a centralized waste management system in which the airport authority administers the waste removal contracts and provides waste disposal and recycling compactors and Dumpsters as a service to the terminal's retail and restaurant tenants and airlines. Cargo area waste disposal is handled separately. Waste disposal fees are not billed independently to the tenants or airlines but are instead rolled into the lease fees.

The airport authority provides a centralized set of Dumpsters and compactors that both the terminal tenants and airlines use. The inventory of disposal containers is as follows:

- Two 30-yard garbage compactors;
- One 40-yard compactor for cardboard;
- Three 30-yard roll-off Dumpsters for recyclables (one for plastics; one for commingled plastic, paper, tin, and aluminum; and one for glass); and
- Four 4-yard green Dumpsters for food waste.

The containers are located just outside a door to the terminal. This location allows easy access for airline personnel, cabin cleaners, and custodial and concession staff.

All public garbage cans in the terminal have commingled recycling containers next to them, and the PDX waste team works with the concession tenants to train and motivate their staff to recycle.

KEY FEATURES OF THE SYSTEM

PDX recycled 538 tons of waste in 2004, achieving a recycling rate of 20 percent. The remediation and waste

PDX AT A GLANCE

Airport ranking (domestic)	34th
Annual domestic passengers	12.6 million
Annual international passengers	392,000
Top three carriers and percent share of passengers:	
Alaska:	19.6%
Southwest:	16.5%
Horizon:	16.5%

Environmental Benefits of PDX Recycling[a]

Recycling rate	20%
Materials recycled	Paper, cardboard, plastics, aluminum, glass, food waste, scrap metal, tires, pallets, buckets, construction waste
Energy savings[b]	4,538 mBtu/year
(equivalent to annual electricity usage of 42 households)	
Greenhouse gas emissions reduction[c]	391 MTCE
(equivalent to taking 290 passenger cars off the road yearly)	

a Based on responses to NRDC's airport recycling survey; additional information provided by CES and the Port of Portland.

b Calculations based on U.S. EPA, "Solid Waste Management and Greenhouse Gases," U.S. EPA, 2002.

c Calculations based on U.S. EPA, "Solid Waste Management and Greenhouse Gases," U.S. EPA, 2002.

project manager attributes this recycling rate, one of the highest in the industry, to careful management and attention to detail. A few of the important elements in making the program a success are:

■ Recycling receptacles placed adjacent to all garbage cans in the terminal;

■ Clear labeling on public receptacles, Dumpsters, and compactors;

■ Comprehensive recycling available to all retail shops, including recycling of cardboard, paper, and plastic wrap;

■ Recycling food waste from airport restaurants;

■ Recycling of cooking oil and grease from restaurants and shops;

■ Strong emphasis on tenant training, education, and outreach; and

■ Outreach to airline personnel to increase recovery of deplaned waste.

INNOVATIONS

Innovative and unusual recycling practices have helped make PDX an airport recycling success story:

■ **Food waste recycling:** In order to make food waste collection for composting economically feasible, PDX partnered with two local flight kitchens and two local hotels to create a combined haul route. Without these added partners to defray the cost, hauling this food waste would not be affordable for the airport.

■ **Used cooking oil sent to biodiesel processing plant:** 3,000 pounds of grease per week are produced at PDX. The airport recently started sending approximately 1,500 gallons per month of used cooking oil to Sequential Biofuels, where it is processed into biodiesel.

■ **Foreign magazine reuse:** Instead of simply recycling the magazines off Lufthansa flights, the German magazines are sorted and donated to a local school as material for German language classes.

■ **Targeting airplane waste:** By conducting detailed waste audits, PDX determined that 45 percent of the waste generated at the airport consisted of waste coming off commercial airplanes. As a result, the airport has started actively engaging the airlines in trying to find ways to recycle more airplane waste. One strategy PDX has been using is to map out the waste flow for each airline to be sure that all parties understand exactly where the opportunities for change are.

LOCAL/REGIONAL INFLUENCES

The city of Portland requires all businesses to recycle at least 50 percent of their waste. This regulation extends to both the airport and the airlines operating on airport grounds.

ECONOMICS

A high local landfill tip fee of $80 per ton makes recycling an attractive alternative to landfill disposal.

CHALLENGES

Though PDX has one of the most successful recycling programs of any airport in the country, there are still a number of challenges it faces in continuing to increase its recycling rate:

■ **Airplane waste:** Nearly half of the airport waste stream comes from airplanes. Sorting and recycling this waste require cooperation from airline representatives and cabin cleaners.

Solution: The waste team has begun working with airline personnel to design a pilot program to capture airplane waste for recycling.

PDX RECYCLING PROGRAM HIGHLIGHTS

Successes
- Comprehensive tenant recycling program for 11 materials
- Well-managed public area recycling with low contamination rates

Innovations
- Partnered with area businesses to make food waste collection economical
- Working to capture recyclables from deplaned waste

Motivations
- Local recycling mandate of 50 percent diversion
- Environmental management system that identifies annual waste targets and objectives
- Alignment with local environmental expectations

Ongoing Challenges
- Capturing airplane waste, which accounts for 45 percent of the airport's waste stream
- Communication among multiple stakeholders, including airport authority, airlines, tenants, and custodial staff
- A total employee base of 10,000, with high turnover rates that require ongoing training efforts

■ **Cost of biodegradable bags:** The biodegradable bags currently being used for the food recycling program cost $0.58 per bag—a cost that adds up quickly when three tons of food waste are collected per week and each bag holds only 30 to 40 pounds of food waste.

Solution: PDX staff is looking for alternative sources of biodegradable bags to bring down this cost.

■ Employee turnover: Concession tenants sort and deliver their waste and recyclables to the Dumpsters and compactors provided by the airport authority. Because employee turnover rates tend to be high, it is hard to keep new employees updated on recycling procedures.

Solutions: The PDX waste team has been focusing its training efforts on tenant managers so that the managers have the tools to train their own employees. Training and outreach efforts include providing the managers with multilingual descriptions of how the recycling program works and ensuring that Dumpsters and compactors are clearly labeled.

■ **Lack of a cost incentive:** Because the airport authority manages waste disposal for all tenants, financial incentives for tenants to recycle do not exist. Without a financial incentive, it is harder to motivate tenants and airlines to participate in the recycling program.

Solutions: PDX is exploring ways to make the cost savings generated by recycling available to the tenants.

PLANS FOR THE FUTURE

In addition to continuing the terminal recycling program and trying to increase food recycling, the main goal for the PDX waste team is capturing more airplane waste for recycling. Toward that end, the waste team has already had several meetings with the airline station managers based at PDX in an attempt to structure a pilot program that is effective and workable for the airlines and the airport.

Seattle-Tacoma International Airport (Sea-Tac)

Seattle-Tacoma International Airport (Sea-Tac), the sixteenth-busiest airport in the United States, provides an example of how a large airport can implement effective recycling programs and save money as a result.[2] Located in a region with high waste disposal fees and a strong environmental culture, Sea-Tac has one of the most innovative and successful recycling programs of any airport in the country. Local environmental regulations and a strong commitment to the program by airport management have contributed to the successful operation of Sea-Tac's recycling program.

CURRENT RECYCLING PRACTICES

Walking though the public terminals at Sea-Tac, it is impossible to miss the distinctive waste and recycling containers. The innovative receptacles in the public terminals (each receptacle has a separate opening for trash, aluminum cans, plastic containers, and paper) are only a small part of the overall recycling initiative at Sea-Tac, but they illustrate the creative thinking that has gone into the recycling program at the airport.

In 2001, the airport's utilities manager contracted with Corporate Recycling Services to improve the airport's recycling program. Under the structure of a performance contract similar to those often used by energy efficiency consultants, Corporate Recycling Services receives compensation only as a percentage of the monetary savings they achieve for the airport. This arrangement reduces risk for the airport while providing the waste management consultants a direct financial incentive to implement cost-effective recycling measures.

