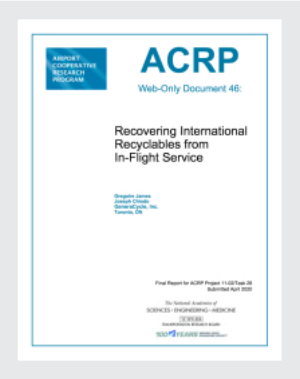

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Recovering International Recyclables from In-Flight Service

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Final Report for ACRP Project 11-02/Task 28
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Cooperating Airports

Australia	Melbourne Airport (MEL)
Brazil	São Paulo–Guarulhos International Airport (GRU)
Canada	Billy Bishop Toronto City Airport (YTZ)
	Toronto Pearson International Airport (YYZ)
	Montréal Pierre Elliott Trudeau International Airport (YUL)
	Calgary International Airport (YYC)
	Vancouver International Airport (YVR)
China	Beijing Capital International Airport (PEK)
	Shanghai Pudong International Airport (PVG)
Fiji	Riga International Airport (RIX)
France	Charles de Gaulle Airport (CDG)
Germany	Frankfurt Airport (FRA)
	Munich Airport (MUN)
Hong Kong	Hong Kong International Airport (HKG)
Iceland	Keflavík International Airport (KEF)
Indonesia	Ngurah Rai International Airport (DPS)
	Soekarno-Hatta International Airport (CGK)
Italy	Leonardo da Vinci–Fiumicino Airport (FCO)
Japan	Tokyo Narita International Airport (NRT)
	Itami Airport Osaka International Airport (ITM)
Malaysia	Kuala Lumpur International Airport (KUL)
The Netherlands	Schipol Airport (AMS)
Thailand	Suvarnabhumi Airport (BKK)
Portugal	Lisbon Portela Airport (LIS)
Singapore	Singapore Changi Airport (SIN)
South Korea	Incheon International Airport (ICN)
Spain	Adolfo Suárez Madrid–Barajas Airport (MAD)
Switzerland	Zurich Airport (ZRH)
United Arab Emirates	Dubai International Airport (DXB)
United Kingdom	London Gatwick Airport (LGW)
	London Heathrow Airport (LHR)
United States	Hartsfield-Jackson Atlanta International Airport (ATL)
	John F. Kennedy International Airport (JFK)
	Las Vegas McCarran International Airport (LAS)
	Los Angeles International Airport (LAX)
	Newark Liberty International Airport (EWR)
	O'Hare International Airport (ORD)
	Orlando International Airport (MCO)
	Orlando Sanford International Airport (SFB)
	San Francisco International Airport (SFO)
	Seattle-Tacoma International Airport (SEA)
	Ted Stevens Anchorage International Airport (ANC)

Airlines

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Canada	Air Transat, Porter Airlines, WestJet
Germany	Lufthansa
Hong Kong	Cathay Pacific Airlines
India	Air India
Indonesia	Garuda Indonesia
Japan	All Nippon Airways
Malaysia	AirAsia
New Zealand	Air New Zealand
Qatar	Qatar Airlines
South Korea	Korean Air
Spain	Iberia Airlines
Thailand	Thai Airways
The Netherlands	TUI Airways, KLM Royal Dutch Airlines
United Arab Emirates	Emirates Airline
United Kingdom	British Airways, Virgin Atlantic
United States	American Airlines, Delta Air Lines, United Airlines

Airport Services

Germany - Fraport AG
Indonesia - Angkasa Pura

Airline Catering Kitchens

Cathay Pacific Catering Services
Emirates Flight Catering
Gate Gourmet
LSG Sky Chefs
Thai Catering

Aviation Industry Associations

Airports Council International (ACI)
International Air Transport Association (IATA)

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Summary

Introduction

The United States Department of Agriculture (USDA) mandates that regulated (i.e., international) waste or 'International Recyclables from In-Flight Service' (IRIFS) can be handled only by a person or business with a compliance agreement with the USDA Animal and Plant Health Inspection Service (APHIS). In general, waste from arriving international flights is disposed of by incineration, sterilization, or grinding into an approved sewage system. The USDA APHIS Recycling Material Exemption identifies situations in which materials can be recycled. However, in most cases, these materials are still disposed of rather than recycled. Similar global practices are prescribed in most airports around the world. The Airport Cooperative Research Program identified that research was needed to uncover opportunities for increasing the share of international waste that is recycled.

When exposed to certain foods or fluids, recyclables arriving on international flights are required to be quarantined due to potential contaminants. As a result, almost every country worldwide prescribes sterilization, incineration, or other disposal methods for these contaminated recyclables. Recovery, and the eventual recycling of IRIFS, is a practice that is generally permitted if items are kept isolated from contamination by defined food or food items. Adherence to specific protocols is also mandatory to ensure recyclables are recovered under certain conditions, and these 'Non-Contaminated Recyclable Materials' (NCRM) may be recovered and recycled in most markets around the world.

A limited number of airports and airlines are engaged in NCRM collection, although even fewer are able to generate revenue streams from this source. Limited international cooperation on the process of recycling contributes significantly to the lack of recovery in the aviation industry. The aviation industry is a closed and controlled ecosystem of procurement, consumption, and disposal, and opportunities exist for the streamlining of extracting NCRM from international in-flight service. Advanced recovery of NCRM could yield greater sustainability and increased profit centers for airport operators.

The existence of environmental support mechanisms within the aviation industry indicates that there is a desire to reduce the industry's carbon footprint. However, since recycling contributes to only a small part of the reduction of that footprint, it receives a commensurately low amount of attention. The leading environmental initiative is the reduction of emissions (European Union 2016). Recycling could also contribute to the reduction of carbon, as recycling aluminum does bring with it carbon reduction (Aluminum Association 2018). These savings, however, have not yet been considered in comparison to the reduction of GHGs from fuel burn savings.

Findings

The aviation industry often cites policy limits as the primary reason for why extracting NCRM from IRIFS does not occur. Findings show, however, that NCRM recovery is occurring at some airports despite apparent policy restrictions.

Complications do arise where airports are unaware of what types of NCRM are expected from arriving airlines. Airlines, after all, are solely responsible for their supply and collection chains curated through internal procurement strategies.

A higher NCRM recovery rate was found in countries where policies mandated in-flight separation before landing. Where policies have been harmonized across previously international borders, such as in the European Union (EU), a higher rate of extraction of NCRM was found.

More astute handling practices generally increase the recovery of recyclables from international in-flight service. Findings suggest supply chains, advanced stakeholder engagement, value chain collaboration, and a globally standardized and adopted approach may be needed to increase NCRM recovery.

Given the complexity of logistics and waste streams, along with the potential for contamination, the requirement for sterilization and incineration is understandable. Yet, despite these complexities and requirements, recycling from international flights is still permitted and can be carried out when items are shown to have no evidence of being exposed to quarantined items.

Some Airports, Airlines and Flight Kitchens (AAFKs) limit recovery of NCRM entirely, not due to the policy limiting the process, but due to the concern of associated fines if recovery is not carried out correctly. In some countries where an absence of a policy restricting NCRM recovery was found, the recycling of NCRM still did not take place.

The monetary value that comes from the collection and eventual recycling of NCRM could offer untapped revenue for airport operators. This value is two-fold; firstly, income from the sale of recyclables and secondly, from the reduction of the volume of Quarantined Waste and the mitigation of its costs of handling. Airport operators can also achieve an environmental milestone through the shaping of the narrative around the issue of waste.

Overall, the key finding of this research is that, with a multi-stakeholder approach, airports, airlines, and flight kitchens, along with support partners, can affect the recovery efficiency of NCRM. Through these collaborative efforts, gaps in supply and collection chains can be addressed. While not yet realized, the development of a standardized procurement strategy within the industry could provide further bridging of the gaps as needed to achieve increased sustainability, reduced cost, and increased operational efficiencies.

Conclusion and Recommendations

Airports have a symbiotic relationship with airlines, each providing value to the other for seamless operation and movement of passengers. However, these parties often utilize separate waste services and manage QW separately. QW from both parties must be quarantined when contaminated. For airlines, it is the international waste and recycling from in-flight service from passengers, and for airports, it is the waste disposed from within terminal buildings generated by these same international passengers.

Both NCRM and QW arise from the reliance on single-use lightweight materials. These materials help ensure passengers can be served in a sterile way and minimize payload weight and, in turn, fuel consumption. Conversely, heavier items with increased recovery potential would contribute to added fuel consumption.

A global review of the aviation industry highlighted only a limited number of airports and airlines who engaged in NCRM collection. NCRM recovery was not necessarily attributed to policy or limitations of the in-place regulations. Generally, increased handling costs, lack of source separation, risk or fear of fines, gaps in stakeholder engagement, lack of perceived return on investment (ROI), and the absence of a globally integrated solution all contributed to the limited diversion of NCRM.

Findings suggest inbound airlines often do not have the local expertise necessary to recover and integrate materials back into the local economy in which they arrive.

Conversely, airport operators have the expertise and access to the assets which could aid airlines to achieve NCRM recovery.

The potential to increase airport revenue could be created by offering specialized programs to inbound airlines. These programs could reallocate existing airline waste expenditures, and additionally, the costs associated with these programs through the monetization of the materials recovered.

Overall, these programs could provide added value to the aviation industry and the environment as a whole. Airport operators could develop improved programs given their land-based operations coupled with

partnerships with local service providers. With an increasingly aware flying public and the lack of recovery programs, the need for increased levels of program delivery becomes even more necessary.

The aviation industry has shown promise by being able to deliver solutions as a unified entity with sustainable aviation fuels as an example despite the increased costs of these types of fuels.

To monetize NCRM, airport operators could:

- Work with airlines to develop a plan for enhanced recycling programs to ensure NCRM is separated on-board and eventually collected and processed on the ground;
- Develop a monetization strategy to engage supply and collection stakeholders to decrease the overall handling costs and increase process efficiency;
- Initiate collaboration projects with other airports to demonstrate a standardized basis for collecting and diverting these materials across the airport chain;
- Expand revenue streams for NCRM recovery in conjunction with stakeholders; and
- Work with airline and airport associations to increase awareness of improved collection opportunities and strategies.

CHAPTER 1 – INTRODUCTION AND BACKGROUND

International air travel continues to grow, and along with it, the quantities of foreign waste from in-flight service. Airlines and airports have efforts in place to manage and reduce waste from these activities; however, the extraction and eventual recycling of recyclables from international in-flight service are often overlooked.

Policies and protocols for the handling of waste from international flights are developed to prevent contamination of flora and fauna of the recipient country, which becomes responsible for handling the waste. Despite these potential threats from waste, the occurrence of contamination from these sources is not well documented.

A low or non-existent contamination rate may be due to a host of reasons, including the stringent handling and processing prescribed methods. These may include incineration, steam sterilization, and disposal in approved landfills to ensure the protection of host countries from potential disease and infestations.

Global findings suggest that the recycling of international waste from in-flight service still occurs despite perceived policy constraints or threats of disease. In general, the higher the attention and importance placed on recycling, the higher the recovery rates. Yet, when compared to other airline environmental initiatives, recycling appears to have a lower priority compared to Greenhouse Gas (GHG) reduction. The USDA APHIS Recycling Material Exemption provides for clear direction on exemptions (USDA 2016) on how the aviation industry and its operators can handle these NCRM.

Findings also suggest that the recovery of NCRM is more advanced in settings that already have stringent domestic recycling programs in place. Operational success in one area encourages emulation for international recovery efforts.

In general, the production of QW or lack of NCRM recovery results from the absence of globally accepted practices; contamination of recyclable materials in-flight; limited stakeholder engagement; and increasingly complex material streams. Addressing these issues would help decrease QW production.

In some cases, a policy may restrict NCRM handling from being separated, collected, or recycled, and stakeholders' perceptions of these policies may have shaped how airlines choose to handle recycling from international flights.

Further findings suggest that in some markets, policies do promote NCRM recovery. For example, in instances where stakeholders worked with a unified collection strategy, a more significant potential in improving recovery was uncovered.

Existing QW handling methods minimize the risk of pathways for invasive pests and pathogens. These practices stem from ensuring protection of national economies and industries from contamination.

To ensure contamination prevention, QW is removed from inbound international aircraft, and either sent for incineration or steam sterilization before being transported to a local landfill.

To minimize the risk of entry of pests and pathogens into the U.S., Customs and Border Protection (CBP) negotiates compliance agreements for handlers and ensures protection of the country.

Compliance agreements issued by CBP authorize haulers, cleaners, and handlers to manage the collection and movement of this waste. The CBP or USDA also ensures the regulation of processing facilities with compliance agreements.

1.1 Regulated Garbage

Regulated garbage is the term used to describe waste that arrives and remains in the U.S. from other countries. The USDA APHIS Recycling Material Exemption defines regulated garbage as unconsumed fresh fruit, vegetables, meat or other plant or animal material, and other refuse of any character whatsoever that has been associated or exposed to any such material.

