



closing the loop

# Road Map for Effective Material Value Recovery

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## Road Map | Executive Summary

Closed-loop material value recovery refers to the efficient collection and reprocessing of used materials for re-use in the next generation of products. Effective recovery preserves the embodied value and environmental safety of materials throughout their life-cycle. This is especially true for used packaging materials. The best recovery opportunities for packaging materials at end-of-life – the most effective ways to preserve their value – are determined by a combination of factors, including policy, funding, infrastructure and technology, geography and demographics, and market forces. A focus on only one type of material, one recovery method, one part of the packaging supply chain, or one part of the country will simply not be able to create the kind of change necessary to capture the material and economic value of the packaging materials we use on a daily basis. The relative success of packaging recycling programs in the European Union suggests that strong, cross-border policies, such as the EU Waste Framework Directive and the Packaging and Packaging Waste Directive, can provide the necessary framework under which efficient packaging material recovery systems operate.

European nations tend to harmonize within their borders as well; some require stewardship organizations to serve the entire country with collection, sorting and reprocessing infrastructure. Australia and Ontario, Canada provide additional examples of recovery systems working towards harmonization but operating outside of the European context. In the United States, however, because waste has traditionally been managed at the local level, jurisdictions develop different priorities and practices, resulting in conflicting infrastructures, interests, and incentives. A notable example: while neighboring rural and urban recycling systems share geography and face similar challenges – reducing transportation costs, securing adequate funding, building a recycling constituency – both may suffer from weak links between their jurisdictions. Noting the prevalent gaps in US recycling systems offers opportunities for useful critiques; noting the many successes around the world within various country, state, and municipal systems identifies practical innovations and emerging best practices – a harmonized systems approach, a four- or five-bin collection system, investment in state of the art sorting technology, extended producer responsibility legislation, “hub and spoke” regional recycling – that may be applied nationwide across the US, and for the purposes of this report, in California.



According to the United States Environmental Protection Agency, during the calendar year 2009, packaging materials and printed paper represented, by weight, more than half of the municipal solid waste generated in the United States. Organic yard and food waste represented another third.

Together, these waste streams account for fully 80 percent of the municipal solid waste in the United States, much of which could be diverted from landfills by an efficient residential collection system. A well-designed system, in fact, could ultimately convert one-way waste streams into closed-loop flows of valuable, re-usable packaging materials. In the United States, however, value-laden material flows are largely untapped. Indeed, in 2009, the U.S. recovered only about one third of all municipal solid waste by recycling or composting. The rest was thrown away.

Recognizing the limitations of a waste management system that squanders natural resources, ignores embodied energy, and demands perpetual investments in new packaging, GreenBlue embarked upon a research project designed to explore alternatives. Funded by California's Market Development Research Grant Program with additional support from GreenBlue's Sustainable Packaging Coalition, the project, called "Closing the Loop", applies a systems approach to the critical analysis of existing material recovery systems. Along with analysis, it provides information and strategic thought that could significantly increase the value recovery potential of all types of packaging at end-of-life, the foundation of closed-loop systems.

Closed-loop material value recovery refers, first of all, to the efficient recovery of used packaging (and other materials) for re-use in the next generation of packaging products. Efficient recovery and re-use preserves the embodied value of materials – previous investments in natural resources and energy, for example – minimizing the need for future inputs. Well-managed value recovery depends on effective coordination of information and technical specifications along the entire supply chain, from material manufacture through recovery. Currently, packaging supply chains, like waste management systems, are not designed for efficient material recovery, leaving the potential value of closed-loop material flows merely a potential value.

A systems approach to value recovery can bring order and coherence to fragmented material flows. Typically, technologies, economics, business models, and policy contexts vary according to material-type and end-of-life options. Along with variance, limited scope is common; most organizations and interest groups tend to focus on a single material type, packaging format or recovery regime. In addition, because waste has been traditionally managed at the local level in the United States, each community has developed different priorities and practices, resulting in often conflicting infrastructures, interests, and incentives.

A systems approach, however, looks at *all* materials, packaging formats, and end-of-life options, both within and across distinct supply chains and recycling platforms. By applying systems thinking to the life-cycle of packaging, "Closing the Loop" attempts to lay out a comprehensive framework for organizing closed-loop material flows, bringing to today's promising, but fragmented, recycling landscape a strategic vision for effective material value recovery.

To do this, "Closing the Loop" accomplished three things:

1. *Guide to Packaging Material Flows and Terminology* graphically portrays the flow of packaging materials through the municipal solid waste stream and presents a packaging vocabulary, the foundation of a clear, consistent, supply-chain language.
2. *Design for Recovery Guidelines for Aluminum, Glass, Paper and Steel Packaging* provides packaging designers with information about how different treatments to, or components of, packaging added during the design phase affect the package's recyclability and compostability.
3. *Labeling for Packaging Recovery* explores various labeling systems and presents a vision of a recycling label that clearly communicates to consumers what they should do with their packaging when they are done using it.

In this final "Closing the Loop" report, Road Map for Effective Material Value Recovery (Road Map), research findings on international packaging recovery systems are examined through the systems-approach lens. The report analyzes not only the infrastructure of various systems, including collection, sorting, and reprocessing technology, but also the waste management policies that support or limit recycling. Focusing on material recovery in four European Union nations, as well as Australia and Ontario, Canada, the "Road Map" presents a series of snapshots of advanced recycling systems and best practices that could improve packaging recovery in the United States.

While much of the Road Map is focused on urban areas, it also includes a section on recovering packaging materials in rural settings. A comprehensive framework for value recovery is by definition inclusive, and given the diverse geographies of the United States, must address the unique challenges of recycling in rural communities.

GreenBlue hopes the Road Map will provide a framework for radically increasing both the quantity of packaging materials recovered and the demand for recycled materials in package design. Unfortunately, a true closed-loop material value recovery system will not be achieved without alignment throughout the supply chain, from package design to recycling. Clear labeling for recovery, standardized collection practices across jurisdictions, investment in efficient processing technologies, and effective waste management policies must be taken into consideration. Whereas small, incremental technological advances and policy shifts create local, short-term wins, a truly closed-loop system will only emerge in the context of comprehensive change.

### Introduction

On the road to comprehensive change, what supports or limits success? Some countries, states, and jurisdictions have been able to achieve high material recovery rates, while others struggle to provide basic recycling services. Still others ignore the issue altogether. What accounts for the difference? What most strongly influences the performance of material recovery systems?

- The kind of collection bins provided?
- The frequency of collection?
- The sorting and processing equipment in place?
- The local economy, demographics and manufacturing industry?
- The flexibility adapt to new materials and recovery technologies?
- The attitude of residents and the culture of corporations?

The answer may well be: All of the above.

First and foremost, the underlying values of a society determine its priorities. In a world in which the scarcity of water, minerals, energy, and even food, is routinely discussed, is the recovery of materials important for environmental, economic or political reasons? What is most important about resource protection and waste management? How are “protection” and “management” defined?

The answers to questions such as these set priorities and drive action. For example, some cities and states have implemented “zero-waste” programs, diverting materials from landfills or setting targets for packaging recovery and re-use. Others prioritize the economics of recycling, collecting materials that are currently valuable. Still others set targets based on the quantity or quality of materials collected.

There is, of course, no one, correct way to work towards a closed-loop material recovery system. The world of packaging is in constant flux. New materials are rapidly created and introduced to the market, with new sorting and recycling technology developed to recover them. The flexibility of a recovery system is critical. One that adapts to local conditions and changes with the packaging industry can consistently optimize value recovery.

The Road Map presents a vision of material recovery in a closed-loop recycling system. The information provided may well be provocative, but may also spark communication between industry, government, public-interest organizations, and consumers who value the stewardship of natural resources. Ideally, the conversation will cross jurisdictions and state lines, and ultimately create an effective material recovery system both coordinated on the national level and sensitive to local needs. It is our hope that the Road Map will be an instrumental guide on the path toward sustainability.

### Methodology

From 2008 through 2011, GreenBlue researched packaging recovery systems worldwide – how they operate, their levels of success and best and worst practices, as well as underlying waste recovery policies throughout Europe and in Australia and Canada.

Primary research included:

- telephone and email interviews;
- in-person interviews with local, state, and national government agencies, packaging producers and retailers, private recycling and waste management organizations, non-profit organizations;
- site visits to material recovery facilities, industrial composting facilities, a waste-to-energy plant, and paper, glass, and plastic reprocessing plants.

The research was conducted in Austria, Belgium, Germany, Switzerland, the United Kingdom, and the Australian states of South Australia, New South Wales, and Victoria. Various US states, Ontario, Canada, and the Netherlands were not visited, but were researched with telephone interviews. Country and site visits were selected for a variety of reasons, including the presence of well-established packaging recovery systems with high recovery rates, perceived best practices, cutting edge technology or infrastructure, and potential comparability to the U.S in terms of geography and culture.

Austria, the Netherlands, and California are described in condensed profiles. In Austria, the only aspect of waste management studied was waste-to-energy, which is the resulting focus of the profile. A brief description of the Netherlands’ packaging tax highlights that country’s unique method of funding its packaging recovery system. A full profile for California was not possible due to lack of available packaging recovery data. However, a modified profile of California’s packaging recovery system is included to better enable comparisons with other systems.



### 2008 Municipal Solid Waste

The municipal solid waste statistics for many of the countries discussed below are presented here. The 2008 data are the most current data available for most countries to enable a comparison.

	Population 2008	Generated (kg/capita)	Total Waste Treated (kg/capita)*	Landfilled (kg/capita)	Total Incinerated (incl energy recovery) (kg/capita)	Material (mechanical) recycling (kg/capita)	Other recycling (including composting) (kg/capita)
Australia**	21,015,000	606	606	364	0	242***	
Belgium	10,666,866	489	472	25	171	164	112
Germany	82,217,837	589	565	3	186	277	98
UK	61,191,951	544	541	287	56	127	72
Switzerland	7,593,494	735	735	0	368	246	121
Ontario, Canada	12,932,300	962	962	723	22 (est)	138	79
US	304,060,000	745	745	402.3	94.4	182	66.2

(Eurostat, 2011c; Statistics Canada, 2010b; Eurostat, 2011a; U.S. Environmental Protection Agency (USEPA), 2009; Environment Protection and Heritage Council (EPHC), 2010)

\*\*“Total Waste Treated” may not equal “Generated” due to exports.

\*\*The most current municipal solid waste data for Australia is for years 2006-2007.

\*\*\*In Australia, the recycling statistic includes composting.



Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
<b>Overarching Policy</b>	<p>Belgium is subject to the EU's Landfill Directive, Waste Directive, and Packaging and Packaging Waste Directive. Belgium has a packaging tax on beverages, but no container deposit program. Belgium also has PAYT trash collection.</p>	<p>The UK is subject to the EU's Landfill Directive, Waste Directive, and Packaging and Packaging Waste Directive.</p>	<p>Germany is subject to the EU's Landfill Directive, Waste Directive, and Packaging and Packaging Waste Directive.</p> <p>Germany has a container deposit program for both refillable and one-way containers; refillables are encouraged over one-way containers via deposit price. Germany also has PAYT trash collection.</p>	<p>Switzerland is not part of the EU, so does not have to comply with EU Directives. There is no comprehensive Swiss packaging legislation. The Beverage Containers Ordinance (2000) sets recycling targets for materials used in beverage containers. The Technical Ordinance on Waste requires all non-recyclable waste to be treated (typically by incineration) prior to landfilling.</p>	<p>Jurisdiction over waste and recycling resides at the state/territory level.</p> <p>Since 1999, Australia has had a voluntary initiative to reduce environmental effects of packaging on the environment - the Australian Packaging Covenant (originally National Packaging Covenant). Signatories are industry, as well as local, state, federal government, industry associations, and NGOs. Companies who don't participate in the Covenant are subject to regulation under the National Environment Protection Measure on Used Packaging Material (NEPM). In 2011, Australia passed framework National Product Stewardship legislation, with televisions and computers as the first products to be regulated.</p>	<p>In Canada, waste is managed at the provincial level. In 2002, the Ontario Waste Reduction Act was passed that obligated industry to pay into a fund that would be used to run a recycling program. This Act created a level playing field for the packaging industry, and also created Waste Diversion Ontario, a provincial government body that develops and regulates waste management programs. WDO authorized Stewardship Ontario as the stewardship organization that would run the Blue Box program for packaging and printed paper.</p> <p>In 2009, the Canadian Council of Ministers of the Environment approved a Canada-wide Action Plan on Extended Producer Responsibility and a Sustainable Packaging Strategy. While not legally binding, the ministers encourage each province to adopt these practices in provincial-level legislation to encourage harmonization of EPR for packaging programs across Canada.</p>
<b>What Is Packaging?</b>	<p>Packaging included in the Belgian system is dealt with separately for household and commercial packaging. Fost Plus the organization is responsible for recovering all household packaging, discussed in this report. A separate stewardship organization, Val-i-pak, recovers commercial packaging.</p>	<p>In the UK, all packaging is included in the recovery system: household, commercial, and industrial.</p>	<p>Packaging is defined as all sales packaging put on the market, including commercial and institutional. It includes service packaging (which helps get items into the hands of end users, like shopping bags and mailing cartons). Transport packaging (which does not go home with end user) is disposed of by manufacturers and distributors.</p>	<p>The packaging types covered by the Beverage Containers Ordinance are: aluminum cans, PET bottles, and glass bottles. Swiss municipalities and packaging material associations also collect paper and board, steel, and non-beverage container aluminum and glass for recycling. The only plastic packaging collected for recycling is PET bottles.</p>	<p>Under the APC, packaging is only retail consumer product packaging and the associated distribution packaging; no commercial, institutional, or business-to-business packaging is included.</p>	<p>According to the 2002 Waste Diversion Act, Designated Blue Box Waste is packaging and/or printed material that consists of one or a combination of glass, metal, paper, plastic, or textiles and that is potentially disposed of in the Ontario municipal residential waste system.</p>



## Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
End-of-life Options	<p>Recovery and recycling are defined by the EU. Recovery is material recycling plus energy recovery plus composting.</p>	<p>Recovery and recycling are defined by the EU. Recovery is material recycling plus energy recovery plus composting.</p>	<p>Recovery and recycling are defined by the EU. Recovery is material recovery plus energy recovery plus composting.</p>	<p>The only end-of-life requirement (for only certain types of packaging) is a recycling rate. All remaining municipal solid waste is incinerated. In 2008, about half of Swiss municipal solid waste was recycled and half was sent to incineration with energy recovery. No untreated waste may be landfilled.</p>	<p>Recycling, composting and landfill are the only options.</p> <p>There are no large scale incineration or incineration with energy recovery facilities in Australia, although some cement kilns there do accept waste as fuel.</p> <p>Two states, South Australia and Northern Territory, have container deposit legislation and both have plastic bag bans. SA also has a landfill ban on packaging materials (glass, paper/board, metals, PET and HDPE; other plastic packaging to be phased in). SA also has higher landfill tipping fees than other states.</p>	<p>Incineration with energy recovery is not a common end-of-life option in Ontario. In 2006, 3% of municipal solid waste not diverted for recycling or composting was incinerated, with the remaining 97% landfilled. Ontario has made investments in anaerobic digestion technology for organic waste.</p> <p>In Ontario, recovery is defined as materials diverted from landfill for recycling.</p>
Packaging Waste Targets	<p>Belgium must meet the EU recycling and recovery targets (combined and material-specific). The EU targets are a minimum recovery of 60%, minimum recycling of 55%. Belgian targets are 80% recycling and 90% recovery rate. Material specific recycling: 60% paper/board, 60% glass, 50% metals, 22.5% plastics, 15% wood.</p>	<p>UK must meet the EU recycling and recovery targets (combined and material-specific). Minimum recovery is 60%, minimum recycling is 55%. Material specific recycling: 60% paper/board, 60% glass, 50% metals, 22.5% plastics, 15% wood.</p>	<p>Germany must meet the EU recycling and recovery targets (combined and material-specific). The EU requires that minimum recovery is 60%, minimum recycling is 55%. Material specific recycling: 60% paper/board, 60% glass, 50% metals, 22.5% plastics, 15% wood.</p> <p>The German Packaging Ordinance set higher recycling targets for Germany than required by the EU: glass (75%), steel (70%), aluminum (60%), paper (70%), composites (60%), and plastics (60%). Germany is well above the targets for all materials.</p>	<p>75% of glass, PET, and aluminum beverage containers must be recycled annually. If this target is not met, the government can impose a mandatory deposit on those types of packaging.</p>	<p>Recycling targets for 2010: Paper/board (70-80%), glass (50-60%), plastics (30-35%), steel (60-65%), aluminum (70-75%), and non-recyclables [plastics #4-7; waxed corrugated; composite] (25%)</p> <p>Packaging to landfill must remain less than 2.54 million tonnes.</p>	<p>The Blue Box program began in 2004 with a recycling target of 50%. In 2008, the Blue Box recycling target was raised to 60%. These targets were met beginning in 2004. The new recycling target is 70% by the end of 2011.</p>

## Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
Type of System	<p>The Belgian system is a full producer responsibility system, where packaging producers pay the full amount (100%) for the collection and recycling of packaging. Industry does not only pay for the system, but also chooses how best to reach the mandated recycling targets while providing recycling service for all citizens. Municipalities share some of the costs for paper collection.</p>	<p>The UK system is an example of a shared producer responsibility system, where costs are spread along the whole packaging supply chain. Local authorities bear some of the financial responsibility for collection and also manage the tender for collection and sorting.</p> <p>Reprocessors/exporters must be accredited by the government before they can issue PRNs (for reprocessing) or PERNs (exporting for recycling). In 2011 several hundred reprocessors and exporters were actively accredited.</p>	<p>The German system is a full producer responsibility program, where producers pay the full amount for collection and recovery of packaging. Municipalities share some of the costs for paper collection.</p> <p>Nine dual systems compete for the contracts with packaging producers. Duales System Deutschland (DSD) is the largest and best-known of the dual systems. The dual systems also contract for collection and sorting of packaging.</p> <p>Germany also has a beverage container deposit program for both refillable and one-way containers, run by Deutsche Pfandsystem GmbH. Deposits for one-way containers are higher than those for refillable containers to encourage the use of refillable packaging.</p>	<p>The Swiss system can be described as shared producer responsibility. Municipalities and material industry associations share responsibility for funding collection and sorting of packaging waste. The industry associations operate voluntarily, but with the consequence that if their material is not recovered at 75%, a mandatory deposit will be levied. Producers, importers, and retailers contribute to the individual material associations to fund collection and sorting.</p>	<p>Australians call the APC a “co-regulatory” scheme, where voluntary participation in the Packaging Covenant is backed up by regulation under the Used Packaging NEPM if a producer is not a part of the Covenant. The APC is not responsible for fully funding recycling collection and processing, but contributes funds to municipalities in the form of grants. Municipalities are responsible for recycling collection and processing.</p> <p>Two states (South Australia and Northern Territory) have container deposit programs.</p>	<p>Ontario has a shared producer responsibility system, with industry stewards and municipalities each contributing 50% of the cost of the Blue Box program. The program is operated by the municipalities. Obligated stewards are brand owners, franchisers, first importers, or manufacturers that supply packaging to the market.</p> <p>There has been some movement toward changing the system to a full producer responsibility system, where obligated stewards pay 100% of the costs of the system. This movement is on hold pending provincial elections.</p> <p>Ontario also has the Ontario Deposit Return program, a deposit system, for most beer, wine, and spirit containers (including aseptic and bag-in-box cartons).</p>

Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
Producer Organization	<p>Fost Plus is a non-profit organization that was established by the packaging industry to fulfill household packaging take-back obligations. (Val-i-pak is a separate organization responsible for industrial packaging take-back obligations.) The Fost Plus board is made up of industry representatives.</p> <p>As of 2010, Fost Plus represents 92% of the packaging market in Belgium.</p> <p>Fost Plus has a monopoly given by the Belgian government under the Cooperation Agreement. This Cooperation Agreement was renewed in 2009 and is up for renewal in 2013. Fost Plus introduces competition into the system by running a competitive tender for curbside collection and sorting services. The fees collected from obligated producers go to contracting collection and sorting, education, and Fost Plus operations. Fost Plus owns the collected materials, and they sell them to recyclers. Profits from the sale of collected scrap packaging are used to offset producer fees.</p>	<p>Unlike most other EU systems, in the UK, all producers in the packaging supply chain share responsibility and must contribute proportionally to meet financial obligations. This includes material manufacturers, converters, brand owners/fillers, importers, and retailers. Companies can choose to meet this responsibility individually or by joining a compliance scheme. 44 compliance schemes were registered with the government in 2011.</p>	<p>In Germany, there are numerous product stewardship organizations (currently 9, including DSD) that compete to fulfill the take-back obligation of producers. All of them compete and negotiate fees directly with packaging producers as well as with collection and sorting companies. They are known as “dual systems,” because a second system for packaging waste recovery operates in parallel to the traditional waste management system. DSD is the original dual system in Germany.</p>	<p>There is no centralized packaging recovery organization in Switzerland. The material industry associations serve as “fee organizations” and collect fees from packaging producers, importers, and retailers to fund the separate material collection systems. There are seven Swiss fee organizations united under the umbrella organization Swiss Recycling: FERRO-Recycling (steel/tinplate), IGORA (household aluminum), INOBAT (household batteries), PRS PET-Recycling Schweiz (PET beverage bottles), SENS Swiss Foundation for the disposal of wastes (electrical and electronic appliances), TEXAID (textiles) and VetroSwiss (glass).</p>	<p>The National Packaging Covenant Industry Association is made up of representatives from industry associations and was the body created to hold and manage the money collected from the members of the Australian Packaging Covenant. There is also an APC Council (APCC) made up of representatives of all levels of government, industry, and NGOs, which oversees the implementation of the APC. The APC’s dual goals have been to improve curbside collection systems and determine best practices for local councils to implement. The APC’s purpose is not to fully fund collection and sorting, but to supplement these services with grants.</p>	<p>Stewardship Ontario is a private, not-for-profit organization that develops, funds, and operates Ontario’s Blue Box Program for packaging and printed paper. It is also known as an Industry Funding Organization, as it represents the packaging industry and uses the collected industry fees to operate the packaging stewardship program. Waste Diversion Ontario is a corporation that cooperates with the Stewardship Ontario to develop a waste diversion plan for the designated waste (packaging and printed paper).</p>

## Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
Fees/Funding	<p>The fees paid by packaging producers are set by Fost Plus, the stewardship organization responsible for fulfilling the packaging industry's take-back obligation in Belgium. Fost Plus also licenses the Green Dot symbol in Belgium. The fees are known as Green Dot fees, and they apply to all household packaging put on the market in Belgium, except for the packaging of companies that fall within the de minimis rule.</p> <p>Fees are based on material type (ease of recyclability) and the weight of the package. Fost Plus publishes the fees on its website and in its annual reports.</p> <p>De minimis rule: If a company puts less than 300 kg of packaging on the market in a year, they are exempt from participating in Fost Plus and do not have to pay fees.</p>	<p>Financing of recycling happens through operation of a tradable permit program. Recycling certificates (PRN - Packaging Waste Recovery Note; PERN - Packaging Waste Export Recovery Note) are electronically issued by reproprocessors or exporters for each tonne of material collected. Each obligated company must purchase PRNs individually or through a compliance scheme based on how much packaging they put on the market each year. The cost of certificates is determined on the open market and is generally understood to represent the cost of collecting and recovering that material. Certificate revenue is supposed to be used to increase recycling infrastructure (collection, sorting, reprocessing, or developing end markets) but lack of transparency in how the money is spent is leading to more transparency and a revision of the PRN system.</p> <p>The UK does not require participation in the Green Dot system, and the Green Dot is not required to be displayed on packaging. However, there are organizations that license the Green Dot in the UK.</p>	<p>Fees are paid by packaging producers to a dual system (so-called because it operates alongside the traditional garbage collection system) and are based on type and weight of packaging material. Dual systems compete to offer packaging producers the lowest fees.</p> <p>In Germany, the fee to license the Green Dot label for use on packaging has been separated from the fees paid to dual systems for collection and sorting. In order to use the Green Dot symbol on packaging, companies must pay a license fee to DSD, the Green Dot organization in Germany.</p> <p>There is no de minimis rule in Germany, so anyone putting any amount of packaging on the market must participate in a dual system.</p>	<p>An advanced disposal fee, paid to the glass fee organization, VetroSwiss, is required for importing any glass bottles (empty or filled) for use within Switzerland. The other material associations for steel, aluminum, and PET packaging collect fees from packaging producers to fund that material's collection and sorting infrastructure. Paper and board recovery is funded by taxpayers via municipal taxes.</p> <p>A mandatory deposit is levied on refillable beverage containers and PVC beverage containers.</p>	<p>Recycling and waste collection is paid for by municipalities via taxpayers.</p> <p>Some industry funds are collected by the APC, but this fund does not (and is not intended to) pay for the costs of collection and sorting of packaging. If they choose to participate in the APC, members of the packaging supply chain pay dues based on their annual sales and position in the supply chain (not the amount or type of packaging material). Packaging manufacturers [converters] pay higher dues (2.7x) than brand owners, wholesalers, raw material suppliers, waste management companies, and other companies. Industry associations, community groups, NGOs, etc. pay one small flat fee. Companies with &lt; \$5million annual sales fall under a de minimis rule and are exempt from participation in the APC.</p> <p>Industry contributes a minimum of A\$3 million annually. State/territory governments match these dues 1:1, so ~A\$30 million dollars is collected over the 5 year APC term. The fees go to fund administration of the APC and provide grants to fund infrastructure, education, and other projects. Individual companies have a maximum contribution cap of A\$286,000.</p>	<p>Fees paid by obligated packaging industry stewards are determined by Stewardship Ontario and Waste Diversion Ontario each year. Once the fees are determined, they are applied to each steward based on the amount and type of packaging they put on the market in the previous calendar year.</p> <p>Fees are paid by industry stewards based on a rate calculated by material and weight. If sales are less than \$2 million/year, a company is exempt from participation. Packaging fee rates are available on Stewardship Ontario's website and archived back to 2003.</p> <p>In an effort to contain costs and standardize best practices, the overall cost of the Blue Box Program is determined by applying and verifying the costs of a best practice model across communities. The "best practice" costs are then split 50-50 with industry and municipalities. Some municipalities may have actual costs that are higher or lower than the best practice model.</p>

Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
Waste Management/ Role of Local Government	<p>Fost Plus manages the packaging waste collection and sorting tender process. The standard agreement is for 5 years. Local government associations receive priority over third party waste management companies if they wish to bid on a tender. In 2008, collection and sorting contracts were divided approximately 50-50% municipal associations to waste management companies. Under the contract, haulers deliver the materials to the specified recycler. Recyclers are guaranteed a certain volume and quality.</p> <p>Municipalities pay for the printed paper portion of paper collection, along with garbage and organics collection.</p>	<p>Local authorities individually manage the packaging waste collection and sorting process. They determine what materials are collected, the bin types, and frequency of service and manage the collection and sorting of packaging waste. All collection systems require separating recyclables from residual waste. They may tender sorting and collection services separately or combined. Local authorities may own and/or operate a MRF and trucks.</p>	<p>Bin type, materials collected, and collection frequency are mandated at the national level and operated by dual systems. Dual systems manage the packaging waste collection and sorting tender process, and municipalities can submit proposals for the contracts. All non-packaging waste, including garbage, organics, and other recycling, is the responsibility of municipalities. Municipalities also pay for the printed paper portion of paper collection.</p> <p>Local governments run public education campaigns about what can be recycled and to encourage public participation.</p>	<p>Municipalities play a significant role in recovering Swiss packaging waste. They determine whether packaging is collected at curbside or drop-off locations. They also perform the collection or contract with waste haulers to do so. Drop-off sites are maintained by communities for all types of recyclables, not just packaging. Municipalities also pay for the collection of paper and board, and fund curbside collections.</p>	<p>Bin type, materials collected, and collection frequency are all determined individually by local government. Some municipalities, such as those in the Melbourne metropolitan area, are joining together to standardize recycling service. Local councils enter into long-term contracts with waste management companies (7-10 years) so it can take time to change the terms of service. APC recommends a best practice of separating waste and recycling contracts.</p>	<p>Municipalities are responsible for operation of the Blue Box program. They decide which materials to collect over and above the five required materials, and they determine how to run the collection, hauling, sorting, and reprocessing of materials. They also make contracts with haulers, MRFs, and reprocessors.</p>

## Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
Collection System	<p>In Belgium, collection (bins and materials) is standardized throughout the country. Many communities have drop-off locations available for all recyclable materials and bulky and hazardous waste.</p> <p>Glass is always collected at drop-off (or “bring”) sites, distributed through communities on a per capita basis. No container deposit exists.</p> <p>Paper and board are collected at curbside once a month.</p> <p>PMD (plastic bottles, metals, drinks cartons) is collected curbside twice a month in light blue bags that consumers must purchase. No other types of plastic aside from bottles are collected for recycling.</p> <p>Fost Plus also pays to collect “household” packaging away-from-home locations, such as special events and street bins. This service is being gradually rolled out to different locations and events.</p>	<p>In the UK, collection (materials, bins, frequency) is not standard and is determined by each of the 433 local authorities in the UK.</p> <p>Landfill fees are increasing in order to make trash disposal more expensive and encourage recycling and composting. Some collection is single stream, some is two bin/paper separate, or two bin/glass separate. Some communities use multi-compartment trucks and drivers load or sort recyclables at truck-side. Glass is also dropped off at bring sites in some communities. There is no deposit system in the UK.</p> <p>According to WRAP study of costs of collection, 44% of curbside is sorted at truck; 35% is single-stream co-mingled; 11% is dual stream partially co-mingled; 10% is none of the above.</p>	<p>In Germany, collection (materials and bins) is standardized throughout the country.</p> <p>Glass is recovered at bring sites for green, brown, and clear glass.</p> <p>Paper is collected in paper containers by municipalities, who pay for the newspaper/magazine fraction and bill the dual systems for the portion that is packaging.</p> <p>Plastics, metals, and drinks cartons are collected in a yellow bin or bag. A “yellow bin plus” program is being piloted to let consumers put non-packaging plastic or metal items in the yellow bin, such as plastic toys or housewares and metal items like cookware or tools. This may change to an orange bin.</p> <p>A black bin is available for the remaining trash, collection of which is a local responsibility and paid for through local fees and taxes.</p> <p>A green bin is used to collect organics. This is done locally by municipalities in about 50% of the country.</p> <p>Yellow bags/bins are provided free to consumers and paid for by DSD fees.</p>	<p>In Switzerland, the collection method is not standardized nationally, allowing for local flexibility. However, the materials collected are standard around the country. Glass, steel, aluminum, paper and board, and PET bottles are collected for recycling. Some communities have curbside collection while others use drop-off sites or even mobile drop-off buses.</p> <p>Beverage containers (glass, PET, and aluminum) are collected separately from other packaging in reverse vending machines or at retail locations.</p> <p>Non-bottle glass is usually collected at drop-off igloos or bins. It is occasionally collected separately at curbside.</p> <p>Aluminum non-beverage packaging is collected together with steel packaging by municipalities, either at drop-off locations or at curbside.</p> <p>Paper and board are collected either at drop-off locations or at curbside.</p>	<p>In Australia, collection (materials, bins, frequency) varies and is determined at the local council (municipality) level. National occupational health and safety regulations are driving the automated lifting of bins and therefore bin type. Collection in Australia is unique in that several companies not only make packaging, but also perform collection and reprocessing.</p> <p>Large wheeled bins lifted by the trucks are becoming the norm due to occupational health and safety laws that aim to reduce worker injuries.</p> <p>Two states in Australia, South Australia and Northern Territory, have a container deposit program. The covered beverage containers are returned to collection depots and sorted by material and brand.</p> <p>Local councils in South Australia are rolling out a pilot curbside food waste collection project.</p>	<p>Municipalities operate the Blue Box program, and they can decide which materials they want to collect, collection frequency, and other collection practices. The Blue Box itself is iconic, and the color is standard across the province. Single stream is popular, but some municipalities offer dual-stream collection (as paper and all other containers).</p> <p>In communities over 5,000 people, municipalities must collect five standard materials plus two others. In general, the most five commonly collected materials are glass, aluminum cans, steel cans, newspaper, and PET. Municipalities may decide to collect additional types of packaging, such as printed paper, corrugated, boxboard and cartons, gable top and aseptic cartons, different types and formats of plastic packaging and film plastics, packing peanuts, aerosol cans, paint cans, or more. The collected materials are currently dependent on municipality; WDO is trying to standardize a minimum number of materials to be collected across all communities.</p> <p>Some municipalities use a pay-as-you-throw garbage system to encourage more recycling, but it is not standard practice in Ontario.</p>

Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
Sorting	<p>Glass is sorted by consumers into clear and colored igloo bins. It is immediately sold to recyclers.</p> <p>Plastic bottles, metals, drinks cartons (known as PMD) are sorted at MRFs, baled, and sold to recyclers.</p> <p>Paper and board are sold to recyclers immediately after collection. The recyclers sort the paper types based on market demand.</p> <p>Collectors, sorters, and recyclers all independently enter data on what materials and how much is present; these numbers are validated.</p>	<p>Paper is usually separated from containers first by trommel screen. According to WRAP, UK paper mills will not accept paper from single stream collection due to glass contamination; that paper is typically exported. Some local authorities use trucks with multiple compartments and operators sort recyclables at truckside, which eliminates the need for a MRF.</p>	<p>Because all packaging is collected in Germany, investment has been made in sorting equipment to separate numerous fractions of packaging waste, including hard-to-recycle materials. Germany has a container deposit law on both one-way and refillable beverage containers, so most of these types of packaging do not enter the curbside system, but go to reverse vending machines or retail dropoffs. Non-deposit glass is collected in bring sites and where consumers sort it by color. All types of paper and board are separated in a paper bin. The yellow bin or bag contains all types of plastics, metals, and multi-laminate cartons. The German system collects all plastics and has conducted a pilot program in Leipzig to expand collected materials to allow residents to put non-packaging plastic (buckets, toys) and metals (frying pans) in the bins as well.</p> <p>German MRFs often feature state-of-the-art technology, such as optical equipment, to sort the variety of plastics accepted for recycling. Hand sorting is used only for quality control.</p>	<p>The Swiss have a high degree of source separation of recyclable packaging, requiring very little post-collection sorting. Beverage containers are already separated when redeemed at reverse vending machines. The ubiquitous and popular drop-off locations require citizens to sort materials into different bins. Materials are even collected in separate collections at curbside. Any steel and aluminum collected together are separated at processing centers. Paper and board, if not already separated, are sorted into different grades of paper. Glass is usually, though not always, sorted by color.</p>	<p>The MRF observed near Sydney operates much in the same way US MRFs operate, using similar technology. One notable difference was that auto batteries were observed as common contaminants in the recycling stream, which does not occur in the US. Other contaminants included videotape and also it was noted that composite/ Tetrapaks would get sorted with the eddy current due to their aluminum layer.</p> <p>First ONP screens separate items by size (repeated 2x). Slanted or angle screens were used to sort 3D (container) items from flat (paper) items.</p> <p>For the “flat” stream, optical sorting was used to separate paper and some plastic.</p> <p>For the three dimensional containers, the glass is crushed and falls through conveyor; an eddy current removes aluminum, an optical sorter sorts PET and then HDPE.</p>	<p>Beverage containers in the Ontario Deposit System (beer, wine, liquor) are returned to Beer Store locations (the province-wide retailer of beer) or other bulk return locations.</p> <p>Using stewards' funds, Stewardship Ontario operates a Continuous Improvement Fund and an Effectiveness and Efficiency Fund to help municipalities and sorting facilities upgrade equipment, maximize the efficiency of the Blue Box operations, and rationalize MRFs. The Effectiveness and Efficiency fund is currently not accepting any additional applications, but existing projects continue and many focus on upgrading MRF equipment, including 14 installations of optical sorting technology since 2005.</p>

## Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
Free Riders	In 2010, Fost Plus estimated that approximately 8-9% of the packaging sold in Belgium is made up of free riders. That year saw a renewed effort by Fost Plus to track down free riders and compel them to participate in the system, as is required by law.	Free riders are investigated by the appropriate government authority (Environment Agency, SEP, or NIEA) based on location within the UK.	Free riders were a big problem when DSD was the only stewardship organization, representing around 30-35% of packaging. Since dual system competition was introduced and participation in a dual system was required, the number of compliant companies increased dramatically.	The material associations are each responsible for getting producers, importers, and retailers to participate in their fee system. Fees are only paid for materials that are recyclable, so for example, composite packaging and all plastics other than PET bottles do not pay into the system.	Free riders are regulated under the NEPM, which is enforced by state government. Under the new APC (2010), the task of tracking free-riders has been assigned to industry. The National Packaging Covenant Industry Association (NPCIA) Secretariat is now responsible for determining free riders, asking that they join the APC, and then turning their names to the state governments if they remain non-compliant. State government conducts surveys at retail stores and follows up with non-members about their NEPM compliance. APC reports that growth in membership is due to this enforcement, as non-members join to avoid the strict NEPM regulations.	Stewardship Ontario is required to discover free riders by doing activities such as market surveillance and shelf surveys.
Consumer Education	Fost Plus is responsible for the on-going education of the public about recycling. A portion of the fees paid by Fost Plus members goes towards education campaigns, including billboards and signs, residential calendars, tv spots, and education in schools. This was approximately €0.33 per person annually.	WRAP does some consumer education and also advises OPRL on the recycling label. Local authorities are responsible for communicating to consumers about collection in the community.	Education is done by municipalities, but is funded by the dual systems. Dual systems have little control over the content of public education programs. In 2008, DSD reported that it allocated 25 Eurocents per person per year for education campaigns. In Berlin, the amount received from DSD was 4.5 million euros (2008). In 2011, the cost for education campaigns was reported to be 1.25 euros/person/year, divided among the nine dual systems.	Material associations and municipalities both work to educate the public on what is recyclable, how to sort, and when and where to bring materials. IGORA, the aluminum association, conducts frequent contests and challenges around the topic of aluminum collection.	Consumer education is done at the state and local level. The APC provides grants for consumer education about recycling and litter prevention.	Stewardship Ontario sees education of consumers as part of its mandate. It also works with municipalities on the promotion of its projects, new services, and media campaigns.



## Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
Recovery Labels	<p>Fost Plus licenses the Green Dot symbol for use on packaging to make consumers aware that a fee has been paid for the proper recovery of the package. It must be used on all packaging. Note that the symbol does not instruct consumers about which packaging goes in the recycling bin; instructions and education are provided by local communities.</p> <p>Vincotte has a compostable label for industrial and home compost.</p>	<p>A recycling label, managed by OPRL Ltd., is used on a voluntary basis to give consumers recycling instructions about each component of a package. The Green Dot label is not required for use in the UK, but can be licensed there.</p> <p>A new label for compostable packaging is being introduced by UK's Association for Organics Recycling in coordination with WRAP. It is designed to fit together with the OPRL recycling label. It also uses the requirements as the Belgian compostable packaging label.</p>	<p>In Germany, DSD licenses the Green Dot symbol for use on packaging to make consumers aware that a fee has been paid for the proper recovery of the package. It must be used on all packaging. Note that the symbol does not instruct consumers about which packaging goes in the correct recycling bin.</p> <p>In Germany, the Green Dot symbol is no longer required on all packaging, but is still encouraged and is commonly used on collection bins and educational materials.</p>	<p>There is no comprehensive label for packaging, although the Green Dot is commonly seen on packaging in Switzerland. Material associations often use a material-specific recycling label, such as the recycling symbol around the abbreviation alu for aluminum.</p>	<p>No comprehensive label for recycling is currently in use in Australia.</p>	<p>No comprehensive label for recycling is currently in use in Canada or Ontario.</p> <p>The Green Dot can be used on packaging, but must be licensed by StewardEdge, the organization running Green Dot North America. In Canada, use of the Green Dot does not indicate recovery financing or recycling. Instead, the Green Dot is licensed to ensure the protection and correct use of the trademark in North America.</p>
Points of Interest	<p>Before Fost Plus began work, 2 million euros was invested in upfront system research and study to determine the best way for Belgium to meet the requirements of the EU Directives.</p> <p>Belgium prioritizes quality of collected materials. PMD is the most expensive fraction of recyclables to collect and process, with approximately 15% non-recyclable residue. Efforts are made to reduce PMD bag residue.</p>	<p>Closed Loop Recycling near London recycles food grade PET and HDPE. Recycling mixed plastics is next.</p> <p>The Courtauld Commitment is an innovative industry agreement to reduce packaging waste, decrease food waste, and increase recycled content in packaging. Some retailers have made a commitment to buy recycled content plastic at virgin prices to help drive recycling and the use of recycled content.</p>	<p>Germany collects all plastic packaging, a difference from many other countries. This has led to investment in and development of sorting and processing technology to deal with hard-to-recycle materials. As seen in Oppin, German MRFs are making extensive use of optical sorting technology and are removing film plastics before they can bind MRF equipment. Hand sorting is only used for quality control.</p> <p>A pilot program to collect same-material non-packaging items alongside curbside packaging collection is innovative, but the funding mechanism is still under discussion.</p>	<p>The Swiss have achieved high recycling rates with the material-specific recovery system. This is because there is a high level of public participation in recycling and public willingness to bring recyclables to drop-off locations and sort materials.</p> <p>Practicality is important to Swiss recycling policies. For example, PET bottles are the only plastics deemed valuable enough to collect.</p>	<p>Australia is unique in that there are some vertically integrated companies who do everything from material manufacture, design, conversion, and finally recycling collection and reprocessing (Amcor, Visy). These companies also work in multiple materials (plastic, glass, paper, aluminum, etc). This vertical integration means there is a built-in feedback loop about the design and recyclability of packaging.</p> <p>The container deposit system in South Australia is operated in a way that requires beverage containers be counted and sorted multiple times, including by hand. It also necessitates expensive trucking of empty, uncrushed containers - a large volume of lightweight material.</p>	<p>Industry stewards originally agreed to participate in the Ontario Blue Box system based on a 50-50% cost share agreement with municipalities. This is a less expensive option in the short term, as industry only pays half the costs of recovering packaging. However, industry stewards have had little control over municipal practices or rising costs of collection and sorting. A move to 100% industry financing would likely lead to greater industry control over collection and sorting practices.</p> <p>The Ontario Deposit Return system also takes most beer, wine, and liquor packaging out of the curbside system. The innovative Canadian packaging system used for beer features standard reusable beer bottles that are used by most breweries in Canada.</p> <p>Toronto's away-from-home recycling bins have an innovative, user-friendly design.</p>

Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
<p><b>Economics of the System</b></p>	<p>Fost Plus owns the materials, and it sells them to recyclers.</p> <p>In 2008, the net cost of operating Fost Plus, collecting materials, and sorting them was 5.5 euros per person (including profits from sale of scrap). In 2009, that total was 6.4 euros/person/year, mainly due to the lower price of scrap materials.</p> <p>In 2009, the operating expenses of Fost Plus were 108.7 million euros, while operating income was 104.3 million euros. Fost Plus maintains a reserve fund to offset any negative years, with any extra funds going to reduce the Green Dot fees in the next year.</p>	<p>Cost of collection varies with each local authority. Variables include materials collected, bin type, tender amounts for collection and sorting, sorted material categories, etc.</p> <p>A 2008 WRAP study presented predicted costs of collection and sorting depending on collection truck, frequency, and whether the local authority is rural or urban. Costs ranged from 14-26 pounds per household per year.</p>	<p>The manager of the container deposit system, the Deutsche Pfandsystem, has cited the costs of recovering a container through the deposit system as three times as expensive as recovering it via the traditional dual system/curbside. The container deposit system removes valuable material from the curbside system, as well as reduces the amount of obligated packaging overall, so the efficiency of the dual systems are reduced, and dual system fees have gone up to cover that. The container deposit system does not report on recovery rates nor financial status, so it is impossible to know exactly how much that portion of the system costs.</p> <p>DSD was originally the only dual system operator and operated as a non-profit. However, when concerns over monopoly in the waste management area required that this service be opened up to competition in 2005, it became a for-profit business. It does not reveal its financial statements, nor do the other nine dual systems.</p>	<p>Because each material association collects fees separately and privately, there is no public data available on the cost of the Swiss system.</p>	<p>In 2006, the cost of collecting recycling in Adelaide, South Australia was 60 Australian cents per pickup (every 2 weeks). The entire 3-bin system costs \$1.45 per household/week. According to Zero Waste South Australia, this is a representative cost for similar cities in Australia.</p>	<p>The cost of running Blue Box system was \$88.8 million Canadian in 2010.</p>

## Road Map | Summary Matrix of Country Profiles

	Belgium	UK	Germany	Switzerland	Australia	Ontario, Canada
Performance	<p><b>2008 Packaging Statistics</b>                      Recycling rate: 93%                      WTE = 2.6%                      Total recovery = 96.6%</p> <p><b>2008 Recycling Rates</b>                      Paper - 89% [EU Target: 60%]                      Glass - 100% [EU Target: 60%]                      Plastic - 39% [EU Target: 22.5%]                      Aluminum/Steel - 94% [EU Target 50%/15%]</p>	<p><b>2008 Packaging Statistics</b>                      Recycling rate: 62%                      WTE = 4%                      Total recovery = 66%</p> <p><b>2008 Recycling Rates</b>                      Paper - 80% [EU Target: 60%]                      Glass - 61% [EU Target: 60%]                      Plastic - 24% [EU Target: 22.5%]                      Aluminum/Steel - 57% [EU Target 50%/15%]</p>	<p><b>2008 Packaging Statistics</b>                      Recycling rate: 71%                      WTE = 24%                      Total recovery = 95%</p> <p><b>2008 Recycling Rates</b>                      Paper - 88% [EU Target: 60%]                      Glass - 82% [EU Target: 60%]                      Plastic - 47% [EU Target: 22.5%]                      Aluminum/Steel - 92% [EU Target 50%/15%]</p>	<p><b>In 2009, the Swiss packaging recycling rates were:</b>                      Paper and board - 88%                      Glass - 95%                      PET bottles - 81%                      Aluminum cans- 91%                      Aluminum pet food cans - 80% (est.)                      Aluminum tubes - 60-70% (est.)                      Steel - 84%</p>	<p><b>In 2009, the overall packaging recycling rate in Australia was 57%. [Target 2010: 65%]</b>                      Paper - 70% [Target: 70-80%]                      Glass - 39% [Target: 50-60%]                      Plastic - 36% [Target: 30-35%]                      Aluminum - 64% [Target 70-75%]                      Steel - 38% [Target 60-65%]</p>	<p><b>In 2009, actual recovery rates in Ontario were:</b>                      Printed Paper = 79.1%                      Paper Packaging = 65.8%                      Glass = 90.5%                      Plastics = 24.9%                      Steel Cans = 58.8%                      Aluminum = 41.9%                      Overall packaging recovery = 55.4%                      Overall packaging + printed paper recovery rate = 65.3%                      Overall target for 2011 is 70%</p>

For Belgium, Germany, UK: (Eurostat, 2011b)

For Switzerland: (Federal Office for the Environment (FOEN), August 2010; VetroRecycling, 2007; Recycling Papier + Karton, 2009; Federal Office for the Environment (FOEN), July 16, 2010)

For Australia: (National Packaging Covenant Council (NPCC), 2009; National Packaging Covenant Council (NPCC), 2010; Australian Packaging Covenant, 2011 June 8)

For Ontario: (Stewardship Ontario, 2009)



### Belgium

#### GEOGRAPHY

Area:	30,278 square kilometers
Comparison:	About the size of Maryland
Population:	10,668,866 (est. 2008)
Population density:	352 people/square kilometer
Urban population:	97% of total population (2008)

(World Factbook, 2011) (Eurostat, 2011c)

#### LEGAL AND POLICY FRAMEWORK

**Administrative regions:** A federal system made up of three administrative regions.

**Official language(s):** French, Flemish (Dutch)

Belgium is a member of the European Union and is subject to EU Directives and other legislation. With regards to packaging recovery and recycling, Belgian legislation incorporates:

**EU Waste Framework Directive** establishes a waste management hierarchy of (in order) prevention, reuse, recycling, other forms or recovery, landfill or incineration without energy recovery (European Commission, 2010b). It also sets targets for recycling and reuse.

**EU Landfill Directive** bans landfilling of municipal solid waste without some form of treatment; it must first be sorted and then recovered by recycling, composting, or waste-to-energy (European Commission, 2010a). The residual ash from waste-to-energy facilities can be landfilled.

**EU Packaging and Packaging Waste Directive** sets common rules that facilitate trade and prevent obstacles to trade throughout EU countries. It sets minimum requirements for packaging and also sets common targets for recycling and recovery for each country (European Commission, 2011). To support the Packaging and Packaging Waste Directive, the European Committee for Standardization developed standards EN 13427-13432 that detail the requirements packaging must meet to conform to the Directive (European Committee for Standardization, 2009).

Through the Packaging and Packaging Waste Directive, the EU set weight-based targets for the recovery and recycling of packaging waste in 1994, later revised in 2004 (European Organization for Packaging and the Environment (EUROPEN), 2007b). There are also material-specific recycling targets, listed below. Recovery includes recycling, composting, and waste-to-energy, among other options. To meet the EU recovery target, at least 60% of packaging must be recovered. To promote recycling, the EU target requires at least 55% and no more than 80% of packaging to be recycled.

All packaging materials have specific recycling targets (European Parliament and Council, December 20, 1994; European Organization for Packaging and the Environment (EUROPEN), 2007a December 5):

- 60 percent for glass
- 60 percent for paper and board
- 50 percent for metals (aluminum and steel)
- 22.5 percent for plastics
- 15 percent for wood

Belgium has well exceeded these targets.

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### Why have a maximum recycling target?

*The 80% maximum recycling target was set by the EU to avoid distortions between member states. In 2003 the amount of packaging material collected in some countries was greater than processing capacity and thus was exported for recycling in other countries, distorting the recipient countries' collection programs. The second reason for the maximum target was that at that time, a cost-environmental benefit analysis was seen as less favorable the higher the recycling rate. Today, the cost-benefit analysis indicates that a higher recycling rate is more favorable than previously thought. The EU does allow for individual countries to set overall recycling targets higher than the upper limit as long as they ensure that their processing capacity is sufficient to avoid distorting the internal EU market. Expanded processing capacity in Asia and other markets also has made the maximum recycling rate a moot point.*



WASTE STATISTICS

Packaging waste data for all packaging are submitted to Eurostat by EU member countries; Green Dot or stewardship organizations may report different statistics based on their obligated packaging (e.g. household packaging). There is no EU requirement to report aluminum and steel separately, resulting in a combined total for metal packaging. Composite packaging is included in the category of its primary material. “Other” packaging includes materials such as ceramics, textiles, etc. The recovery rate is for all packaging; there is no specific recovery rate by material type.