Since Corporate Recycling Services came onboard in 2001, the amount of waste diverted for recycling has increased by 800 percent—from 100 tons in 2000 to 900 tons in 2005.[3]

SEA-TAC AT A GLANCE[a]

Airport ranking (domestic)[b]	16th
Annual domestic passengers	26.37 million
Annual international passengers	2.44 million
Top three carriers and percent share of passengers:	
Alaska:	35%
Horizon:	12%
United:	11%

Environmental Benefits of Sea-Tac Recycling[c]

Recycling rate	14%
Materials recycled	Paper, cardboard, plastics, coffee grinds, scrap metals
Energy savings[d] *(equivalent to annual electricity usage of 149 households)*	16,187 mBtu/year
Greenhouse gas emissions reduction[e] *(equivalent to taking 485 passenger cars off the road yearly)*	654 MTCE
Cost savings of $178,000[f]	16,187 mBtu/year

a 2004 Seattle-Tacoma International Airport Activity Report, http://www.portseattle.org/seatac/statistics/

b Airport ranking based on FAA passenger activity for 2003. http://www.faa.gov/arp/planning/stats/

c Based on responses to NRDC Airport recycling survey.

d Calculations based on U.S. EPA, "Solid Waste Management and Greenhouse Gases," U.S. EPA, 2002.

e Calculations based on U.S. EPA, "Solid Waste Management and Greenhouse Gases," U.S. EPA, 2002.

f Sea-Tac Airport Waste Reduction and Recycling Program, "Accomplishments for the year 2004." Port of Seattle.

LOGISTICS OF SEA-TAC WASTE MANAGEMENT

The logistics of waste management at Sea-Tac are similar to those at many large airports. The airport authority is in charge of the waste removal and recycling contracts for the terminal buildings and tenants (such as shops and restaurants), and each airline is responsible for its own waste contracts. As a result, waste Dumpsters and compactors in the terminal buildings are owned by the airport authority and used by the janitorial staff and the tenants, while additional waste Dumpsters on the airfield are owned and used by each airline.

To date, the airport authority's program has focused on waste generated in the public areas of the terminals, offices, and by the terminal tenants. Because they have their own waste contracts, the airlines have not yet participated in the airport authority's recycling initiatives, with the exception of paper recycling in the ticketing and administrative offices. The airport authority has proposed a plan to extend the recycling program to airlines in the near future.

The airport authority has three separate waste contracts:

- One general hauler takes the nondiverted waste, glass, wood, and coffee grinds;
- A recycling hauler takes the commingled recyclables (aluminum cans, plastic bottles, mixed paper, plastic stretch film, plastic shrink wrap, and plastic bags); and
- A scrap metal recycler takes the discarded metal.

Tenants are billed for waste disposal similarly to the way they are billed for energy or water—on a "pay as you throw" basis, meaning that each tenant pays a monthly fee according to how much waste it disposes of. To create an incentive for the tenants to recycle, the airport authority does not charge for materials that are recycled, only for those that end up in the trash compactors.

KEY FEATURES OF THE SYSTEM

The amount of material recycled at Sea-Tac increased from 112 tons in 2000 to 700 tons in 2004 and reached 900 tons in 2005.[4] The airport's utilities manager attributes this increase in material diverted from the landfill to a number of initiatives:

- Prominent recycling receptacles in public areas;
- Desk-side paper recycling in all administrative offices;
- Coffee grinds and filters collected for composting from all airport coffee shops;
- Glass beer and liquor bottle recycling for restaurants and bars;
- Cardboard recycling for all retail shops;
- Cooking oil and grease recycling for restaurants; and
- Monthly recycling updates, training, and reminders at tenant meetings.

INNOVATIONS

Some of the recent additions to the Sea-Tac recycling program include:

- **Coffee grind recycling**: Sea-Tac coffee shops generate as much as seven tons of used coffee grinds and filters each month. By diverting this to the Cedar Grove composting facility, the airport authority reduces disposal costs for coffee grinds by 70 percent per ton. With landfill disposal costs at approximately $110 per ton, that results

SEA-TAC RECYCLING PROGRAM HIGHLIGHTS

Successes
- Achieved annual cost savings of $178,800 in 2004
- Received two awards for recycling programs since 2001

Innovations
- Composting coffee grinds and filters from terminal coffee shops
- Diverting used cooking oil to a biodiesel processor
- Electronic compactor monitoring to allow "pay as you throw"

Motivations
- Cost savings
- Environmental stewardship
- Alignment with local environmental expectations and culture: desire to "be a good neighbor"

Recurring Challenges
- Managing multiple waste streams
- Continually ensuring that janitorial staff follow recycling procedures

in a cost savings of $9,240 per year. To close the recycling loop, airport maintenance buys Cedar Grove's finished compost product for use on the grass strips between the runways and for general landscaping soil amendment.

■ **Recycling of used cooking oil:** Sea-Tac sends 1,000 gallons of bulk grease to a biodiesel plant each month.

■ **Pay-as-you-throw and electronic monitoring:** Tenants are charged each time they use the garbage compactor through an electronic monitoring system on the compactor. This system also monitors how full the compactor is and notifies the hauler when it is ready to be picked up.

ECONOMICS

Four years after revitalizing its recycling program, Sea-Tac is already achieving annual costs savings of $178,000—an amount that has increased every year. To date, the recycling program has included only the airport authority and terminal tenants, but Sea-Tac plans to extend the recycling program in 2006 to all the airlines operating at the airport.

A shortage of available local landfill space, high waste disposal fees, and a robust regional recycling infrastructure all contribute to the overall cost-effectiveness of Sea-Tac's recycling program.

Limitations on available landfill space mean that most waste generated in the Seattle area is shipped by rail over 200 miles away to landfills in Oregon and eastern Washington. The combination of high transportation costs and a tip fee of roughly $80 per ton brings the total cost of waste disposal for Sea-Tac to approximately $110 per ton.

On the other hand, the Seattle region offers abundant markets for recyclables—local and regional mills are in need of recycled paper, and easy access to Pacific Ocean shipping means proximity to the growing market for recyclables in Asia.

Expanding the materials collected for recycling beyond the usual glass, plastic, aluminum, and paper has also provided cost savings for the airport. Collecting coffee grinds for compost costs Sea-Tac only $20 per ton, compared to the $110 per ton it would cost to dispose of them in the landfill. Similarly, the used cooking oil from airport restaurants is picked up free of charge by Sequential Biofuels, compared with a cost of approximately $100 per ton for cooking oil to be collected and disposed of by a standard rendering service.

CHALLENGES

Despite the overall success of Sea-Tac's recycling program, the airport faces some ongoing challenges to improving and maintaining it:

■ **Educating and training users:** A successful recycling program depends on consistent participation from the people generating waste. In Sea-Tac's terminals, the large number of concessionaires and vendors, administrative staff, and other airport workers makes ongoing education and motivation difficult.

Solutions: The airport posted signs on terminal trash and recycling receptacles and around Dumpsters and compactors. Training for vendors includes a recycling component, and participants are reminded to recycle and informed of new initiatives at monthly meetings.

■ **Participation of janitorial staff:** No matter how well passengers and other waste generators in the terminal separate their recyclables into the designated containers, these efforts will go to waste if the janitors simply combine all discards collected into one Dumpster. Waste managers have to work with janitorial managers to improve participation among the janitorial staff.

Solution: The airport is considering including requirements to adhere to airport recycling programs in janitorial contracts.