The following is the regulation on the policy definition of regulated garbage extracted from Title 7 Code of Federal Regulations 330.400 - 330.403 and Title 9 Code of Federal Regulations 94.5, regulated garbage is not allowed to be imported, except from Canada (last modified Aug 20, 2018):

> *1. Regulated Garbage (Foreign Food Waste) includes, but is not limited to, food scraps, table refuse, food wrappers or packaging materials and other waste material from stores, food preparation areas, crews' or passengers' quarters and from aircraft or ships generated during international travel. Regulated Garbage also means meals and other foods that were available for consumption by passengers or crew on an aircraft but were not consumed. Plastic disks or plastic waste contaminated with foreign source food and garbage will be managed as Regulated Garbage (U.S. Navy).*
>
> *2. According to 9 CFR 94.5, regulated garbage is defined as "All waste materials that is derived in whole or in part from fruits, vegetables, meats or other plant or animal (including poultry) material, any other character of refuse whatsoever that has been associated with any such material" (U.S. Code of Federal Regulations).*
>
> *3. Additionally, 9 CFR 94.5 (c) (2) states "Garbage on or removed from a means of conveyance is regulated garbage, if, when the garbage is on or removed from the means of conveyance, the means of conveyance has been in any port outside the United States and Canada within the previous 2-year period" (USDA, APHIS 1998)*.

Industry Storage Guidance (FAA)

Section 121.577 of the U.S. Federal Aviation Regulations (FAR) prohibits an airline from movement while on the surface, taking off, or landing with any lose items not adequately stowed following FAR Section 121.589 (FAA 1994). These regulations do affect where airlines can store specific items during movements on the ground and throughout critical phases of flight. The FAR may impede recyclable collection if the storage of cans is left unsecured during critical stages of flight. Having these cans in the galley, for example, could affect an evacuation or pose a safety issue during heavy braking upon landing. These storage guidelines sometimes limit the ability of cabin crews to separate and store recyclables.

Chapter 33 of the FAA Cabin Safety and Flight Attendant Management, Section 6 Safety Assurance System, addresses additional storage options. It stipulates that if a receptacle in the cabin of the airplane, including the lavatory, is intended for the stowage of carry-on baggage, cargo, or trash; it must meet structural, restraint, and fire containment requirements to ensure flight, ground, and emergency landing load conditions (FAA 2018).

U.S. Policy & Regulations

U.S. policy and regulations, as noted by the objective of the study, indicate recycling may occur in a controlled environment.

Non-U.S. Laws/Practices

The goal of non-U.S. laws and practices is to maintain the separation of recyclables from specific food items. There are distinctions and similarities in policies from around the world, which dictate how materials can be handled. These policies are rooted in avoidance of certain foods being comingled with QW, rather than an overarching exclusion of recycling entirely.

1.2 Quarantined Waste (QW) and NCRM

The term Quarantined Waste is defined as:

> *all waste material derived in whole or in part from fruits, vegetables, meats, or other plant or animal (including poultry) material, and 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, passengers' or crews' quarters, dining rooms, or any other areas on means of conveyance. For purposes of this part, garbage also means meals and other food that were available for consumption by passengers and crew on an aircraft but were not consumed (U.S. 2014).*

For the Primer, regulated garbage will be referred to as QW. In general, QW originates from an area with different policies and regulations from the port in which it is offloaded, disposed of, or handled. With the identification of waste or recyclables as QW, the extraction of recyclables cannot occur due to possible contamination. Items from international in-flight service that are not contaminated and thus, and whose recycling is permitted will be referred to as NCRM.

1.3 History

Contamination of IRIFS can arise from certain foods and pests or pathogens from those foods. These potentially invasive species are non-native and may cause environmental harm to plant and animal life, including risk to humans in the receiving country.

Often, disruption to native flora and fauna can occur if invasive species are left to spread uncontrollably in a host country. These disruptions could hypothetically cause environmental and economic damage. In the event contamination occurs and requires rectification with high financial or other investments, their reversal may not be feasible. Therefore, protecting national borders against pests and pathogens becomes a necessary goal. However, protecting against biological invasions is difficult because those whose actions result in invasions, (in the case of this report, airlines or their related supply or collection mechanism for example) would seldom bear legal responsibility (Perrings et al. 2005).

Quarantine practices can be traced as far back as 1347-1352 during the Black Death plague epidemic, where the plague was spread by sailors, vermin and cargo arriving in Sicily (Mafart and Perret 1998). By the middle of the nineteenth century, scientists and health administrators began to reach consensus around the need for sanitary conditions for diseases such as cholera (Tognotti 2013). Thus, restructuring of international regulations was formed and approved by a number of International Sanitary Conferences (Howard-Jones 1975). The basis of the conferences played a significant role in the formation of the World Health Organization in 1948 (WHO 2018).

In the U.S., for more than 100 years, the Department of Agriculture has been developing and enforcing agricultural regulations to prevent harmful insects and microorganisms from entering the country. Currently, the USDA's APHIS heads up this effort. APHIS was established in 1972 (USDA, APHIS 2015).

The USDA's first task involved the livestock industry. Bans were placed on U.S. meat exports, affecting the sale of these products in European markets. Therefore, attention was required to be paid to the development of practices for the control of diseases (USDA, APHIS 2012).

1.3.1 Ship Industry

Maritime transport played a significant role in the development of current global QW and NCRM protocols. The historical reference of incidences also highlights the link of how policies may have been based on risk mitigation. There also appears to be a historical connection between early ship practices and the policies on which QW handling procedures are based.

The International Convention for the Prevention of Pollution from Ships is also a significant influencer of environmental protocols. Established in 1973, and later amended in 1978, it is an international agreement on how ships can minimize pollution both from accidents and routine operations (IMO 2018a). The shipping industry has always played a significant role in the global movement of people and goods. In the late 1960s, however, and with the advent of jet propulsion, air transport soon became the primary choice for many.

The International Marine Organization (IMO) is one such group that originally focused on waste at ports. Most of their efforts today, however, are rooted in reducing garbage being discharged at sea (IMO 2018b).

1.3.2 Aviation Industry

It was not until the 27th World Health Assembly in 1974 that the then Director-General of the World Health Organization, Dr. Halfdan Mahler professed the need for responsibility for the proper handling of waste from international traffic (WHO 2009). Also, in that year, with air traffic hovering around 420 million passengers (World Bank 2018), and in light of future expected growth, the need was identified to ensure the safety of food, water, and the waste derived from the increased activity of international travel.

The outcome of these activities produced the second edition of the Guide to Hygiene and Sanitation in Aviation in 1977 (WHO 2009). Thus, waste disposal practices would have to ensure the protection of public health while not breaching the high standards of hygiene (WHO 2009).

Stakeholders in transportation management were identified and recommended to work with health authorities giving guidance on what was to become recommendation WHA27.46 aimed at improving the safety of waste handling practices (WHA 1974). Then, the International Health Regulations (2005) were implemented and became a legally binding agreement for all 192 WHO Member States. These regulations revolved around reducing the spread of disease through international ports. The agreement also provided guidance on ensuring health protection measures would be undertaken in the event of an outbreak.

1.4 Airports and Recycling

1.4.1 NCRM Collection

Limited examples were found of airport operators who managed NCRM recovery. These examples include airports in Germany, Japan, and the Netherlands, which all demonstrated some form of separation and collection of NCRM. Conversely, airports in countries such as the U.S., Canada, and Australia mostly incinerated recyclables entirely and, in Australia’s case, even unconsumed aluminum-contained beverage products were destroyed.

ACI, a non-profit organization representing the world's airport operators, has consistently cited waste management and recycling programs as the key to being responsible members of an integrated community. ACI has demonstrated support for domestic collection programs, and these local programs ensure recyclables are diverted from landfill.

The Eco Airport Toolkit, published by the International Civil Aviation Organization (ICAO), also indicates that successful airport waste management implementation has the potential to positively impact airport authorities, customers, and the surrounding community at large (ICAO 2018).

Recycling typically brings with it reduced waste and reduced handling costs as well as increased environmental benefit. In a survey conducted by Keep America Beautiful, the top two reasons why people recycle are to reduce the amount of waste to landfill (51%) and to conserve Earth’s resources (43%). The same study also points to the increasing trend that 68% of millennials prefer to buy consumables from companies that use packaging that can be recycled (Keep America Beautiful 2016).

Recycling program adoption has been shown to stem from behaviors rooted in a number of human factors including from the mitigation of guilt to private values and social norms (Viscusi et al. 2011). Increased

personal interest in recycling may also be associated with the emotion or reaction to a feeling or obligation to compensate for a person's perceived causing of environmental damage (Baumeister 1998).

In our global review of Airlines, AAFK, it was found that 88% of stakeholders were interested in collaborating to find a more workable solution for the recovery of NCRM. Stakeholders also have the ability, through access to both intellectual capital and resources, to reach these goals given their experience in the management of complex issues.

Airline NCRM is essentially the sum of its proactive actions given the procurement, consumption, and collection from their activities. Airport NCRM from its international terminal operations is also typically quarantined as it falls under the same policies regulating IRIFS. This waste includes international passengers' discarded material after deplaning. Thus, recovering international recyclables from airports and in-flight service is potentially a controllable process given that it is contained within a closed and controlled airport setting.

Airport buildings have limited space, which is occupied by tenants at a cost, and allocating non-revenue-generating space to waste handling may not be feasible. Managing waste typically functions as an off-site managed process. Similarly, on-site facilities for waste and recycling are rare. One such example, however, is Gatwick Airport (LGW), in the UK, which has demonstrated how the shift to on-site management of materials can work. Future airport developments are now also incorporating the inclusion of on-site source separation of materials. London Heathrow (LHR) is also spearheading advanced recycling programs through the utilization of technologies processing plastics on-site.

In the case of LGW, collection and transportation mechanisms generally in place to haul these materials away from airports are avoided due to on-site processing. This airport processes waste into energy and reduces the environmental load associated with the disposal while increasing the sustainability footprint of these airports.

In spearheading programs like this, airport operators can affect more control on the variables lost when relegating the management of waste to third parties.

Waste reduction can help airport operators increase their revenue generation, and offset operational costs associated with handling when reducing their dependence on waste management companies to process their recyclables off-site.

Airport buildings may be spread out across thousands of acres, often serving different needs. Since the movement of nonessential ground vehicles is discouraged, recycling efforts involving increased logistics along with increased truck movements may not be feasible from many of these satellite buildings. These factors, as well as cost, were cited by airports that did not have elevated recycling programs and mentioned challenges such as servicing waste programs for remote buildings due to proximity, traffic constraints, and cost.

To ensure efficient waste management, airports typically contract multiple providers to service buildings. Market volatility coupled with reduced commodity prices for recyclables may limit recycling program development. Complex material streams within single-stream collection programs may increase contamination incidences and ultimately increase the cost associated with separating recyclables. Material complexity or conversely, the lack of a homogenized waste stream, limits the extraction of value and may restrict airport participation.

To extract greater value from recycling, guidelines for airports include investing in recycling infrastructure to allow for increased participation. Some airports, however, do not yet focus on these initiatives because such initiatives do not currently have high ROIs. To handle NCRM, airports would need to develop a separate collection mechanism to allow for handling and recapture. This added infrastructure would aid their workforce in separating materials. NCRM items intended for single-use do not typically have value and therefore are discarded.

Airports NCRM programs are limited as they would need to earmark increased areas for its handling. Airports and their stakeholders have concerns about penalties that come with quarantine violations and therefore avoid handling them. The risk versus reward in this instance often acts as a hindrance to increased NCRM extraction and QW handling.

If any recyclables come into contact with quarantined items, they, in effect, become QW and thus, need to be treated as such. In some cases, even if recyclables are only suspected of having been exposed to QW, they need to be treated accordingly. Given their size, airports face challenges in delivering a concerted collection effort of NCRM. According to senior staff at numerous airlines and airports, since international airlines do not budget additional resources for the increased activity to handle NCRM, these materials are often discarded. Given the costs of waste services, airports have found challenges in allocating more resources to these types of added functions. Some airports do take an active role in creating working groups with airlines; other airports have a range of difficulties in espousing a platform to support increased needs for waste and recycling storage. Airports are pursuing sustainability at a feverish pace as both internal and external interest in sustainability programs has increased. Airport and airline executives typically allocate resources to programs demonstrating bottom-line benefits.

Airports, like airlines, manage a host of environmental issues outside of recycling. Most are focused on delivering sustainability balance, including wildlife hazards, greenhouse gas management, air quality, de-icing, and noise management, among others. Sustainability issues typically require an operational cost to implement correctly, and unless programs generate revenue or save money, these efforts may likely develop slowly.

1.5 Pest and Pathogens

Pathogen Pathway Analysis as defined by the USDA is an evaluation of the entire process from start to finish that examines the risk of adverse effects within a population and models specific combinations of pathogens and products.

1.5.1 ISPM 11

Pest Risk Analyses (PRA) are conducted by APHIS in line with the International Standard for Phytosanitary Measures No. 11 (Secretariat, International Plant Protection Convention 2016) in conjunction with the Food and Agriculture Organization of the United Nations (FAO).