BELGIUM: HOUSEHOLD AND COMMERCIAL PACKAGING WASTE DATA FOR 2008 (TONNES)

Material	Packaging Waste Generated	Packaging Recycled	Recycling Rate	Recovery Rate
Glass	400,000	400,000	100%	
Plastic	302,000	117,780	39%	
Paper and Board	643,000	560,700	89%	
Aluminum	132,000	124,080	94%	
Steel				
Wood	196,000	113,680	58%	
Other	17,000	8,160	4.8%	
Total	1,690,000	1,335,100	79.0%	95%

(Eurostat, 2011b)

HISTORY AND SYSTEM DESCRIPTION

Fost Plus is the non-profit organization accredited by the Belgian government to manage the industry take-back obligation of household packaging waste across the entire country and meet EU recovery and recycling targets (Fost Plus, n.d.[a]). (A separate organization, Val-i-pak, is responsible for collecting commercial and industrial packaging waste.) Packaging waste management is organized at a national level, and Fost Plus operates as a government-sanctioned

monopoly (Fost Plus, n.d.[b]). Competition in the system takes place on the local level as collection, sorting, and reprocessing needs are all competitively tendered to municipalities and waste management companies.

Fost Plus has approximately 5,600 obligated member companies (i.e. fillers including brand owners, retailers, first importers), representing 92% of the household packaging sold on the Belgian market. This means that 8% of packaging sold in Belgium is put on the market by companies who are not Fost Plus members and who have not contributed fees to pay for its recovery. Because this packaging still finds its way into Fost Plus-funded collection bins without paying into the system, both the packaging and the company responsible for it are termed “free rider.” The members report their annual packaging amounts to Fost Plus and then pay a fee based on the amount of packaging and material type used. For this fee, Fost Plus takes on the individual company take-back obligations and pays the full cost of running the packaging recovery system, including consumer education. It also has full control and choice over how to best reach the recycling targets, but must provide service to all citizens throughout Belgium. Fost Plus owns the legally designated packaging materials collected for recycling. Fost Plus also contributes to collection of on-the-go packaging.

Using the industry fees, Fost Plus contracts for collection and sorting services at the local level. Municipalities receive priority in the tender process. If a local municipality wishes to perform the collection or sorting, Fost Plus contracts for this directly with the municipality. If the local municipality does not wish to take on these services, a public call for tender is made (Fost Plus, n.d.[c]). Fost Plus supervises the tender process, and the waste contractors are chosen through an agreement between the municipality and Fost Plus (personal communication, S. Boussamaere, August 11, 2011). From a legal point of view, the municipality, not Fost Plus, is the holder of the contract. However, Fost Plus pays for the services rendered. About half of the collection and sorting contracts are given to municipalities, while the other half are tendered publicly.

Fost Plus has standardized the packaging materials collected, best collection practices, and the types and colors of bags, bins or drop-off sites across the country. It also specifies the material volume and the quality level of collected materials that is to be delivered to recyclers, and can assess a penalty or award a quality bonus to the local collection/sorting contractors. Fost Plus sells the collected materials to recyclers (processors) based on market prices. Collection, sorting, and recycling data are collected and monitored by Fost Plus using an internet-based reporting form that also helps with auditing and verification. For example, a recycler’s entered data on volume of materials received must be validated by both the collection and sorting organizations in order to be accepted as valid.



### COLLECTION

Collection is divided by packaging material and requires some sorting on the part of citizens.

Glass packaging is collected only at drop-off or “bring” sites with large glass igloos, where it is separated into clear and colored glass bins. Igloo containers are emptied and the glass is sent directly to recyclers, with no additional sorting.

Mixed paper and board is collected once a month in bundles at curbside. Consumers must bundle the paper and board separately from other recyclable materials. It is sent directly to paper recyclers, who will sort it into specified bales based on market demand. All types of printed paper and packaging are collected together, but Fost Plus pays only for the packaging portion, which is 30% of the total. Fost Plus is billed for this portion of paper collection and sorting expenses by either the municipality or private contractor, depending on who holds the contract. The remaining 70% of paper collection costs are paid by the municipality. When the value of paper is more than the cost of collection (current situation) the municipality can profit from collecting paper. If the value of paper is less than the cost of collection, the obligated printed paper producers (newspaper, magazine publishers) contribute to a fund to make up the cost difference for the municipalities (S. Boussamaere, personal communication, August 11, 2011).

Plastic, metals, and drinks cartons (known as PMD) are collected twice a month in translucent blue plastic bags at curbside. The blue bags must be purchased by consumers at supermarkets or other shops; this is the only cost of the system not paid for by Fost Plus. The bales of sorted PMD are sold to reprocessors in Belgium or the EU.

Bottles are the only plastics collected for recycling. Fost Plus gives several reasons for this. First, it is easier for consumers, who simply need to remember “bottles only” no matter the resin type. Second, plastic bottles are typically made of PET and HDPE, so bottle-only collection targets polymers that are readily recyclable. Finally, collecting only bottles provides a consistent, homogeneous stream of high quality materials in large quantities. When asked why other types of plastic resins or formats are not added, Fost Plus admitted that while they could increase recycling targets a few percentage points by adding all plastics, the 60-70% cost increase for collection and sorting would not provide an adequate return on investment. The products that can be made from mixed plastics are limited, and it was decided that it would be revenue-negative to collect and sort the plastics for sale on the Asian market.

Some municipalities have found markets for selected non-bottle plastics and are beginning to collect these materials in parallel to the Fost Plus-funded collection efforts. Non-bottle plastics are only collected at community recycling drop-off locations, not at curbside. An example of this is Ivarem, a group of eleven municipalities, which provides a pink bag to residents that can be filled and brought to recycling drop-off centers. The amount and quality of these collected mixed plastics are reportedly low in comparison to the collected PMD materials (J. Goossens, personal communication, August 12, 2011).

Belgium does not have a beverage container deposit program. Some brands still sell beverages, such as water, juice, and carbonated drinks, in refillable bottles. In addition, all recyclable packaging can also be brought to local drop-off centers. Drop-off centers also collect household hazardous waste and electronics. Drop-off sites are approximately located one per 10,000 people. In areas with new construction, collection facilities, such as large underground bins for multi-family dwellings, are being incorporated into the overall site design.

Fost Plus has been rolling out on-the-go collection services across the country, starting with schools, festivals and events, and businesses (Johan Goossens, personal communication, June 28, 2011).



*Light blue PMD bags are put out for collection.*



*An example of a recycling drop-off site featuring underground collection bins (Haarlem, Netherlands).*



**SORTING**

Glass is pre-sorted by consumers at the drop-off igloo sites. Mixed paper is sorted by recyclers into specified grades. With both paper and glass separately removed from the rest of the recycling stream, contamination of both is prevented and high quality material is available for paper and glass reprocessors.



*Neighborhood glass drop-off site.*



*PMD bags are delivered to the sorting facility.*

The PMD, or lightweight, packaging fraction is the only part of the packaging waste stream that is sorted at a MRF. After curbside collection, PMD is sent to a sorting center (or MRF). During research, we visited a Veolia-run MRF in Belgium which operated as described here. The blue bags are ripped open by a large screw with teeth to evenly distribute the PMD contents on a conveyor belt. First, a magnet pulls steel packaging off the belt. Second, an optical sorter separates clear PET bottles, drinks cartons, and green PET bottles from the rest, and they are then optically sorted from each other. From the original conveyer, another optical sorter pulls HDPE and blue PET into a third stream, which are then optically separated. Aluminum is removed using an eddy current. Anything remaining on the belt then goes around the loop again. Hand-sorting is used for quality control purposes after optical sorting. Workers pull off any packaging mistakenly sorted into the wrong stream. The MRF reported the biggest contaminants to their sorting system were all types of non-bottle plastic packaging, and noted that light blue plastic is the color most often missed by the optical sorters.

Other contaminants include plastics used for gardening containers and polystyrene containers used to package fruit. The bales that result from the MRF sorting are clear, green, and blue PET bottles, HDPE bottles, steel, aluminum, and multi-laminate drinks cartons. The film from the PMD bags is collected at the MRF and sent to a waste-to-energy facility. The residue and moisture in the film resulting from PMD collection makes recycling impossible. After sorting, the bales are sent to reprocessors located within Belgium or in other EU countries.



*Full bags are broken by a toothed screw, allowing bags and PMD materials to fall to a conveyor belt for sorting.*



*Hand sorting is used for quality control. A worker ensures only drinks cartons are on the conveyor belt.*



*Separated materials are collected in bunkers before being baled (drinks cartons on left, green PET bottles on right).*



*Bales of clear, green, and blue PET bottles.*



### REPROCESSING/RECOVERY

Fost Plus sells the bales of collected materials to recyclers in Belgium and the EU. A list of contracted recyclers is maintained on the Fost Plus website (Fost Plus, 2011b).

No waste may be landfilled in Belgium unless it has been treated (i.e. sorted, recycled, composted, incinerated) first, as specified in the Landfill Directive. Waste-to-energy infrastructure is commonly available, and all municipal solid waste not collected for recycling is sent for energy recovery. Composting of organic waste is available in many municipalities, although the service is provided at the local level.

### ANALYSIS OF SYSTEM

#### General

- Fost Plus is recognized as being one of the most successful and cost-efficient programs in Europe. In 2010, the recycling rate for household packaging was 91.5% and the recovery rate was 94.9% (Fost Plus, 2010) The Belgian program provides service to the entire country.
- A producer responsibility system for packaging should be rolled out gradually instead of all at once. The Fost Plus system was not created overnight. Only after a €2 million investment in upfront research was the system gradually implemented across the country.
- As long as targets are met, the Belgian experience suggests that it make sense to collect what is easily recycled. Add additional materials only if it makes financial sense to collect and sort them.
- The on-going education of consumers, especially in-school programs for youth, is critical. The cost of these efforts has held steady at 0.33 € per person per year (Fost Plus, 2011a).



*Bale of aluminum packaging.*

#### Infrastructure & Operations

- Removing paper and glass from the rest of packaging materials in separate collections reduces contamination, maintains high quality materials, and reduces sorting and equipment repair costs at the MRF.
- A standard national system coordinates materials collected, collection frequency, bin/bag type, and best practices for collection and sorting.

#### Policy

- One stewardship organization operating at the national level keeps things simple and efficient. In Belgium, it was determined that introducing competition at the national stewardship organization level would undermine performance and efficiency; therefore the effort was made to strengthen competition at the local operations level for collection, sorting, and reprocessing services. The stewardship organization must apply to the government for reaccreditation every 5 years, with the current accreditation period ending in 2013.
- Recycling must be supported by implementing complementary policies: pay-as-you-throw trash, landfill bans on untreated municipal solid waste, etc.
- A container deposit program was determined to be unnecessary, as Belgium's recycling targets have been met and exceeded with the current curbside system. Other reasons Belgium does not have a container deposit program include time and effort involved for consumers, disadvantage to small retailers in time and retail space, and the cost of a separate collection and logistics system.

#### Financing

- The non-profit status of the stewardship organization, Fost Plus, and rigorous inspection and auditing provides transparency and inspires industry and consumer confidence. All data and system statistics are available on-line.
- The high recycling and recovery rates are achieved by Fost Plus at a low per capita cost. The annual cost per capita to operate the Fost Plus system is relatively stable: €8.98 (€4.87 after sale of materials) in 2008, €8.85 (€6.40 after sale of materials) in 2009, and €9.35 (€5.20 after sale of materials) (Fost Plus, 2009; Fost Plus, 2010; Fost Plus, 2011a).





## Germany

### GEOGRAPHY

Area:	348,672 square kilometers
Comparison:	Slightly smaller than Montana
Population:	82,217,837 (2008)
Population density:	235 people/square kilometer
Urban population:	74% of total population (2008)

(World Factbook, 2011) (Eurostat, 2011c)

### LEGAL AND POLICY FRAMEWORK

Administrative regions	A federal republic of 16 states
Official language(s):	German

Germany is a member of the European Union and is subject to EU Directives and other legislation. With regards to packaging recovery and recycling, German legislation incorporates:

**EU Waste Framework Directive** establishes a waste management hierarchy of (in order) prevention, reuse, recycling, other forms or recovery, landfill or incineration without energy recovery (European Commission, 2010b). It also sets targets for recycling and reuse.

**EU Landfill Directive** bans landfilling of municipal solid waste without some form of treatment; it must first be sorted and then recovered by recycling, composting, or waste-to-energy (European Commission, 2010a). The residual ash from waste-to-energy facilities can be landfilled.

**EU Packaging and Packaging Waste Directive** sets common rules that facilitate trade and prevent obstacles to trade throughout EU countries. It sets minimum requirements for packaging and also sets common targets for recycling and recovery for each country (European Commission, 2011). To support the Packaging and Packaging Waste Directive, the European Committee for Standardization developed standards EN 13427-13432 that detail the requirements packaging must meet to conform to the Directive (European Committee for Standardization, 2009).

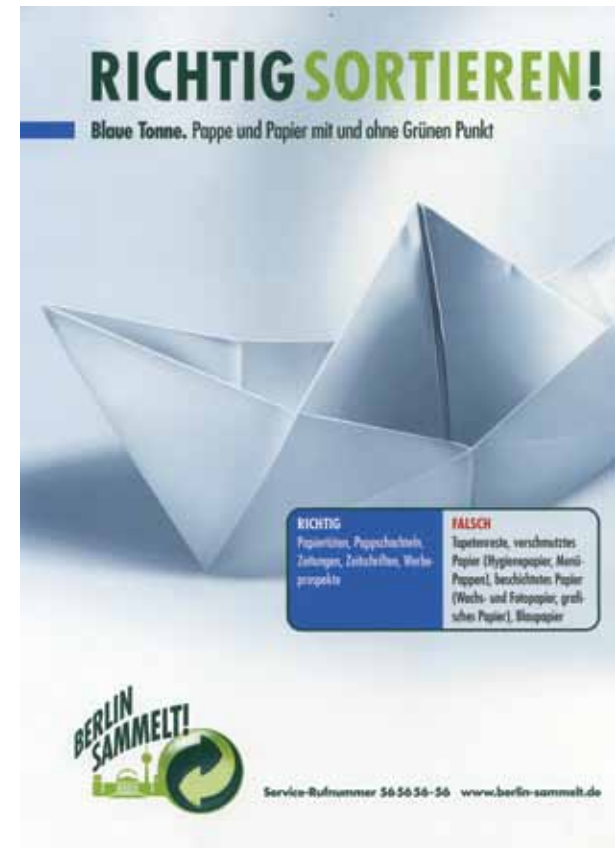
Through the Packaging and Packaging Waste Directive, the EU set weight-based targets for the recovery and recycling of packaging waste in 1994, later revised in 2004 (European Organization for Packaging and the Environment (EUROPEN), 2007b). There are also material-specific recycling targets, listed below. Recovery includes recycling, composting, and waste-to-energy, among other

options. To meet the EU recovery target, at least 60% of packaging must be recovered. To promote recycling, the EU target requires at least 55% and no more than 80% of packaging to be recycled.

All packaging materials have specific recycling targets (European Parliament and Council, December 20, 1994; European Organization for Packaging and the Environment (EUROPEN), 2007a December 5):

- 60 percent for glass
- 60 percent for paper and board
- 50 percent for metals (aluminum and steel)
- 22.5 percent for plastics
- 15 percent for wood

Germany has exceeded these targets.



A public education campaign poster from Berlin explaining what goes in the blue bin (paper and board).



WASTE STATISTICS

Packaging waste data for all packaging are submitted to Eurostat by EU member countries; Green Dot or stewardship organizations may report different statistics based on their obligated packaging (e.g. household packaging). There is no EU requirement to report aluminum and steel separately, resulting in a combined total for metal packaging. Composite packaging is included in the category of its primary material. "Other" packaging includes materials such as ceramics, textiles, etc. The target recovery rate is for all packaging and there is no specific recovery rate by material type.

GERMANY: HOUSEHOLD AND COMMERCIAL PACKAGING WASTE DATA FOR 2008 (TONNES)

Material	Packaging Waste Generated	Packaging Recycled	Recycling Rate	Recovery Rate
Glass	2,869,000	2,352,580	82%	
Plastic	2,372,000	1,114,840	47%	
Paper and Board	6,940,000	6,107,200	88%	
Aluminum	912,000	839,040	92%	
Steel				
Wood	2,571,000	745,590	29%	
Other	380,450	0	0%	
<b>Total</b>	<b>16,044,450</b>	<b>11,159,250</b>	<b>71%</b>	<b>95%</b>

(European Organization for Packaging and the Environment (EUROPEN), 2011; Eurostat, 2011b)

HISTORY AND SYSTEM DESCRIPTION

In Germany, packaging waste is managed at the national level, though some variability in implementation exists due to local community preferences. Other types of waste are managed by municipal government.

Germany's 1991 Packaging Ordinance was the forerunner of the wave of EU waste legislation that was translated into national laws across Europe in the 1990s. The Packaging Ordinance established the concept of producer responsibility and take-back obligation. After the EU's Packaging and Packaging Waste Directive took effect in 1994, the Packaging Ordinance was updated in 1995, with the new content taking effect in 1998. The Packaging Ordinance was amended five times in the years between 2000 and 2009, with the fifth amendment currently in effect.

Under the Ordinance, "producers" are manufacturers and distributors of sales packaging, defined as any packaging that ends up with the private consumer. This includes product packaging, but also items such as foodservice packaging, shopping bags, or shipping cartons to transport online purchases (Der Grüne Punkt - Duales System Deutschland, 2011d). These producers are obligated to participate in a "dual system" to ensure that the packaging is collected for recovery. (A dual system is so named because it operates parallel to the traditional waste disposal system.) The role of the dual system is to serve as the coordinating hub between producers and waste management companies and reprocessors.

Originally, obligated producers could self-comply with packaging take-back requirements or pay a fee to the one established dual system (Duales System Deutschland, or DSD) that fulfilled their packaging take-back obligation for household packaging under the EU Packaging and Packaging Waste Directive. Due to concerns about DSD operating as a monopoly, in 2001 the European Commission required Germany to introduce competition at the level of the stewardship organization. In 2009, the fifth amendment to the Packaging Ordinance obligated packaging producers to participate in a dual system to fulfill their packaging take-back obligation; producers could no longer take back packaging at retail in self-compliance (Der Grüne Punkt - Duales System Deutschland, 2011c). This change was intended to limit free riding. Today, producers have a choice of nine dual systems (including the original, DSD) that compete with each other at the national level for the business of fulfilling the producer's take-back obligation for household packaging. A dual system must be able to collect recycling nation-wide in order to be considered a valid system. Dual systems also compete based on competitive fees, customer service, quality, and reliability. Despite the competition, DSD remains the market leader as of 2011 (U. Denison, personal communication, July 7, 2011).



Along with the fee paid to the dual system, producers must also fill out a Certificate of Compliance, which is submitted to the government. The Certificate lists the packaging materials and weight of packaging that was put on the market in a calendar year, along with proof of participation in a dual system (Der Grüne Punkt - Duales System Deutschland, 2011a). The dual systems report their data to the German state governments and to an independent registry operated by the German Chamber of Commerce. Packaging volumes are not reported by dual system, but are reported as a national total to the EU (U. Denison, personal communication, July 7, 2011). There is no central authority to monitor participation in a dual system or investigate free riders. Germany's system puts the burden on industry to self-police (U. Denison, personal communication, July 7, 2011).

In the past, fees not only fulfilled the producer's take-back obligation, but also licensed the Green Dot logo for use on packaging. The Green Dot indicates to the public that the producer of the package has fulfilled its take-back obligations under the Packaging Ordinance and that the proper disposal method of the package had been paid for. In practice, the Green Dot signals consumers to put the package into the recycling collection bin. In 2009, changes were made to the Green Dot program. Producers are no longer legally obligated to use the trademark, though they are encouraged to do so (Der Grüne Punkt - Duales System Deutschland, 2011b). DSD remains the sole licensor of the Green Dot trademark in Germany, and the license fees to participate in a dual system are now separate from the fees to license the Green Dot.

Germany also has a mandatory container deposit system, which operates parallel to the dual system and municipal trash collection, in effect a third "dual system." It is organized and managed by the Deutsche Pfandsystem GmbH. Most beverage containers (both refillable and one-way) have deposit fees. Refillable bottles and other "ecologically advantageous" packaging have a lower deposit fee (€0.08 for <0.5 liter or €0.15 for >0.5 liter) than one-way bottles (€0.25) to encourage use of refillable packaging (Container Recycling Institute, 2010). Despite this, the quantity of refillable beverage packaging has declined dramatically in favor of one-way bottles (Prognos AG, 2007). Refillable beverage containers are most commonly used for beer. Containers are collected at any retailer where beverages are sold or in reverse vending machines. The retailers settle directly with the producers and distributors for the repayment of the deposit fees.

Education and consumer outreach about curbside recycling is done by municipalities, but is paid for by the dual systems at approximately €1.25 per capita per year (U. Denison, personal communication, July 7, 2011). The dual systems divide the cost of consumer education using a formula that takes into account each dual system's overall market share and share of licensed materials. The dual systems have little control over the content of the public education campaigns.

### How it Works

In practice, the nine dual systems first must vie for the business of packaging producers, who are required to participate in a dual system to fulfill their packaging take-back obligation. Fees are calculated based on the amount of sales packaging sold on the market, packaging material used, and its weight. The dual systems offer to collect and manage the fees, and they win contracts with producers by offering competitive fees as well as better customer service, quality, and reliability of service.

Though they offer tender and make contracts for collection, sorting, and reprocessing, dual systems themselves usually do not engage in these activities. A dual system's role has been to serve as the coordinating hub between producers and the waste management companies, although more and more waste management companies are expanding their activities by establishing themselves as dual systems. This allows them to capitalize on synergies with their existing collection and sorting activities.

Once a dual system has contracted even one kilogram in licensed packaging volume, it is obliged to start operating and contracting for collection and sorting services. The dual systems all use the same collection infrastructure in a given location. Utilizing nine sets of infrastructure would be redundant and inefficient.

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### A hypothetical example of the collection tender process and costs

*Dual System A has a market share of 35% of packaging, while Dual System B has a 10% market share. Remaining market share is split among Dual Systems C-I. Dual System A wins responsibility for a collection lot through the lottery, so it is responsible for paying 50% of total collection costs + (35% market share x 50% of the remaining collection volume) = 67.5% of collection volume and costs in that lot. Dual System B would then be responsible for 10% market share x 50% remaining collection volume, or 5%. The remaining Dual Systems C-I are likewise responsible for collecting and paying for their market share percentage x 50% of the remaining collection costs.*

*This process is repeated for all of the collection lots in the country.*



As the sole dual system in the past, DSD contracted with collection and sorting companies. Today, the tender process is quite different. Contracts for collection are tendered now by all nine of the dual systems in an annual, lottery-based process. The country is divided into collection lots, defined as small, medium, or large, based on municipal clusters or population. Larger dual systems typically bid on more lots than do smaller dual systems, but no dual system can win more lots than its market share percentage. In the lottery, one dual system is selected from the pool of interested dual systems to manage collection in that lot. The responsible dual system would conduct the tender first to get the total collection cost, and then all the dual systems divide it up and set their fees to cover their portion according to market share per fraction (glass, lightweight packaging). In each of its lottery-assigned lots, the responsible dual system is guaranteed ownership of 50% of the packaging volume and must pay for 50% of the collection costs. The remaining 50% of volume and costs are split by all nine systems, including the winning system, based on their market share of the packaging fraction.

The tender process for sorting is done by each of the nine dual systems independently. Once the material in a lot is collected by each dual system, it is brought to a storage area and divided into different piles based on the lot percentages for which each dual system is responsible. The dual systems independently decide where to bring the collected volume to be sorted. This is an economic decision and is based on transportation costs. Dual systems contract with MRFs independently, and MRFs may have sorting contracts with multiple dual systems (U. Denison, personal communication, July 7, 2011). In some cases, if a dual system with a low market share has only a small quantity of collected materials, it may enter into an agreement with a larger dual system to take care of sorting its small quantity of materials.

### COLLECTION



A recycling drop-off site at a rest stop on the highway. Like residential collection, paper, lightweight packaging, and three colors of glass (igloos) are collected here.

Collection is divided by material type and requires sorting on the part of consumers.

Glass is typically collected by color at drop-off or “bring” sites, where it is sorted into clear and colored bins. Most glass beverage containers are collected through the beverage deposit program using reverse vending machines or retail redemption centers.

Mixed paper and board is collected at curbside in a paper/cardboard bin or at drop-off sites. Municipalities manage the paper drop-off and bill dual systems based on the packaging portion of the paper. Municipalities are responsible for the cost of the newspaper and magazine fraction of collected paper. Regular sampling is done to ensure that the fractions are being correctly billed to either dual system or municipality. Approximately 75% of collected paper is newspapers/magazines and 25% is packaging.

Lightweight packaging (analogous to Belgium’s PMD) is collected by dual-system-contracted haulers at curbside in either yellow bags or yellow bins. Yellow bin items include all plastics, metals, drinks cartons, and other composite packaging. The bags are financed by the license fees paid by the fillers or retailers.

A pilot project has been underway to explore the collection of “same-material non-packaging” items in the yellow bin or in a separate new orange bin (Der Grüne Punkt - Duales System Deutschland, 2011e; Waste-to-Energy Research and Technology Council (WtERT), 2009). This would mean that recyclable but non-packaging items such as plastic toys or frying pans could be collected along with packaging. There is still a lot of debate about how this type of collection will be funded and who will do it. The responsibility for and ownership of all non-packaging waste resides with municipalities, while packaging materials are the responsibility of and are owned by the packaging industry and the dual systems. A separate collection bin for same-material, non-packaging items would increase the waste management system’s complexity. Municipalities are interested in this fraction of waste because they would like additional materials to maximize the capacity of local waste-to-energy plants. The packaging industry would like to collect more recyclable materials and take advantage of the sorting and reprocessing infrastructure it has developed for hard-to-recycle materials. In addition, it would like to prevent municipalities from collecting packaging for incineration, along with the same-material, non-packaging items.