PLANS FOR THE FUTURE

Although the Sea-Tac recycling program has been successful at terminal buildings, the program has not yet

successfully targeted waste from airplanes, which typically represents approximately 45 percent of all the waste generated at an airport.[5]

In 2006, Sea-Tac plans to expand its recycling program to include the airlines that operate at that airport. The airport authority will buy and install several large waste and recycling compactors to be placed around the airstrip and will take control of all waste management activities on the airport grounds. This shift means that there will be only one central waste management contract, and the airport authority will bill the tenants and airlines for waste management.

The airport's utilities manager cites several reasons for incorporating the airlines into the centralized waste management system:

■ **Reducing the danger of flying object debris currently associated with several older airline waste Dumpsters:** Currently, each airline has its own Dumpsters on the airstrip. These nonstandardized (and often low-cost) Dumpsters often do not effectively capture loose material that can be blown free by the wind. Centralized management allows the airport authority to take control of waste management on the airstrip by purchasing new, sealed compactors that eliminate this hazard.

■ **Reducing truck traffic on the airfield:** Because each airline has its own Dumpsters placed in many locations on the airstrip, there is a lot of truck traffic to and from the Dumpsters to deposit airline waste. The multiple waste haulers from several different waste contracts also drive on the airstrip to pick up waste. Having centralized compactors means that overall truck traffic will decrease, as fewer haulers will make fewer trips to pick up containers, and the airport authority can arrange for pickups only when containers are full.

■ **Reducing the number of birds and rats scavenging from the old Dumpsters:** Similar to the flying object debris problem, the open Dumpsters attract birds and rats, which can pose aviation and safety hazards.

■ **Creating cost savings for airlines:** Having a single large waste management contract provides the airport authority with more leverage in negotiations with waste haulers than any of the airlines have with their smaller, individual contracts. Also, by providing recycling receptacles free of charge, the new program will give the airlines the option of saving even more money by separating the recyclables (which will be picked up for free) from the rest of the waste stream (which airlines pay to have picked up).

■ **Increasing the overall recycling rate of the airport:** By providing a cost incentive to the airlines to recycle—airlines will be charged for using the waste compactors, but the recycling compactor will be free—the airport authority expects the airlines to be motivated to increase recycling as a cost-saving measure.

Expanding the current terminal waste management and recycling program to encompass all the waste generated on airport grounds will nearly double the potential cost savings at Sea-Tac.

APPENDIX B

Parties Responsible for Airport Waste Management Decisions

Airport waste management is affected by four groups of decision makers at an airport:

1. Airport authority
2. Retail and restaurant tenants
3. Individual airlines
4. Flight catering services

Airport Authority

In the United States, airport authorities operate airports. Most airport authorities are created by states or counties. Depending on the airport, the authority may act only as a property manager—leasing terminal space and operating rights to concession tenants and airlines—or it may be more directly involved in the daily operation of the airport.

The airport authority is ultimately responsible for all activities that occur on the airport premises. The day-to-day waste management responsibility of airline and tenant areas is assigned through leases and contracts. For waste management, this usually means that the airport authority oversees waste management in terminal public areas and airport authority offices. At airports where one airline has a dominant share of traffic, the airline assumes responsibility for waste management in that terminal.

Retail and Restaurant Tenants

Retail shops and restaurants are typically run by private companies that lease space from the airport authority or from a management company contracted to manage concessions. In some cases, a single management company will obtain all the concession rights for an airport or at a single terminal, and then will either operate the concessions itself or sublet space to the individual shops and restaurants. For example, Oakland International Airport's concessions are run by Delaware North Travel Hospitality Services.[1]

Waste generated by concession tenants is sometimes managed by the airport authority's waste management contract and sometimes managed by the individual tenants or the concession management company. When the airport authority manages the disposal of tenant waste, the costs are either included as part of the lease fee or are billed independently as a utility service.

Even when the airport authority oversees waste disposal, tenants are usually responsible for taking the waste from the shop or restaurant to the outdoor Dumpster or compactor provided by the airport authority. In cases where the terminal has a single concession management company, that organization may arrange custodial services for all the shops and restaurants.

Individual Airlines

Airline waste consists of in-flight (airplane) waste and waste from airline offices, ticketing booths, and passenger gate areas. (Airlines also generate waste at hangars, maintenance facilities, and cargo operations, but those waste

streams are outside the scope of this study.) Generally, airplane waste is produced in two streams: food catering and cabin cleaning.

Food catering waste usually consists of waste collected after a food or beverage service. The waste is off-loaded by the flight catering service to a flight kitchen where it is disposed of.

Cabin cleaning waste is collected by flight attendants as they walk through the airplane between meals and by the cleaning crews or flight attendants that go through the plane between flights. Waste collected during the flight is stored in garbage bags in the galley, and then off-loaded by the cabin cleaning crews or provisioning agents (who restock the airplane with snacks and drinks) while the planes are on the ground. In cases in which the airline does not have its own waste management facilities, the flight kitchens may contract to remove all the waste from the airplane.

Flight Catering Services

Flight kitchens are usually located near airports, but not necessarily on airport premises, and may use waste management services different from those used by the airport or airline. Depending on the size of the airport, there may be one or several flight kitchens servicing the airport. Flight kitchen waste consists mostly of food preparation waste and waste removed from airplanes.[2]

Flight kitchens usually handle their own waste management separately from the airports, so they have not been included in this study. Additionally, as the share of passengers served by low-cost airlines (which do not use flight kitchens) increases, the percentage of passenger traffic serviced by flight kitchens will decline. The number of meals prepared for the U.S. airline market by LSG Sky Chefs, a prominent flight catering company, fell by more than half from 2000 to 2004, and the company has closed nearly a third of its U.S. kitchens.[3]

APPENDIX C

Project Methodology

Surveys

NRDC collected industry data and other information for this report through three surveys. One survey was circulated to airports, another was circulated to airlines, and a third was distributed to passengers to document their observations of waste management practices in-flight and in airports across the country.

NRDC collaborated with the American Association of Airport Executives (AAAE) and the Air Transport Association of America (ATA) to distribute surveys to U.S. airports and airlines and identify case study participants. The airlines and airports were asked to provide information on how they manage their waste disposal, how much waste they dispose of, how recycling programs are operated (where applicable), and what materials they recycle.

Response rates to the surveys were as follows:

The response rate to the airport survey among large airports was greater than 50 percent. The 30 airports responding to the survey account for 39 percent of passenger traffic in the United States.

Table 8 Airport Survey Responses

Airports ranked by size[a]	Survey responses	Total airports of this size in the industry	Response rate (percentage of total 2004 U.S. passengers represented)
Large hub	16	30	34%
Medium hub	7	37	5%
Small hub	4	72	0.5%
Non-hub	3	243	0.01%
Total	30		39%

a The FAA defines airports by size as follows: a large hub services >1 percent of total U.S. passenger boardings annually; a medium hub services 0.25 percent to—1 percent of total U.S. passenger boardings; a small hub services 0.05 percent to 0.25 percent of total U.S. passenger boardings; and non-hubs service more than 10,000 passenger boardings but less than 0.05 percent of total U.S. passenger boardings.[b]

b The Federal Aviation Administration (FAA), "Airport Categories," 01/26/06January 26, 2006. http://www.faa.gov/airports_airtraffic/airports/planning_capacity/passenger_allcargo_stats/categories/

Table 9 Passenger Observation Survey Responses

Number of flights observed	Number of airlines observed	Number of airports observed
76	16	38

AIRLINE SURVEY RESPONSES

The airline surveys were distributed by ATA to the members of the association's environmental committee. NRDC received responses from five major carriers that collectively represent 39 percent of U.S. airline passenger traffic.

Passenger surveys provided passenger observations of airport recycling programs and anecdotes from flight attendants about recycling in-flight waste.

Airport Profiles

In addition to the surveys, NRDC conducted a more in-depth investigation of seven large airports and three

medium airports. These investigations included interviews with airport recycling coordinators and site visits. In the course of these investigations, NRDC obtained insights into the logistics of the industry's waste management practices; a better understanding of the relationships among airport authorities, terminal tenants, and airline personnel; and suggestions for overcoming the challenges faced by airports implementing recycling programs.