1.5.2 Pathways

APHIS has identified QW as a pathway to potentially contain threatening unknown pest and pathogens. ISPM 11 also describes pathways through natural spread, packing material, mail, garbage, and passenger baggage etc. These pathways could deliver pests and could risk native flora and fauna and along with it, economic repercussions to the U.S. economy.

1.5.3 Review

Multiple agencies were engaged and consistent evidence was found that policies were based on risk minimization versus specific research. These findings were supported by interviews with governmental bodies. This led to the conclusion that policies were not based on specific case studies. It was also found that policies were focused on reducing or eliminating potential threats of diseases rather than remedies, specific issues, causes and/or effects. Discussions with the Canadian Food Inspection Agency (CFIA) and APHIS also confirmed this conclusion.

1.5.4 Pathway Analysis

The USDA APHIS analyzes present, future, and emerging threats to animal health to estimate the likelihood of a damaging event, and to determine potential pathways of introduction and spread. (USDA, APHIS 2018)

APHIS uses data to provide epidemiological assessments of issues affecting animal health. These assessments form the basis

1.5.5 PRA

Pest Risk Assessments are divided into three broad steps and, as per ISPM 11, they include the following assessments: categorization of the pest; probability of pest introduction and spread; and potential for economic and environmental impacts.

The above ensures phytosanitary protocols with regard to pests and pathogens. Invasions by non-indigenous species pose a problem of increasing magnitude and threaten the stability of ecosystems and their economies. Despite the potential enormity of this problem, relatively little is known about the importance of various invasion pathways (Liebhold et al. 2006).

CHAPTER 2 – INDUSTRY PRACTICES

Airline operations are highly complex and provide a seamless global mode of transportation; however, the industry itself is subject to uncertainties. Disruption for a scheduled or even an unscheduled airline can occur. Daily, the traveling public numbers in the millions, with some carriers reaching a few hundred thousand each day. IATA currently forecasts 4.358 billion travelers per year (IATA 2018).

NCRM Recovery Practice

NCRM recovery was mostly handled by airlines and not airports, although airports can get involved. Airlines reviewed displayed either a low, medium, or high adherence to on-board recycling and separation. Cabin crews on flights which demonstrated little to no NCRM recovery also had little evidence of corporate guidelines on the topic. On flights displaying medium adherence, corporate direction was evident, although not consistently amongst crews reviewed on the same flight.

Airlines reviewed, which had high adherence to NCRM recovery, displayed both a consistent and significant knowledge of separation techniques. These airlines also had the highest self-reported diversion rates. Notably, these airlines operated from airports where collecting NCRM was mandated by law or had programs originated at an airline base.

2.1 On-board Practices and Ground Operations

On-board sorting and ground operations teams were both found to be necessary to ensure NCRM recovery. Without on-board in-flight sorting, ground operators interviewed were not permitted to extract recyclables from quarantine items. Handling support was essential to ensure the continued isolation and ultimate recovery of NCRM on the ground.

On-board practices and ground operations were, therefore, significant factors in successful NCRM recovery. For airlines reviewed and polled, on-board in-flight sorting added to higher diversion. Airlines that had on-board compactors exhibited high NCRM extraction from in-flight service. Airlines using on-board compactors also showed higher sorting efficiency, given the ability to have a well-known, consistent, and dedicated collection point for the placement and storage of NCRM.

2.1.1 Waste Logistics

Aviation industry waste logistics are complex, given multiple separate stakeholders who are charged with handling and managing recovery at different stages. NCRM and QW also carry increased liability and exposure to risk if breaching handling protocols.

For the purpose of the study, international in-flight service can be separated into two categories: QW which includes recyclables contaminated by food, and Non-Contaminated Recyclable Materials from International In-flight Service (NCRM from IIFS).

QW Practices

For QW, generally, a linear flow of handling methods and procedures took place. The processes included:

- Items were typically placed in identifiable (color coded) bags;
- Provisions were made for ensuring items were placed in quarantine or quarantined storage;
- Provisions were made to ensure no contamination of the localized region;
- Items were placed directly in incineration or steam sterilization on-site;
- Items were transported to incineration or steam sterilization off-site; and
- Assurance was made that an approved path to deep-bury landfill or ash disposal was followed.

NCRM

Airlines, airports and flight kitchens handled NCRM as regular recyclables. For groups that dealt with these materials, the handling processes included some or all of the following:

- Items were marked as NCRM,
- Items were kept separate from quarantined items, and
- Items were either baled or sent off-site for processing.

2.2 Airline Practices

Airlines and their waste programs are managed by third parties such as flight kitchens, facility managers or waste handlers. Opportunities exist for stakeholders to implement programs for NCRM recovery and QW reduction. In instances where flight kitchens were directly controlled or managed by the airline, and where recycling was deemed a priority, a higher degree of influence and recovery was evident over that of their non-airline owned counterparts. These areas may affect how NCRM is collected by airport operators.

2.2.1 Cabin Crew Procedures

In general, airline cabin crews provide passengers with food and beverages throughout a flight. Their dissemination can range depending on the length of the flight, from ‘buying on-board’ on short-haul international flights to providing complimentary meals for passengers for long-haul international flights.

Airline cabin crews that displayed NCRM diversion were more educated on the topic than their non-participating colleagues. Crews who managed NCRM understood the composition of materials as well as the practices needed to keep items separate. This suggests that, for airlines with no NCRM recovery programs in place, increased knowledge of material composition and separation techniques would likely enhance recovery.

2.2.2 Aircraft Storage Design

Aircraft storage techniques are limited to trolleys and safe stowage as directed by regulators. Airline manufacturers contacted for input and insight provided existing and future outlooks on the issue of a zero waste cabin. Existing aircraft trolleys are designed for food and beverage dissemination, and designs for separate NCRM recovery were not readily evident. In recent years, Airbus has been involved in more advanced trolley designs through their BizLab projects. In addition, a number of unique storage techniques are currently available in the marketplace including compaction units which reduce storage requirements.

2.2.3 Space Constraints

Aircraft storage space is limited. Space constraints can be a greater issue on longer transoceanic or transcontinental flights, where storage for a more significant amount of food and waste is required. Increased storage is also required for different recycling streams if NCRM is being recovered. In this situation, the recyclable material must be kept separate to ensure reduced contamination and therefore housed in a different location, ultimately using more valuable space. Other studies in the area of airline recycling also cited space constraints as a challenge for storing materials for recycling (Cascadia Consulting Group et al., 2014).

Those with elevated recycling processes in the aviation industry featured ground diversion practices to ensure successful NCRM recovery. Crews also received training and were provided with the necessary infrastructure and tools, for example, on-site sorting practices, ISO 14001 certification, and the formation of stakeholder partnerships.

2.3 Costs, Savings, and Revenue

Recycling brings with it the potential to uncover revenue through partnerships with waste collection firms and supply chain stakeholders. Airport operators could realize savings through recovering NCRM or devising recovery programs with their airline customers. Additionally, the costs associated with QW would be reduced through volume reduction from the extraction of NCRM.

In the aviation industry, QW handling generally represents high processing costs. These costs are mostly attributed to steam sterilization, incineration, and specialized handling procedures would be reduced. By extracting a higher level of recyclables and ensuring NCRM recovery, the volume and therefore costs of QW handling would decrease.

The waste industry provides services to both airlines and airports carrying with them the potential liability of QW. The waste industry ensures their handling practices meet strict regulations. To ensure these obligations are met, waste companies embed increased handling costs into their service agreements. Additionally, waste companies offset their cost through revenue from recyclables.

NCRM collection, therefore, when handled per the law, can bring with it the prospect to increase recycling and reduce operating costs by the sheer reduction in the volume of QW.

2.4 Case Studies

The German Act called *Kreislaufwirtschaftsgesetz,* or KrWG, is an example of recycling promotion which assists in facilitating NCRM recovery. The Act's purpose is "to promote the recycling of natural resources and to ensure the protection of man and the environment in the production and management of waste."

The success of recycling practices in Germany may be due to the clarity of the law, and airlines in Germany are able to recycle more than their North American counterparts. Even further steps are being taken in Germany to increase diversion in collaboration with airport operators.

While highlighted in Germany, a general trend in the EU points towards a direct relationship between the regard for materials and the effectiveness of NCRM programs. Similar results are found in Japan, where there is a culturally higher regard for resource preservation. This perspective perhaps points to why stakeholders in Japan work together to support more effective diversion practices. As regard for materials is increased, the recovery rate was found to also increase.

2.4.1 Case Study A

- Policies did allow for NCRM collection
- NCRM programs were not executed by airlines
- Airlines worked together to elevate current practices
- Enforcement office cited low budget for enforcement of policy
- Short NCRM pilot initiated, but canceled

Case Study A was a review of three major international airports operating under the same policy. The airports are significantly distant from each other, and each has different owners and operators.

The regulator for these airports was the same, given that the airports were located within the same geographical border. In one of the airports reviewed, domestic and international flights often shared airline boarding gates, posing a challenge in executing an NCRM program which could adhere to the law, as cited by the regulator. At this airport, in particular, the body managing the enforcement of the policy had challenges with regards to allocating additional resources for recycling enforcement initiatives. That is, the enforcement officers did not have the time or manpower to ensure protocols were being followed.

In one example in North America, an NCRM recovery pilot was initially approved by the regulator but later canceled. The regulator cited a potential risk of contamination to the environment by NCRM and QW, due to a breach in established protocol. Bags of unidentified NCRM were left outside an established quarantined boundary, and therefore the project was canceled due to risk.

A lack of similar protocols and procedures with waste recovery at airports posed a significant logistical challenge for airlines. Despite well-intentioned efforts, airlines were hard pressed in developing identical programs at all airports. Members of a multi-airline panel, for example, indicated that success in NCRM could occur with greater support from stakeholders, i.e., airports, regulators, and enforcement bodies.

2.4.2 Case Study B

- Policies did allow for NCRM
- NCRM programs present
- Airlines cited low importance of NCRM recovery

Case Study B features a region containing airports of various sizes and varying levels of passenger traffic. It is also bound by an extensive geographical range, including remote areas. The remoteness of some airports often stretched resources and equipment where it was not economical for NCRM recovery. In high passenger volume airports, airlines cited budget concerns for additional space that would be required for NCRM recovery.

Discussion with airlines in this market indicated a limited amount of resources and manpower to execute NCRM recovery. Domestic diversion was stated as a much easier process to implement. International NCRM recovery efforts were complicated when airport programs were different from city to city. Where international and domestic flights were handled and the source of NCRM was unclear, flight kitchens did not wish to risk handling because of potential fines. Therefore NCRM was typically identified as QW and discarded.

This case study found that a lack of consistency at airports contributed to the complexity of NCRM recovery abroad. Catering facilities found reduced NCRM programs due to space constraints within their facilities. Space constraints have also increasingly become an issue in this market due to climbing passenger volumes.

2.4.3 Case Study C

- Developed and developing regions
- Both high and low policy restrictions
- Both high and low enforcement
- Both high and low NCRM recovery

This case study was unique in that it covered a market with emerging growth. This market relied predominantly on incineration for handing QW. A lack of available infrastructure and execution capital were stated as limiting factors as to why an increase in NCRM recovery was not found.

This specific range of policy restrictions in this case study included the following findings. In cases where a high policy restriction was found or where no NCRM was recovered, almost all waste was incinerated. Conversely, in cases where low policy restrictions existed, a higher NCRM recovery was evident. The main reason why airlines recycled NCRM in this market was that it was mandated by law. Specifically in this market airlines were more inclined to follow a mandate by an airport, rather than being given a choice to recycle.

In addition, airlines admitted to difficulty in implementing or adhering to programs for each airport. For a medium-sized airline operating to more than 100 cities, for example, having different procedures for each added to the complexity and contributed to the lack of participation. In markets where NCRM recovery was

mandated by law, airlines had no choice but to abide and therefore complied. Airlines, however, could not always allocate new resources each time a new initiative was presented.

The case study also yielded the following with regards to enforcement. High enforcement of existing QW policies in conjunction with successful airport collection programs generally yielded positive results or high NCRM recovery rates while in areas of low enforcement of existing QW policies, or where policy existed with no enforcement, it was uncovered that adherence to policy was limited, or QW was landfilled without being treated.

Case Study Summary

In general, it was found that the larger the pool of stakeholders, the lower the probability of NCRM recovery. Extenuating circumstances coupled with operational challenges, for example, all affect recovery or lack thereof. Most markets do allow NCRM collection but only if certain conditions are met.

Airport operators have their own unique challenges when creating NCRM recovery programs. Given that we are still at the dawn of the sustainability era, the airport industry, like many other industries, struggles with introducing new and effective programs that meet bottom-line corporate objectives.

As an aside, airlines have been challenged to implement their own programs. A medium-sized airline operating to more than 100 cities is often tasked with managing waste streams and different procedures for each airport. These issues are part of the reason why airlines do not participate in individual airport programs. In markets where NCRM recovery was mandated by law, airlines had no choice but to comply. Airlines, however, could not always allocate new resources each time a new initiative was presented at an airport and often opted out.