Collection bins for on-the-go packaging in a Berlin train station. The bins collect trash, lightweight packaging, glass, and paper. The materials collected and the bin colors are consistent with curbside recycling (blue means paper, yellow means lightweight packaging).





Compost is managed by municipalities at a local level and is collected curbside in brown bins. Residual trash is collected in black bins.

Beverage containers subject to the container deposit are collected at retail locations or in reverse vending machines.

Drop-off sites, often in conjunction with a material recovery facility (MRF), accept packaging and are also available for household hazardous waste, electronics, yard waste, and minor home construction waste.

Landfilling of untreated or combustible waste is banned in Germany. Waste must first be sorted and then recovered by recycling, composting, or waste-to-energy; anything left over is landfilled.

### SORTING

In 2008, as a part of the research for this report, we visited a lightweight packaging sorting facility in Oppin, Germany operated by Tönsmeier. It began operation in early 2008 and processes about 300 tonnes per day. The plant's tipping hall has a capacity of 1,100 tonnes, which is about three days' worth of processing storage capacity. The Oppin plant handles waste from 2.5-3 million people. The facility runs 24 hours per day and is cleaned 6 times per day. Of special note is that the facility features 14 optical Ti-tech brand sorters to separate packaging material, allowing for very specific sorted streams, high quality materials, and fast sorting speeds.

70% of material arrives in the yellow bags, which must be opened. 30% of material is collected from yellow bins and arrives loose.

First, the bags are broken open by a large screw. Next, a sieve drum (or trommel) tumbles all of the materials and separates out three streams on separate conveyor belts based on object size: <140 mm, 140-220 mm, >220 mm. All items <140 mm are sent back through the trommel again.

The 140-220 mm stream first goes past air suction, where 90% of film plastics are removed. This prevents the film plastics from binding the equipment. The film is carried off on a conveyor belt to be baled.

Any extremely small pieces <20 mm are sorted out of the sieve drum. This stream typically contains some glass pieces, small plastics, dirt, and other small objects. It is diverted to the storage hall and is trucked to an incineration plant two or three times per day.

Two conveyor belts carry the lightweight packaging. First, all pieces of aluminum between 20-200 mm are removed by an eddy current. Multi-laminate cartons are sorted using near infrared optical sorting. Steel is pulled off the belt using a magnet. Plastic is separated using infrared optical sorting. The sensor determines what the material is, where it is on the conveyor belt, what size object it is. HDPE is sorted out first, and then PP and PET. Paper and board are optically sorted out if they are present, though paper is not supposed to be placed in the yellow bags/bins.



An optical Ti-tech sorter separating plastics at high speed.



A truck dumps yellow bags and yellow bin materials in the storage hall.



A screw opens the bags, allowing the contents to be sorted.



A view of the sieve drum (trommel).



As a first sorting step, air suction is used to remove film plastics before they can bind the sorting equipment.



All of the streams flow on conveyor belts through a quality check room where manual checking occurs. Remaining aluminum or plastic is hand-picked out in quality control room. The control room operators use computer systems to watch all optical sensors and cameras. Fourteen bunkers hold the sorted material streams with three different belts for baling. Each bunker can be emptied into multiple balers, so if one baler is already working, another can be used at the same time.

The facility also offers drop-off bins for green waste, home construction waste, electronics, and other bulky items.

According to the facility operators, new sorting fractions can be added to the system. However, for it to be financially worthwhile to sort a new fraction, a new packaging material must have 20,000 tonnes on the market.



*The sorted plastic film stream heads through quality control.*



*After being sorted by size, multiple conveyor belts take the lightweight packaging for further sorting.*



*A bunker containing steel packaging.*

### REPROCESSING/RECOVERY

Glass is taken directly from the color-sorted drop-off sites to glass reprocessors. There, the glass is beneficiated, after which it can be made back into new glass packaging or put to other beneficial uses (fiberglass, abrasives).

Paper and board are taken from curbside bins and drop-off sites to paper sorting facilities. The paper is sorted by air stream to separate heavy board from lighter paper. Based on market demands, the various types of paper are baled into specific paper types for sale.

Metals and plastics are separated at the lightweight packaging sorting facilities and then sent for recycling or waste-to-energy. Recovery and recycling targets for plastics can be met through a mix of technologies such as mechanical recycling (a minimum of 60%), feedstock (chemical) recycling, and energy recovery. In the sorting facilities, plastics are separated from each other by optical sorters at the MRF, but also separated again using a float-sink tank during reprocessing. Film plastic collected is mechanically recycled, regranulated, and melted into new products. PET bottles (mainly in the bottle deposit system) are collected and can be sent to bottle-to-bottle recycling plants.

At the time of the research visit to the Oppin facility, the bales of multi-laminate cartons were being sent to Finland for fiber recycling. The fiber is most often used for tissue and towel production, but may also make molded pulp packaging or corrugated containers. The aluminum and polyethylene can be sent either to cement kilns or to aluminum reprocessors. In cement kilns, the plastic provides energy for the process and the aluminum strengthens the cement. Reprocessing the aluminum from multi-laminate cartons requires a specialized facility using plasma pyrolysis. The low-density polyethylene plastic is converted into paraffin, while the resulting 99% pure aluminum is cast into ingots (Pedroso & Bastos Jr., 2006). This technology is currently being piloted in Brazil but is not yet widely used.



### ANALYSIS OF SYSTEM

#### General

- 95% of the German population has access to curbside recycling and other convenient recycling locations, such as bring sites.
- Germany has extremely high recycling rates, and Germans are willing to do some pre-sorting of materials to allow glass and paper to be collected separately from other packaging.

#### Infrastructure and Operations

- On-the-go collection bins collect the same materials and use same color code as curbside and household drop-off collection bins. Consistency is critical.
- Removing glass and paper from other packaging materials means high material quality and low wear and tear on sorting and reprocessing equipment.
- Collection of all packaging materials and all plastics has spurred investment in and development of sorting and reprocessing technology for hard-to-recycle materials. State-of-the-art optical sorting technology is supported by the need to meet high national recycling targets, sorting facility competition for the business of dual systems, and the landfill ban on untreated waste. However, some criticize the German system for the cost and effort of sorting packaging fractions that are not efficient or economically worthwhile, especially if they end up at waste-to-energy facilities in the end.
- The separate bottle deposit program significantly drives up the cost of the German system and removes both volume and the most valuable materials from the recycling stream managed by the dual systems (glass, aluminum, steel, PET beverage containers). In effect, it creates a third “dual system” next to recycling and trash collection that incurs costs in consumer time, effort, and return logistics. In the first half of 2003 after the introduction of the mandatory deposits, DSD reported that the beverage containers now taken out of the dual system resulted in a loss of 16% of its fee income (European Organization for Packaging and the Environment (EUROPEN), 2004). With easy-to-recycle and valuable beverage containers removed from the system, dual systems must still meet the same recycling targets, but with materials that are harder to sort and more expensive and difficult to recycle. This has eroded the efficiency of the dual systems. Prior to the mandatory deposit for one-way containers, EU and German recycling targets for beverage containers were already being met by the dual systems’ household collection, which achieved an 80% recycling rate at a cost of €250 million in dual system fees (Beck, February 24, 2009). While the introduction of the deposit system in 2003 increased beverage container recycling rates to 95%, it achieved the additional 15% at an additional cost to retailers and bottlers of €461 million per year over and above the €250 million (Beck, February 24, 2009). The container deposit program has also been criticized for its complexity, expense, and lack of

transparency. The types of beverages included or not included, as well as different deposits based on different types of packaging make the system complicated for consumers to understand. Retailers and bottlers do not report the financial details of the system, which are considered proprietary, though retailers benefit from the sale of materials as well as securing customer return trips to the store to return bottles. The cost of the reverse vending machines and other return logistics, as well as inconvenience to consumers in terms of time and effort are also mentioned as negative aspects of the program.

- There is an innovative pilot program to collect compatible materials from non-packaging sources in recycling bins. But the question remains, how does this extra fraction get funded? (Waste-to-Energy Research and Technology Council (WtERT), 2009) Industry and retailers have expressed willingness to fund the approximately €125 million additional cost of this collection, provided the management of the bin will remain under industry control (U. Denison, personal communication, October 18, 2011).
- Education is seen as extremely important, and is funded correspondingly. Berlin has campaigns focused on educating immigrant populations about how to recycle using multiple languages, media formats, etc.



A public education campaign poster from Berlin explaining what goes in the yellow bin (lightweight packaging).



### Policy

- There has been a great deal of confusion about the expansion of competition and the emergence of multiple dual system companies in Germany. The goal of the government is to encourage competition in all aspects of recycling and waste management. However, harmonization of service for customers, a need for consistent quality for recovered materials, and minimization of duplicative collection and sorting services is generally considered to be easier to achieve with one centrally-coordinated system. It is true that having nine dual systems participate in a collection and sorting tender process makes the system much more complicated than if only one dual system existed. However, this process allows dual systems to differentiate themselves and gain a market advantage by owning or making contracts with specific sorting plants to generate specially sorted recycle products that the competition cannot produce.
- The option of self-compliance under the Packaging Ordinance allowed a large number of free riders. In that case, retail locations had to accept any packaging a consumer returned to point of purchase. However, this option was rarely used by consumers, so some companies were able to avoid participation in a dual system and also avoid paying for the costs of taking back packaging in-store. The new rules require companies to participate in a dual system, so free riding has decreased dramatically.
- Because the dual systems are private companies competing against each other, there is a lack of transparency when compared to non-profit organizations in other countries. No annual reports are issued and there is no ability to compare finances. Competition at the dual-system level is not a problem in and of itself, but in Germany it has created a lot of confusion and inefficiencies in its implementation. Competition is considered a good thing at the operations level of collection, sorting, and reprocessing, however.
- Germany continues to support the refillable bottle system. The mandatory one-way beverage container deposit program was designed to promote the use of refillable beverage containers; this has not succeeded. One-way bottle packaging continues to increase at the expense of refillables, despite the higher deposit amount leveraged on one-way bottles (Beck, February 24, 2009).

### Financing and Economics

- Germany has a reputation for being one of the highest-cost recycling systems in the world for producers. This is generally attributed to the mandated full-country roll-out of the dual system program in a relatively short period of time, along with the inclusion of all packaging materials in the program and the need to develop infrastructure to deal with hard-to-recycle materials. However, over time, other country programs have become equally or more expensive than the German program. Today it is impossible to compare dual system fees to calculate cost per ton of material, because the dual systems guard that information closely. Cost per capita may be a better way to assess and compare the financial health of a program.





## United Kingdom

### GEOGRAPHY

Area:	241,930 square kilometers
Comparison:	Slightly smaller than Oregon
Population:	61,113,205 (July 2009 est.)
Population density:	253 people/square kilometer
Urban population:	90% of total population (2008)

### LEGAL AND POLICY FRAMEWORK

**Administrative regions:** The United Kingdom is made up of Great Britain (England, Scotland, Wales) and Northern Ireland. Within these, waste is managed by 433 local authorities.

**Official language(s):** English

The UK is a member of the European Union and is subject to EU Directives and other legislation. With regards to packaging recovery and recycling, UK legislation incorporates:

**EU Waste Framework Directive** establishes a waste management hierarchy of (in order) prevention, reuse, recycling, other forms or recovery, landfill or incineration without energy recovery (European Commission, 2010b). It also sets targets for recycling and reuse.

**EU Landfill Directive** bans landfilling of municipal solid waste without some form of treatment; it must first be sorted and then recovered by recycling, composting, or waste-to-energy (European Commission, 2010a). The residual ash from waste-to-energy facilities can be landfilled.

**EU Packaging and Packaging Waste Directive** sets common rules that facilitate trade and prevent obstacles to trade throughout EU countries. It sets minimum requirements for packaging and also sets common targets for recycling and recovery for each country (European Commission, 2011). To support the Packaging and Packaging Waste Directive, the European Committee for Standardization developed standards EN 13427-13432 that detail the requirements packaging must meet to conform to the Directive (European Committee for Standardization, 2009).

Through the Packaging and Packaging Waste Directive, the EU set weight-based targets for the recovery and recycling of packaging waste in 1994, later revised in 2004 (European Organization for Packaging and the Environment (EUROPEN), 2007b). There are also material-specific recycling targets, listed below. Recovery includes recycling, composting, and waste-to-energy, among other options. To meet the EU recovery target, at least 60% of packaging must be recovered. To promote recycling, the EU target requires at least 55% and no more than 80% of packaging to be recycled.

All packaging materials have specific recycling targets (European Parliament and Council, December 20, 1994; European Organization for Packaging and the Environment (EUROPEN), 2007a December 5):

- 60 percent for glass
- 60 percent for paper and board
- 50 percent for metals (aluminum and steel)
- 22.5 percent for plastics
- 15 percent for wood

The UK has dramatically improved recycling rates over the past decade, going from 28% in 1998 to 62% in 2008, to avoid fines from the EU (European Organization for Packaging and the Environment (EUROPEN), 2011).

### WASTE STATISTICS

Packaging waste data for all packaging are submitted to Eurostat by EU member countries; Green Dot or stewardship organizations may report different statistics based on their obligated packaging (e.g. household packaging). There is no EU requirement to report aluminum and steel separately, resulting in a combined total for metal packaging. Composite packaging is included in the category of its primary material. “Other” packaging includes materials such as ceramics, textiles, etc. The target recovery rate is for all packaging and there is no specific recovery rate by material type.

UK: HOUSEHOLD AND COMMERCIAL PACKAGING WASTE DATA FOR 2008 (TONNES)

Material	Packaging Waste Generated	Packaging Recycled	Recycling Rate	Recovery Rate	EU Target 2008
Glass	2,360,000	1,439,600	61%		60%
Plastic	2,185,000	524,400	24%		22.5%
Paper and Board	3,839,000	3,071,200	80%		60%
Aluminum	821,000	467,970	57%		50%
Steel					
Wood	1,227,000	932,520	76%		15%
Other	292,450	0	0		
<b>Total</b>	<b>10,724,450</b>	<b>6,649,159</b>	<b>62%</b>	<b>66%</b>	<b>55% recycling, 60% recovery</b>

(European Organization for Packaging and the Environment (EUROPEN), 2011; Eurostat, 2011b)



## HISTORY AND SYSTEM DESCRIPTION

In order to comply with the EU Packaging and Packaging Waste Directive, the UK adopted the concept of extended producer responsibility in 1995, but has implemented it quite differently than most countries in Europe.

Under a typical packaging extended producer responsibility scheme, businesses must take responsibility for the packaging that they put on the market and fulfill their obligation to take back the packaging or ensure it is properly recovered by paying a material and weight-based fee to a stewardship organization to finance recovery infrastructure. In contrast, to fulfill their take-back obligation in the UK, producers participate in a unique, market-based, tradable credit system, similar to the pollutant trading programs used to limit air pollutants that cause acid rain and smog. These credits are known as Packaging Recovery Notes (PRN) or Packaging Export Recovery Notes (PERN). Unlike other European countries where “producer” is narrowly defined, in the UK, the Department for Environment, Food, and Rural Affairs (DEFRA) requires the cost of collection, sorting, and reprocessing packaging waste to be spread along the packaging supply chain, extending to businesses and local authorities (Department for Environment, Food, and Rural Affairs (DEFRA), 2011). Because of this, the UK system can be described as a shared producer responsibility system.

In the UK, “producer” is defined as any business handling more than 50 tonnes of packaging and with an annual turnover of 2 million pounds (MRW, 2005). This includes any business that manufactures raw materials, converts or fills packaging, sells packaging to the final user, or imports packaging. Each year packaging producers must either register with the Environment Agency or join a compliance scheme, along with providing data on the amount of packaging handled in the previous year. In 2011, 44 compliance schemes were registered with the government (The Environment Agency, 2007). Producers must purchase the number of PRNs they need (either directly or through a registered compliance scheme) to comply with the business recycling target set by the government. This is based on their position in the supply chain, as follows:

### Allocation of responsibility for recovery of packaging, based on position in supply chain

Raw material manufacturer	6%
Converter	9%
Packer/filler	37%
Retailer	48%
<b>TOTAL</b>	<b>100%</b>

(U.K. Secretary of State for Environment, Food, and Rural Affairs, 2007)

An accredited reprocessor can issue a PRN and an accredited exporter can issue a PERN for reprocessing in another country. (The abbreviation PRN will be used from now on to refer to both PRN and PERN, as they are functionally the same for the purposes of this document.) A PRN is issued for every tonne of packaging material recycled or recovered (MRW, 2005). The PRNs are material-specific and state whether the material was recycled or recovered (through waste-to-energy, for example). The proceeds from sale of PRNs must be used to improve collection or reprocessing infrastructure or for the development of secondary UK markets (MRW, 2005).

The Environment Exchange is the established marketplace for trading PRNs. In theory, this tradable credit system is extremely efficient in encouraging producers to promote higher rates of recycling and recovery for their packaging and packaging materials (Department for Environment, Food, and Rural Affairs (DEFRA), 2010b). For example, when a material is new or hard or expensive to collect and is therefore collected in a small quantity, the price of that material's PRNs will increase due to lack of supply. On the other hand, if a material is widely and easily collected, the price of that material's PRNs will decline. The money received from the sale of the PRNs is put towards infrastructure improvements to collect, sort, and reprocess more of the material or the establishment of secondary markets.

The government sets targets for both recycling and total recovery (recycling is one form of recovery). Recycling targets are set at 92% of total recovery, emphasizing that recycling is preferred and the majority of recovery will happen via recycling.

UK Business Recycling Targets	2006	2007	2008	2009	2010	2011	2012
Paper	66.5%	67%	67.5%	68.5%	69.5%	69.5%	69.5%
Glass	65%	69.5%	78%	80%	81%	81%	81%
Aluminium	29%	31%	35%	38%	40%	40%	40%
Steel	56%	57.5%	68%	68.5%	69%	71%	71%
Plastic	23%	24%	26%	27%	29%	32%	32%
Wood	19.5%	20%	20.5%	21%	22%	22%	22%
Overall Recovery	66%	67%	72%	73%	74%	74%	74%
Minimum amount of recovery to be achieved through recycling	92%	92%	92%	92%	92%	92%	92%

Source: (Department for Environment, Food, and Rural Affairs (DEFRA), 2010a)



While the PRN system has enabled the UK to meet the EU recycling and recovery targets, it has been criticized for a lack of transparency, as well as not requiring producers to share enough of the local authorities' financial responsibility for recycling collection (Department for Environment, Food, and Rural Affairs (DEFRA), 2011). DEFRA has stated that no changes will be made to the system at present, but both the cost-sharing and the system as a whole will be reconsidered in light of the expected update of the EU Packaging and Packaging Waste Directive in 2014 (Department for Environment, Food, and Rural Affairs (DEFRA), 2011).

In addition to the PRN system, the UK uses a wide variety of other policies to promote recycling, including landfill taxes, disposal taxes, financing of infrastructure improvement, market development, and public education. The UK's Waste Strategy for England 2007 lays out new targets for recycling and composting, recovery of materials, and reductions in overall municipal solid waste (Secretary of State for Environment, Food, and Rural Affairs, May 2007). The Waste Strategy introduces the possibility of banning materials (e.g. packaging) from disposal in landfill and will annually increase landfill taxes to encourage recycling. In 2011, DEFRA released an updated Waste Strategy for England. A significant change for the UK government is the stated goal to promote life cycle analysis and thinking around all waste management policy and decisions, as well as to "promote the reporting of waste management in carbon terms, as an alternative to weight-based measures" (Department for Environment, Food, and Rural Affairs (DEFRA), 2011). The focus on carbon (both embodied and emitted) is a change from past practice. The 2011 Waste Strategy also renews the national emphasis on voluntary industry responsibility, such as with retailers and brand owners in the Courtauld Commitment (discussed below).

The following equation is used to calculate the tonnes of packaging that must be offset by a company's purchase of PRNs.

*Tonnes handled x Supply chain allocation x Business recycling target = Tonnes to offset (rounded to nearest tonne)*

Where

- "Tonnes handled" is tonnes of packaging (to the nearest tonne) handled in the previous year;
- "Supply chain allocation" is the percent allocation based on position in the supply chain;
- "Business recycling target" is the annual business recycling target by material set by the government.\*

One additional step is needed to calculate number of PRNs needed. The producer must also make sure to purchase at least 92% of recycling-specific PRNs to meet the minimum target of 92% recovered through recycling.

*\*(U.K. Secretary of State for Environment, Food, and Rural Affairs, 2007; U.K. Secretary of State for Environment, Food, and Rural Affairs, 2008).*

The Waste & Resources Action Programme (WRAP) assists local councils with guidance on best waste management practices. This includes advice on collection, sorting, and reprocessing recyclable materials, as well as organic materials and residual waste.

### COLLECTION

Waste is managed at the local level by 433 local councils. The councils operate independently from each other, with little coordination. Each council determines which materials are collected and the collection schedule. In addition, bin size and shape are determined by local councils. There may be drop-off sites as well as recycling available in local retail stores. In addition, the UK is starting to make recycling bins available in public places for on-the-go packaging.

As of 2007, 94% of UK households have access to curbside recycling collection from their local council. According to WRAP, over 180 local authorities are emphasizing increased recycling and reduced waste by switching to an alternate weekly collection schedule, where recycling and residual waste are collected on alternating weeks (WRAP, July 13, 2007). The idea of alternate weekly collection has been controversial across the country, as some citizens complain of odors and pest problems when residual waste is collected only every two weeks (Department for Environment, Food, and Rural Affairs (DEFRA), 2011).

On-the-go bins reflect the lack of overall collection coordination. In one area of London visited during the research trip, multiple street bins were seen, all of which collected different recyclables, and had different shape, colors, and logos.



*In a London park in the Borough of Camden, bins are set out for each material, including glass sorted by clear, green, and brown. The labels are faded and difficult to read.*



*In the London Borough of Camden, a different set of on-the-go bins collects only paper and plastic bottles and beverage cans.*



*Yet another on-the-go recycling bin style on the same street in Camden as the previous bins. These bins are collecting all materials in one single stream: glass, plastic, cans, and paper. The bins are in good condition.*



*A final on-the-go collection bin type just down the street in the same Camden area. These large dumpsters are collecting separated materials, though in this case, glass is being collected as mixed glass. The labels are worn and difficult to read.*



In fact, many of these issues identified were later described as barriers to more successful on-the-go collection in London. Barriers cited include lack of consistently located recycling bins, no standard on-the-go collection system across London, lack of storage, contamination, and costs to the Boroughs to implement a system (London Assembly Environment Committee, May 2009).

The upcoming 2012 Olympic Games in London are advertised to be zero waste to landfill, which provides motivation to increase on-the-go recycling across the city. London has been studying the coordinated recycling systems set up for the Sydney, Australia Olympic Games and has recommended investing in more bins, clearly labeled, across the city by 2012 (London Assembly Environment Committee, May 2009). In addition, the London Assembly suggests that packaging for the Games be selected based on ease of recyclability of the material in London-based reprocessing facilities.

### SORTING

The trend toward single-stream recycling collection means more materials must be sorted from each other than ever before in the UK. A WRAP survey found 61 material recovery facilities operating in England (Dougherty Group, LLC on behalf of WRAP, September 2006). It is interesting to note that glass is not routinely accepted at MRFs in England, though newer MRFs with better equipment do accept glass in the co-mingled materials (Dougherty Group, LLC on behalf of WRAP, September 2006). This also may be because glass has traditionally been collected at bring sites throughout the UK, so the glass is already separated. According to the 2006 WRAP study, MRFs in England usually have less rigorous material and bale specifications than do MRFs operating in Europe or the United States (Dougherty Group, LLC on behalf of WRAP, September 2006).

### REPROCESSING/RECOVERY

A research visit to the Closed Loop Recycling (CLR) facility in Dagenham, outside of London, demonstrated a state-of-the-art plastics reprocessing facility that produces recycled plastics suitable for food contact. Currently, the plastics that are reprocessed at CLR are PET and HDPE, with mixed plastics designated as the next potential feedstock. The plant was designed by consultants from Nextek Incorporated.

At the time of the research visit in 2008, the demand for recycled plastic in the UK was considered to be five to six times higher than the supply. The CLR plant was being pilot-tested at the time of the visit and was due to come online in December 2008 to try to meet some of that demand. CLR's facility can reprocess 35,000 tonnes of plastics per year. Several drivers were helping to drive up the collection of plastics that are reprocessed at CLR. DEFRA has worked with the milk industry to require all milk to be packaged in 50% recycled content HDPE by 2020. Closed Loop Recycling also noted that Coca-Cola had a goal of 25% recycled PET by 2010. One retailer, Marks & Spencer, had also agreed to purchase recycled plastic at virgin prices for its private line of packaging (R. Dvorak, personal communication, November 4, 2008). These drivers were helping to increase collection of plastics, along with providing a price guarantee to CLR to justify the investment in the sorting technology and the construction of a new facility.

Bales of sorted plastics arrive at Closed Loop Recycling from a MRF operated by Veolia, which uses optical sorting technology for the plastics. Nevertheless, CLR reported that the bales contained up to 20% contamination and had to be re-sorted to separate out metals and film plastics from the PET and HDPE bottles. Infrared optical sorters identify the polymers as PET, HDPE, or "other." These streams are sorted again by color, and colored PET and HDPE is sent elsewhere for reprocessing. Clear and light blue PET and natural HDPE are reprocessed by CLR. Hand-sorting is done at the very end to remove any other obvious contaminants.



Bales of PET and HDPE plastics arrive at Closed Loop Recycling from the Veolia-operated MRF.