NRDC visited seven airports: Oakland International Airport, Seattle-Tacoma International Airport, Portland International Airport, Los Angeles International Airport, Baltimore-Washington International Airport, Boston Logan International Airport, and Fort Lauderdale International Airport.

The three airports that were not visited but participated through phone interviews were Philadelphia International Airport, Port Columbus International Airport, and San Francisco International Airport.

Along with the generation of our own survey data, NRDC reviewed several recent studies that have examined the opportunities for recycling, and challenges faced, at the following airports and airlines: Portland International Airport,[1] Los Angeles International Airport,[2] Denver International Airport,[3] Toronto International Airport,[4] Vienna International Airport (Austria)[5], and Cathay Pacific Airways (based in Hong Kong).[6] These studies share similar descriptions of the challenges faced in implementing successful recycling programs.

A Method of Comparing Success

The amount of waste generated at an airport correlates with the number of passengers who travel through the airport. More passengers means more waste generated. Because the number of passengers (and hence the amount of waste generated) varies throughout the year, some airport managers track the total amount of waste generated at the airport and divide that by the total number of passengers at the airport to get a pounds per passenger estimate, which can be used to compare monthly waste management costs and savings achieved.

Similarly, because the number of passengers differs from airport to airport, the total amount of waste generated by a given airport in a year will be different from the amount generated at another airport. To allow comparisons between airports, the pounds per passenger estimate can be used to determine the average amount of waste generated per passenger throughout the industry, and to compare relative amounts of waste generated across different airports.

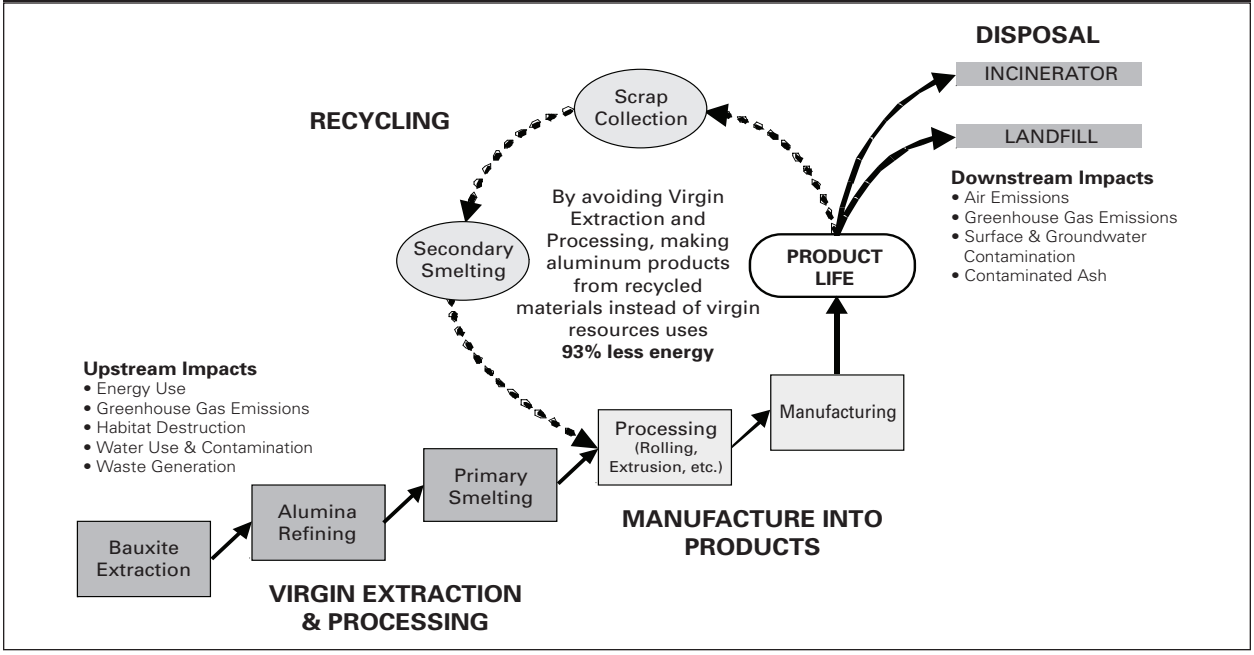
APPENDIX D

Environmental Benefits of Recycling

Recycling waste provides environmental advantages over relying on virgin resources for manufacturing or using landfills or incinerators for disposal. The products we use—and ultimately dispose of—share some common lifecycle stages:[1]

1. Extraction and processing of raw materials (or collection of post-consumer recycled materials);
2. Transport to processor;
3. Manufacture of materials into products;
4. Transportation of materials and products to markets;
5. Use by consumers; and
6. Waste treatment, disposal, or recycling.

Figure 10 Basic Lifecycle Diagram of Aluminum Products[4]



Source: NRDC, 2006. The diagram is based on a lifecycle diagram found in Martcheck, "The Importance of Recycling to the Environmental Profile of Metal Products," Alcoa, 2000.

Every stage of a product's lifecycle has environmental, energy, and greenhouse gas (GHG) impacts that can be mitigated by using already refined recycled products instead of unprocessed virgin resources.

With respect to a product's lifecycle, the benefits of recycling fall into two categories: upstream and downstream benefits. Upstream benefits include energy savings, emissions reductions, reduced water use, and habitat conservation achieved by avoiding raw material extraction. Downstream benefits include reductions in air emissions and water pollution achieved by not sending waste to a landfill or incinerator. Recycling materials avoids the need to deposit waste in landfills and also avoids the air emissions and ash disposal caused by incineration. Using recycled content in the manufacturing process also saves energy compared with burning the same material in waste-to-energy plants.[2]

Figure 10 illustrates the lifecycle of aluminum. Reprocessing recycled aluminum through secondary smelting requires 93 percent less energy than is needed to extract virgin bauxite, refine it, and perform primary smelting.[3]

Lifecycles for other materials (such as paper, glass, and plastic) have similar characteristics, although the technological processes and associated environmental impacts vary widely. For each of these materials, however, creating products from recovered materials reduces the overall environmental impacts associated with the lifecycle of the product.

Upstream Benefits: Energy Savings, Emissions Reductions, Resource Preservation

The U.S. Environmental Protection Agency (U.S. EPA) has calculated the energy and GHG emissions benefits of manufacturing products from recycled material. The avoided energy consumption and emissions from the extraction and primary manufacturing industries more than offsets the energy needed to collect, sort, and reprocess recycled waste. See Tables 10 and 11 for a list of energy and emissions benefits by material type.

Downstream Benefits: Avoided Water Contamination and Air Emissions

The downstream impacts of waste management involve the environmental damage incurred by sending materials to a landfill or incinerator. Landfills generate hazardous air emissions and threaten surface and groundwater supplies.[4]

Incinerators "generate a wide range of toxic air pollutants—including dioxins, furans, heavy metals such as mercury, cadmium, and lead, acid gases, and fine particles—as well as contaminated ash."[5] In addition, the substantial amounts of contaminated ash created by incineration still need to be disposed of in a landfill.