2.5 EU Zero Waste Cabin

An on-going study in the EU, ‘Zero Waste Cabin,’ and its interim report *Tackling International Airline Catering Waste Management*, has a project goal to decrease or eliminate QW entirely (Fullana-i-Palmer et al. 2018). The study was funded with USD $2,992,000 by the EU’s financial instrument for the environment and nature conservation LIFE (Environment and Climate Action Program).

Preliminary findings from the study show the potential of reducing QW. This elimination could result in significant cost savings to the aviation industry and airport operators by combining recycling, NCRM, and QW handling. Eliminating QW could also reduce or limit handling costs while increasing diversion. It could also alleviate logistical challenges in managing both NCRM and QW separately. The prospect of such a significant policy change and the eradication or harmonization of QW policy, however, could take decades to be fully realized.

While the goal of eliminating QW is ideal, many airlines reviewed struggle to implement basic recycling programs within their own operations due to gaps in supply and inconsistent collection chains. Similarly, airport retail stores are also not governed by QW policies, and also struggle to implement recycling programs. In the interim, the only way the aviation industry can reduce QW is through decreased contamination and increased NCRM recovery allowable and in line with existing global policies.

Costs of Collecting NCRM

Capital expenditures and operational costs related to the management of NCRM are part of the aviation industry’s cost of doing business. Handling and processing fees ensure compliance and may potentially mitigate risk and allow waste providers to recover NCRM. In many cases, flight kitchens can incorporate the recovery of NCRM by adding additional resources, workforces, and costs. These additional costs would include the separation of NCRM processing and handling fees associated with the handling of NCRM.

For AAFKs who chose to recover NCRM, additional waste contracts increased costs. Despite the fact that NCRM reduces overall waste volume and reduces cost, QW handling is still also required. Services such

as steam sterilization, off-site incineration or approved landfill disposal are still necessary. Costs were generally low for AAFKs who utilized landfill in countries where no policies governed QW. Training for stakeholders to ensure proper procedures were followed added to NCRM recovery costs.

In some island-based countries, QW incineration was a preferred handling method as it ensured the handling of QW was complete and also alleviated the logistical issue of having to recover and recycle NCRM.

Incineration on-site also allowed some airports to keep operation costs low where landfill prices were high, or where options for QW were not available. In some markets, incineration was a more streamlined way to handle both QW, NCRM, and ensured the lowest cost for airlines and airports.

For island-based airports, whose remoteness was a factor, incineration also was the most cost-effective strategy, especially where incineration was used to produce energy. In areas where landfill cost was expected to rise, AAFKs were exploring cost reduction strategies which included increased NCRM recovery.

Procurement Savings

Savings in procurement costs can be approved through the reuse of packaged goods as per the governing policy body. Some items, including certain food and beverage items, can remain on-board the aircraft as long as they are isolated from QW as per US guidelines. Items allowed to remain aboard, include some food items and beverages, provided those items have not come into contact with QW. Items exposed to QW must be handled as QW and placed in quarantine as per *Foodstuffs on Aircraft Exempted from Removal as Regulated Garbage* (USDA APHIS 2018).

Synergy Savings

Combining NCRM from airports and airlines can increase both NCRM recovery and savings. The mutual management of waste by airports and airlines could create a platform where small recovery facilities ensure increased recycling. Airports who have implemented this change have found reduced operating costs for the service rendered.

Sterilization and Incineration Costs

Increased NCRM recovery reduces QW. While increased recovery may require initial and upfront capital expenditure to ensure proper program development, it can contribute to increased savings and may decrease QW and its costly treatments.

CHAPTER 3 – AIRPORTS AND THE CIRCULAR ECONOMY

The circular economy (CE) model parallels a process of nature, also known as biomimicry, where all waste is used as a resource for the future continual development of nature. The CE also takes into consideration energy preservation or energy optimization, where energy is expended to maintain vitality or invested in capturing future energy.

The CE model also incorporates reuse, refurbishment and remanufacturing of materials; and the faster they can be returned to use, the higher the potential savings on the shares of material, labor, energy, and capital embedded in the product and on externalities such as GHG emissions, water or toxicity (The Ellen MacArthur Foundation 2018).

Conversely, the linear economy (LE) focuses on various phases of product creation, from idea to the market with little to no recapture. These phases include extraction, processing, assembly, transport, usage, energy, and disposal. CE focuses on the handling and reuse of components that otherwise would have been destined to landfill, incineration, or other forms of unproductive or non-economically beneficial disposal. Ultimately, the aim is for an optimum economic resource efficiency model designing waste out of the business systems.

As the CE becomes adopted in supply and collection chains, the advantages for the aviation industry would be reduced costs and increased environmental benefit.

3.1 Opportunity for Airports

The economic benefit of having a CE over today's current 'take-make-dispose' LE will reduce scarcity, volatility, and pricing of materials and the disruption of the economy's future manufacturing base (The Ellen MacArthur Foundation 2018).

Airports can integrate and leverage their sites to incorporate a CE model. This model can be carried out by embedding collection and recycling infrastructure to capture materials at airports. Airports can then return them to the global, national, or local economies. Recapturing materials in an airport setting may face some challenges, but it has been demonstrated in several markets.

Gaps do still exist in the recovery of NCRM in the aviation industry, and the potential of extracting more material is possible given its closed and controlled ecosystem. The CE model could also be applied to airports where the continuous flow of known materials from flight operations could be cataloged and recovered.

3.2 Recycling Disruption

On July 18, 2017, China filed a petition to the World Trade Organization (WTO) requesting a halt to the acceptance of 24 categories of solid waste. Historically, China imported and recycled these categories and used them as raw materials for new products. As of January 2018, however, the now-closed China border has left materials to be stockpiled. Waste companies are now forced to store materials from collections. Citing lack of storage room, waste companies have applied to regulators to landfill these materials. Given the historic processing of recyclable materials in Asia, US infrastructure and processing abilities have lagged. The closure of the border in China has disrupted current recovery practices but may also promote the development of new material recovery facilities within the US.

The EU is still targeting a ban on single-use plastics. France, for example, is slated to penalize companies who make new materials using virgin plastic versus from recyclable sources. This penalty may increase the costs of goods made of non-recycled plastic. The goal is to increase the use of recycled plastic nationwide by 2025 (Phys.Org 2018).

Volatile raw material prices do affect collection strategies and subsequent profitability, which typically yield an increase in landfilling. As markets fluctuate, waste collection firms find that, given their existing collection infrastructure, recycling is not profitable. Even before the ban, recycling was in crisis due to low profits of recovering recyclables within the collection chain. A 2016 article in the *New York Times*, stated, "recycling is in a crisis; it used to be that all players in the recycling ecosystem were able to make a profit" (Gellesfeb 2016).

3.3 Recovery of Waste at Airports

Some airports have used waste to provide energy to their facilities instead of collecting and diverting. Airports, such as Gatwick Airport in the United Kingdom, are utilizing waste-to-energy WTE. WTE facilities can ensure the meeting of policy requirements while ensuring the safeguarded of flora and fauna when processing QW. WTE can also be carried out on-site and can demonstrate carbon and cost savings through the reduction of transportation for off-site handling.

Pyrolysis has also shown promise for the development of sustainable aviation fuel (SAF) from waste. While not a focus of this research, numerous waste items have been shown to deliver subject fuel with enhanced benefits for the aviation industry. The process can also use biomass, including lignocellulose inputs. (Graham et al. 2011). Many firms are reviewing this process and partnerships between Fulcrum Energy, for example, along with United Airlines, Cathay Pacific and Waste Management could potentially utilize QW as a feedstock (Fulcrum Bioenergy 2018).

Similar to pyrolysis and waste-to-energy, gasification is a thermal process which utilizes heat to break down matter from waste. Unlike waste-to-energy, however, but like pyrolysis, gasification produces hydrocarbons and a mix of gases which ultimately depend on the production of gases on the input variables of waste. The production gases, or syngas, can also be used to power different power plants.

3.4 Public Support of Sustainability Initiatives

In one study, 70.4% of airline passengers were willing to pay more than $20 to offset the carbon emissions generated during their journey (Jou and Chen 2015). With the Business for Social Responsibility organization stating that 93% of global consumers wanting to see social or environmental issues addressed, there could be more room for advanced NCRM recovery programs funded through creative economic driven platforms.

CHAPTER 4 – FINDINGS

The following questions were used to understand how NCRM was handled in the primary outreach.

1. How is NCRM handled (i.e., recycled, incinerated, landfilled, etc.)?
2. Does your organization follow existing government policy for NCRM?
3. Does your organization generate revenue from NCRM, if recovered? If so, which items?
4. Are there any initiatives either current or on the horizon with regards to how NCRM will be handled?

4.1 Scenarios

As a result of the above outreach the following scenarios were uncovered.

4.1.1 In-Place QW Policy & High NCRM Recovery

With in-place QW policy with high NCRM recovery, all stakeholders including AAFKs as well as ground operation and waste management worked in unison. Training programs were originally initiated by the airline. The success of the program was rooted in a highly motivated airline which looked to achieve the recycling of NCRM as a major corporate objective.

Summary

- Stakeholder collaboration was evident
- Third-party NCRM waste management partner was on hand
- Training of all stakeholders took place
- Heightened level of corporate guidelines was evident

4.1.2 In-Place QW Policy & Low NCRM Recovery

At destinations with in-place QW policy and with low NCRM recovery, a collection of hurdles was found. Airlines in this market had a corresponding lack of environmental initiatives as it pertained to recycling. Airports had high cost waste programs which deterred airline participation. Airlines in this market also were subjected to remote airports with limited and sparse geography and limited support programs.

Summary

- Lack of environmental programs/initiative
- Low interest/corporate objectives
- High cost of implementation
- Sparse geography/multiple stations
- Inconsistent airport support/programs

4.1.3 In-Place QW Policy & No NCRM Recovery

Markets with QW policies and no NCRM recovery budgets and enforcement limitations are seen as significant challenges for implementation of advanced programs. Complex airport and airline operations with limited support mechanisms in-place for recovery of recyclables, in general, were also cited as issues. In some cases, some groups were satisfied with current recovery results and did not see the need to challenge these targets.

Summary

- Low budgets
- Enforcement body limitations
- High cost to implement
- Not enough vision/corporate guidelines
- Satisfied with progress

4.1.4 No QW Policy In-Place & No/Low NCRM Recovery

Some markets had no QW policies in-place, and yet still displayed little to no NCRM recovery. These markets saw advanced programs as costly choices especially in light of low landfilling costs. Similar hurdles in these markets also saw real estate space as limited for separate collection areas for recycling.

Summary
- High throughput volume
- Costly to execute
- Limited real estate flexibility
- Low landfill costs

It should be noted that a market displaying an absence of QW policy in-place with high NCRM recovery was not found.

4.2 Generalized Findings

Gaps

Gaps in NCRM recovery from in-flight waste programs provide unique challenges given the complex chain of custody behind the sourcing and handling of materials on an international scale. Aviation industry professionals, supply and collection chains all had some degree of knowledge, although rarely did one group have intimate or clear command of all facets of recovery. Even those solely tasked with the management of waste within an organization sometimes had limits in fully comprehending program efficacy or outcomes. The challenge of these gaps appears to grow as the number of international destinations offered by an airline increases.

Policy Harmonization

The EU was found to have harmonized policies blending handling and recovery practices for QW. Previously recognized international borders within the current EU, with separately developed standards for recovery, are now merged. Countries operating independently now work under 1069/2009 of the European Parliament as of October 21, 2009. The standardization of these policies brought into effect similar handling requirements and procedures across all borders. Given the success of this model, the aviation industry has an excellent example from which to review the efficiency of these measures. Governments which are considering bans for single-use plastics, for example, should also consider adopting a similar framework for the future development of advanced recovery practices. Adoption of harmonization policies and recovery could also lead to the evolution of policies encouraging more advanced recovery practices.

Station Inconsistency

Station inconsistencies generally present operational challenges for all airline operators. While domestic recycling may or may not occur at different airports, NRCM recovery was more challenging. Airlines cite station inconsistency as a factor which dissuades or discourages recycling recovery. All US carriers, for example, cite airport inconsistencies as an issue for the collection of recyclables, not just NCRM. The availability of recycling reclamation, or waste providers, is cited as a factor that reduces recycling.

Station inconsistency has been showed to be a challenge for airlines to manage and is difficult for airlines to handle on their own. Different practices and procedures at various airports also confuse cabin crews. Crews sometimes have no idea of recycling programs at airports at a particular destination. While cabin crews are certified by aviation authorities to operate aircraft for safety, they could also be qualified to carry out recycling practices in line with policies if given the proper training and support.

Some airports, however, could mandate recycling from airlines and assist them with the recovery. In global NCRM recovery examples like Kansai, Japan, where the airport consistently provides airports with NCRM recovery, airlines were more inclined to participate.

Flight Kitchen Support

International carriers compete with each other and operate many of the same routes. Some airlines own and operate their own catering company, while others utilize third parties. Flight kitchens are often responsible for serving multiple airlines with differing mandates, materials, and operating needs. These operational challenges complicate the NCRM recovery process.