The bales are broken and sent to be sorted at CLR.



Plastic bottles are sent through a trommel for the initial sort at CLR.



The mixed plastic bottles are sent through a series of sorting technologies to remove aluminum and steel, and then to an optical sorting machine to be separated by polymer type.



The plastic flakes are washed and sent through a float-sink operation.



Bags of clean, sorted plastic flake.

Once the plastics are sorted, they are ground into 10 mm pieces and are sent into a hydrocyclone, where pieces of film, labels, too-small flakes, and dust are sucked up and out. Then the flakes are sent for washing, after which they are put through a float-sink tank to separate PET (which sinks) from HDPE (which floats). The flakes are washed and dried again, and again sorted first by polymer and then color. This brings the flakes to 99.98% purity. The rejects in each step are run through the sorting process again to recover as much plastic as possible.

After sorting, the HDPE flakes are extruded into pellets. Clean PET flake is also sold to other companies. Each batch of pellets and flake are tested with a variety of lab tests for quality control, including gas chromatography (calibrated using virgin polymer), spectrophotometry to measure color and brightness, viscosity, water content, pH, and particle size distribution. The plastics reprocessed by CLR are safe for use in food-contact applications.

In 2008, CLR was planning to focus next steps on recycling mixed plastics.

#### HIGHLIGHT ON A PUBLIC-PRIVATE PARTNERSHIP: WRAP

The UK government has partnered with industry to fund a unique organization, Waste & Resources Action Programme (WRAP), devoted to tackling a number of issues, including waste management best practices, packaging reduction, creation of a packaging labeling system for recycling, and minimization of food waste. WRAP is a private company backed by government funding that is working to prevent and reduce packaging waste and develop markets that use recycled materials. In 2005, grocery retailers, brand owners, and suppliers signed a voluntary agreement with WRAP called the Courtauld Commitment to reduce packaging waste and innovate better packaging that will greatly reduce the food wasted by UK households. In 2010, the Courtauld Commitment moved into Phase 2 (WRAP, 2011a). Phase 2's targets are further reductions in packaging and food waste, as well as increased recycled content in packaging and reductions in packaging weight. As of May 2011, there were 50 signatories to the Commitment Phase 2 (WRAP, 2011b).

WRAP also developed a voluntary package recycling label and labeling system, supported by data that communicates to consumers about how to dispose of the packaging (OPRL, Ltd., 2011a). When the label was launched, WRAP handed ownership and administrative obligations over to the British Retail Consortium and its subsidiary company, OPRL, Ltd., which stands for "on-pack recycling label." Building on an initial nationwide access-to-recycling data collection effort completed by WRAP, OPRL now annually updates the data on access to recycling in the UK by surveying local councils. OPRL manages the use of the label, and uses the access-to-recycling data they collect to designate a material "widely recycled," "check local recycling," or "not currently recycled" (OPRL, Ltd., 2011b). *Closing the Loop: Labeling for Package Recovery* discusses this label in greater depth.



WRAP's mission is broader than packaging. Its vision is "A world without waste, where resources are used sustainably," which allows it to be active not just in packaging, but in any sector it identifies for guidance on sustainability and resource use (WRAP, 2011c). Its goal is to help the UK governments meet their sustainability goals and commitments and to encourage resource efficiency across the UK through wise use of resources. Its unique position allows it to serve as a liaison between government, business, and individuals (WRAP, 2011d). To this end, it is focusing on diverse topics such as litter, food waste, consumer practices, composting, business supply chain best practices, and farming.

### ANALYSIS OF SYSTEM

#### General

- 94% of the UK population has access to curbside recycling.
- Recycling rates are improving, but are not as high as the best-performing EU countries.

#### Infrastructure & Operations

- Lack of and poorly-coordinated on-the-go collection remains a problem, but awareness is growing about the importance of coordinating the collection across jurisdictional boundaries, clear signage, and accepting the same materials on-the-go as at curbside. The London Olympic Games may provide the boost for better on-the-go collection in that city.
- There is currently no harmonization of recycling programs between local authorities. Materials collected, bin type, and collection frequency are all different from municipality to municipality. Alternate weekly collection of garbage and recycling is an innovative experiment in encouraging recycling and discouraging residual waste generation.
- The UK is funding innovation in its reprocessing infrastructure, and is developing markets for recycled content materials. Working with the packaging and retail industry to use more recycled content in packaging and encouraging them to purchase recycled polymers from the reprocessors are two ways that the government has provided crucial support to this policy goal. In particular, the UK is pioneering the production of 100% recycled food-grade plastics as well as mixed plastics reprocessing. Aiding the establishment of domestic secondary markets that make use of recycled materials continues to drive waste management policy decisions.
- An innovative on-pack recycling label originally designed by WRAP and now managed by OPRL Ltd., a subsidiary of the British Retail Consortium, is slowly being rolled out on packaging across the UK. It is hoped that the clarity of the label's instruction will increase recycling rates. The Green Dot label is not used for UK-based packaging.

#### Policy

- The UK's system of tradable credits (PRN) has had success in increasing the nation's recycling rates, but it doesn't encourage the improved design of packaging and the reduction of packaging waste. The PRN system has been criticized for lack of transparency and for being too complicated. It may be an indication of why the UK is the only country to have implemented this market-based, tradable credit system for packaging producer responsibility.
- An emphasis on carbon, both embodied and emitted, instead of weight-based measurements for packaging signify a change in recycling goals. Aluminum and plastic packaging have relatively low recovery rates, but are the most carbon-intensive materials. Efforts to increase recycling rates of these materials will be high priority in the coming years.
- WRAP, funded by industry and the UK government through DEFRA, is playing a large and important role in consulting on packaging and food waste, recycling best practices, labeling for package recovery, research, and much more. The Courtauld Commitment, spearheaded by WRAP, is an innovative way of getting public commitments from retailers and the packaging industry to help reduce packaging waste and design packaging to prevent food waste.
- The annual increase in the landfill tax is one way to encourage recycling, composting, and other disposal techniques.

#### Financing and Economics

- The UK's producer responsibility system is unique in Europe in attributing the costs of the system to all participants in the packaging supply chain, from material manufacturers to converters to retailers. Most other systems obligate only brand owners, retailers, or first importers.
- Many packaging companies see the PRN costs the way they would see a tax – as a fixed cost. In those cases, companies do not see that they have control over lowering the cost of their PRNs by improving package design. If a producer can pay for a PRN, the incentive to change package design is limited. To counter this, additional emphasis on improving packaging design for recyclability is expected.
- Because the UK's recycling programs operate at the municipal level and there is little transparency in the PRN system, there is no good national estimate for cost of recycling collection and processing per capita.



## Switzerland

### GEOGRAPHY

- Area:** 39,997 square kilometers
- Comparison:** Slightly less than twice the size of New Jersey
- Population:** 7,593,494 (2008 est)
- Population density:** 190 people/square kilometer
- Urban population:** 73% of total population (2008)

(World Factbook, 2011) (Eurostat, 2011c)

### LEGAL AND POLICY FRAMEWORK

**Administrative regions:** A confederation of 26 cantons (or states).

**Official language(s):** French, German, Italian, Romansch

Switzerland is part of EFTA (the European Free Trade Area) but has opted out of the EEA (European Economic Area). Legally, Switzerland has no obligation to follow any EU Directives, including the Packaging and Packaging Waste Directive (Pro Europe, n.d.b). However, as it is surrounded by EU member countries, Switzerland has tried to harmonize its waste and packaging policies in order to avoid trade barriers.

There is no overarching national Swiss legislation on packaging, but the Beverage Containers Ordinance (2000) does spell out specific targets and prescriptions for packaging material or characteristics of beverage containers (Federal Authorities of the Swiss Confederation, 2000).



Switzerland has its own legislation, the Technical Ordinance on Waste, similar to the EU's Landfill Directive. It states that all non-recyclable waste must be treated first before it can be landfilled (Federal Office for the Environment (FOEN), 2009e). In practice this means that non-recyclable municipal solid waste is sent for incineration with energy recovery.

*A Swiss public education campaign for recycling featuring Pixar's Wall-E character.*

### WASTE STATISTICS

Since January 2000 all non-recyclable, combustible waste in Switzerland must be incinerated for energy recovery.

In Switzerland in 2009:

- 5,481,644 tonnes of MSW was generated
- Approximately 0% of MSW was landfilled (number not reported)
- 2,680,359 tonnes of MSW was incinerated with energy recovery (49%)
- 2,801,285 tonnes of MSW was recycled (51%)

(Federal Office for the Environment (FOEN), August 2010)

SWITZERLAND: RECOVERED HOUSEHOLD AND SMALL BUSINESS WASTE DATA 2009 (TONNES)

Material	Packaging Waste Generated	Packaging Recycled	Recycling Rate
Glass	350,313	331,507	95%
Plastic (PET only)	46,349	37,543	81%
Paper and Board	1,500,510	1,316,888	88%
Aluminum cans	7,033	6,400	91%
Aluminum pet food cans			80% est
Aluminum tubes and other aluminum			60-70% est
Steel	14,000	11,760	84%

(Federal Office for the Environment (FOEN), August 2010; VetroRecycling, 2007; Recycling Papier + Karton, 2009; Federal Office for the Environment (FOEN), July 16, 2010) (R. Varis, personal communication, June 16, 2011)



### HISTORY AND SYSTEM DESCRIPTION

Switzerland does not have a comprehensive packaging waste legislation, but the Beverage Containers Ordinance applies to materials used for beverage packaging. The Federal Office for the Environment (FOEN) is responsible for implementing the Beverage Containers Ordinance. The Ordinance places a mandatory deposit on refillable beverage containers and non-refillable polyvinyl chloride (PVC) beverage containers. It also obligates the take-back of non-refillable beverage packaging. The Ordinance states that 75% of glass, PET, and aluminum beverage containers must be recycled annually. If the material recycling target is not met, the government can impose a mandatory deposit scheme on that type of beverage container.

Manufacturers and importers of beverages must report to FOEN annually on volume of refillable and non-refillable beverages imported to Switzerland, along with packaging material, type of beverage, and container weight.

Any company importing glass beverage bottles (empty or filled) for use within Switzerland must pay an advanced disposal fee to a “fee organization.” The fee organization is essentially the same as a stewardship organization in other countries, although its responsibility is limited to glass beverage bottles. This organization must use the fees to collect, transport, sort, and clean the glass and cullet, as well as conduct public education campaigns about the importance of recycling glass. Glass is currently the only beverage packaging material to be subject to an advanced disposal fee.

In practice, each material’s industry recycling organization is responsible for meeting the recycling targets for its respective beverage container, maintaining collection infrastructure for that material, or both. The exception to this is for paper and board, the collection of which is the responsibility of municipalities. There are no official recycling targets published for non-beverage container packaging. This material-specific division of responsibility is unique to Switzerland. Instead of one or more stewardship organizations being responsible for all types of packaging, Switzerland’s system consists of each material organization operating its own packaging recovery system, including fees, infrastructure, and public education. Municipalities drive recycling behavior by using pay-as-you-throw garbage collection, the proceeds of which go to fund municipal waste collection.

Producers, bottlers, importers, and retailers pay a fee per container to the private material-specific organization, which goes to pay for collection, transportation, sorting, and public education for that packaging material. The collected fees are used to reimburse municipalities for the cost of collection and transport. If the private material collection organizations do not meet their recycling targets, the government may threaten to impose a deposit scheme or a tax on that material. In all cases to date, the organizations have improved their recycling rate and have thereby avoided a tax.

There are seven Swiss recycling organizations united under the umbrella organization Swiss Recycling: FERRO-Recycling (steel/tinplate), IGORA (household aluminum), INOBAT (household batteries), PRS PET-Recycling Schweiz (PET beverage bottles), SENS Swiss Foundation for the disposal of wastes (electrical and electronic appliances), TEXAID (textiles) and VetroSwiss (glass) (Federal Office for the Environment (FOEN), 2008c).

Recycling is encouraged at the municipal level by charging for each garbage bag in a pay-as-you-throw scheme (Pro Europe, n.d.b).

### COLLECTION

Recycling is always available at community recycling centers, scrap metal yards, and drop-off sites. It also may occur at curbside (separately by material), at retailers, and/or in bins and reverse vending machines in public places. Each material organization provides and maintains the drop-off bins, pays for collection, sorting, and reprocessing of that material. Municipalities are responsible for financing the collection of paper and board. The organizations also reimburse municipalities, retailers, or citizens if their material is collected by those groups.

**PET beverage bottles:** Only PET beverage bottles (no other PET packaging formats) are collected for recycling in Switzerland. PRS PET-Recycling Schweiz is the material organization responsible for meeting the recycling target for PET beverage containers. The membership of PRS covers 97% of the PET beverage bottles sold in Switzerland. PRS maintains 26,000 collection points at retailers and reverse vending machines for PET bottles across the country (Federal Office for the Environment (FOEN), 2009f). Cities and municipalities collect about 20% of all the PET bottles via curbside collection (Federal Office for the Environment (FOEN), 2009f).

**Other plastic:** No other plastic packaging, including non-beverage container PET, is collected for recycling. It goes in the municipal solid waste disposal bin for incineration with energy recovery (Federal Office for the Environment (FOEN), 2008a). However, the government has suggested that non-beverage container plastics may eventually be included in recycling targets.



*Only PET beverage containers are collected for recycling in Switzerland.*





A green glass bottle bank at a community recycling drop-off center.

**Glass:** VetroSwiss is responsible for glass collection and the collection and management of the advanced disposal fee for glass bottles. Non-bottle glass is collected by color in bottle banks at drop-off sites. Some communities collect glass separately in the curbside collection system.

**Aluminum:** IGORA is responsible for collecting aluminum in Switzerland. Aluminum beverage cans, pet food containers, and tubes (for mayonnaise, tomato paste, etc.) are all collected, along with any other packaging labeled with the “alu” recycling symbol. Beverage cans have been collected separately from other aluminum packaging to keep track of beverage container recycling rates. The Nespresso brand of individual aluminum coffee capsules are also collected separately from other aluminum packaging at drop-off locations, as they still contain coffee grounds and require special processing to remove the coffee prior to recycling (IGORA, n.d.).

Aluminum beverage cans may be deposited at retail locations, bars, events, and schools in can crushers provided by IGORA. All aluminum packaging can go in curbside collection or in bins at community drop-off centers. Steel packaging is often collected in the same bin as aluminum packaging, due to the ease of sorting them from each other. IGORA conducts on-going public education campaigns to encourage aluminum recycling. Contests and awards are frequent.



Aluminum cans are collected at the local recycling center.



Recycling iconography for a combined steel and aluminum collection bin.

**Steel** is collected curbside and in drop-off sites. In some areas it is collected together with aluminum. Ferro Recycling is the organization that is responsible for managing the per-package fees for users of steel packaging, as well as ensuring steel meets its recycling targets.

**Paper and board** is collected at curbside and also in bins at community drop-off sites. The curbside paper collection is separate from other materials, so newspapers and board must be tied in separate bundles. Corrugated must be flattened. Traditionally, collection of paper and board has been financed by local government. However, due to the fluctuations in the recycled paper market, there is some movement towards a new financing agreement between municipalities and the buyers of recovered paper. This agreement would guarantee a buyer for the recovered paper, as well as a minimum price floor for local governments (Federal Office for the Environment (FOEN), 2009d).

**Other:** Swiss recycling collection drop-off centers also collect a variety of other materials in their own bins: wood, textiles, tires, batteries, electronics, appliances, compact fluorescent light bulbs, plate glass, mattresses, and much more. Many of these items are also collected at retailers and special collection locations. Some communities have pioneered the use of a retro-fitted school bus that drives to new locations daily to collect all types of materials for recycling.



Aluminum Nespresso coffee capsules have a special collection bin at neighborhood drop-off centers, as well as at Nespresso coffee shops.



Paper is collected in a separate bin at the local recycling drop-off center.



## SORTING AND REPROCESSING

About a third of all glass that is collected is reprocessed into new container glass in Switzerland. Another third is exported, and the final third is used by the construction industry as aggregate or gravel substitute (Federal Office for the Environment (FOEN), 2009g).

Aluminum is baled and sent to Germany and Italy for reprocessing (Federal Office for the Environment (FOEN), 2009c).

Steel is sorted from aluminum at scrap yards throughout Switzerland. It is reprocessed both domestically, as well as exported for reprocessing (Federal Office for the Environment (FOEN), 2008b).

Paper and board may be reprocessed domestically or abroad, depending on the type and quantity of waste paper collected. If paper is collected separately from corrugated, it may be delivered directly to a paper mill. If all paper is collected together, it will be sorted into different grades first (Federal Office for the Environment (FOEN), 2009d).

PET beverage containers are sorted by color, ground into flake, and reprocessed. Clear and light blue containers are remade into new beverage containers, while other colors of PET bottles are used for other applications, such as fiber or strapping. Most PET beverage containers are reprocessed domestically, though some are exported (Federal Office for the Environment (FOEN), 2009f).



A retrofitted school bus travels to a new location each day, collecting all types of recyclables.



Collection of fluorescent light bulbs and batteries at the drop-off center.



Collection of ceramics at the drop-off center.



Other items collected include plate glass, clothing and shoes, wood, and mattresses.



### ANALYSIS OF SYSTEM

#### General

- Switzerland has high recycling rates for the collected packaging materials.
- It is unlikely that the Swiss system would become widespread in the US, because it requires a high level of participation from consumers.

#### Infrastructure & Operations

- Glass and paper are collected separately from other materials in curbside collections. A great deal of sorting is also done by consumers at drop-off locations or through the use of reverse vending machines.
- The Swiss focus plastics recycling collection on PET bottles only. No other plastics are collected, even HDPE, which is usually collected as a valuable commodity in other countries. This fact means that sorting collected plastics is extremely simple, since only one kind of polymer should be present in recycling bins.
- A retro-fitted recycling school bus is innovative. Since it is mobile, it can reach both the elderly who can't make it to recycling centers as well as people in remote areas.
- Lots of drop-off centers are available for an urbanized population.
- Collection and reprocessing of unusual items, such as Nespresso aluminum capsules, is quite advanced and well-accepted as evidenced by high rates of public participation.

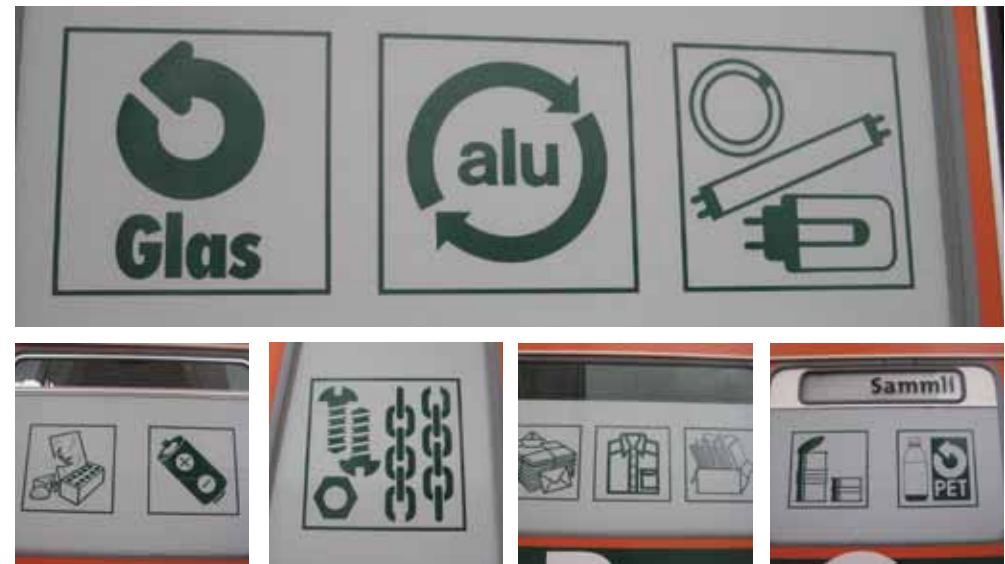
#### Policy

- Responsibility for packaging recovery is assigned to a number of different organizations, each responsible for a single packaging material. There is little coordination between materials, except for steel and aluminum. Dividing responsibility by packaging material type works in a small country where the population is extremely diligent about recycling everything, not just packaging.
- Producers who use multiple materials for their product packaging must work with individual material organizations, which adds bureaucracy and is not as efficient as dealing with one packaging organization.
- There is no disincentive or penalty for using packaging that is not collected for recycling, such as most plastics, since all municipal solid waste not recycled is sent for incineration with energy recovery.

- The threat of a mandated deposit program has resulted in high recycling rates of PET bottles, aluminum cans, and glass bottles (though there is an advanced disposal fee for non-refillable glass bottles).
- Waste-to-energy is a significant and accepted component of Swiss waste disposal, at approximately 50% of municipal solid waste. The Swiss see this as an alternative to using coal, natural gas, or oil. In general, waste-to-energy is an important strategy in countries where landfill space is limited or landfill disposal is discouraged by law.

#### Financing and Economics

- The Swiss do not try to collect all materials for recycling. Because fewer types of materials are collected, sorting costs are lower. Sorting costs are also lower because many materials are collected separately at drop-off centers or special collection bins for only one type of material.
- In 2009, it cost approximately 23 Swiss francs per capita per year for the collection and processing of recyclable materials (Federal Office for the Environment (FOEN), 2009a).
- Plastics (other than PET bottles) are not collected due to the high cost required to collect and process them (Federal Office for the Environment (FOEN), 2009b).



Simple iconography helps communicate with the public, explaining which materials can be recycled.



### Australia

#### GEOGRAPHY

Area:	7,682,300 square kilometers
Comparison:	Slightly smaller than the area of the lower 48 US states
Population:	21,262,641 (July 2009 est.)
Population density:	2.76 people/square kilometer
Urban population:	89% of total population (2008)

#### CURRENT POLICY SITUATION

**Administrative regions:** A federal system comprised of 6 states and 2 territories.

**Official language:** English

In Australia, waste is managed at the state level. States create and manage policies such as landfill bans, container deposit legislation, or material bans. States also set policies that local municipalities must follow. In practice, municipalities are responsible for implementing policies by providing waste and recycling collection to citizens, funded by local taxes.

As an island nation, Australia imports a majority of its packaging and also exports many of the recyclables collected to Asian trading partners. Diana Gibson of Sustainability Victoria estimated 30% of collected recyclables were sent to Asia in 2009. Incineration (with or without energy recovery) and backyard burning are banned in Australia, leaving recycling, composting, and landfill as the current disposal options. (Waste-to-energy does exist in a few Australian states today, but only in the form of cement kilns that accept waste materials, such as tires, as sources of energy (S. Moore, personal communication, July 11, 2011; B. Baker, personal communication, July 14, 2011)).

In 1999, the Environmental Protection and Heritage Council (a law-making body made up of state-level ministers) proposed the creation of the National Packaging Covenant (NPC), complemented by the Used Packaging Materials National Environmental Protection Measure (NEPM). Participation by the packaging industry in the NPC was to be entirely voluntary; however, if a packaging producer chose not to participate, they would be subject to the NEPM regulation. Once it was passed at the federal level, the Used Packaging NEPM regulation has since been translated into the legislation of all Australian states or territories.

Starting with a 2003 packaging recycling rate baseline of 39%, Australia's overall packaging recycling target was 65% for 2010 and was raised to 70% by 2015 (Australian Packaging Covenant Council, 2010). A twin goal was to have no increase in the amount of packaging going to landfill.

National-level product stewardship action has increasingly been seen in a positive light, due to the variations in each state's version and implementation of the Used Packaging Materials NEPM. Because the implementation and interpretation of the NEPM varies significantly among the Australian states and territories, harmonization at the federal level was identified as a way to avoid the need to comply with eight state regulations.

On November 5, 2009, all Australian state and territory governments agreed to adopt a new federal waste policy, entitled The National Waste Policy: Less waste, more resources (Commonwealth of Australia, 2009b). The Environment Protection and Heritage Council spearheaded the movement. In essence, the policy aims to achieve economic, environmental, and social benefit by waste reduction and better management by 2020. This document was endorsed by the Council of Australian Governments in 2010.

2010 brought a flurry of activity. In July, the Australian Packaging Covenant (APC) replaced the National Packaging Covenant (NPC). Later that year, the Australian Department of Sustainability, Water, Environment, Population, and Communities produced the "Product Stewardship Legislation Consultation Paper," which lays out the need for and the process towards legislation on product stewardship (Commonwealth of Australia, 2010). In 2011, this legislation was introduced to the Australian Parliament, passed, and went into effect in August. Though it does not specifically call out packaging waste (due to the existence of the APC), it will establish a federal legislative basis for the application of product stewardship policy tools on a variety of products.



## WASTE STATISTICS

In Australia in 2006–07, 22,707,000 tonnes of waste was recycled (52%), and of that amount, 5,082,000 tonnes (or 22%) was from the municipal waste stream. 21,069,000 tonnes of waste was landfilled (48%) (Commonwealth of Australia, 2009a).

For packaging waste specifically, the Australian Packaging Covenant Council (APCC) reports that the recycling rate increased from 39% recycled in 2003 to 62.5% in 2010 (Australian Packaging Covenant, 2011 May 20). The remainder of packaging waste is presumed to have been landfilled, as no incineration option exists.

## RECYCLING RATES BY MATERIAL

Material	2003 baseline	2008 actual	2009 actual	2010 targets	2010 actual
Paper/cardboard	49%	72%	70%	70-80%	75.5%
Glass	26%	38%	39%	50-60%	47%
Plastics	20%	33%	36%	30-35%	34.8%
Steel cans	36%	32%	38%	60-65%	30.3%
Aluminum cans	63%	64%	64%	70-75%	67.4%
Overall rate	39%	57%	57%	65%	62.5%

(National Packaging Covenant Council (NPCC), 2009; National Packaging Covenant Council (NPCC), 2010; Australian Packaging Covenant, 2011 June 8).