Table 10: U.S. EPA Energy and Material Recovery Rate Data[7]

	Energy Needed to Manufacture One Ton of Product (million Btu)							
	Virgin Manufacturing			Recycled Manufacturing				
Materials Recycled	Process Energy	Transport Energy	Total Energy	Process Energy	Transport Energy	Total Energy	Loss Rates for Recovered Materials[a]	Net Energy Saved by Recycling (mBtu)
Aluminum cans	205.80	7.47	213.27	14.85	0.40	15.25	7%	184.16
Steel	31.58	4.60	36.18	11.78	4.03	15.81	2%	19.96
Glass	6.49	0.58	7.07	4.32	0.34	4.66	12%	2.12
PET	32.82	N/A[b]	32.82	4.17	0.08	4.25	22%	22.28
Corrugated cardboard	25.13	1.31	26.44	11.73	0.80	12.53	7%	12.94
Newspaper	39.92	0.50	40.42	21.98	0.03	22.01	10%	16.57
Office paper	37.01	N/A	37.01	20.12	N/A	20.12	40%	10.13
Magazines	32.99	N/A	32.99	31.97	N/A	31.97	33%	0.68
Mixed paper (remade into boxboard)	32.26	1.79	34.05	22.53	0.01	22.54	33%	7.71

a When any material is recovered for recycling, some portion of the recovered material is unsuitable for use as a recycled input (e.g., contaminants may be present), and some portion of the material is lost in the remanufacturing process. Consequently, manufacturing one ton of new material generally requires an input of more than one ton of recovered materials. (Source: U.S. EPA, "Solid Waste Management and Greenhouse Gases," U.S. EPA, May 2002, p. 57.) Loss rates for recycled materials have been included in this table to enable calculation of net energy saved through recycling as opposed to landfilling or incineration. Loss rates for virgin materials are in nearly all cases much higher than those for recycled materials.

b N/A = transport energy for that material has been included in the process energy total.

Table 11 Energy and Emission Factors Used in Calculations

Materials Recycled	Energy Savings Per Ton Recycled			Greenhouse Gas Emission Reduction (Metric Tonnes of Carbon, MTCE)
	Reduction in Energy Use Compared with Virgin Recycling	Energy Saved (Million Btu)	Equivalent Energy in Barrels of Oil	
Aluminum cans	93%	184	31.8	4.12
Steel	56%	20	3.4	0.5
Glass	34%	2	0.4	0.09
PET	87%	22	3.8	0.43
Corrugated cardboard	53%	13	2.2	0.79
Newspaper	46%	17	2.9	0.74
Office paper	46%	10	1.7	1.3
Magazines	3%	1	0.1	0.62
Mixed paper remade into boxboard)	34%	8	1.3	0.78
Composting food waste	—	—	—	0.82
Composting mixed organics	—	—	—	0.32

Quite simply, recycling means less garbage going to landfills and incinerators, and consequently fewer air emissions and less water contamination.

Calculation Methodology

The energy and greenhouse gas emission calculations used in this report are based on data from the 2002 U.S. EPA report "Solid Waste Management and Greenhouse Gases: A Life-Cycle Assessment of Emissions and Sinks." The energy and emissions factors in the EPA's report are determined by comparing the amount of energy used (and emissions created) in the manufacture of a product from virgin material with the amount of energy needed (and emissions created) when manufacturing the same product from recycled materials. Also taken into account is the fact that for every ton of recyclables collected, contamination and collection inefficiencies mean not all of the collected material will be available for remanufacture.

APPENDIX E

Benefits of Recycling by Material Type

The benefits in the table below are based on the estimate that 1.28 pounds of waste per passenger is generated by domestic airline passengers throughout the U.S. The percentage of the industry waste stream allocated to each material is based on the waste composition estimates described in the introduction to this report. Benefits are calculated for each of three potential recycling rates: 25 percent, 50 percent, and 70 percent. For example, assuming that the total amount of waste generated per passenger is 1.28 pounds and that aluminum constitutes 1 percent of the waste generated by airports and airlines, achieving an industry-wide recycling rate of 25 percent for aluminum would result in a greenhouse gas emissions reduction of 4,378 tons annually, equated to the removal of 3,243 passenger cars from the road.

Potential Environmental Benefits Available Through Recycling in the U.S. Air Travel Industry

ALUMINUM CANS
% of waste stream: 1%
Estimated total tons disposed of in 2004: 4,250

	POTENTIAL RECYCLING RATES		
Benefits	**25%**	**50%**	**70%**
Energy Savings (mBtu) (Equivalent No. of Households' Annual Energy Use)	195,669 (1,800)	391,337 (3,600)	547,872 (5,040)
Greenhouse Gas Emission Reductions (Metric Tonnes) (Equivalent No. of Cars Removed From Road Yearly)	4,378 (3,243)	8,755 (6,485)	12,257 (9,079)
Contribution to Overall Recycling Rate at U.S. Airports	0.25%	0.50%	0.70%

NEWSPAPER
% of waste stream: 14%
Estimated total tons disposed of in 2004: 63,000

	POTENTIAL RECYCLING RATES		
Benefits	**25%**	**50%**	**70%**
Energy Savings (mBtu) (Equivalent No. of Households' Annual Energy Use)	246,825 (2,271)	493,651 (4,541)	691,111 (6,358)
Greenhouse Gas Emission Reductions (Metric Tonnes) (Equivalent No. of Cars Removed From Road Yearly)	11,008 (8,154)	22,015 (16,307)	30,821 (22,830)
Contribution to Overall Recycling Rate at U.S. Airports	3.50%	7.00%	9.80%

CARDBOARD
% of waste stream: 12%
Estimated total tons disposed of in 2004: 54,000

	POTENTIAL RECYCLING RATES		
Benefits	**25%**	**50%**	**70%**
Energy Savings (mBtu) (Equivalent No. of Households' Annual Energy Use)	164,938 (1,517)	329,876 (3,035)	461,826 (4,249)
Greenhouse Gas Emission Reductions (Metric Tonnes) (Equivalent No. of Cars Removed From Road Yearly)	10,073 (7,461)	20,145 (14,922)	28,203 (20,891)
Contribution to Overall Recycling Rate at U.S. Airports	3.00%	6.00%	8.40%

MAGAZINES, OFFICE AND MIXED PAPER
% of waste stream: 14%
Estimated total tons disposed of in 2004: 63,000

	POTENTIAL RECYCLING RATES		
Benefits	**25%**	**50%**	**70%**
Energy Savings (mBtu) (Equivalent No. of Households' Annual Energy Use)	224,655 (2,136)	449,311 (4,271)	763,828 (7,261)
Greenhouse Gas Emission Reductions (Metric Tonnes) (Equivalent No. of Cars Removed From Road Yearly)	15,452 (11,728)	31,085 (23,455)	52,844 (39,874)
Contribution to Overall Recycling Rate at U.S. Airports	3.50%	7.00%	12.00%

PET PLASTIC
% of waste stream: 2%
Estimated total tons disposed of in 2004: 9,000

	POTENTIAL RECYCLING RATES		
Benefits	**25%**	**50%**	**70%**
Energy Savings (mBtu) (Equivalent No. of Households' Annual Energy Use)	120,059 (1,141)	240,117 (2,282)	408,199 (3,880)
Greenhouse Gas Emission Reductions (Metric Tonnes) (Equivalent No. of Cars Removed From Road Yearly)	977 (737)	1,953 (1,474)	3,321 (2,506)
Contribution to Overall Recycling Rate at U.S. Airports	0.50%	1.00%	2.00%

GLASS
% of waste stream: 2%
Estimated total tons disposed of in 2004: 9,000

	POTENTIAL RECYCLING RATES		
Benefits	**25%**	**50%**	**70%**
Energy Savings (mBtu) (Equivalent No. of Households' Annual Energy Use)	5,969 (57)	11,938 (113)	20,294 (193)
Greenhouse Gas Emission Reductions (Metric Tonnes) (Equivalent No. of Cars Removed From Road Yearly)	195 (147)	390 (294)	663 (500)
Contribution to Overall Recycling Rate at U.S. Airports	0.50%	1.00%	1.70%

APPENDIX F

The Cost of Waste Management

The overall costs of waste management for an airport can be grouped into two categories: fixed equipment and transportation costs, and variable disposal costs based on tonnage.