In some countries in the EU, NCRM is recovered seamlessly, and in other EU countries, recovery is completely absent. Some flight kitchens operating under the same policy or laws struggle while others excel. In others markets, adherence to NCRM diversion does not occur unless required by law.

Airlines in North America recover NCRM in some cases, although their success typically depends on obtaining flight kitchen support.

The flight kitchen system initiates at the point where the outbound flight begins. Trolleys are loaded with standardized items for both short-haul and long-haul international flights, and catering companies load products. Using a specialized distributor or logistics company allows the airline and caterer to better manage the flow of materials from aircraft to flight kitchen and back again. (Jones 2012) By understanding this inherent relationship, evidence of a specialized logistics contributes to NCRM recovery.

Once the aircraft bound for departure is confirmed, trolleys are loaded into an airside vehicle which then loads the contents onto the plane slated for departure. Passengers enjoy an array of products and services from catering meals which are usually sourced locally. Hot and cold meals are stored in trolley units and packed with dry ice for temperature control.

The meal service offered on international routes often varies between legacy and low-cost carriers and by the length of the flight. Low-cost carriers offer a limited variety of meal options for purchase on short-haul and long-haul international flights, while full-service, full fare long-haul flights typically offer meals at no additional cost and have a full array of offerings. Both types of meals create substantial waste streams, especially when individually packaged.

Low-cost carriers often have food waste from unsold meals, where long-haul flights have a significant amount of package waste from a greater array of offerings. Waste total estimates run as high as 500 kg per flight, including food, galley and cabin waste. (Li, et al. 2003)

From the surveying of international outbound flights, on-board recycling is nearly non-existent, except in some markets where it is mandated. Inbound flights, where aircraft are returning to their home base, typically have a significantly higher rate of NCRM recovery. Hence, it is the outbound flights which need additional encouragement to implement more NCRM.

Fines

Policies mandate the issuance of fines if a violation of the handling of QW is found in gathering NCRM. Stakeholders have therefore demonstrated significant caution in the recovery of NCRM around the world. If recyclables are contaminated and recovered or handled outside the general accordance of QW handling methods, the company or handler violating protocols could be subject to fines. These fines could be as high as $300,000 in the US and may also include imprisonment.

> *Any person who knowingly violates the Plant Protection Act (PPA) (7 USC. §§ 7701 et. seq.) and/or the Animal Health Protection Act (AHPA) (7 USC. §§ 8301 et. seq.) may be criminally prosecuted and found guilty of a misdemeanor which can result in monetary penalties, a one-year prison term,*

> *or both. Additionally, any person violating the PPA and/or the AHPA may be assessed civil penalties of up to $300,000 per violation or twice the gross gain or gross loss for any violation that results in the person deriving pecuniary gain or causing pecuniary loss to another, whichever is greater.* (USDA, APHIS 2016).

US policies allow for NCRM, yet the issue of fines due to mishandled QW is an impeding factor preventing stakeholders' participation.

In Europe, some airlines have no issue with the fact that fines are present, they simply take greater care in the handling of NCRM. Airlines in Europe also involve other stakeholders to ensure an integrated management of NCRM. One airline, in particular, has initiatives that include training videos for its staff and funds a staging area in concert with a third party for the recovery and separation of NCRM.

Contamination

In cases where Non-Contaminated Recyclable Materials were not recovered, contamination of quarantined items was a major limiting factor in their lack of recovery. To ensure NCRM recovery, contamination must be avoided. Policies generally indicate that either food waste items or the collection of fluids are responsible for contaminating recyclables. For NCRM recovery to occur, QW policies generally state that materials must be kept separated from banned foods at all times for recovery consideration.

While cabin crews can influence either positively or negatively the outcome of how materials are handled, there are instances where stakeholders lower down the value chain, can similarly contribute to adverse outcomes due to being misinformed regarding the status of various components.

Recovery of NCRM in Europe is usually managed by third parties, who are subsidized by the value of the NCRM. These third parties are also often responsible for ensuring the collection, separation, and handling of NCRM and QW destruction. Having a third-party manager for QW and NCRM, while costly, can provide accountability and deliver positive recovery results and consistency. In some countries, where NCRM is the law, and where third parties manage NCRM, airlines generally state a higher NCRM recovery than at other destinations.

Space Constraints

Part of the issue with handling NCRM on-board aircraft is the fixed space available in-flight. Airlines are often challenged to ensure NCRM stays separate from food contaminants. While long-haul flights do have larger aircraft, they also have a larger number of travelers to serve resulting in more waste to contend with. A larger space allocation could be set aside on long-haul flights to handle both waste streams separately (i.e., QW and NCRM). Long-haul, wide-body aircraft have multiple galleys and separations are needed at each galley, compounding the space issue.

Given the increased reliability and fuel performance of jet engines and the Extended-range Twin-engine Operational Performance (ETOPS), airlines are now operating single-aisle, narrow-body aircraft on longer routes. These smaller aircraft are now flying increased distances and carrying with them more food and beverages for these extended flights. These aircraft, however, have not been redesigned to increase galley spaces or waste collection.

Aircraft manufacturers have assisted with promoting recycling initiatives. However, they have not developed any added galley components in their aircraft for increased recovery. Cabin and galley support mechanisms could assist in increasing separation of materials resulting in increased recovery.

Airlines that use compactors take a more proactive approach and are ultimately more successful with NCRM recovery. Typically, airlines which were more advanced in NCRM recovery did overcome space constraints, while others, which did not, cited policy issues as challenges. Some airlines also store separated NCRM in lavatories for the landing phase, but this practice may not always be permitted.

Education

Interviews with cabin crews found inconsistencies in their understanding of company protocol with regards to NCRM; specifically, a lack of information around material types and separation categories. Crews were also found to mix waste and recyclables, stating that they did not have any direction to do otherwise. In contrast, knowledge about NCRM recovery was higher in crews from countries where NCRM recovery was mandated.

Sustainability Approach

Given the emerging trend of advanced environmental programs, the size of sustainability teams is growing. Airline operations have matured over decades, and environmental and corporate sustainability initiatives have been adopted by the industry during this period. Airlines have had to develop and ensure reporting on key metrics. They are also just beginning to initiate sustainable processes around lifecycle elements, such as, product choice, sustainable procurement and, eventually, recycling. While NCRM recapture is regarded as important for airlines, these processes take time to implement.

An airlines' waste team is often comprised of just a few waste professionals and therefore the additional cost and manpower required to elevate NCRM recovery would be difficult to justify. Additionally, the following were cited by environmental teams as potential challenges to developing NCRM recovery programs:

- Too many destinations;
- Lower on the scale of importance; and
- Limited support from airports.

Overall, airline environmental leaders cited recycling as a critical topic which could be addressed by airports, but not as important when compared to other environmental initiatives such as fuel saving initiatives or diminishing GHG production. This focus is likely justified given that typically 99% of GHG emission is derived from the operation of jet engines throughout the flight phases. Airlines were also sometimes challenged in allocating human resources to recycling initiatives given the wide geographic range of airline operations.

Procurement and Supply Chains

More intelligent procurement and supply chain practices may also shape eventual waste recovery. While procurement theoretically could contribute to the increased recovery of NCRM, existing collection practices may suggest that even with integrated supply chains, NCRM may still be disposed of. Specifically, even if all items were recyclable, NCRM recovery rates may remain the same, given that the root cause of QW is contamination from certain quarantined food items. Removal of the contaminant itself may be one way to increase NCRM.

Airports could partner with AAFKs to address the opportunities and challenges of recycling on international flights. More collaboration is needed to create an agreement specifying which materials and which practices would be the basis of developing a global standard for recyclables from in-flight service. Based on airlines polled in the US, 80% indicated that NCRM recycling is still a significant challenge. For flight kitchens surveyed, 60% report difficulties with recycling due to the volume of material, impacting on time and space limitations required for extracting recyclables from mixed domestic and international trolleys arriving simultaneously.

CHAPTER 5 – AIRPORT GUIDELINES

Airport operators can utilize this guidelines section to understand how to increase NCRM collection and separation within their operations. In the US, processing NCRM may vary due to restrictions placed on waste managers by local CBP officers. Airports can work with stakeholders, including waste providers, catering companies and airlines to recover NCRM. In general, the redesign and selection of materials could also aid in the increased potential of recovery of recyclables from international in-flight service.

5.1 On-Site Processing

On-site processing is a method by which separation of NCRM materials occurs on airport grounds and includes short-term storage of non-contaminated recyclables from in-flight service. On-site processing can be instrumental in supporting recovery of NCRM from in-flight service. Coupled with airline support, airport operators can leverage their existing land-based infrastructure to develop advanced collection strategies on-site.

Airport operators may require added financial investment which would include new infrastructure for on-site processing, however, these costs could be offset from the sale of recyclables directly to commodity markets. As sustainability becomes more critical for airline customers, airport operators have an opportunity to develop programs for visiting airlines that could collectively benefit the industry. By providing heightened handling, collection and waste management programs for visiting airlines, airport operators could also develop new untapped revenue for their airport.

As more airline companies combine their collection efforts and accumulate NCRM, increased throughput efficiency will result; thereby further reducing costs for participants. By building an NCRM recovery program for airlines, airport operators have an added opportunity for an increased volume of collected recyclables, which can provide additional revenue from the sale of these materials.

5.2 Standardization

Airports and airlines may share in the responsibility of increasing the diversion of NCRM through standardized materials and handling practices for recovery. For NCRM recovery to occur, harmonizing of waste collection services, the mutual management of waste contracts, and the shared sorting of materials, could advance recovery. Together with the support of waste providers and the pooling of financial and human capital resources, airport operators could play an instrumental role in continuing their support of airlines.

Standardizing materials and handling processes between airports and airlines could also streamline airline procurement practices and provide cost and operation efficiencies. By knowing in advance what international airlines would discard, airport operators could be better equipped to handle inbound waste streams.

For airport operators to increase NCRM collection, a standardized recycling infrastructure could be useful. Airlines may not have dedicated collection mechanisms in place at all airports. Still, airport operators could begin to offer these types of added services for increased revenue opportunities and environmental stewardship. Together with the collaboration of airline on-board separation, airport operators could play a pivotal role in spearheading NCRM initiatives.

Airlines often require added space for the separation of NCRM materials on arrival. Airport operators, therefore, could collaborate with airlines to offer their airport for sorting. This type of support could aid in providing cost and operational efficiencies for the entire industry and could pave the way for a more globally adopted and standardized recovery process.

A globally standardized airport-based collection process would allow airlines to know in advance what items can be recovered at destination airports. This process would further prevent in-flight crews from having to change their sorting habits for each airport continually. Without the consistent, standardized support of airports, airlines often elect to avoid separating on-board altogether. In effect, airports across the world could work together to replicate their collection practices, giving airlines greater consistency from airport to airport.

Given that waste disposal directly affects the surrounding environment of airports (Li, B., et al. 2018), an opportunity exists for all stakeholders, including AAFKs, to work together. In doing so, QW and NCRM recovery would result in local environmental impact reduction.

5.3 Consistent Handling Practices

Neither airport operators nor airlines were found to be solely responsible for recovery. Airlines are responsible for the on-board collection and separation of waste and recyclable materials. Airports also devise and have predetermined handling methods and protocols for their waste streams. Due to different airport collection protocols, inbound airlines often struggle to adhere to these various and ever-changing programs. Conversely, since each airline has its own policy for handling waste, airports often struggle with the complexity of incoming airline waste. Furthermore, airlines are not always in the position to separate waste according to each governmental policy and operations of each destination airport. Airlines, therefore, choose to follow the prescribed quarantining of waste and recycling rather than separate waste.

These gaps and inconsistencies at airports are significant factors in the current limits to NCRM recovery, further reducing airline participation. While each airport is well-intentioned in its efforts to devise its sustainability programs, it is precisely these individually unique programs that reduce airline participation in NCRM recovery. Airport inconsistencies, therefore, are key in keeping NCRM and recyclables from being separated, collected, and processed.

An opportunity may exist, therefore, to develop a consistent handling practice within the aviation industry. Airport operators, from multiple destinations, could work together to form a standard recovery program, which could result in increased airline adoption. Airlines could then design procurement and collection initiatives in line with this standard, which could also occur alongside legally accepted guidelines of NCRM collection policies.

5.4 Supply Chain and Procurement

QW is categorized as such due to being contaminated by food remnants. Many countries accept recyclables that have not been exposed to fluids or food remnants, and therefore will lawfully receive non-contaminated recyclable materials into local recycling streams. Airlines demonstrating successful recovery of NCRM from international flights provide more instruction on separation techniques for their in-flight cabin crews. Often with these advanced techniques, airport operators have opportunities for collecting recyclables that are not contaminated.

Packaging that envelopes consumed and unconsumed items eventually becomes QW when mixed with quarantined items. NCRM isolated from quarantined items are generally accepted into recycling streams provided that the packaging is recyclable. Recycling from in-flight service could increase if airlines were to procure items that are both recyclable and have a higher chance of remaining uncontaminated during in-flight service. As airport operators become increasingly aware of airline supply chains, this knowledge could be used to ensure the identification of these materials by the airport after the flight without airline involvement. The understanding of airline supply chains by airports could, therefore, result in successfully increasing the recovery of NCRM on the ground.