## HISTORY AND SYSTEM DESCRIPTION

The National Packaging Covenant (NPC) was begun in 1999 as a five-year voluntary effort to “minimize the environmental impacts arising from the disposal of used packaging, conserve resources through better design and production processes and facilitate the re-use and recycling of used packaging materials” (Commonwealth of Australia, 2011). However, at the same time, the Used Packaging NEPM was created to regulate those packaging producers who did not join the Covenant. This NEPM was intended to limit free riders. The NPC was renewed for one additional five year period, after which it was replaced by the Australian Packaging Covenant (APC) in 2010. The new APC has no expiration date. The APC is termed a co-regulatory product stewardship scheme in Australia, which means that voluntary participation is backed up by regulation (Commonwealth of Australia, 2010). The APC covers

only retail consumer product packaging and the associated distribution packaging; no commercial or institutional packaging is included. The goal of the APC is not to fund the collection and processing of packaging materials, but to supplement municipal and state efforts through grants and education.

In contrast to other countries where the stewardship organizations include only packaging producers, membership in the APC is more open and includes not only companies along the packaging supply chain, but also local, state, and federal government, industry associations, community groups, and NGOs. This is based on the concept that product stewardship must include all those involved in the life cycle of a product, not just the producer (Commonwealth of Australia, 2010).

In the APC, the packaging industry pays dues based on annual company sales and position in the supply chain, not the amount or type of packaging material they place on the market (Australian Packaging Covenant, 2011). Packaging manufacturers (companies that manufacture or import packaging materials) pay higher dues (2.7 times higher) than brand owners, wholesalers, raw material suppliers, waste management companies, and other companies. It is expected that over time, the APC will move to one general rate, based on packaging-related turnover, for all companies along the supply chain. Other members of the APC (industry associations, community groups, NGOs) pay one small flat fee annually. Industry contributes a minimum of A\$3 million annually to the APC (personal communication, Stan Moore, April 16, 2011). State and territory governments together match these dues 1:1, so approximately A\$6 million dollars is collected annually for administration, grants, projects, etc. Individual companies have a maximum contribution cap of A\$286,000. The dues are not intended to cover the full cost of collection and sorting, but are to be used for education and grants.

The APC is run by a Secretariat. The APC dues are held and managed by the National Packaging Covenant Industry Association (NPCIA; name to change soon), a body made up of representatives from industry associations. Overseeing the implementation of the APC is the APC Council (APCC), made up of representatives of all levels of government, industry, and NGOs. The NPCIA manages the APC projects. Formerly, under the NPC, the project goals were to improve curbside collection systems and determine best practices for local councils to implement. The new APC strategic plan calls for increasing the away-from-home packaging recycling rate to 70% by 2015, as well as bolstering local secondary markets for reprocessing and increasing the use of recycled content in Australian-made packaging (Australian Packaging Covenant Council, 2010).

If a company does not participate in the APC, the National Environment Protection Measure (NEPM) on Used Packaging Materials is used to regulate it (Environment Protection and Heritage Council (EPHC), 2011). Though the NEPM is enforced at the state level, it is a national policy designed to ensure that companies participating in the APC do not face a market disadvantage (Commonwealth of Australia, 2005). Those companies that do not participate in the APC are subject to more onerous performance and reporting obligations than those required under the Covenant. They must individually achieve material recovery targets that are over and above those targets collectively set under the Covenant, and report periodically.



If a producer decides to join the APC, it must first pay its dues for the current year. It then has three months to submit an Action Plan with its planned contribution to achieving the APC's targets and minimizing packaging waste. It must also produce an annual report that describes the efforts to meet its Action Plan targets. Finally, it must agree to undergo an independent audit of these activities if required (Australian Packaging Covenant, 2010). In the past, a criticism of the NPC had been that companies were not strictly held to their Action Plan goals and there were no common reporting metrics. The new APC requires all signatories to lodge an Action Plan and to provide an Annual Report. The Plan and Report must address the eight key performance indicators (KPIs) under the Australian Packaging Covenant Council strategic plan. There are systems in place to assess that each signatory has addressed each KPI, and an external auditor is expected to conduct an audit of a representative sample of signatories each year (S. Moore, personal communication, July 11, 2011).

Companies with less than A\$5 million annual sales fall under a de minimis rule and are exempt from participation in the APC. Free riders are regulated under the NEPM, enforced by state government. In the past under the NPC, the state governments conducted surveys at retail stores and followed up with non-members about their NEPM compliance. Under the new APC, the task of tracking free-riders has been assigned to industry. The National Packaging Covenant Industry Association (NPCIA) Secretariat is now responsible for determining free riders, asking that they join the APC, and then turning their names to the states if they remain non-compliant (personal communication, Stan Moore, April 16, 2011). APC reports that growth in membership is due to this action by states, as non-members are joining to avoid NEPM regulations.

The APC has approximately 650 signatories as of May 2011 (personal communication, Jennifer King, May 26, 2011).

### COLLECTION

Waste management is handled by state and local governments. The collection system (including frequency of service, bin type, etc.) ultimately depends on the municipality, although the municipalities are influenced by state laws and regulations. Occupational health and safety laws have forced curbside collection across Australia to switch to larger, rolling bins that are lifted mechanically by the truck rather than using hand-lifted crates.

In general, curbside recycling collection in Australia is single stream, with paper, glass, metals, and plastics all collected in the same bin. South Australia's beverage container deposit program collects designated beverage containers at depots, though some may find their way into the curbside collection.

Rural areas in Australia do not necessarily have curbside service, but typically have drop-off sites.

### State Strategies: Victoria

In the state of Victoria, Sustainability Victoria is the agency that makes waste policy and provides delivery of programs. The state Environmental Protection Agency coordinates by providing the regulatory enforcement.

#### ***Standardize and coordinate collection.***

There are 79 local councils (or local governments) in the state of Victoria. The 30 councils in the metropolitan Melbourne area cover 75% of the state population. A beginning strategy has been for the state to encourage the councils to standardize bins and service with the following system:

- A 120 liter bin for landfill, collected weekly.
- A 240 liter bin for single stream recycling collected every 2 weeks. They would like to standardize plastic collection by including all rigid plastics #1-7.
- An organics bin, collected every two weeks (alternating with recycling) for composting.

To implement this strategy, the Melbourne Metropolitan Waste Management Group (MMWG), a state government body, works with the 30 local Melbourne councils. Activities have included standardizing bin type, collection frequency, materials collected, and consumer education campaigns. The MWMG also serves councils by making and managing regional collection contracts for landfill, recycling, and composting (Metropolitan Waste Management Group, 2007). The goal is to promote best practices and maximize resource recovery across municipalities. The standardization of recycling services should make it easier for consumers to understand the system and participate.

#### **Other waste strategies designed to drive recycling:**

##### ***Landfill levy.***

Victoria assesses a landfill levy on top of the regular tipping fee. The money that is collected through the levy goes to fund infrastructure for both municipal and commercial/industrial solid waste. It is also used to build or improve material recovery facilities. In the Melbourne metropolitan area, this levy is A\$12 per tonne for commercial and A\$8 for MSW. The total tipping fee in Victoria is around A\$70-80 per tonne.

##### ***Zero waste strategy with goals.***

Victoria has a zero waste strategy with an overall goal of 75% by weight of all solid waste recovered for recycling, reuse, and energy by 2014. More specifically, the combined goal for municipal solid waste recovery rate for reuse and recycling is 45% by 2008-09 and 65% by 2014 (Sustainability Victoria, 2010). In 2008-9, 43% was reached.



### ***Container deposit program***

Victoria has chosen not to implement a container deposit program, but instead to focus on improving the curbside recycling system.

### ***Landfill ban***

In Victoria, in order to institute a landfill ban, the state must wait until at least two recyclers can accept and handle the banned material before the ban goes into effect. This makes landfill bans difficult without cooperation by recyclers. This is different than in South Australia, where landfill bans are enacted and the recyclers must subsequently find a way to manage that new waste stream.

### **State Strategies: South Australia**

South Australia is considered by many to have the most stringent waste management policies in the country, and it has achieved the second highest recycling rate (Commonwealth of Australia, 2009a). Zero Waste South Australia is the state government body that makes waste policy, while the state Environmental Protection Authority enforces it. Local governments manage the actual collection of recyclables.

### ***Standardize and coordinate collection.***

To achieve a standard recycling system across the state, South Australia government has paid local municipalities to standardize their services and has provided technical assistance. South Australia is also piloting organics collection in the state capital, Adelaide.

### ***Case study: Beverage Container Deposit Program***

South Australia was the only Australian state with an active container deposit program until 2011, when the Northern Territory passed its own law. Litter reduction, not recycling, was the primary goal of the program when implemented. The deposit was increased from 5 to 10 cents in 2009. There is an average 73% return rate for all beverage containers, including liquid paperboard cartons. The return rate for most beverage container materials is higher than 73%, but liquid paperboard is a recent introduction to the system and currently brings down the average return rate. One advantage of the container deposit program is that the state can accept or reject a new container to the program based on packaging material or design.

The program covers most beverages and containers, including glass, metal, PET, and HDPE. Liquid paperboard for beverages such as flavored milk was recently added to the program. Wine is excluded, as well as milk and juice in containers larger than one liter.

South Australia's container deposit system means that consumers must bring beverage containers to a drop-off depot to reclaim their deposit. (Other recyclables in South Australia are typically collected at curbside.) Beverage containers are brought to collection depots where employees count them and sort them by brand, in particular beer versus soft drink, and refund consumer deposits. In 2009, there were approximately 110-120 collection depots that send their loose, uncrushed collected containers via truck to four super-collectors. The super-collector is the middleman who manages contracts between brand owners and depots. The brand-sorted beverage containers are weighed by the super-collector, who pays the collection depot by weight. Although the collection depots pay consumer deposits by the piece and super-collectors pay collection depots by weight, the amounts "usually work out," according to Edward Nixon of Statewide Recycling, a supercollector. Brand owners demand extra care in this step, because they keep whatever deposits go unclaimed on their containers. Because of the rigorous sorting by the container deposit program, South Australia's collected beverage container materials are of extremely high quality and consistently receive a high market price.

### ***Zero Waste goals.***

South Australia has a goal of reducing all waste sent to landfill by 25% by 2014 from a 2002-2003 baseline. As of 2009-2010, it had reached a 17.2% reduction, and with a greater emphasis on organics collection, is on track to reach its 25% goal. The state has specific goals for curbside recycling collection, which are to increase the recycling of all municipal curbside solid waste to 50% in 2008 and 75% in 2010 (Zero Waste SA, 2005).

### ***Landfill fees.***

Landfill tipping fees are higher in South Australia than other states to encourage recycling. Waste depot license fees are also levied and collected by the South Australia Environmental Protection Authority. 50% of the fees go to fund Zero Waste South Australia's activities (Zero Waste SA, 2011). The fees are scheduled to increase in the coming years to up to A\$50/tonne for metropolitan Adelaide, with lesser levy increases in rural areas.

### ***Landfill bans.***

South Australia banned single-use plastic bags in 2009. In 2010, it also banned the landfilling of most packaging materials (glass, metal, paper, PET, and HDPE) (Government of South Australia, n.d.). Landfill bans on other plastic packaging are due to be phased in over 2011 and 2012 (Government of South Australia, 2010). Unlike the state of Victoria, landfill bans can be implemented before any collection infrastructure is in place.



A drive-through collection depot where consumers bring their beverage containers for sorting.



An employee hand-sorts beverage containers by brand. Consumers are refunded their deposit based on number of containers.



Auto batteries dropped off at the beverage container collection depot.



Bins are emptied by brand into large metal cages. The cages are loaded onto trucks and transported to the supercollector.



Beverage containers are sorted into bins by brand.



A truck transports empty loose beverage containers from a collection depot to a super-collector in South Australia.



Bins of collected liquid paperboard beverage containers.



Bin of aluminum cans sorted by brand.



Materials are sorted again through a mini-MRF by the supercollector, weighed, and baled.



Bales of green PET bottles are destined for reprocessing in Sydney or export to China.





**SORTING**



*Bales of HDPE bottles are sent to be reprocessed in Adelaide, South Australia.*

With the exception of rural recycling collection drop-off sites where materials are sorted by consumers, Australian MRFs process materials collected in single-stream bins. The Visy Smithfield MRF near Sydney that was visited during the research trip used similar automated technology to that seen elsewhere; hand-sorting was not used. At that time, the Smithfield MRF processed around 620 tonnes of material daily and 150-160,000 tonnes/year.

Compared with most companies, Visy is unusual in its vertically integrated structure. It is a material manufacturer, packaging designer and converter, recycling hauler, MRF owner and operator, and reprocessor for glass, plastic, and paper. The Smithfield MRF is co-located with a paper plant, which allows for efficiencies in transporting paper for reprocessing. It

also provides Visy with a direct feedback loop for encouraging them to design packaging for recyclability, as they fully expect to collect, sort, and reprocess the packaging they design for their clients.

Typical contaminants at the Visy Smithfield MRF included hoses, wire, videotape, CDs, HDPE bottle with PVC shrink sleeves, PET with aluminum labels, and multi-laminate cartons (eddy current mistakenly sorts them with aluminum packaging due to their aluminum content). Other

common contaminants seen in the Smithfield MRF that would be considered extremely unusual in the United States were lead-acid car batteries and small propane tanks disposed of in household recycling bins.

Unlike the MRFs in Belgium and Germany, the Smithfield MRF did not use a drum or trommel to separate materials. The material is first placed on an ONP screen (ONP refers to old newspapers) that separates collected materials by size. Large items continue up to a conveyor belt, while small items fall through the screen. The small items are divided by size again by a second ONP screen. Plastic bags are a significant problem when they wrap around the screens, and the MRF must shut down every 4-5 hours to remove bags from the first ONP screen and once per day to remove bags on the second ONP screen.

Next, slanted (or angled) screens allow three-dimensional objects to fall toward the center while paper or other flat items remain on the outer edges. This step separates the containers from the paper. The flat fraction is sent to the optical paper sorter, which removes any plastic that may have gotten mixed in. 90% of the paper is sent directly to Visy's on-site paper mill, which saves on baling costs. The glass in the three-dimensional container stream is broken and pieces fall through the conveyor belt, while suction removes any paper from the glass stream. The glass is sent to Victoria for further sorting and reprocessing.

An eddy current sorts the aluminum from the non-ferrous metal containers. A Titech-brand optical sorter is used for PET and HDPE. The Visy PET reprocessing plant located about 40 minutes away takes the clear PET. Anything not identified is sent back around the entire process again to make sure all recyclable material is identified and sorted.



*Typical recycling bins near Melbourne, Victoria. Due to worker health and safety concerns, bins are all equipped with wheels and are designed to be lifted hydraulically by the recycling truck*



*Single stream recycling arrives at the Visy #1 for sorting.*



Materials are loaded onto a conveyor belt at Visy's Smithfield MRF.



Plastic film, netting, and other contaminants bind the screening equipment and cause frequent work stoppages for cleaning.



The screen separates large paper items from smaller paper items and containers.



The slanted (or angled) screens separate flat paper (stays on the outer edge of the screen) from three-dimensional containers (roll down the slope).

## REPROCESSING

In Australia, several vertically integrated companies, including Visy and Amcor, make packaging and also collect, sort, and reprocess it. This means that these recyclers have a direct connection to packaging designers in a way that most recyclers do not. If a package causes problems at a MRF or during reprocessing, they have a way to address those problems.

Steel is not reprocessed in Australia. All steel packaging is imported and then exported as scrap bales. Due to geography, the primary export market for collected recyclable materials is Asia.

## CASE STUDY: GLOBAL RENEWABLES MSW REPROCESSING

During research, one municipal solid waste reprocessing facility outside of Sydney was visited. Global Renewables' UR-3R Eastern Creek Facility uses residual municipal solid waste destined for landfill as its feedstock. Despite the presence of curbside recycling collection, the residual waste stream still contains some recyclable materials. The waste stream is 40-60% organics; 30% recyclables; 2% hazardous e-waste, car batteries (12,000/year), and 1,000 gas bottles/year; and 4% textiles and inert materials. 12-15% of the recyclable material is paper that is separated out and sent to Visy for recycling. 6% of the recyclables is broken glass. The majority of the recyclable portion is plastic.

Global Renewables' goal is to reduce the use of virgin resources and recover embodied energy. To do this, they separate out any remaining recyclable materials from the residual waste, put small organics through an anaerobic digester, and compost the rest. The biogas produced by anaerobic digestion is currently enough to power the plant itself. The goal is 70% diversion from landfill, but in 2009 they operated at 63%. Global Renewables receives carbon credits on the voluntary market for avoided methane release.

The feedstock is approximately 55% organics when delivered to the facility, which runs three shifts 24 hours a day, five days a week. Misting controls dust, but employees must work in the constantly misted atmosphere. Employees hand sort items that are obviously incompatible with composting and anaerobic digestion, such as large paper items (sent to Visy) or car batteries and gas bottles. 3% of plastic is also handpicked. The feedstock goes through a bag splitter machine and then over wind sifters that pull lightweight plastics off with cyclonic action. The lightweight plastics are then fed through a Titech optical sorting machine. 95% of the wind sifted plastics are plastic films.



Residual municipal solid waste is brought to the Global Renewables' receiving area.



Workers at Global Renewables hand pick recyclables from the residual municipal solid waste stream. Misting is used to prevent dust.



After the bags are broken, film plastics are removed using wind sifters that pull the plastics off in a cyclone at Global Renewables.



After initial sorting to remove recyclables, the feedstock sent to the percolators is 90% organic material. Organic materials that are 80 millimeters or less in size are fed to the percolators and adjusted for moisture. Two streams of material emerge: liquid is sent to anaerobic digesters and solids are sent to composting.

The anaerobic digesters are inoculated using anaerobic microbes from the sewage system that are fed to build up and maintain the microbe culture. Easily digestible organics are hydrolyzed into solution in the percolator. This liquid, referred to as percolate, is collected and fed into the anaerobic digesters. Its high organic content is ideal food for the anaerobic bacteria, which produce methane gas. The anaerobic digestion process has a nine day residence time. Four hundred to five hundred cubic meters of methane is produced per hour. It is collected, desulfurized to remove sulfur dioxide, and then combusted to produce approximately 2 megawatts of electricity.

The larger organics and fiber solids from the percolator are pressed to extract percolate and then sent into the composting process. Despite prior sorting, the material to be composted is initially around 40% plastic by volume. The compost building has negative air pressure, with air being drawn down through the compost and out. After the initial composting period of 2.5 weeks, the compost is moved to an intermediate refinery, where an eddy current and magnet pull out any

remaining metals and much of the plastic is screened out. At this point, the compost produced is immature and still active. Then the compost goes to maturation for 6-8 weeks, after which the less than 20 mm glass fines are screened out and an air knife knocks light plastics out before a final 10 mm screen.

Green (yard) waste that is collected at Global Renewables is composted separately for sale to the gardening market. The compost product from the primary Global Renewables process is not suitable for this market because there is considerable residual glass and plastic in the finished product. However, the glass and plastic remaining in the compost product is acceptable for agricultural or roadside applications. Copper, lead, and zinc are the other main contaminants, but they have measured well below the allowable agricultural limits. It was noted during the Global Renewables tour that Australia's soils are extremely old and weathered, and it was suggested that for many areas, any compost amendment is better than nothing.



*Containers of recyclables hand-picked from the residual municipal solid waste stream. The materials are quite dirty.*



*Everything not sorted out as recyclable goes to composting. The waste, which is approximately 40% plastic, is composted on conveyor belts inside a building with negative air pressure to reduce odor outdoors.*



*The Global Renewables compost is screened multiple times to try to remove remaining plastic and glass.*



*The finished compost product at Global Renewables still has considerable small pieces of glass and plastic.*



### ANALYSIS OF SYSTEM

#### General

- Compared to European systems, the APC has been less effective in increasing recycling rates and providing a funding mechanism for a comprehensive packaging waste system. Until recently, its voluntary nature meant that participation was not strictly enforced. The APC was not designed to fund the actual cost of packaging recovery, but to supplement the existing municipal system with grants for equipment and education campaigns. The packaging industry has left the responsibility for paying for and operating a system to local and state governments. As a consequence, the APC has not harmonized best practices, bin types, collection frequency, or materials collected.
- Unique to Australia, several companies, such as Amcor and Visy, are vertically integrated from material manufacture to packaging design, converting, curbside collection, and even reprocessing. This allows easy co-location of sorting and reprocessing facilities, as well as a valuable “design for recycling” feedback loop, because companies know that the packaging they place on the market will come back to them for sorting and reprocessing.

#### Infrastructure & Operations

- States are leading the way for groups of municipalities to standardize bin type, collection schedules, and collected materials. However, municipal-run programs still differ greatly in materials collected, bin type, and collection frequency.
- At the MRF visited near Sydney, plastic film was not removed early in the processing, requiring a great deal of down time to remove the bags bound up in the screens.
- In South Australia, collection depots for beverage containers require a significant amount of labor in order to count each returned beverage container manually. This is offset in part by volunteer labor. Reverse vending machines were not used.
- Occupational health and safety regulations are driving bin design towards large rolling bins lifted mechanically by the truck and away from crates.
- Reprocessing municipal solid waste as seen at Global Renewables is an innovative idea attempting to move to “zero waste.” However, the resulting compost was suitable only for remediation, agricultural, and roadside sites due to the remaining bits of plastic, glass, and other materials remaining in the compost product.

#### Policy

- The Government of Australia is moving towards more comprehensive and coordinated action on recycling and waste management. The National Waste Policy, the recently-passed product stewardship legislation, and the Australian Packaging Covenant all point towards a more harmonized national waste management policy in Australia. However, there is currently little harmonization among states in implementing this policy.
- A lack of deposits for car batteries and propane tanks results in these items being placed in recycling bins and creating potential hazards at the MRF.
- Harmonization is important. This is demonstrated by the fact that packaging producers would rather participate in the national co-regulatory APC than comply with the state-by-state regulatory variations of the Used Packaging Material NEPM.
- Landfill bans in South Australia have positively contributed to high recycling rates.
- With waste-to-energy not available as a disposal option, a greater importance is placed on recycling and composting efforts. Combined with a global trend towards lightweight packaging, such as flexible pouches, landfills are the sole disposal option for an increasing amount of non-recyclable packaging in Australia.
- Two Australian states have container deposit programs, with other states considering introducing legislation. Litter prevention is the main impetus for these programs.

#### Finance and Economics

- The APC is unique among stewardship organizations in placing the largest financial obligation on packaging manufacturers; most organizations obligate retailers and brand owners instead. The APC’s practice of spreading take-back obligation across the supply chain is most similar to the system in the UK, where take-back obligation is also assessed based on supply chain position.
- South Australia’s container deposit system produces high quality materials, but is inefficient in requiring all containers to be counted by hand at collection depots and then trucked uncrushed to be re-counted by super-collectors. Transporting the empty, loose containers is an inefficient use of fuel for the weight transported.



**Ontario, Canada**

**GEOGRAPHY**

- Area:** 917,741 square kilometers
- Comparison:** Larger than France and Spain combined
- Population:** 12,932,300 (2008)
- Population density:** 14.4 people/square kilometer
- Urban population:** 85%

As of 2010, approximately 47% (6.2 million) of Ontario’s population lives in the Greater Toronto Area.

(Government of Canada, 2005; Government of Canada, 2009; Queen’s Printer for Ontario, 2010a)

**CURRENT POLICY SITUATION**

**Administrative regions:** The most populous province of Canada; one of ten provinces and three territories making up Canada.

**Official language(s):** English and French

In Canada, waste is managed at the provincial or territorial level. Therefore, the Ontarian government creates its own policies and legislation concerning waste management, recycling, container deposit, and extended producer responsibility for packaging. In practice, municipalities are responsible for providing waste and recycling collection to citizens.

With the passage of the Waste Diversion Act of 2002 to promote the concept of reducing, reusing, and recycling waste, responsibility for waste management rests with the Minister of Environment, who also works with the non-profit organization Waste Diversion Ontario (WDO) and relevant industry funded (or stewardship) organizations (Queen’s Printer for Ontario, 2010c).

The Minister of Environment can designate materials for which Waste Diversion Ontario must develop a program. The Minister can also set targets and dates, as well as regulate the creation of industry funding organizations. WDO is tasked to work with the industry funding organizations to develop and operate waste diversion programs. WDO also advises the Minister on ways to improve waste diversion. The industry funding organizations manage an industry sector’s participation in contributing to a fund that is used to create and run a diversion or recycling program. For the packaging industry, this organization is Stewardship Ontario. An important feature of the Waste Diversion Act is that it creates a level playing field for the packaging industry by legally requiring all obligated stewards to participate in funding the Blue Box Program for curbside recycling.

In 2009, the Canadian Council of Ministers of the Environment approved a Canada-wide Action Plan on Extended Producer Responsibility and a Sustainable Packaging Strategy (Canadian Council of Ministers of the Environment, 2011). While this action plan is not legally binding, the ministers encourage each province to adopt these practices in provincial-level legislation to encourage harmonization of extended producer responsibility (EPR) for packaging programs across Canada within six years of adoption of the Action Plan (Canadian Council of Ministers of the Environment, 2009 October 29).

**WASTE STATISTICS**

In 2004, Ontario’s Blue Box curbside recycling target was set at 50%. For 2008, the Blue Box recycling target was raised to 60%. These targets were both met ahead of schedule. The new recycling target is 70% by the end of 2011.