Fixed Equipment and Transportation Costs

EQUIPMENT RENTAL OR PURCHASE COSTS

Compactors, open-top roll-off containers, front-load Dumpsters, and balers are purchased or leased from the waste hauling company.

HAULING COSTS

Hauling costs are charges to pick up a Dumpster or compacted waste and transport it to a landfill, incinerator, or recycling center. Waste haulers generally charge on a per-trip basis to cover their expenses, which include labor, fuel, insurance, and maintenance. A per-trip charge means there is a fixed charge associated with having a garbage container emptied regardless of how much material it contains. Contracts can be established to have the waste hauler pick up containers on an as-needed basis, but pick-ups are often established on a regular schedule—i.e., a container will be emptied daily, weekly or twice a week regardless of how full it is.

PERSONNEL/MANAGEMENT COSTS

Many airports operating recycling programs employ a dedicated part- or full-time program manager.

Variable Disposal Costs Based on Tonnage

LANDFILL OR INCINERATOR TIP FEE

A tip fee is the charge for disposing of waste at a landfill or incinerator. Generally this is charged on a per-ton basis.

RECYCLING PROCESSING FEE

This fee covers the cost of sorting the recyclables and finding a market for the recycled materials. In regions with a strong market for recycled materials, the processing fee may be lower than the local landfill or incinerator tip fee. If the demand for recyclables is strong, airports may receive revenue for their recyclable items instead of paying a processing fee. (For example, Seattle-Tacoma International Airport receives $40 per ton for scrap metal and $30 per ton for commingled recyclables, and does not pay a separate processing fee.[1])

REVENUE FROM RECYCLABLES

Manufacturers will pay recycling processors for recyclable materials. Airports with on-site sorting facilities may directly realize these revenues through selling their sorted and baled recyclables. However, in most cases, airports do not have an on-site sorting facility and instead use a recycling contractor to dispose of their recyclables. In these cases, any revenue the airport may receive for its recyclables will be less than revenues paid for presorted materials, as the hauler must recoup the cost of sorting the materials.

APPENDIX G

NRDC Survey Form

There were 30 responses to the NRDC airport survey. The respondents included more than 50 percent of the large airports in the United States and represented 39 percent of the total U.S. passenger traffic in 2004.

NRDC Airport / Airline Recycling Project—Airport Data Collection Survey

PART I: SURVEY RESPONDENT INFORMATION

Respondent Name:	Date:
Title:	Phone Number:
Street Address:	Fax:
	Email:

PART II: AIRPORT INFORMATION

Airport (official name):		
City:	State:	Zip Code:

PART III: GENERAL WASTE MANAGEMENT / RECYCLING INFORMATION

Airline Waste Disposal

5. Do the airlines manage their own waste disposal, or does the airport authority coordinate their waste disposal?

- ☐ Airlines Manage
- ☐ Airport Authority
- ☐ Other (please specify):

5b. If the airport authority manages waste disposal for the airlines, how is the cost passed through to them?

- ☐ Rolled into lease/landing fee
- ☐ Billed independently
- ☐ Other (please specify):

5c. Do the airlines manage their own recycling programs (if they have one), or does the airport authority?

- ☐ Airlines Manage
- ☐ Airport Authority
- ☐ N/A (no recycling)
- ☐ Other (please specify):

5d. If the airport authority **does not** manage waste disposal and/or recycling for the airlines, are there any waste management policies or requirements in the lease agreements / contracts that the airlines must abide by? *If yes, please explain:*	Y / N

Tenant / Concessions Waste Disposal

6. Do the concession tenants manage their own waste disposal, or does the airport authority coordinate their waste Disposal?

- ☐ Tenants Manage
- ☐ Airport Authority
- ☐ Other (please specify):

6b. If the airport authority manages waste disposal for the tenants, how is the cost passed through to them?

- ☐ Rolled into lease fee
- ☐ Billed independently
- ☐ Other (please specify):

6c. Do the concession tenants manage their own recycling programs (if they have one), or does the airport authority?

- ☐ Tenants Manage
- ☐ Airport Authority
- ☐ N/A (no recycling)
- ☐ Other (please specify):

6d. If the airport authority **does not** manage waste disposal and/or recycling for the tenants are there any waste management policies or requirements in the lease agreements / contracts that the tenants must abide by? *If yes, please explain:*	Y / N
7. Have any waste audits or waste characterization studies been done at your airport?	Y / N
8. Who is the contracted waste hauler for the airport authority:	

PART IV: SPECIFIC WASTE DATA

Please provide the information below which should be available from your waste disposal contractor. If it is easier, simply send or attach any waste tracking spreadsheets, or copies of waste removal receipts, you have to Peter Atkin via email, fax, or postal service.

9. How much solid waste do you dispose of annually in tons? *Only include municipal solid waste. Do not include materials separated for recycling, hazardous wastes or other controlled substances. **PLEASE SPECIFY WHICH YEAR THE DATA IS FOR _____*			
10. What is the cost for transportation and disposal of the waste in question 8? *(Either total amount, or per ton)*	*Disposal*	*Transport.*	***Total Cost***

10a. What other services are bundled in the costs listed in question 9?

- ☐ Compactor and Roll-off bin lease fees. *How many of each do you have:*
- ☐ Maintenance and service fees for the compactor & roll off bins
- ☐ Other services. Please explain:

11. Which of the following waste streams are included in the data you are providing? (check all that apply)

- ☐ Public Terminals
- ☐ Airport Administrative Offices
- ☐ Terminal Retail & Restaurant Concessions
- ☐ Airline Offices & Ticketing
- ☐ Airline De-Planed Waste
- ☐ Flight Kitchen Waste
- ☐ Airport Landscaping / Green waste
- ☐ Airport Support Services *(vehicle maintenance shops, carpentry shops, signs & graphics, etc)*
- ☐ Construction Waste

Other waste streams not listed:

PART V: RECYCLING PROGRAMS

12. Do any local, state or federal recycling regulations or incentives apply to your airport? *(ex. State or local requirement to recycle a certain percentage or waste, commercial recycling regulations, etc.) If so, what are the regulations?*	Y / N
13. Does the airport have a waste reduction program? *If so, please summarize the program:*	Y / N

14. Does the airport have a recycling program? *(If no, skip to question 24)*	Y / N

15. Which areas of the airport participate in the recycling program? *(check all that apply)*

- ☐ Public Terminals
- ☐ Airport Administrative Offices
- ☐ Terminal Retail & Restaurant Concessions
- ☐ Airline Offices & Ticketing
- ☐ Airline De-Planed Waste
- ☐ Flight Kitchen Waste
- ☐ Airport Landscaping / Green waste
- ☐ Airport Support Services (vehicle maintenance shops, carpentry shops, signs & graphics, etc)
- ☐ Construction Waste

Other:

16. What materials are recycled? *(check all that apply)*

- ☐ Office Paper
- ☐ Newspapers
- ☐ Cardboard
- ☐ Plastic Beverage Containers
- ☐ Other Plastics
- ☐ Aluminum
- ☐ Glass
- ☐ Aseptic Packaging (ex. juice boxes)
- ☐ Food waste & organics
- ☐ Green Waste (landscaping)
- ☐ Steel / Tin containers
- ☐ Scrap Metal
- ☐ Plastic Film
- ☐ Tires
- ☐ Construction Waste

Other Materials:

17. Please give a brief description of how the airport recycling program works (ex: who is responsible for the program, how are materials collected—are materials source separated or single stream, where are recycling bins located)

18. How does the airport manage cardboard from shops, restaurants and airplanes?

19. How do security regulations affect your recycling effort?

20. Do you have any staff or tenant incentives to promote recycling? If yes, please briefly describe how the incentive program works:	Y / N

21. Does the airport have any public education, outreach, or promotional programs associated with its recycling activities? (how do tenants & employees learn about recycling policies and opportunities?) *If yes, please explain:*	Y / N

22. Who is the airport authority's recycling contractor?

For the following question, as in part IV, if it is easier, simply send or attach any tracking spreadsheets, or recycling contractor receipts to Peter Atkin.