Additional airport guidelines for operators should include information relating to contamination reduction of NCRM by QW. Often, effort which goes into isolating NCRM onboard is wasted when items are contaminated on the ground by quarantined items. Similarly, if NCRM and QW are collected in the vessel

or by the same professional, the risk of contamination could increase. To prevent cross-contamination on the ground, QW and NCRM must stay isolated from each other. Airport operators can provide front-line support using employees who are trained in the identification and sourcing of NCRM. Airport handling practices could be developed in the early stages of implementation of these efforts by the airport operator or even in-flight kitchen staff involved in extracting waste streams from flights.

An opportunity may exist to pool resources with industry partners to achieve a more harmonized collection platform. This could be carried out through harmonizing procurement and interdepartmental collaboration and ultimately standardizing collection strategies.

5.5 Policy Adherence

An opportunity exists for airport operators to ensure industry stakeholders follow existing policies regarding NCRM and its recovery. Risk assessments can be utilized in conjunction with the assistance of enforcement officers to help airport operators deliver NCRM programs that could be adopted by more airlines.

Streamlining and standardizing the recovery process of NCRM by all airport operators could increase airline participation and throughput efficiency. Through the development of more standardized collection across more airports, policymakers could be assured that NCRM programs can succeed in line with their initially intended policy goals.

By following policies more closely, airport operators could play an instrumental role in the standardized collection of NCRM. Airport operators could also benefit from the assistance of airline associations, such as IATA, who have historically worked with regulators to ensure policy requirements. This support from IATA, for airports with NCRM recovery programs, would, in turn, ultimately help airlines to achieve their objectives of becoming more sustainable.

International airlines, at times, face additional challenges when choosing to divert NCRM. If airport operators can demonstrate clear and concise program delivery, then international airlines may have a more significant opportunity to deliver on NCRM programs.

Some international communities, however, are beginning to update policies with a focus on the CE and bans of single-use plastics. These actions demonstrate how policies can stimulate recovery practices. Airlines may then have the legal framework needed to adapt to newer policies for each market or completely revise their packaging, if need be. It may be more economical for airlines to perform a system-wide changeover of supply chains to ensure compliance with airport operations and local recovery laws.

5.6 Waste Collection

Partnering with the waste collection industry can be valuable to airport operators because it can provide the necessary supportive strategy for the recovery of NCRM. This supportive strategy can give airport operators the tools, processes, systems, and methods to accomplish waste diversion goals when working to recover NCRM. NCRM recovery requires airport operators to comply with international laws and regulations, and the waste collection industry can offer the necessary support to ensure compliance given their extensive experience and supporting infrastructure.

Often AAFKs individually select their own waste providers. Working with a single provider, however, could offer more effective cost and operational efficiencies when choosing to recover NCRM. Without support from the waste collection industry, airport operators may continue to find NCRM recovery challenging. By taking a multi-stakeholder approach that includes the waste collection industry, the increase of NCRM recovery could occur. An opportunity also exists for airport operators to integrate their waste contracts with those of participating airlines to allow for the harmonious recovery of NCRM.

In-flight kitchens are responsible for supplying and typically coordinating the collection of in-flight materials from inbound aircraft. Airlines, in many markets, have the responsibility of managing their own waste requirements. Airport operators have waste collections and contracts providing support to their terminals.

The aviation industry ecosystem of airlines, airports and flight kitchens collectively has the opportunity to harmonize waste contracts. Combining collection efforts to recover materials from operations, including NCRM, and domestic operations can improve cost and operational efficiency.

Improvements in the ecosystem management and collection of NCRM can result in cost savings with particular attention paid to logistics of NCRM from inbound flights. Airport operators may be hard pressed to influence airlines to improve on-board separation practices; however, many airlines are motivated to begin to do so amid global pressures to increase material recovery from operations. Some additional areas of focus include on-site processing, source separation, airline/airport working groups, harmonized waste contracts. Streamlining and increasing collection can also increase throughput efficiency and result in cost savings, revenue generation, or both.

5.7 Cost and Cost Savings

Landfill usage is preferred in some markets because it remains a lower-cost option compared to recycling. The added costs associated with required QW handling, sterilization, and incineration may also discourage recycling. NCRM also requires separate transport to ensure materials remain uncontaminated, and these added costs may also prevent recovery. Depending on where an airport is located, revenue obtained from NCRM may or may not subsidize these more costly programs. Some airport operators may be dis-incentivized to maintain NCRM programs due to the high costs associated with developing and implementing them. A shared and mutually adopted program across the value chain may be a more cost-effective solution.

To reduce the cost differential between QW and NCRM recovery, airport operators could share their costs with airline tenants and airline partners to increase throughput efficiency for NCRM. This can be carried out through the harmonized procurement of waste services and by consolidating valuable materials. In doing so, a more significant amount of recyclables can be recovered, thereby further reducing costs.

Overall, gaps in the NCRM recovery chain occur from a lack of collaborative collection through a multi-stakeholder approach. Airlines, airports, catering companies, and waste managers typically work in silos by individually managing waste streams. This limits recovery and cost efficiency and reduces the revenue-generating potential for airport operators.

Airport operators can work with existing stakeholders in determining the best types of NCRM for recovery in conjunction with existing recyclables. Airport operators can also reach out to participating airlines to understand their waste streams and on-board program material types. In doing so, airport operators could have increased data on what materials to expect, and therefore can plan to adequately manage them upon arrival.

5.8 Development of NCRM Recovery Programs

Handling QW is costly. By developing NCRM programs, airport operators could reduce their waste costs through the added revenue generated from the sale of non-contaminated recyclable materials. In extracting NCRM, airport operators could also reduce the volume of QW and its related handling and processing costs.

For airport operators to begin NCRM recovery programs, airlines would need to implement on-board separation. Increased separation can give airport operators significantly more volumes of recyclables. As program efficiencies increase, airport operators could also realize higher profitability. The proper development

of NCRM programs requires contamination prevention of collected materials, so that airport operators will need to keep collected materials isolated from QW at all times.

Monetization of recyclables, however, can be difficult due to fluctuations in market commodity prices, and these fluctuations can deter airport operators from initiating NCRM recovery. Potential contamination can also prevent airport operators from collecting NCRM and decrease its ability to manage and monetize recyclables. When recyclables are not contaminated, however, and they are collected and recycled, both economic and environmental sustainability can be realized. Airports could provide a higher oversight of in-flight waste and NCRM, but instead, choose to leave the responsibility for this to the incoming airlines' themselves. By choosing to manage waste from in-flight programs with that of international terminals, airports could close, capitalize, and monetize these gaps.

5.9 Increasing Stakeholder Engagement

To increase NCRM recovery, airport operators can work to spearhead harmonized, industry-wide communication to develop a platform for airlines to use.

Through the hiring of systems or design consultants to investigate and address handling issues, airport operators can design and implement strategies to ensure NCRM recovery is carried out while adhering to local laws. By engaging stakeholders, as it pertains to their use and collection of NCRM, airport operators can be better equipped to understand how to decrease the contamination of NCRM while helping to increase its diversion.

Through the development of working groups, in conjunction with industry professionals across all stakeholders, airport operators can be instrumental in developing and ensuring that the aviation ecosystem has the support necessary to create NCRM programs at their airports. Stakeholder engagement is essential for airport operators to spearhead because of their expertise in managing local issues. Each airport operator has some level of control over what can be collected and discarded at their airports. By offering their land-based operations, airport operators can engage stakeholders to provide NCRM recovery, which ultimately can increase revenue-generating opportunities, as well as a ROI.

5.10 Education and Knowledge

Airport operators should consider ensuring that all staff who handle NCRM are adequately educated and trained for its handling. Training of airport professionals and staff in the policy knowledge of NCRM handling can aid in the development, implementation, and successful execution of recovery programs. Airport operators looking to extract value from NCRM productively and consistently should consider providing the necessary education to their staff who handle these items. This training should include information on the handling, materials types, NCRM laws, QW requirements, and separation categories. In the early development of NCRM programs, a multi-stakeholder approach is vital to ensure isolation from contaminants throughout the entire value chain of materials.

CHAPTER 6 – CONCLUSIONS

The aviation industry benefits from a closed and controlled ecosystem of procurement, consumption, and collection of consumables when it comes to the handling of recyclables. Airport operators are well positioned to play a unique and instrumental role in extracting value through the development of advanced handling and recovery of NCRM, with a resulting increase in currently untapped revenue streams.

Despite this closed ecosystem, airport operators face hurdles similar to those of other industries, including the challenge of successfully implementing recycling programs in conjunction with other stakeholders. Airport operators, however, do benefit from having some control and flexibility regarding how issues are managed on their site, given their control over their land-based operations.

Global examples of airport operators working alongside industry stakeholders for the recovery of NCRM were low overall. Airports have demonstrated, however, an ability to bring together stakeholders in some markets and have demonstrated the successful implementation of sustainability programs. In many cases, sustainability programs such as NCRM can offset operational costs, or aid in the reallocation of budgets to deliver operational excellence in the area of recycling. A combination of invasion risk-related tariffs and support for biosecurity-enhancing measures in exporting countries would tackle the fundamental causes of the invasive species risks of globalization. (Perrings et al. 2005).

A challenge for airport operators remains in the extraction of the value of NCRM due to the materials selection process beginning with the airlines and continuing higher up the value chain; specifically, during the stage of procurement. Airline procurement strategies are also very complex and have limitations partially due to their long-established supply chains.

Existing manufacturing facilities are also tooled in specific ways and, as many airlines require changes to packaging, suppliers often cannot pivot in an economically viable way. Changing or influencing these value chain processes can be very difficult in the short-term. Procurement and supply chain variables, therefore, can place stresses and limits on what airport operators can collect. Airport operators, however, can shape the outcome of what they receive by initiating dialogue with their airline customers. Doing so could ensure streamlined collection, separation at source, and the possibility of generating untapped revenue through NCRM recovery.

Increased collaboration and supply chain standardization can give airport operators a leading edge in sustainability stewardship while providing a feedback loop for future procurement strategies for airlines. In essence, land-based airport operations could offer a staging area for inbound airlines. As more airlines work with airport operators from visiting markets, the throughput efficiency and revenue from an advanced collection of NCRM can be realized.

When working in unison, the chains of procurement, consumption, and recovery could also deliver value to airport operators. Often the inbound recovery of IRIFS or International Catering Waste (ICW) is not recycled due to a breakdown of this chain resulting in QW for both airlines and airports. QW is then regulated according to a receiving country's long-standing policies for all ports. QW is prohibited from being recovered due to it potentially acting as a vector for pests and pathogens, possibly threatening other industries.

Under certain circumstances; however, recycling of ICW may occur, but only if no contamination is evident. These Non-Contaminated Recyclable Materials may be handled without restrictions. In most countries if NCRM is sorted and isolated from QW, recycling may occur.

The act of recovering NCRM itself may be straightforward, but carrying out all the protocols to ensure it is collected without incident may be complicated. Every municipality has a different waste service provider, each of whom is limited on what they can recycle. Each airport may have a preferred handling method and protocol for recovery. Often this has a ripple effect on inbound airlines, dictating how an airline manages its operations regarding waste at that station.

Airports may also assign airlines the handling of their own waste which brings in a third party, adding even more complexity to the process. Third-party waste and recycling services also have their own handling methods and these myriad of challenges can stem well-intentioned stakeholders from taking the lead on handling QW and NCRM. Collectively, these inconsistencies compound recovery challenges resulting in reduced program efficacies. In summary, varying protocols at each station can diminish participation and motivations. However, with all of these compounding complexities, some airports still manage to execute recovery of NCRM. Typically, only a handful of airports and airlines globally do so and in a manner which pays for and operates their material recovery.

Airports which offer NCRM and QW support for visiting airlines have been shown able to reduce their operating costs by grouping together fees and waste streams of attending airlines. Conversely, individual airlines that choose to practice recovery on their own paid the price of higher costs and handling fees to do so. Due to globally low NCRM recovery programs and reduced industry participation, typically a higher price is commanded for these programs, which drives down interest as a result and further reduces the benefit of ROI.

Due to the currently generally low number of airports managing NCRM recovery, airlines are forced to absorb the cost of carrying out waste diversion. Thus, individual airlines typically opt out of recovering NCRM altogether. This practice decreases motivation further unless stakeholders are motivated for increased environmental stewardship through a higher diversion rate. Furthermore, as airlines decline recovery participation, it reduces the throughput efficiency that would have existed otherwise.

In general, NCRM recovery in the aviation industry is low, and airports could gain economically from managing airlines' entire waste stream. An opportunity to have increased sustainability, increased diversion and cost reduction could also be realized.

In the words of one airline waste professional, “I guess there is someone across the ocean who is doing the same things as me, wondering if, when their planes land … their materials are going to get recycled.”

Aviation stakeholders have limited budgets and, while more carbon-intensive reduction initiatives take precedence over recycling programs, the industry still regards them to be necessary. Despite this, NCRM recovery has seen limited adoption to date.