Total waste generation, 2008: 12,442,459 tonnes

Ontario waste disposal, 2008:

- Residential 3,231,399 tonnes
- Non-residential: 6,400,160 tonnes
- Total: 9,631,559 tonnes

Total waste diverted, 2008 2,810,900 tonnes (as recycling or organics)

Residential waste diverted, 2008 1,878,899 tonnes

Diversion rate, 2008: 22.6%

(Statistics Canada, 2010a)



In 2006 in Canada, 97% of the municipal solid waste not diverted for recycling or composting was sent to landfill, while 3% was incinerated with energy recovery (Canadian Council of Ministers of the Environment, 2009 October 29). In the proposed (but not yet accepted) update of the Waste Diversion Act, incineration would not count towards diversion targets, but would be grouped with landfill as disposal.

BLUE BOX MATERIAL RECYCLING RATES, BY MATERIAL

Material	2008 actual	2009 actual	2011 target
Printed Paper	80.1%	79.1%	
Packaging			
Paper packaging	68.5%	65.8%	
Glass	86.4%	90.5%	
Plastics	23.2%	24.9%	
Steel cans	55.9%	58.8%	
Aluminum	39.3%	41.9%	
Overall packaging recovery rate	55.2%	55.4%	
Overall (packaging + printed paper) recovery rate	65.9%	65.3%	70%

(Stewardship Ontario, 2009) (Stewardship Ontario, 2010)

HISTORY AND SYSTEM DESCRIPTION

The curbside recycling bin is known as the “Blue Box” in Ontario. The Blue Box program began in the early 1980s as a pilot curbside recycling collection program in Kitchener. Several years later it was expanded Ontario-wide. Funding came from an initial partnership of the beverage industry, municipalities, and provincial government (Stewardship Ontario, 2011a). In the 1990s, industry participation expanded beyond the beverage industry (Stewardship Ontario, 2011a). While 94% of Ontario’s households had access to Blue Box recycling and there was a desire to increase the amount of waste diverted from landfill and recycled, the recycling rate had not reached 50%.

In 2002, the Waste Diversion Act was passed and the Minister of Environment designated “blue box waste” as a waste stream for which WDO must develop a program to address (Waste Diversion Ontario, n.d.). Blue box waste is the printed paper and packaging waste collected in residential curbside bins (Waste Diversion Ontario, February 26, 2010). The Act requires that the Blue Box Program must provide for payments to municipalities of 50% of the net costs incurred by the municipalities for Blue Box Program implementation (Queen’s Printer for Ontario, 2010b).

At the same time, the Minister designated as obligated stewards for packaging waste Ontario-resident companies who are brand owners, franchisers, first importers, or manufacturers that supply packaging to the market (Stewardship Ontario, n.d.c). The creation of an industry funding organization, Stewardship Ontario, was also authorized by the Waste Diversion Act. Stewardship Ontario is a private, not-for-profit organization that develops, funds, and operates Ontario’s Blue Box Program for the obligated packaging industry. It is overseen by a board of directors representing obligated industry, industry associations, and independent organizations. Stewardship Ontario works with WDO to meet the diversion and recycling targets and dates set by the Minister for blue box materials.

In 2004, the Blue Box Program was officially launched in its current incarnation. That year, the first Blue Box stewards filed steward’s reports and paid fees to Stewardship Ontario, which used the fees to contribute 50% of the costs of the residential curbside Blue Box Program.

Stewardship Ontario is responsible for monitoring the marketplace for free riders. They do this in a variety of ways, including market surveillance and shelf surveys. Failure to report and pay stewardship fees is against the law and non-compliant stewards may incur penalties, fees, and interest charges.

Ontario has a shared producer responsibility system for packaging, with industry stewards and municipalities each contributing 50% of the cost of the Blue Box program. The program is physically operated by the municipalities and is funded 50% by municipalities and 50% by the industry members of Stewardship Ontario. In 2009, the Minister of Environment proposed updating the Waste Diversion Act to change the Blue Box program funding structure to be 100% financially supported by industry. While most Ontarians believe this will happen in the future, at present this proposal is on hold pending upcoming elections.



In an effort to contain costs and standardize best practices, the overall cost of the Blue Box Program is determined by applying and verifying the costs of a best practice model across communities. Therefore, industry does not pay 50% of actual costs, but 50% of “best practice” costs. Some municipalities may have actual costs that are higher or lower than the funds they receive based on the best practice model.

Fees, based on the type of packaging material and weight, are determined by Stewardship Ontario and Waste Diversion Ontario each year. Once the fees are determined, they are applied to each obligated steward based on the amount and type of packaging they put on the market in the previous calendar year. Ontario does have a de minimis provision: if a steward’s sales are less than C\$2 million per year, that company is exempt from participation. Packaging fee rates are available on Stewardship Ontario’s website and archived back to 2003 (Stewardship Ontario, n.d.a). These fees go towards paying Stewardship Ontario’s operations and funding of projects to promote program efficiency, best practices, market development, and consumer education, as well as 50% of the net cost of implementing the Blue Box program (collection, transportation, processing) (Stewardship Ontario, 2011b).

Selected beverage packaging for alcoholic beverages is covered separately under two coordinated deposit return programs. One is for beer containers and is operated by The Beer Store, while the other is focused on wine and spirits and is run as the Ontario Deposit Return Program with the participation of The Beer Store (The Beer Store, n.d.; Ontario Deposit Return Program, n.d.). All other beverage containers are designated under the Blue Box Program.

### COLLECTION

Municipalities operate the curbside Blue Box program. There are mandatory materials that must be collected in all Blue Box programs, but municipalities may still decide which additional materials they want to collect, as well as collection frequency and other practices (Stewardship Ontario, n.d.b). More than 95% of Ontarians have access to the Blue Box recycling program.

The materials mandated for collection throughout the Blue Box program are glass, aluminum and steel food and beverage cans, newsprint, and PET bottles (Waste Diversion Ontario, February 26, 2010). Municipalities must collect at least two additional types of packaging materials, such as printed paper, corrugated, boxboard and cartons, aluminum foil, gable top and aseptic cartons, different types and formats of plastic packaging and film plastics, packing peanuts, aerosol cans, paint cans, or more. WDO is trying to standardize the materials to be collected across all communities (Waste Diversion Ontario, February 26, 2010).

In addition to curbside collection, drop-off recycling centers accept Blue Box waste, along with other items, such as green waste, household hazardous waste, electronics, tires, and home renovation waste.

Under Ontario’s Deposit Return Program (ODRP), alcoholic beverage containers are returned by consumers to Beer Store locations (the province-wide retailer of beer) or other bulk return locations. The deposit-bearing beverage containers are not supposed to be included in the Blue Box, though consumers do place some of these containers into the Blue Box system (C. van Rossem, personal communication, July 5, 2011). In some cases, people will scavenge Blue Boxes at curbside to gather beverage containers for the deposit value, or a municipality may separate and redeem the beverage containers as income. The Blue Box fees are not meant to cover the collection and sorting of beverage containers, since they are covered by the ODRP.

Canada’s breweries are unique in their use of refillable bottles. The program features the use of an industry standard bottle. The bottles are collected, washed, and refilled as part of an industry-run program. In combination with Ontario’s deposit on all beer, wine, and liquor packaging, the refillable bottle used by industry encourages material recovery and reuse.

Toronto has introduced a new design for public bins to collect on-the-go recycling. These bins are designed to provide a positive experience for the public. Because people don’t like touching the flap covering the bin opening when depositing a container, the Ontario bins are designed to open with the use of a foot pedal. The on-the-go bins also feature a container for cigarette butts in an effort to combat litter. These bins have the potential to reach the 47% of Ontario’s population that lives in the Greater Toronto Area.



An on-the-go bin for recycling, trash, and cigarette butts in Toronto. The bins feature foot pedals.



As stated above, municipalities determine which materials to collect in bins, and this applies to on-the-go collection as well. Municipalities do not all use the same public bins, and on-the-go bins do not necessarily collect the same items that can be put in the Blue Box.

Some municipalities use a pay-as-you-throw garbage system to encourage more recycling, but it is not standard practice in Ontario.

### Organics and Anaerobic Digestion

26 Ontario municipalities, including the metropolitan Toronto area, have started curbside organic collection. The organics collection typically includes some types of compostable packaging.

In 2001, the city of Toronto adopted a “zero waste to landfill” goal by 2012. To help meet that goal, it introduced the source separated organics “Green Bin” program. The program, operated separately from the Blue Box Program, was further supported when Toronto’s landfill closed in 2002 and the city’s landfill disposal costs increased 300% in order to ship the waste to Michigan (City of Toronto, 2011a). Reducing waste to landfill therefore means a significant reduction in disposal costs to residents. In addition to composting infrastructure, Toronto has invested in anaerobic digestion facilities to first generate methane (and electricity) from the organic waste prior to composting it (City of Toronto, 2011b).

Organics at curbside are collected every week to minimize pests and odors (City of Toronto, 2011a). Toronto sends around half of its collected organics to composting facilities, and half to anaerobic digestion facilities after which the digestate is aerobically composted and cured (Gorrie, 2010). The surrounding local governments that make up the greater Toronto area send their organics directly to composting facilities.

As of 2010, the City of Toronto had reached a 47% diversion rate, including organics, Blue Box, household hazardous waste collection, and more (City of Toronto, 2011c). The City plans to emphasize organics collection in multifamily homes and apartment buildings to further raise its diversion rates.

## ANALYSIS OF THE SYSTEM

### General

- Canada and Ontario provide a good case study for the US, as geography, language, culture, and packaging are similar.
- An important lesson for the US is demonstrated by the Canadian Council of Ministers of the Environment report urging harmonization of packaging EPR programs across provinces and territories.
- The Blue Box is an icon in Ontario. It has an extremely positive brand image and brand identity, which helps to sell the program and encourage participation and support.

### Infrastructure & Operations

- An attempt to standardize the materials collected is being made by Stewardship Ontario and Waste Diversion Ontario. The “best practice” model is a way to contain costs when collection practices are not standardized across municipalities. Currently, however, each municipal collection program is unique.
- Investment in composting and anaerobic digestion infrastructure will help Ontario and Toronto in the goal of diverting waste from landfill. In particular, anaerobic digestion will also provide waste-to-energy capacity as electricity is produced from methane.
- Stewardship Ontario has made an investment in mixed plastic processing facilities. The two facilities now operating are considered successful and are struggling to meet the demand for their recyclate product.
- Toronto’s new on-the-go collection bins are thoughtfully designed, easy to use, and encourage away-from-home recycling in Ontario’s largest metropolitan area.
- Most communities use single stream collection, though some dual stream programs still exist. Sorting facilities must therefore sort all types of packaging, unlike many European programs where glass and paper are collected separately.
- The Ontario beer industry has successfully built and maintained a strong refillable glass bottle program, featuring standard bottles used by all breweries. Their deposit program is administratively separate from – but logistically works with – the deposit program on liquor and wine bottles.



### Policy

- It is generally accepted that Ontario is moving towards a full producer responsibility program where industry pays 100% of the costs but also would have more control over the Blue Box program operations.
- Waste diversion from landfill is one of Ontario's main goals. To that end, Ontario has encouraged organics collection in the green bin and has invested in both industrial composting and anaerobic digestion infrastructure.
- Provincial regulation (O. Reg. 101/94) requires municipalities with at least 5,000 residents to offer a Blue Box recycling program and collect at least five mandatory materials (aluminum, glass, newsprint, steel, PET bottles) and two others to be selected by the municipality.

### Financing & Economics

- Shared producer responsibility financial model (50% municipality - 50% industry) means a lower bill for the obligated packaging industry to pay overall than full producer responsibility (100%). Nevertheless, there is dissatisfaction on the part of industry that has little say in how the Blue Box program is run and what its costs are. Industry's 2010 share of Blue Box expenses was C\$88.8 million.
- Municipalities are reimbursed by industry for 50% of "best practice" collection and processing, which can mean actual reimbursement of more or less than 50%, depending on municipal collection efficiency.



### Austria

#### GEOGRAPHY

Area:	83,871 square kilometers
Comparison:	Slightly smaller than Maine
Population:	8,217,280 (est. 2011)
Population density:	98 people/square kilometer
Urban population:	68%

(World Factbook, 2011)

A waste-to-energy facility, MVA Pfaffenau in Vienna, Austria, was the only facility visited in Austria. The reason behind this visit was to better understand waste-to-energy as a common end-of-life option for packaging in many European countries. Therefore, an in-depth description of the Austrian system is not included.

#### LEGAL AND POLICY FRAMEWORK

Austria is a member of the European Union and is subject to EU Directives and other legislation. With regards to packaging recovery and recycling, Austrian legislation incorporates:

**EU Waste Framework Directive** establishes a waste management hierarchy of (in order) prevention, reuse, recycling, other forms of recovery, landfill or incineration without energy recovery (European Commission, 2010b). It also sets targets for recycling and reuse.

**EU Landfill Directive** bans landfilling of municipal solid waste without some form of treatment; it must first be sorted and then recovered by recycling, composting, or waste-to-energy (European Commission, 2010a). The residual ash from waste-to-energy facilities can be landfilled.

**EU Packaging and Packaging Waste Directive** sets common rules that facilitate trade and prevent obstacles to trade throughout EU countries. It sets minimum requirements for packaging and also sets common targets for recycling and recovery for each country (European Commission, 2011). To support the Packaging and Packaging Waste Directive, the European Committee for Standardization developed standards EN 13427-13432 that detail the requirements packaging must meet to conform to the Directive (European Committee for Standardization, 2009).

Through the Packaging and Packaging Waste Directive, the EU set weight-based targets for the recovery and recycling of packaging waste in 1994, later revised in 2004 (European Organization for Packaging and the Environment (EUROPEN), 2007b). There are also material-specific recycling

targets, listed below. Recovery includes recycling, composting, and waste-to-energy, among other options. To meet the EU recovery target, at least 60% of packaging must be recovered. To promote recycling, the EU target requires at least 55% and no more than 80% of packaging to be recycled.

All packaging materials have specific recycling targets (European Parliament and Council, December 20, 1994; European Organization for Packaging and the Environment (EUROPEN), 2007a December 5):

- 60 percent for glass
- 60 percent for paper and board
- 50 percent for metals (aluminum and steel)
- 22.5 percent for plastics
- 15 percent for wood

Austria has exceeded these targets.

In terms of the overall packaging recovery systems, Austria's system is similar to that of Belgium. ARA is Austria's non-profit stewardship organization, filling the role in Austria that Fost Plus does in Belgium. In Austria, paper, glass, metal, and plastic bottles are recycled. All other non-bottle plastic packaging, including film plastic, other packaging, and municipal solid waste is sent to waste-to-energy facilities.

#### HISTORY AND FACILITY DESCRIPTION: MVA PFAFFENAU

MVA Pfaffenau is a waste-to-energy facility that has been operating since 2008. It is owned by the city of Vienna. It has a capacity of processing 250,000 tonnes per year of waste. In 2008, 770 tonnes of municipal solid waste per day was brought to the facility. Twelve bays are available for trucks to tip their load into bunkers. The plant has a capacity of 18,000 m<sup>3</sup> of waste (1800 trucks' worth). There are two incineration lines, each working at a rate of 16 tonnes per hour. The plant operates seven days per week, but delivery of waste only takes place five days per week.

As of 2008, MVA Pfaffenau received both residential waste and bulky waste, but not much commercial waste. Accurate characterization of the typical municipal solid waste stream is important so that the plant can be run efficiently. Pfaffenau was aware of the feedstock contents it would receive upon opening based on the feedstock sent to existing waste-to-energy plants in Vienna. It contains textiles, plastic bags, non-bottle plastic, as well as organics.



OPERATION

Bulky waste is shredded before incineration. Two cranes carry waste from the storage bunker to the two incineration lines. There are fire extinguishers linked to temperature sensors in the bunker to make sure the waste doesn't catch on fire as it sits. All the air needed for incineration is drawn from the bunker. This means that the air pressure in the bunker is lower than the outside air, reducing any potential smells coming from the bunker.



Delivery bays where trucks dump collected municipal solid waste at MVA Pfaffenau.

A look inside one of the delivery bays.



The inside of MVA Pfaffenau.

The heat from burning waste goes to the boiler, which heats water until it evaporates. The steam turns turbines to create electricity. The flue gas cools but it can still be used to preheat the water in the boiler. MVA Pfaffenau can deliver about 70 GWh per year of electricity and 400 GWh per year of district heat to the grid. This provides 25,000 households with electricity, and 50,000 homes get heat through the 1,000 km of piping in the district heating network in Vienna. It also supplies year-round heat for hot water. The steam condenses back into liquid water and then gets pumped back to the boilers to start the process again.



A small window shows the incineration line in action.

The incinerator typically produces between 7-15 MJ/kg of waste, but it is typically 9 MJ/kg. Plastic produces higher amounts of energy when burned. Too much plastic waste in the feedstock can cause the facility to operate outside of these optimum parameters. Too high caloric value can reduce the throughput of the facility, thereby reducing the capacity of the plant. This is why it is important for plastic to be diverted for recycling and for the facility operators to accurately characterize the feedstock. This allows them to mix in non-plastic waste to reduce the caloric value of a load containing large amounts of plastic.



Cranes lift waste from the deep storage bunkers into two incineration lines (on right). The incinerator incinerates waste at temperatures greater than 1000°C for about one hour. Thirty percent of the waste becomes slag residue and is further treated to separate out metals. The rest of the ash/slag, considered to be "treated" under the EU Landfill Directive, is then sent to landfill.



There is a four-step cleaning process for the gas.

- Gases are sent through an electrostatic precipitation process, where charged dust particles are collected.
- The gases are passed through water. Chlorine, fluorine and heavy metals are rinsed out of the gases. The water used in the scrubbers is treated by raising the pH to 9.5 using lime and sulfur dioxide to separate out the heavy metals and mercury. This produces a filter cake containing concentrated metals. The process produces gypsum that can be sold or landfilled, and the metals are sent for long-term hazardous waste storage in an underground bunker in Germany.
- Gas is sent over coke with fine pores where toxics accumulate. The coke allows for adsorption of any gaseous toxic materials. When the active coke is used up, it is replaced and the old coke is incinerated at the facility.
- The gas is heated to 180°C and sprayed with ammonia water, which flows through ceramic catalyzers. Nitrous oxide combines with the ammonia to form water vapor and nitrogen.

The cleaned gases are emitted from an 80-meter-tall stack, after being checked twice. The size of particles leaving the stack is less than or equal to 10 micrometers. The biggest problem identified by the plant manager is carbon monoxide. Organic substances, sulfur dioxide, hydrochloric acid, hydrofluoric acid, mercury, and dioxins are all measured at different intervals determined as required for that substance.



Some of the gas cleaning technologies used at MVA Pfaffenau.

### ANALYSIS OF FACILITY

Dr. Helmut Allgeuer, plant manager at MVA Pfaffenau, stated that a waste-to-energy facility is not operated for the sole purpose of producing energy. Its value also must take into account that it is a waste disposal solution. He provided a quick explanation of the financing and operating costs of the plant compared with the revenue received from energy production:

“Our plant has a capacity of 250,000 tonnes/year of waste, can deliver about 70 GWh/year of electricity and 400 GWh/year of district heat to the grid. Based on a price for electricity of approx. 40 EUR/MWh and district heat of approx. 12 EUR/MWh you can earn about 8 million EUR/year by energy production. Investment cost for our plant was approx. 200 Mio EUR. If you finance this with 4,5% for 20 years it will cost you approx. 15 Mio EUR/a (with 0% it would be 10 million EUR). Since you also have costs for plant operation and maintenance, you can see it is not possible to finance a typical waste incineration plant with high environmental standards only by energy production.” (H. Allgeuer, personal communication, March 26, 2010).



A view of the 80 meter tall stack.



### Netherlands

#### GEOGRAPHY

Area:	41,543 square kilometers
Comparison:	Slightly less than twice the size of New Jersey
Population:	16,847,007 (est. 2011)
Population density:	405.5 people/square kilometer
Urban population:	83%

(World Factbook, 2011)

Though the Netherlands were not visited as a part of research, their system is worth a brief mention, as it is different from most countries in Europe in its implementation of extended producer responsibility.

The Netherlands is part of the European Union, and must comply with the various EU Directives detailed above in previous country profiles. The Dutch Packaging Decree (2006) set national packaging recycling targets of 70 percent that met and exceeded the EU recycling targets. This changed starting in 2008, when the government of the Netherlands instituted a packaging tax. The tax is determined by type and amount of material in a package and is “based on the damage the material does to the environment” (Pro Europe, n.d.a). The damage is determined with a carbon-footprint-based assessment.

In the Netherlands, the stewardship organization that helps producers fulfill their packaging take-back obligation is Nedvang, a non-profit organization. As in most countries, producers have the option of fulfilling their packaging take-back obligations on their own or collectively. Most choose to do so through Nedvang. Nedvang makes contracts with municipalities and waste processors, and also is responsible for collectively reporting its members’ activities to the government. Municipalities collect the materials and are paid by Nedvang. Any revenue generated from the materials is put back in the waste fund (Pro Europe, n.d.a).

Unlike most other countries in Europe, instead of paying a Nedvang-determined fee to pay for collection sorting, and reprocessing infrastructure, producers pay a packaging tax set by the government. The government can set the tax at any rate they determine; the packaging industry does not determine the financial portion of the system. Nedvang does consult with the government on the allocation of the total budget. The tax is collected by the government and put in a waste fund. For 2007-2012, the annual tax collected is set at 365 million euros, with 115 million euros guaranteed annually to cover producer responsibility costs (Dutch Network for Plastics Packaging, 2008; Nedvang, 2010). The remaining two thirds of the tax (250 million euros) can be used by the government as it wishes.

The material fee categories in order from highest to lowest tax rate are: aluminum, plastics, ferrous metals, paper/cardboard, glass, wood. Composite packaging (such as multilayer pouches or cartons) fees are based on the amount of each material used in the package.

Glass is color-sorted and collected in containers at bring sites or recycling drop-off locations. Paper and board is collected at curbside once a month. Collection of plastic packaging is a new focus of Nedvang, and municipalities can choose which types of plastics they collect and whether it will be collected curbside or at drop-off locations. Wood and metals are collected separately.

A packaging tax means that the problem of free riders is almost eliminated. The tax also influences the choice of packaging materials, so the weight of packaging put on the market in the Netherlands has decreased by 30% (Nedvang, 2010). However, the packaging tax is heavily criticized because most of the money collected does not go for recycling or waste management costs, but can be used by the government as it wishes.



### California

#### GEOGRAPHY

Area:	403,932.836 square kilometers (155,959.34 square miles)
Population (2010):	37,253,956
Population density:	92.22 people/square kilometer (238.9 people/square mile)
Urban population:	87%

(U.S. Census Bureau, 2011; Stanford University Rural Health, 2010)

#### LEGAL AND POLICY FRAMEWORK

Effective January 1, 2010, Senate Bill 63 (Strickland, Chapter 21, Statutes of 2009) merged programs created by California's integrated waste management and beverage container recycling laws into the new Department of Resources Recycling and Recovery, or CalRecycle. Important programs administered by CalRecycle include oversight of waste disposal facilities, and recycling and reuse of materials including organics, electronic devices, beverage containers, used oil, and waste tires. These programs support California's mandate that local jurisdictions divert at least 50 percent of their waste from landfills.

In California, waste policy may be determined at both the state and local government level. Waste collection is managed by municipalities or counties. Local government is also responsible for meeting the per capita landfill diversion targets.

#### Division of Recycling: Beverage Container Recycling

CalRecycle's Division of Recycling (DOR) administers the 1986 California Beverage Container Recycling and Litter Reduction Act (Act) (AB 2020, Margolin). The primary goal is to achieve and maintain an 80 percent recycling rate for most aluminum, glass, plastic, and bimetal beverage containers sold in California, reducing beverage containers as a component of litter within the state, and to make beverage container recycling integral to the California economy.

At the heart of the program is California Redemption Value (CRV), a deposit-like fee that encourages the recycling of eligible beverage containers. CRV applies to most non-alcoholic beverages, as well as beer and malt beverages, wine coolers, and distilled spirits coolers. Notable exclusions from CRV are milk and infant formula, 100 percent vegetable juice in containers larger than 16 ounces, and 100 percent fruit juice in containers 46 ounces or larger, along with wine and distilled spirits.

The program is funded through payments made by beverage distributors on each eligible CRV beverage container sold or offered for sale in the state. These payments are deposited into the California Beverage Container Recycling Fund (CBCRF). CRV is 5 cents on containers of less than

24 ounces, 10 cents on containers that are 24 ounces or larger. The distributor cost is passed along to retailers who buy CRV eligible beverages, then to consumers when they purchase beverages. Consumers can get CRV back by returning their empty containers to recycling centers. Recycling centers are reimbursed out of the Recycling Fund.

Legislation also provides additional financial incentives to recyclers, processors, and manufacturers. The incentive based programs are intended to boost beverage container recycling, increase recycling markets, improve infrastructure, improve the quality of recycled materials, and encourage manufacturers to use recycled material as feedstock.

#### Integrated Waste Management (IWM)

AB 939, (Sher, Chapter 1095, Statutes of 1989) is California's Integrated Waste Management Act (IWMA). The IWMA created an integrated waste management hierarchy to guide a state board and local agencies to implement source reduction, recycling, composting, and environmentally safe transformation of California waste. The California Integrated Waste Management Board was eliminated at the end of 2009 as a result of SB 63. The board's programs are now administered by CalRecycle.