23. What amount of recyclables are collected annually in tons? What are the disposal and transportation costs? What revenue, if any, is generated from the recyclables? ***(please fill out any that apply)***
***PLEASE SPECIFY WHICH YEAR THE DATA IS FOR _____*

Recyclable	***Amount (tons)***	***Disposal Cost ($/ton)*** *(if any)*	***Transportation Cost ($/ton)*** *(if separate from disposal costs)*	***Revenue*** *(if any)*	***Avoided Disposal Cost*** *(if known)*
Commingled Recyclables:					
Office Paper:					
Newspaper:					
Cardboard:					
Glass:					
Aluminum:					
Plastic Beverage Containers:					
Other Plastics:					
Aseptic Packaging:					
Food Waste & Organics:					
Steel / Tin Containers:					
Scrap Metal:					
Plastic Film:					
Tires:					
Construction Waste:					
Total Recyclables:					

24. From your perspective, what are the biggest challenges to implementing a successful and comprehensive recycling program in the airport environment?

25. Are you interested in having your airport's experience written up as a case study?	Y / N
26. Would you like to receive a copy of our report when it is completed?	Y / N

THANK YOU FOR YOUR HELP!

Endnotes

Executive Summary

1 A Boeing 747-400 airplane includes 73.5 tons of high-strength aluminum.
http://www.boeing.com/commercial/747family/pf/pf_facts.html

2 In this case, "passenger" is used to mean passenger departures.

3 If the per passenger average is consistent industry-wide, 425,000 tons of waste were generated at U.S. airports in 2004. Combined, the largest 30 airports in the United States account for 70 percent of the air travel industry's waste generation.

4 In 2003, Americans generated 4.5 pounds of municipal solid waste per person per day. U.S. EPA, "Municipal Solid Waste: Basic Facts," 2005. http://www.epa.gov/epaoswer/non-hw/muncpl/facts.htm. City population data are from http://www.demographia.com/db-2000uscityr.htm, 2000.

5 U.S. EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2003," EPA530-F-05-003, April 2005.

Introduction

1 Eight additional airports provided total waste generation data—including areas outside the scope of this study such as construction, landscaping, and flight kitchen wastes—but did not report passenger-related waste separately.

2 The relative percentages are aggregated from quantitative survey responses from 10 airports, and corroborated by discussions with waste management experts at three major airports (Portland International, Baltimore-Washington International, and Fort Lauderdale International airports), as well as by waste audits done at Portland International Airport (2005) and Los Angeles International Airport (2002).

3 Conversation with Michael Orphanos, Southwest provisioning supervisor at Oakland International Airport, March 16, 2005.

4 The percentages and types of waste are based on waste audits performed at Los Angeles (LAX) and Portland International airports (PDX), and recycling data provided by San Francisco (SFO), Baltimore-Washington (BWI), and Fort Lauderdale (FLL) airports.

Chapter 1

1 The UK Sustainable Cities and Aviation Network, "Wastes Management," The UK Sustainable Cities and Aviation Network, 2000. http://www.scan-uk.mmu.ac.uk/

2 Source: NRDC 2006. Based on interviews with airport managers and on-site visits.

3 Source: NRDC 2006. Based on interviews with airport managers and on-site visits.

4 Conversation with Doug Holbrook, Sea-Tac manager of utilities and business management, July 12, 2005.

5 Conversation with Ralph Hill, landside operations manager, Oakland International Airport, July 28, 2005.

6 Conversation with Dan Roloff, Corporate Recycling Services, March 6, 2006.

7 Baltimore-Washington International Airport, Portland International Airport, Port Columbus International Airport, Pittsburgh International Airport, Dallas-Fort Worth International Airport, Denver International Airport, Bob Hope Airport (Burbank), Burlington International Airport, Cincinnati/Northern Kentucky International Airport, Colorado Springs Municipal Airport, Orlando International Airport, Phoenix Sky Harbor International Airport, Redding Municipal Airport, Reno-Tahoe International Airport, Lambert St. Louis International Airport, Tallahassee Regional Airport, Tampa International Airport, Quad City International Airport, Metropolitan Oakland International Airport.

8 Philadelphia International Airport, Roanoke Regional Airport, Lincoln Municipal Airport.

9 Los Angeles International Airport, Salt Lake City International Airport, Seattle-Tacoma International Airport, San Francisco International Airport, San Jose International Airport.

10 Boston Logan International Airport.

11 Fort Lauderdale International Airport.

12 Miami International Airport.

Chapter 2

1 As per the FAA 2004 "Passenger Boarding and All-Cargo Data" (November 8, 2005, http://www.faa.gov/arp/planning/stats), there were 627 million domestic air passengers in 2004. If each of those passengers generated 1.28 pounds of waste at U.S. airports, the total domestic passenger-related airport waste generation in 2004 was 802,560,000 pounds (401,280 tons). According to the FAA, an additional 67 million international passengers boarded planes at U.S. airports in 2004. Because international aircraft waste is treated separately due to USDA regulations (see Chapter 2), only the waste estimated to be generated by passengers in the terminals (as opposed to on the airplane) has been included in this calculation.

Of the 10 airports that provided data to NRDC about how much passenger-related waste they disposed of in 2004, only five provided data for terminal public areas, retail and restaurant tenants, and airlines. These five airports handle about 8 percent of U.S. passenger departures (FAA, "CY 2004 Passenger Boarding and All-Cargo Data"). Four other airports, which handle about 7 percent of U.S. passenger departures, reported waste disposal data for only the terminal public areas and retail and restaurant tenants, but not airplane waste. The average amount of waste generated at these airports was 0.68 pounds per passenger departure. These data suggest that airline waste accounts for about half of the total waste generated in airport terminals. (Eight additional airports provided total waste generation data including areas outside the scope of this study such as construction, landscaping, and flight kitchen wastes, but did not report passenger-related waste separately.)

Calculation: (627 million passengers * 1.28 lbs/passenger) + (67 million passengers * 0.68 lbs/passenger) = 424,060 tons.

2 NRDC 2006. Based on responses to the NRDC Airport Survey and interviews with airport managers.

3 FAA, "CY 2004 Passenger Boarding and All-Cargo Data," November 8, 2005. http://www.faa.gov/arp/planning/stats/

4 In 2003, Americans generated 4.5 pounds of municipal solid waste per person per day. U.S. EPA, "Municipal Solid Waste: Basic Facts," 2005. http://www.epa.gov/epaoswer/non-hw/muncpl/facts.htm. City population data is from: http://www.demographia.com/db-2000uscityr.htm, 2000.

5 The 31 percent recycling rate is for 2001. U.S. EPA, http://www.epa.gov.

6 The 30 responses to the NRDC airport survey included more than 50 percent of the large airports in the United States and represented 39 percent of the total U.S. passenger traffic in 2004.

7 Los Angeles International Airport, Oakland International Airport, Burlington International Airport, Reno-Tahoe International Airport.

8 Pittsburgh International Airport, Dallas-Fort Worth International Airport, Boston Logan International Airport, Bob Hope Burbank International Airport, Colorado Springs Municipal Airport, Miami International Airport, Orlando International Airport, Phoenix Sky Harbor International Airport, Redding Municipal Airport, Roanoke Regional Airport, Tampa International Airport.

9 Baltimore-Washington International Airport, Portland International Airport, Port Columbus International Airport, Salt Lake City International Airport, Denver International Airport, Seattle-Tacoma International Airport, San Francisco International Airport, Philadelphia International Airport, Lambert St. Louis International Airport, Tallahassee Regional Airport.