Revenue-generating platforms could be used to increase sustainability as evidenced by the rising popularity with airline passengers, and the general public, of carbon emission offsets. In one study, 70.4% of airline passengers were willing to pay more than $20 to offset the carbon emissions generated during their journey (Jou, R.-C., and T.-Y. Chen. 2015). With the Business for Social Responsibility organization stating that 93% of global consumers wanting to see social or environmental issues addressed, there could be more room for advanced NCRM recovery programs funded through creative economic driven platforms.

It is evident that the global aviation industry is committed to advancing sustainability. The unification of the industry’s stakeholders could ensure seamless and uninterrupted NCRM recovery. As sustainability value in the marketplace becomes increasingly important to consumers, airlines and airports have an opportunity to capitalize on closing the gaps of NCRM recovery. Closing these gaps could add economic value to the industry's bottom line as well as add sustainability value to travelers. In doing so, the aviation industry could be in a position of greater leadership in environmental initiatives.

Abbreviations and Acronyms

AAFK	Airport, Airlines and Flight Kitchens
ACI	Airports Council International
AD	Active Disassembly
APHIS	Animal and Plant Health Inspection Service
BSE	Bovine Spongiform Encephalopathy
CBP	Customs and Border Protection (US)
CE	Circular Economy
CFIA	Canadian Food Inspection Agency
CRM	Communications Resource Management
ETOPS	Extended-range Twin-engine Operational Performance Standards
ETS	Emissions Trading System (EU)
FAA	Federal Aviation Administration (US)
FAO	Food and Agriculture Organization (UN)
FAR	Federal Aviation Regulations (US)
GHG	Greenhouse Gas
HS	High Separation
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IIFS	International In-flight Service
IRIFS	International Recyclables from In-Flight Service
IMO	International Maritime Organization
LE	Linear Economy
LPG	Landfilling as Percent of Generation
LS	Low Separation
MRF	Material Recovery Facility
MS	Medium Separation
NCRM	Non-Contaminated Recyclable Materials
NTSB	National Transportation Safety Board (US)
PPQ	Plant Protection & Quarantine
PRA	Pest Risk Analysis
QPAS	Quarantine Policy, Analysis and Support
QW	Quarantined Waste
ROI	Return on Investment
SAF	Sustainable Aviation Fuels
USDA	United States Department of Agriculture (US)
WTO	World Trade Organization

APPENDIX A – SAMPLE QUARANTINED WASTE ABSTRACTS

Canada (CAN)

Governing Body
Federal Government of Canada

Legislation Published By
The Minister of Justice

Legislations
- Health of Animals Act (S.C. 1990, c. 21), section 17
- Health of Animals Regulations (C.R.C., c.296), section 47 and subsection 105(3)
- PPA (S.C. 1990, c. 22), section 8.3
- Plant Protection Regulation (SOR/95-212), all associated regulations

Regulation/Policy Name(s)
International Waste Directive (TAHD-DSAT-IE-2002-17-6)

Waste Name
International Waste (IW)

Regulation/Policy Published
October 15, 2012

Operating Procedures
International Waste Standard Operating Procedure

Enforcing Body (EB)
Canadian Border Services Agency (CBSA)
Monitors: Collection, transport, storage, disposal of International Waste (IW)

Maintaining Body (MB)
CFIA
Establishes: Policies and procedures of International Waste (IW)

European Union (EU)

Incorporating Countries
Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom (including England, Scotland, Wales, Northern Ireland).

Governing Body
Council of the EU European Parliament

Legislation Published By
Official Journal of the European Union

Legislations
- A. Regulation (EC) No 1069/2009 of the European Parliament of October 21, 2009
- B. Commission Regulation (EC) No 142/2011 of the European Parliament of February 25, 2011

Regulation/Policy Name(s)
- A. Laying down health rules as regards animal by-products and derived products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Animal by-products Regulation)
- B. Implementing Regulation (EC) No 1069/2009 of the European Parliament and of the Council laying down health rules as regards animal by-products and derived products not intended for human consumption and implementing Council Directive 97/78/EC as regards certain samples and items exempt from veterinary checks at the border under that Directive

Waste Name
Catering Waste

Purpose
To prevent the spread of disease and profitability of farming
To establish rules for and to protect public and animal health
To protect the safety of the food and feed chain

Date of Issue
(October 21, 2009) Regulation (EC) No 1069/2009
(February 25, 2011) Regulation (EC) No 142/2011

Operating Procedures
Individual EU Member States

Enforcing Body (EB)
Individual EU Member States

Maintaining Body (MB)
Individual European Union Member States

The United States of America (USA)

Governing Body
US Federal Government

Legislation Published By
The Office of the Federal Register National Archives c/o USDA

Legislations
Title 7 Code of Federal Regulations 330.400
Title 7 Code of Federal Regulations 330.401
Title 7 Code of Federal Regulations 330.402
Title 7 Code of Federal Regulations 330.403
Title 9 Code of Federal Regulations 94.5

Regulation/Policy	Name(s)
7 CFR 330.400 - Regulation of certain garbage	
7 CFR 330.401 - Garbage generated on-board a conveyance	
7 CFR 330.402 - Garbage generated in Hawaii	
7 CFR 330.403 - Compliance agreement and cancelation	
9 CFR 94.5 - Regulation of certain garbage	

Waste Name
Regulated Garbage

Purpose
To prevent the spread of dangerous plant diseases and insect pests specified in §§ 318.13, 318.58, and 318.82 or other plant pests which exist in these areas. Also, to prevent the dissemination of plant pests and livestock and poultry diseases, garbage is regulated as otherwise provided in this part because of international movements of means of conveyance (USDA. APHIS. 2006).

Regulation/Policy Published
(January 1, 1998) Title 7 Code of Federal Regulations 330.400
(January 1, 2011) Title 7 Code of Federal Regulations 330.401
(January 1, 2011) Title 7 Code of Federal Regulations 330.402
(January 1, 2014) Title 7 Code of Federal Regulations 330.403
(January 1, 1998) Title 9 Code of Federal Regulations 94.5

Operating Procedures
Plants for Planting Manual, Animal Product Manual
Federally Recognized State Managed Phytosanitary (FRSMP)

Enforcing Body (EB)
U.S. CBP

Maintaining Body (MB)
APHIS
PPQ
Quarantine Policy, Analysis and Support (QPAS)

Code of Federal Regulations (USA)

Title 9 - Animals and Animal Products
Volume: 1 Date: 2012-01-01 Original Date: 2012-01-01

Title: Section 94.5 - Regulation of Certain Garbage.

Context: Title 9 - Animals and Animal Products. CHAPTER I - ANIMAL AND PLANT HEALTH INSPECTION SERVICE, DEPARTMENT OF AGRICULTURE. SUBCHAPTER D - EXPORTATION AND IMPORTATION OF ANIMALS (INCLUDING POULTRY) AND ANIMAL PRODUCTS. PART 94 - RINDERPEST, FOOT-AND-MOUTH DISEASE, EXOTIC NEWCASTLE DISEASE, AFRICAN SWINE FEVER, CLASSICAL SWINE FEVER, SWINE VESICULAR DISEASE, AND BOVINE SPONGIFORM ENCEPHALOPATHY: PROHIBITED AND RESTRICTED IMPORTATIONS.

(a) ***General restrictions*** -

(1) ***Interstate movements of garbage from Hawaii and U.S. territories and possessions to the continental United States.*** Hawaii, Puerto Rico, American Samoa, the Commonwealth of the Northern Mariana Islands, the Federated States of Micronesia, Guam, the U.S. Virgin Islands, Republic of the Marshall Islands, and the Republic of Palau are hereby quarantined, and the movement of garbage therefrom to any other State is hereby prohibited except as provided in this section in order to prevent the introduction and spread of exotic plant pests and diseases.

(2) ***Imports of garbage.*** In order to protect against the introduction of exotic animal and plant pests, the importation of garbage from all foreign countries except Canada is prohibited except as provided in paragraph (c)(2) of this section.

(b) ***Definitions*** - *Agricultural waste.* By-products generated by the rearing of animals and the production and harvest of crops or trees. Animal waste, a large component of agricultural waste, includes waste (e.g., feed waste, bedding and litter, and feedlot and paddock runoff) from livestock, dairy, and other animal-related agricultural and farming practices.

Approved facility. A facility approved by the Administrator, Animal and Plant Health Inspection Service, upon his determination that it has equipment and uses procedures that are adequate to prevent the dissemination of plant pests and livestock or poultry diseases, and that it is certified by an appropriate Government official as currently complying with the applicable laws for environmental protection.

Approved sewage system. A sewage system approved by the Administrator, Animal and Plant Health Inspection Service, upon his determination that the system is designed and operated in such a way as to preclude the discharge of sewage effluents onto land surfaces or into lagoons or other stationary waters, and otherwise is adequate to prevent the dissemination of plant pests and livestock or poultry diseases, and that is certified by an appropriate Government official as currently complying with the applicable laws for environmental protection.

Carrier. The principal operator of a means of conveyance.

Continental United States. The 49 States located on the continent of North America and the District of Columbia.

Garbage. All waste material that is derived in whole or in part from fruits, vegetables, meats, or other plant or animal(including poultry) material, and other refuse of any character whatsoever that has been associated with any such material.

Incineration. To reduce garbage to ash by burning.

Inspector. A properly identified employee of the U.S. Department of Agriculture or other person authorized by the Department to enforce the provisions of applicable statutes, quarantines, and regulations.

Interstate. From one State into or through any other State.

Person. Any individual, corporation, company, association, firm, partnership, society, or joint stock company.

Shelf-stable. The condition achieved in a product, by application of heat, alone or in combination with other ingredients and/or other treatments, of being rendered free of microorganisms capable of growing in the product under non-refrigerated conditions (over 50 °F or 10 °C).

Sterilization. Cooking garbage at an internal temperature of 212 °F for 30 minutes.

Stores. The food, supplies, and other provisions carried for the day-to-day operation of a conveyance and the care and feeding of its operators.

Yard waste. Solid waste composed predominantly of grass clippings, leaves, twigs, branches, and other garden refuse.

(c) *Garbage generated on-board a conveyance* -

(1) *Applicability.* This section applies to garbage generated on-board any means of conveyance during international or interstate movements as provided in this section and includes food scraps, table refuse, galley refuse, food wrappers or packaging materials, and other waste material from stores, food preparation areas, passengers' or crews' quarters, dining rooms, or any other areas on the means of conveyance. This section also applies to meals and other food that were available for consumption by passengers and crew on an aircraft but were not consumed.

(i) Not all garbage generated on-board a means of conveyance is regulated for the purposes of this section. Garbage regulated for the purposes of this section is defined as “regulated garbage” in paragraphs (c)(2) and (c)(3) of this section.

(ii) Garbage that is commingled with regulated garbage is also regulated garbage.

(2) *Garbage regulated because of movements outside the United States or Canada.* For purposes of this section, garbage on or removed from a means of conveyance is regulated garbage, if, when the garbage is on or removed from the means of conveyance, the means of conveyance has been in any port outside the United States and Canada within the previous 2-year period. There are, however, two exceptions to this provision. These exceptions are as follows:

(i) *Exception 1: Aircraft.* Garbage on or removed from an aircraft is exempt from requirements under paragraph (c)(4) of this section if the following conditions are met when the garbage is on or removed from the aircraft:

(A) The aircraft had previously been cleared of all garbage and of all meats and meat products, whatever the country of origin, except meats that are shelf-stable; all fresh and condensed milk and cream from countries designated in § 94.1 as those in which foot-and-mouth disease exists; all fresh fruits and vegetables; and all eggs; and the items previously cleared from the aircraft as prescribed by this paragraph have been disposed of according to the procedures for disposing of regulated garbage, as specified in paragraphs (c)(4)(ii) and (c)(4)(iii) of this section.

(B) After the garbage and stores referred to in paragraph (c)(2)(i)(A) of this section were removed, the aircraft has not been in a non-Canadian foreign port.

(ii) *Exception 2: Other conveyances.* Garbage on or removed in the United States from a means of conveyance other than an aircraft is exempt from requirements under paragraph (c)(4) of this section if the following conditions are met when the garbage is on or removed from the means of conveyance:

(A) The means of conveyance is accompanied by a certificate from an inspector stating the following:

(1) That the means of conveyance had previously been cleared of all garbage and of all meats and meat products, whatever the country of origin, except meats that are shelf-stable; all fresh and condensed milk and cream from countries designated in § 94.1 as those in which foot-and-mouth disease exists; all fresh fruits and vegetables; and all eggs; and the items previously

cleared from the means of conveyance as prescribed by this paragraph have been disposed of according to the procedures for disposing of regulated garbage, as specified in paragraphs (c)(4)(ii) and (c)(4)(iii) of this section.

(2) That the means of conveyance had then been cleaned and disinfected in the presence of the inspector; and

(B) Since being cleaned and disinfected, the means of conveyance has not been in a non-Canadian foreign port.