10 Los Angeles International Airport (LAX) reported a diversion rate of about 50 percent, but the program at LAX includes construction waste. Without construction waste, LAX's recycling rate is about 20 percent. San Francisco International Airport (SFO) also reported a recycling rate of 50 percent, but the SFO recycling program does not include airline waste.

11 This total is based on the average figure of 1.28 pounds of waste per passenger derived by the airport survey responses.

12 U.S. EPA, "Solid Waste Management and Greenhouse Gases," U.S. EPA, May 2002.

13 U.S. EPA, "Solid Waste Management and Greenhouse Gases," U.S. EPA, May 2002.

14 A Boeing 747-400 airplane includes 73.5 tons of high-strength aluminum.
http://www.boeing.com/commercial/747family/pf/pf_facts.html

15 City of Los Angeles Department of Public Works, "Best Practices Report 2000," p. 17.

16 "Solid Waste Price Index," *Solid Waste Digest,* March 1999.

17 Conversation with Don Duerr, president, Airport Recycling Specialists.

18 2004 fee data were collected through the NRDC airport survey, Waste Management Quotes, and City Solid Departments of Sanitation. Where no local data were available, the state average price was used from *Solid Waste Digest*'s "Solid Waste Price Index 1999" (adjusted to reflect the 6 percent increase in national solid waste disposal prices from 1999 to 2004 as cited in the National Solid Wastes Management Association's 2005 Tip Fee Survey, March 2005). The overall average was determined through a weighted average of local area tip fees and the percentage of overall passenger traffic at each airport.

19 In this case, "passenger" is used to mean passenger departures.

20 Conversation with Don Duerr and Andy Duerr, president and vice president of Airport Recycling Services, October 17, 2005.

21 Sea-Tac Airport Waste Reduction and Recycling Program, "Accomplishments for the Year 2004." Port of Seattle.

22 Conversation with Doug Holbrook, Sea-Tac manager of utilities and business management, July 12, 2005.

23 Conversation with Dan Roloff, Corporate Recycling Services, November 7, 2005.

24 Conversation with Richard Keller, Maryland Environmental Services, November 10, 2005.

25 Conversation with Ralph Hill, landside operations manager, Oakland International Airport, July 28, 2005.

26 The American Forest & Paper Association, "State Recycling Goals and Mandates," 2002, http://www.afandpa.org/Content/NavigationMenu/Environment_and_Recycling/Recycling/Recycling.htm

27 U.S. EPA, "Municipal Solid Waste Generation, Recycling, and Disposal in the United States: Facts and Figures for 2003." U.S. EPA.

28 Letter from the City of Portland's solid waste and recycling division to the airline station managers at Portland International Airport, July 2001.

29 Title 7 of the Code of Federal Regulations requires that all "...waste material derived in whole or in part from fruits, vegetables, meats, or other plant or animal material, and any other refuse of any character whatsoever that has been associated with any such material on board any means of conveyance, and including food scraps, table refuse, galley

refuse, food wrappers or packaging materials, and other waste material from stores, food preparation areas, passenger's or crew's quarters, dining rooms, or any other areas on means of conveyance" removed from aircrafts arriving from any airport outside the United States and Canada be "removed in tight, leak-proof receptacles under the direction of an Animal and Plant Health Inspection Service inspector to an approved facility for incineration, sterilization, or grinding into an approved sewage system." Cited from: Code of Federal Regulations, Title 7, Sec. 330.400. 7CFR330, pp. 415-418.

30 USDA Manual for Agricultural Clearance, 06/2005-01, pp. 3-1-4.

31 Bureau of Transportation Statistics, T-100 International Market, 2004.

32 The calculations for this table use the same information as Table 5.

Chapter 3

1 Based on responses to the NRDC Airline Survey and correspondence with airline personnel.

2 Bureau of Transportation Statistics, DOT T100 Segment Database, 2004.

3 Communication with Ralph Hill, Landside Operations Manager for Oakland Airport, July 28, 2005.

4 Communication with Art Lee, San Francisco International Airport, November 5, 2005.

5 Communication with Doug Holbrook, utilities manager, Seattle-Tacoma International Airport, July 12, 2005.

6 Conversation with James Anderson, general manager LSG SkyChefs at LAX, September 13, 2005.

7 Conversation with Michael Orphanos, provisioning supervisor for Southwest Airline at Oakland International Airport, March 16, 2005.

8 Communication with Doug Holbrook, utilities manager, Seattle-Tacoma International Airport, July 12, 2005.

Chapter 4

1 1999 Waste Generation Study, Unincorporated San Mateo County, December 13, 2000.

2 Conversation with Michael Orphanos, provisioning supervisor for Southwest Airlines at Oakland International Airport, March 16, 2005..

3 1999 Waste Generation Study, Unincorporated San Mateo County, December 13, 2000.

Conclusion

1 FAA forecast 2005-2016.

2 Based on an average of 1.28 pounds of waste generated per passenger.

3 Airports Council International—North America, "ACI-NA 2005 Airport Capital Development Needs," 2005.

Appendix A

1 CES is a consulting group based at Portland State University.

2 Ibid.

3 Sea-Tac Airport Recycling, Corporate Recycling Services, January 10, 2005.

4 Ibid.

5 Portland International Airport, Waste Audit, 2004.

Appendix B

1 Conversation with Ralph Hill, landslide operations manager for Oakland Airport, July 28, 2005, and from Pia Sarkar, "SFO all Ready For Gourmets," *San Francisco Chronicle,* December 15, 2005.

2 Peter Jones, *Flight Catering,* 2nd ed., Oxford: Elsevier, 2002.

3 James F. Peltz, "Decline of the In-Flight Meal Leaves Airline Caterers Hungry," *Los Angeles Times,* January 2, 2006.

Appendix C

1 Community Environmental Services has conducted and published the results of four waste characterization studies at Portland International Airport: February 2002, April 2003, October 2003, and January 2005.

2 Cascadia Consulting Group, Mary Loquvam Consulting, Sky Valley Associates, TerraStat Consulting, "LAX Waste Characterization and Quantification Study," Final Report, January 2002.

3 "Denver International Airport Integrated Waste Management Program," Final Report, November 2005.

4 J. Lynes, 1999, "An Examination of the Current Barriers to Effective Waste Reduction in the Airline Industry: A Case Study of Toronto's Lester B. Pearson International Airport," in the proceedings of the *Canadian Transportation Research Forum's Annual Conference*, Montreal, vol. II, pp. 815-829.

5 B. Malle-Bader and N. Pedoe, "Waste Management in the Air and on the Ground: An Ecology Model of Vienna International Airport," in N. Pedoe, D. Raper, and J. Holden, *Environmental Management at Airports—Liabilities and Social Responsibility Conference,* Manchester Airport, London: Thomas Telford, 1995.

6 X.D. Li, C.S. Poon, S.C. Lee, S.S. Chung, F. Luk, "Waste Reduction and Recycling Strategies for the In-Flight Services in the Airline Industry," in *Resources Conservation & Recycling* 37 (2003), pp. 87–99.

Appendix D

1 U.S. EPA, "Solid Waste Management and Greenhouse Gases: A Lifecycle Assessment of Emissions and Sinks," May 2002, p. ES-3.

2 U.S. EPA, "Solid Waste Management and Greenhouse Gases: A Lifecycle Assessment of Emissions and Sinks," May 2002, p. 136.

3 U.S. EPA, "Solid Waste Management and Greenhouse Gases," May 2002.

4 Allen Hershkowitz, "Too Good to Throw Away: Recycling's Proven Record," (New York: Natural Resources Defense Council, 1997), p. 27.

5 Allen Hershkowitz, "Too Good to Throw Away: Recycling's Proven Record," (New York: Natural Resources Defense Council, 1997), p. 38.

Appendix F

1 Conversation with Dan Roloff, Corporate Recycling Services, November 7, 2005.