(3) ***Garbage regulated because of certain movements to or from Hawaii, territories, or possessions.*** For purposes of this section, garbage on or removed from a means of conveyance is regulated garbage, if at the time the garbage is on or removed from the means of conveyance, the means of conveyance has moved during the previous 1-year period, either directly or indirectly, to the continental United States from any territory or possession or from Hawaii, to any territory or possession from any other territory or possession or from Hawaii, or to Hawaii from any territory or possession. There are, however, two exceptions to this provision. These exceptions are as follows:

(i) ***Exception 1: Aircraft.*** Garbage on or removed from an aircraft is exempt from requirements under paragraph (c)(4) of this section if the following two conditions are met when the garbage is on or removed from the aircraft:

(A) The aircraft had been previously cleared of all garbage and all fresh fruits and vegetables, and the items previously cleared from the aircraft as prescribed by this paragraph have been disposed of according to the procedures for disposing of regulated garbage, as specified in paragraphs (c)(4)(ii) and (c)(4)(iii) of this section.

(B) After the garbage and stores referred to in paragraph (c)(3)(i)(A) of this section were removed, the aircraft has not moved to the continental United States from any territory or possession or from Hawaii, to any territory or possession from any other territory or possession or from Hawaii, or to Hawaii from any territory or possession.

(ii) ***Exception 2: Other conveyances.*** Garbage on or removed from a means of conveyance other than an aircraft is exempt from requirements under paragraph (c)(4) of this section if the following two conditions are met when the garbage is on or removed from the means of conveyance:

(A) The means of conveyance is accompanied by a certificate from an inspector stating that the means of conveyance had been cleared of all garbage and all fresh fruits and vegetables, and the items previously cleared from the means of conveyance as prescribed by this paragraph have been disposed of according to the procedures for disposing of regulated garbage, as specified in paragraphs (c)(4)(ii) and (c)(4)(iii) of this section.

(B) After being cleared of the garbage and stores referred to in paragraph (c)(3)(ii)(A) of this section, the means of conveyance has not moved to the continental United States from any territory or possession or from Hawaii; to any territory or possession from any other territory or possession or from Hawaii; or to Hawaii from any territory or possession.

(4) ***Restrictions on regulated garbage.***

(i) Regulated garbage may not be disposed of, placed on, or removed from a means of conveyance except in accordance with this section.

(ii) Regulated garbage is subject to general surveillance for compliance with this section by inspectors and to disposal measures authorized by the PPA and the AHPA to prevent the introduction and dissemination of pests and diseases of plants and livestock.

(iii) All regulated garbage must be contained in tight, covered, leak-proof receptacles during storage on-board a means of conveyance while in the territorial waters, or while otherwise within the territory of the United States. All such receptacles shall be contained inside the guard rail if on a watercraft. Such regulated garbage shall not be unloaded from such means of conveyance in the United

States unless such regulated garbage is removed in tight, covered, leak-proof receptacles under the direction of an inspector to an approved facility for incineration, sterilization, or grinding into an approved sewage system, under direct supervision by such an inspector, or such regulated garbage is removed for other handling in such manner and under such supervision as may, upon request in specific cases, be approved by the Administrator as adequate to prevent the introduction and dissemination of plant pests and animal diseases and sufficient to ensure compliance with applicable laws for environmental protection. *Provided that,* a cruise ship may dispose of regulated garbage in landfills at Alaskan ports only, if and only if the cruise ship does not have prohibited or restricted meat or animal products on-board at the time it enters Alaskan waters for the cruise season, and only if the cruise ship, except for incidental travel through international waters necessary to navigate safely between ports, remains in Canadian and U.S. waters off the west coast of North America, and calls only at continental U.S. and Canadian ports during the entire cruise season.

(A) Application for approval of a facility or sewage system may be made in writing by the authorized representative of any carrier or by the official having jurisdiction over the port or place of arrival of the means of conveyance to the Administrator, Animal and Plant Health Inspection Service, U.S. Department of Agriculture, Washington, DC 20250. The application must be endorsed by the operator of the facility or sewage system.

(B) Approval will be granted if the Administrator determines that the requirements set forth in this section are met. Approval may be denied or withdrawn at any time, if the Administrator determines that such requirements are not met, after notice of the proposed denial or withdrawal of the approval and the reasons therefor, and an opportunity to demonstrate or achieve compliance with such requirements, has been afforded to the operator of the facility or sewage system and to the applicant for approval. However, approval may also be withdrawn without such prior procedure in any case in which the public health, interest, or safety requires immediate action, and in such case, the operator of the facility or sewage system and the applicant for approval shall promptly thereafter be given notice of the withdrawal and the reasons therefore and an opportunity to show cause why the approval should be reinstated.

(iv) The PPQ Programs and Veterinary Services, Animal, and Plant Health Inspection Service, will cooperate with other Federal, State, and local agencies responsible for enforcing other statutes and regulations governing disposal of the regulated garbage to the end that such disposal shall be adequate to prevent the dissemination of plant pests and livestock or poultry diseases and comply with applicable laws for environmental protection. The inspectors, in maintaining surveillance over regulated garbage movements and disposal, shall coordinate their activities with the activities of representatives of the U.S. Environmental Protection Agency and other Federal, State, and local agencies also having jurisdiction over such regulated garbage.

(d) ***Garbage generated in Hawaii*** -

(1) ***Applicability.*** This section applies to garbage generated in households, commercial establishments, institutions, and businesses prior to interstate movement from Hawaii, and includes used paper, discarded cans and bottles, and food scraps. Such garbage includes, and is commonly known as, municipal solid waste.

(i) Industrial process wastes, mining wastes, sewage sludge, incinerator ash, or other wastes from Hawaii that the Administrator determines do not pose risks of introducing animal or plant pests or diseases into the continental United States are not regulated under this section.

(ii) The interstate movement from Hawaii to the continental United States of agricultural wastes and yard waste (other than incidental amounts (less than 3 percent) that may be present in municipal solid waste despite reasonable efforts to maintain source separation) is prohibited.

(iii) Garbage generated on-board any means of conveyance during interstate movement from Hawaii is regulated under paragraph (c) of this section.

(2) ***Restrictions on interstate movement of garbage.*** The interstate movement of garbage generated in Hawaii to the continental United States is regulated as provided in this section.

(i) The garbage must be processed, packaged, safeguarded, and disposed of using a methodology that the Administrator has determined is adequate to prevent the introduction and dissemination of plant pests into noninfested areas of the United States.

(ii) The garbage must be moved under a compliance agreement in accordance with paragraph (e) of this section. APHIS will only enter into a compliance agreement when the Administrator is satisfied that the Agency has first satisfied all its obligations under the National Environmental Policy Act and all applicable Federal and State statutes to fully assess the impacts associated with the movement of garbage under the compliance agreement.

(iii) All such garbage moved interstate from Hawaii to any of the continental United States must be moved in compliance with all applicable laws for environmental protection.

(e) ***Compliance agreement and cancelation*** - (1) Any person engaged in the business of handling or disposing of garbage in accordance with this section must first enter into a compliance agreement with the APHIS. Compliance agreement forms (PPQ Form 519) are available without charge from local USDA/APHIS/Plant Protection and Quarantine offices, which are listed in telephone directories.

(2) A person who enters into a compliance agreement, and employees or agents of that person, must comply with the following conditions and any supplemental conditions which are listed in the compliance agreement, as deemed by the Administrator to be necessary to prevent the introduction and dissemination into or within the United States of plant pests and livestock or poultry diseases:

(i) Comply with all applicable provisions of this section;

(ii) Allow inspectors access to all records maintained by the person regarding handling or disposal of garbage, and to all areas where handling or disposal of garbage occurs;

(iii)

(A) If the garbage is regulated under paragraph (c) of this section, remove garbage from a means of conveyance only in tight, covered, leak-proof receptacles;

(B) If the garbage is regulated under paragraph (d) of this section, transport garbage interstate in sealed, leak-proof packaging approved by the Administrator;

(iv) Move the garbage only to a facility approved by the Administrator; and

(v) At the approved facility, dispose of the garbage in a manner approved by the Administrator and described in the compliance agreement.

(3) Approval for a compliance agreement may be denied at any time if the Administrator determines that the applicant has not met or is unable to meet the requirements set forth in this section. Prior to denying any application for a compliance agreement, APHIS will provide notice to the applicant thereof, and will provide the applicant with an opportunity to demonstrate or achieve compliance with requirements.

(4) Any compliance agreement may be canceled, either orally or in writing, by an inspector whenever the inspector finds that the person who has entered into the compliance agreement has failed to comply with this section. If the cancelation is oral, the cancelation and the reasons for the cancelation will be confirmed in writing as promptly as circumstances allow. Any person whose compliance agreement has been canceled may appeal the decision, in writing, within 10 days after receiving written notification of the cancelation. The appeal must state all of the facts and reasons upon which the person relies to show that the compliance agreement was wrongfully canceled. As promptly as circumstances allow, the Administrator will grant or deny the appeal, in writing, stating the reasons for the decision. A hearing will be held to resolve any conflict as to any material fact. Rules of practice concerning a hearing will be adopted by the Administrator. This administrative remedy must be exhausted before a person can file suit in court challenging the cancelation of a compliance agreement.

(5) Where a compliance agreement is denied or canceled, the person who entered into or applied for the compliance agreement may be prohibited, at the discretion of the Administrator, from handling or

disposing of regulated garbage. (Approved by the Office of Management and Budget under control numbers 0579-0015, 0579-0054, and 0579-0292) [71 FR 49317, Aug. 23, 2006]

(United States Department of Agriculture. 2006).

Germany (GER)

Governing Body
Bundestag (Parliament)

Legislation Published By
Bundestag

Legislations
- (Kreislaufwirtschaftsgesetz - KrWG) "Circular Economy Act of 24 February 2012 (Federal Law Gazette I, p. 212), which has been amended by Article 2 (9) of the Law of 20 July 2017 (Federal Law Gazette I, p. 2808)
- (Gewerbeabfallverordnung - GewAbfV) "Commercial Waste Ordinance of 18 April 2017 (Federal Law Gazette I p. 896), which has been amended by Article 2 (3) of the Act of 5 July 2017 (Federal Law Gazette I p. 2234)
- (TierNebG) "Tierische Nebenprodukte-Entsbeungsgesetz" of January 25, 2004 (Federal Law Gazette I, p. 82), which was last amended by Article 1 of the Act of 4 August 2016 (Federal Law Gazette I, p. 1966

Regulation/Policy Name(s)
- (Kreislaufwirtschaftsgesetz - KrWG) Law for the Promotion of Recycling and Safeguarding the Environmentally Sound Management of Waste
- (Gewerbeabfallverordnung - GewAbfV) Ordinance on the management of commercial settlements and certain construction and demolition waste
- (TierNebG) Animal by-products elimination legislation

In Conjunction with EU Regulations (Germany. 2012)
This Act is designed to implement Regulation (EC) No 1069/2009 of the European Parliament and of the Council of 21 October 2009 laying down the health rules for animal by-products not intended for human consumption and repealing Regulation (EC) No 1774/2002 (Regulation on animal by-products) (OJ L 300, 14.11.2009, p. 1, L 348, 4.12.2014, p. 31), most recently amended by Regulation (EU) No 1385/2013 (OJ L 354, p 86), and directly or indirectly adopted acts of the European Community or of the European Union adopted within its framework or for its implementation.

Waste Name
Waste for Disposal

Purpose
§ 1 Purpose of the Act - to promote the recycling of natural resources and to ensure the protection of man and the environment in the production and management of waste. The prevention of waste, recycling of waste, disposal of waste and other waste management measures. **Error! Bookmark not defined.**

Regulation/Policy Published
(February 24, 2012) KrWG
(April 18, 2017) GewAbfV
(January 25, 2004) TierNebG

United Kingdom (GBR)

Incorporating Countries (Exceptions)
England, Scotland, Wales (not Northern Ireland in some cases)

Governing Body

Government of the United Kingdom, Scotland, Wales and the EU

Legislation Published By
Secretary of State

Regulation/Policy Name
Article 5 of Commission Regulation (EC) No. 811/2003 European Parliament and of the Council
The Animal By-Products Regulations 2005 No. 2347 (NB: Changes to the legislation are being made)
The Animal By-Products (Enforcement) (Wales) Regulations 2014 No. 517 (W. 60) Wales Statutory
The Animal By-Products (Enforcement) (Scotland) Regulations 2013 No. 307 Scottish Statutory Instruments
The Animal By-Products Regulations 2005 No. 2347 UK Statutory Instruments
The Animal By-Products (Enforcement) (England) Regulations 2011 No. 881

Legislations (DAFRA/EU)
- The Animal By-Products (Enforcement) (England) Regulations 2011 (SI 2011/881):
- Regulation (EC) 1069/2009:
- Regulation (EC) 142/2011:
- The TSE (England) Regulations 2010

Waste Name
ICW, Category 1 Waste and Animal by-products (ABPs).

Regulation/Policy Published
Published: September 4, 2014
Updated: November 6, 2014

Purpose
To ensure the disposal of ABPs prevents a disease outbreak.
To ensure protection of water, air, soil, plants and animals
To ensure noise or odors are minimized
To ensure adverse effect to the countryside (special interest) does not occur

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