SB 1322 (Bergeson), enacted in union with AB 939, implemented state programs to:

- Change manufacturing and consumption habits
- Increase the procurement of recycled materials by the state
- Improve markets for recyclable materials
- Conduct research and development to improve the manufacturing processes for recycled materials
- Define terminology both common and industry
- Provide programs for waste management development at the state level
- Inform and educate the public about waste management

CalRecycle's waste management programs are funded through a variety of fees, including tipping fees for waste taken to landfills, and fees on the sale of motor oil, tires, and electronic devices such as computers and televisions with display screens larger than four inches.

Among the key tenets of recycling and recovery programs is that producers should assume some responsibility for the materials and packaging they sell. CalRecycle has engaged in a variety of program activities concerning products and their impact on California's fragile ecosystems and environment.



### Extended Producer Responsibility (EPR)

EPR (sometimes called product stewardship) is a strategy placing shared responsibility for end-of-life product management on producers instead of the general public. EPR encourages product design changes to minimize negative impacts on public health and the environment at all stages of a product's lifecycle. EPR provides for the incorporation of costs to recycle or recover a product and disposal into the total cost of a product. EPR is a waste reduction strategy providing incentives to eliminate waste and pollution through product design, allowing CalRecycle to carry out its mission and goals for the citizens of California (California Department of Resources Recycling and Recovery (CalRecycle), 2011f).

Numerous legislative hearings have been held in California discussing EPR policies. Testimonies from a wide variety of experts have been heard by the state legislature. Among topics discussed were the economic and environmental impacts of EPR in other regions and states, and how California may benefit. While bills have been introduced into the legislature over the past several years to create an EPR program for California, legislation was not passed until 2010.

California has established extended producer responsibility (EPR) programs for product categories such as paint, medical sharps, carpet, and tires. While bills have been introduced into the legislature over the past several years to create an EPR program for packaging and printed paper, packaging EPR legislation has not yet passed.

### Mandatory Commercial Recycling

California is the first state in the U.S. to enact a statewide program to reduce greenhouse gas (GHG) emissions by diverting commercial solid waste from landfills with the passage of AB 3411 (Chesbro, Chapter 476, Statutes of 2011). The law sets a statewide waste diversion goal of 75 percent by 2020. Recycled materials can reduce GHG emissions from multiple phases of product production including extraction of raw materials, preprocessing and manufacturing. The commercial sector generates nearly three fourths of the solid waste in California, with most waste disposed in landfills readily recyclable. Businesses and multi-family dwellings of five or more units that produce at least four yards of waste per week are now required to recycle. Local jurisdictions will oversee implementation of these programs with assistance from CalRecycle (California Department of Resources Recycling and Recovery (CalRecycle), 2011g).

### California Jurisdictional Packaging Bans

With 1,100 miles of coastline (California Coastal Commission, n.d.), the issue of marine debris has been driving the discussion about EPR for packaging. California's Ocean Protection Council has led this effort. A number of California municipalities have also begun charging fees for or banning certain types of packaging, such as plastic bags or expanded polystyrene. This is typically in response to litter and marine debris concerns.

### Government Incentives for Beverage Container Recycling

The state of California provides several incentive programs intended to support the processing of recycled beverage containers and the market for creating recycled content products. Three of these incentive programs are the Quality Incentive Payment (QIP) Program, the Plastic Market Development Payment (PMDP), and Processing Payments.

The QIP program is designed to improve the quality and marketability of empty glass, plastic, or aluminum beverage containers collected for recycling (California Department of Resources Recycling and Recovery (CalRecycle), 2008). For example, it assists glass processors in the creation of high quality end use cullet. This supports the state statute that requires a minimum percentage of recycled content in all glass containers and fiberglass produced in California.

The PMDP provides an incentive for program participants to purchase California-generated plastic beverage containers (PET and HDPE) and create quality end use recycled-content feedstock, particularly plastic flake and pellets (California Department of Resources Recycling and Recovery (CalRecycle), 2007). It also incentivizes plastic manufacturers to purchase and utilize the California-processed feedstock when making new recycled-content plastic products, such as clamshells, sheeting, strapping, new containers.

The Processing Payments program is a part of the CRV deposit program (California Department of Resources Recycling and Recovery (CalRecycle), 2010). It provides a financial incentive to processors and recyclers to offset the costs of collecting and processing beverage containers when the costs are greater than the scrap value of the material. The processing payments offered by CalRecycle are adjusted annually based on the scrap value of each beverage container material and its associated collection and processing costs.

## WASTE STATISTICS

### 2010 CALIFORNIA WASTE GENERATION STATISTICS

Total MSW generation:	86.85 million tons
Total waste disposal:	30.4 million tons (4.5 lbs/person/day)
Total waste diverted:	56.45 million tons
Diversion rate:	65%



The state of California does not collect recycling data for packaging materials other than beverage containers. This makes it impossible to truly compare the recycling rate for packaging with the other countries and provinces described above. The recycling rates for beverage containers in California are listed here.

California Beverage Containers	2008 Recycled	2010 Recycled
Glass	76%	85%
PET	62%	68%
HDPE	91%	92%
PP	1%	4%
PS	1%	8%
#7/Other	7%	10%
Steel/bimetal cans	14%	12%
Aluminum	84%	94%
Overall beverage container (CRV) recycling rate	74%	82%

(California Department of Resources Recycling and Recovery (CalRecycle), 2011d)

For a reference, in the US, beverage containers represent approximately 15 percent of all packaging by weight, or 17.5 percent by weight if glass wine and liquor bottles are included. When total municipal solid waste is considered, beverage containers including glass make up only approximately 5 percent of all waste by weight (US Environmental Protection Agency (USEPA), December 2010). Although California’s beverage container recycling rate is high, it is impossible to extrapolate that rate to non-beverage container packaging.

Unfortunately, California does not collect packaging recycling rate data, with the exception of CRV beverage containers covered under the Act. The best way to estimate a California recycling rate is to extrapolate national recycling data published by the EPA or purchase data from trade associations and consultants (H. Le, CalRecycle, personal communication, September 6, 2011).

#### HISTORY AND SYSTEM DESCRIPTION

In 1989, California was diverting only 10% of generated municipal solid waste from landfills. The Integrated Waste Management Act of 1989 (AB 939) passed and went into effect in 2000, with the goal of achieving 25% landfill diversion by 1995 and 50% diversion by 2000. Diversion was to be achieved by source reduction, recycling, and composting. The Act also established a state integrated waste management hierarchy to guide the Integrated Waste Management Board and local agencies in implementation, in order of priority: (1) source reduction, (2) recycling and composting, and (3) environmentally safe transformation and land disposal (California Department of Resources Recycling and Recovery (CalRecycle), 2011a).

In 2007, after California’s municipalities had difficulty meeting the diversion targets due to increased population growth, the diversion target was normalized to an equivalent per capita disposal target. Monitoring disposal per capita makes comparing progress easier, even with population growth. The 50% per capita disposal target is based on 50% of generation from 2003-2006 (California Department of Resources Recycling and Recovery (CalRecycle), 2011c).

Like all other US state recycling programs, there is no state-level standardization for California’s packaging recovery system. Recycling collection is the responsibility of local government or jurisdictions. Collection practices, bin types, and materials and formats collected vary widely from city to city. In some communities, the city collects and sorts the packaging. In other communities, the service is contracted out to the private sector. In other locations, households must contract for private recycling subscription, some have only drop-off sites, and other communities have no recycling collection at all.





**Single Stream Recycling and Collection**

Despite this variability, California is part of a nationwide trend towards adoption of “single stream” curbside recycling. Jurisdictions cite many benefits derived from switching to single stream collection, including increased volume, ease of adding new material types to collection, increased diversion, reduced collection costs, reduced worker injury and worker’s compensation costs, and increased participation by resident and businesses.

However, the introduction of single stream collection systems has not had such uniformly positive results for recycled product manufacturers due to the increased levels of contamination. Manufacturers have seen costs increase for cleaning and screening the poorly processed materials, increased internal costs, poor quality feedstock, increased recyclables lost, increased uses of raw (virgin) materials, and increased landfill costs due to the large volume of unusable materials (Kinsella & Gertman, February 2007).

**Composting**

In California, an estimated sixteen percent of landfilled waste consists of food, representing over five million tons per year. New initiatives have proven successful in recovering food waste and converting it into valuable end uses. Curbside collection of segregated organics is growing in popularity. A growing number of commercial scale composting sites have been permitted to handle many types of food discards (California Department of Resources Recycling and Recovery (CalRecycle), 2011e).

Food scraps, yard trimmings, and other organics (including compostable packaging) represent approximately one third of municipal solid waste in the US (U.S. Environmental Protection Agency (USEPA), December 2010). Because of the quantity of organics and California’s landfill diversion goals, several California cities, including San Francisco and Los Angeles, have implemented curbside organics collection (Yepsen, 2009).

**Waste-to-Energy - Transformation**

Waste-to-energy is not a common end-of-life option for municipal solid waste in California. California has only three permitted waste-to-energy plants in the state, which during 2010 received 0.8 million tons of waste. While not considered part of the waste hierarchy, California waste-to-energy plants receive limited diversion credit for transforming waste to energy. In 2010, 99 percent of California’s estimated 30.4 million tons of non-recycled trash was landfilled in California, while approximately 1 percent was exported to landfills outside the state (California Department of Resources Recycling and Recovery (CalRecycle), 2011b).



The three-bin system in practice (single-stream recycling, organics, residual waste) in Beverly Hills, CA.



A single-stream recycling bin in Orinda, California. All recyclables are collected together.



An advertisement on a bus encourages San Francisco residents to participate in the curbside organics collection.



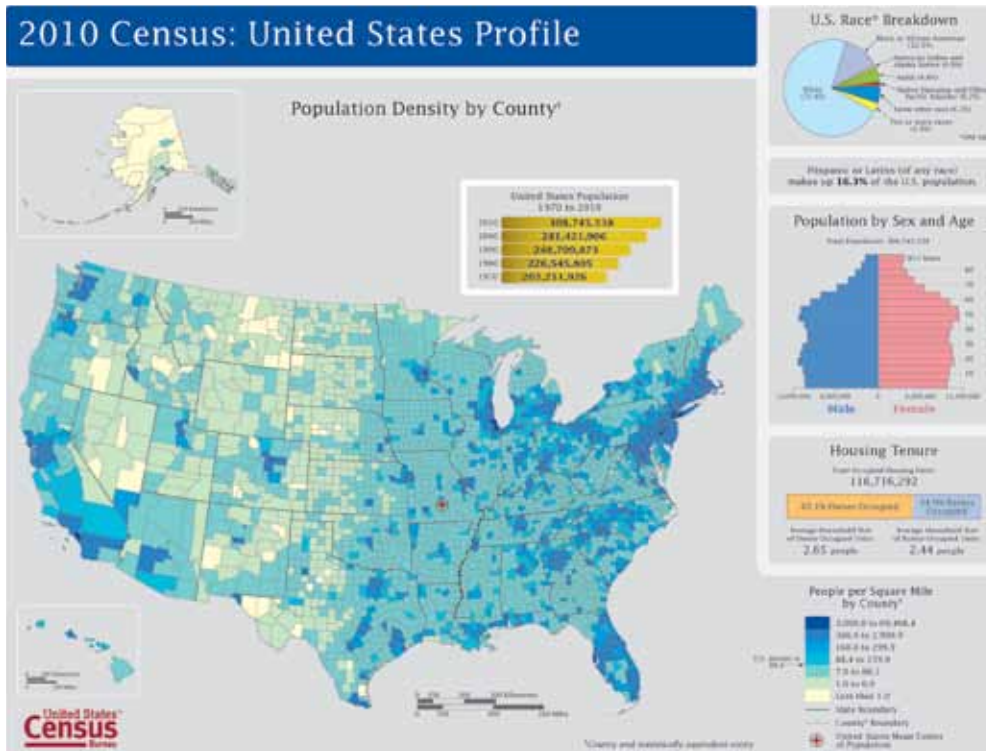
Members of the US waste management and packaging industries commonly offer only faint praise for Europe's high-performance recycling programs. "It's no wonder recycling rates are so high in Europe," they say. "Most European countries are so small and densely populated it's easy to recycle there. It's much different in the US. There are great distances between cities here, especially in the West, and there are vast, empty spaces between rural communities too. Some of our rural states are larger than entire countries in Europe!"

In other words, geography matters. While many of the New England states may be comparable to European countries in terms of size and population density, the overall geography of the US can more fairly be compared to Canada and Australia; each has densely populated cities and suburbs surrounded by large, sparsely populated rural areas. In the United States, according to the 2000 US Census, 21 percent of the population lives in rural jurisdictions, defined as places with a population of 2,500 or fewer (US Census Bureau, n.d.). While Europe's best practices offer valuable

models for urban recycling in the United States, they may not yet translate well in rural North America, where recycling has proven to be particularly challenging.

In many rural areas there is no recycling infrastructure to speak of and connections to more advanced urban systems are often costly and impractical. Neighboring towns may recycle and reject different materials, and hauling contracts may restrict cross-jurisdictional cooperation, leaving recycling programs in many states a puzzling assortment of fragments. Clearly, if there is to be a comprehensive, cost-effective material collection system in the United States, it will have to address the unique challenges of rural recycling. Some homegrown solutions are in order.

The challenges are formidable. To take their measure, GreenBlue surveyed the current landscape of rural recycling by conducting telephone interviews with waste management officials in seven US states - Iowa, Minnesota, Nebraska, New Mexico, North Carolina, Texas, and Wisconsin - as well as in Snohomish County, Washington; Chittenden County, Vermont; South Australia, Australia; and Ontario, Canada. Their responses are the subject of this section.



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Geography and climate play a significant role in rural recycling. Mountainous terrain, island communities, dirt roads, or long hauls can make collection a challenge. In remote areas, snow and other inclement weather can delay or even prevent trucks from making their regular rounds. If curbside collection is available in rural communities, it is often costly; a sparse population must bear the significant expense of wide-ranging collection.

Political boundaries are another factor affecting material collection and reprocessing. Collection practices and types of materials collected may change at each state, county, or municipal boundary. Municipal-level hauling and sorting contracts vary as well. Fragmentation is compounded when states and communities fail to cooperate, which is the direct result of a recycling system primarily funded and operated at the local government level. While there may be a transfer station, a material recovery facility (MRF), or a re-processor just across a municipal line, haulers may be required to stay within the city, county, or state, often driving great distances to do so.

Problems such as these are widespread. Recycling programs in Texas and Ontario both reported political-boundary issues. Some communities in North Carolina collect fewer materials than their local MRF is capable of sorting, leading to missed recycling opportunities. In Minnesota, St. Paul collects aseptic cartons, while Minneapolis (its twin across the river) does not. Theoretically, if St. Paul can find a market for cartons, Minneapolis should have access to the same market. Unfortunately, there is usually no incentive for local governments to take a broader view of the geography of an area (its "waste-shed") and work together. In some cases, there are actually disincentives and barriers to cooperation.



The geographical distribution of material re-processors (paper-recycling mills, glass plants, steel and aluminum smelters, and plastic recyclers) can make it even more difficult for rural areas to find markets for their collected materials. While some materials, such as aluminum and paper, are always in demand and have a well-established market, the demand for others, such as glass and plastics, is influenced greatly by distance and transportation costs. Glass is heavy and low value; there's little reward for hauling it far. Light, voluminous plastic has a high economic value, but doesn't transport well in loose form. Though the demand for both glass and plastic is robust, long-haul expenses discourage buyers.

Advanced processing and storage, and the targeted collection of clean, high-quality materials can mitigate transportation costs and elastic demand. But neither is widely available, and the emerging popularity of single-stream collection presents a trade-off; whereas single-stream recycling yields materials of lower quality with higher levels of contamination, it also presents a substantial opportunity to improve the quantity of materials collected and the efficiency of transportation.

A different scenario occurs in states with container deposit legislation. In those states, beverage container materials (glass, PET and HDPE plastic, aluminum, and sometimes bimetal) are collected in reverse vending machines, collection depots, or in retail settings. These options not only efficiently sort material types into clean waste streams, the collected materials are in high demand; re-processors favor them for their purity and high value, even when hauling costs are high.

### CHALLENGING MATERIALS FOR RURAL RECYCLING

By far, glass is the most difficult material for rural recycling programs to handle. State officials in Iowa, Nebraska and Texas reported that many rural recycling programs have dropped glass collection altogether due to its low value and the scarcity of nearby re-processors. According to a speaker at the Virginia Recycling Association's 2011 Annual Conference, a glass beneficiator is only economically viable if it can process 40,000 tons of glass per year and the per capita generation of potentially recyclable glass is about 70 pounds annually (A. House, plenary presentation, May 10, 2011). Therefore, the minimum population needed within transportation distance of a glass beneficiator is 1,142,857, a population density not often found in rural areas. This suggests the need to use techniques that improve the economics of glass handling, such as storage bunkers and bulk transport, which can partially overcome transport issues.

In Nebraska, the glass reprocessed in-state is used in some limited road construction and civil engineering projects, and also for countertops, but Nebraska lacks glass markets to recycle the material back into containers. In Texas, some rural communities are warned against accepting glass due to safety concerns, and if glass is left unsorted, they have to pay to recycle it. Distance

to market and difficulty meeting color-sorted specifications are the reasons many New Mexico programs do not collect glass. The glass re-processor of high-value, color-sorted glass in Snohomish County, Washington is in an urban area and is so difficult to reach through congested urban traffic the costs of transportation override the economic value of the color-sorted glass. As a result, clean, color-sorted glass from drop-off centers is mixed back together for a closer market, even though mixed color cullet is a lower value commodity. Though some Iowa communities have dropped glass collection from curbside routes, Iowa code stipulates that communities must still offer glass collection (e.g. drop-off) somewhere within each solid waste planning area. In North Carolina, though it is recognized that the glass industry is desperate for more material, many rural communities see glass as a problem because of its low value and its tendency to damage MRF sorting equipment. One waste management official called glass "the hardest material to deal with, especially in rural programs." Another called glass recycling "a problem in search of a solution."

Plastics are the next most problematic materials for rural communities. Both New Mexico and Nebraska noted that plastics are not always collected in rural areas, but if they are, fewer types and formats of plastic packaging are collected than in urban areas. "Problem plastics" refers especially to mixed plastics, as PET and HDPE bottles are generally welcomed in collection. Chittenden County, Vermont attempted to collect expanded polystyrene, but the program was discontinued because it took a year to accumulate a truckload, and the closest end market closed down. Snohomish County's drop-off locations do not collect plastics, citing poor economics and the space required to accumulate adequate quantities to bale and transport. Ontario suffered the same problems in finding markets for mixed plastics, but after Stewardship Ontario invested in market development, there are now two mixed plastic reprocessing facilities that are struggling to meet the high demand for their recycled product. A communications campaign about Ontario's mixed plastic reprocessing and recycled-content products has been a critical component of the province's effort to encourage the public to recycle more plastic.

Multi-laminate and fiber cartons are the third most difficult material to capture in rural collection programs. In Chittenden County, Vermont, cartons are not collected due to the scarcity of nearby markets. However, Wisconsin reported an increase in carton collection and recycling due to the activities of the industry-run Carton Council.

Rural difficulties with certain materials may be mitigated by single stream collection, if a sophisticated single-stream MRF is available to sort the materials. Where small quantities of materials and transport distance are issues, additional items like non-bottle plastics or cartons placed in single stream bins can hitchhike a ride to a MRF with little to no additional cost. South Australia reported that a healthy market demand is partially limited by the transport time and cost of bringing materials to market from rural locations.



### BIN TYPE, COLLECTION FREQUENCY, COLLECTION OPERATORS

In rural areas, the great distances traveled to collect small quantities of recyclable materials and transport them to transfer stations or re-processors makes collection costly. For this reason, rural areas are often not served by curbside recycling service. Rural communities often use source-separated recycling drop-off or collection sites, where consumers bring their materials and sort them into large, material-specific bins or trailers. For less common materials like polystyrene, it may take months or years to accumulate a full load at drop-off centers. If space is limited, adding additional drop-off bins for new materials is problematic. Compared to curbside collection, drop-off locations are less costly to operate, but also collect less material. Drop-off locations may also be located near or hosted by a retail location, allowing consumers to drop off their recycling when shopping.

In general, states reported a move towards single stream collection. An exception was Ontario, where dual stream collection (paper packaging in one stream, all other packaging in another) is more common in rural communities than in urban settings. Where curbside collection is available, states and counties report using a variety of bin types, including traditional boxes, wheeled carts with lids, and bags. In South Australian municipalities that provide recycling services, 240-liter recycling and organics collection bins are used alongside 140-liter garbage bins. There is a weekly garbage collection but recycling and organics are collected fortnightly. In Iowa, the public pays for trash pickup in municipality-provided 90-gallon trash bins, leading some people to dump recyclable material in the trash bin with the mentality that “if I am paying for this [trash service], I need to fill it.”



A recycling drop-off site in rural Virginia.

Some rural municipalities have implemented pay-as-you-throw (PAYT) trash collection in an effort to encourage recycling. However, most officials reported that the number of communities using PAYT ranged widely, from “some” to “common.” PAYT is the norm in Washington State, but most states acknowledge that the PAYT systems are not widespread. Some are difficult to enforce, others simply fail to work as planned. Only one, New Mexico, is attempting to educate communities about PAYT.

States reported a variety of operational methods. In some states, only municipalities provide collection services. In others, collection is contracted out to private haulers or they use a mix of private and public operations.

### STATE AND LOCAL POLICIES RELEVANT TO RECYCLING

In many European countries, stewardship organizations are required to serve the entire country with collection, sorting, and reprocessing infrastructure in order to be approved for operation by the government. This ensures that no area of the country is neglected or lacks recycling infrastructure. Policies are quite different in Australia, Canada, and the US, where recycling collection is specified by state or provincial laws, many of which do not include recycling requirements for either urban or rural areas. With no mandate to provide recycling collection in rural areas, it is no surprise that many rural programs are available only on an ad hoc basis. However, this is not the case in all rural communities, where a good foundation may exist but performance and access to recycling could be improved.

In Ontario, there is a provincial mandate to recycle in communities with more than 5,000 residents. If the community has fewer residents, they have to provide recycling service only if they also provide waste services. In South Australia, the decision to provide recycling services is made individually by local governments.



Consumers typically sort their packaging by material at drop-off sites, leading to clean, high-quality materials.



In the US, there is a wide variety of state and local recycling requirements, ranging from

- no state requirement at all; all recycling is voluntary (New Mexico, Vermont, North Carolina, Nebraska, Texas)
- a state requirement that recycling opportunities be provided; it is not specified that it must be curbside collection (Iowa)
- a state requirement to provide curbside recycling in communities over a certain population size, such as 5,000 (Minnesota and Wisconsin)
- a state requirement that all communities provide either curbside or drop-off opportunities to recycle (Wisconsin)

Local, state, and provincial recycling policy may be influenced by wider goals, such as a landfill diversion goal (Ontario, Iowa, North Carolina), a zero waste goal (South Australia), and litter reduction goals via container deposit laws (Vermont, Iowa, South Australia). While not directly requiring recycling, some states and counties also use indirect policy options to encourage recycling. Making dumping and open burning illegal is a common strategy. Another policy tool, used by North Carolina; Chittenden County, Vermont; Wisconsin, and South Australia is to implement landfill bans of packaging materials, such as PET bottles, corrugated containers, or aluminum cans. Wisconsin's ban includes printed paper. In general, landfill and open burning bans run the gamut from strictly enforced to unenforced. Some local communities have also banned the use of specific packaging items, such as plastic single-use bags and expanded polystyrene, because of issues surrounding their disposal.

Other policy options include state grants and technical assistance to communities to help get recycling programs started and find reprocessing markets. These programs also provide education about pay-as-you-throw (PAYT) waste disposal. In some cases, it is not government, but non-profit organizations that help get recycling programs started. Service-level requirements can be a useful policy tool for local government. These requirements specify what kind of garbage, recycling, and organics collection services are to be provided, including frequency of service and types of materials to be collected. Private companies must then provide services that meet the service level as a condition of doing business in the community.

### FUNDING

Of the surveyed recycling programs, Ontario is the only one currently operating under an extended producer responsibility (EPR) program for packaging. In Ontario, obligated packaging stewards fund half and municipalities fund the other half of recycling collection. In reality, municipalities may contribute something more or less than half. Stewards pay 50% of the cost of recycling as

determined by best management practices, penalizing poor-performing municipalities whose programs are less efficient than the best management practices require. The source of municipal funding for the 50% share of recycling costs varies between municipalities: it may come from the sale of collected materials, from the city's general waste management fund, utility fees, or a per-bag tax on trash.

In the US, funding for rural recycling comes from a wide variety of sources, including:

- Local government taxes or fees for solid waste and recycling collection (either specifically designated for this service or else included in a general property tax)
- Individual household subscriptions to recycling haulers
- Landfill tipping fees
- State grants
- State lottery proceeds
- Fees or taxes on sale of unrelated items (e.g. tires, "items that contribute to litter," fee for all new businesses)
- Federal grants
- Sale of collected materials
- Consumers of beverages included in container deposit programs

Because rural recycling collection can be quite expensive, the need for reliable funding sources is ever-present. Although there are a number of potential funding sources, as listed above, many restrictions apply. In the case of local fees and taxes, there may not be support for adequate funding to modernize or expand collection systems, hindering the development of infrastructure to more efficiently access markets and limiting public education and outreach. In some cases, the funding sources may not be used to fund physical collection of traditional recyclables. Instead, they may be used for activities such as public education, coordination, administrative oversight of recycling programs, or state agency operation. Often the fees are channeled into a state fund that provides recycling grants, but the money may be susceptible to escheating or being swept into general funds when there is economic need. Alternatively, the funds collected from taxes and tipping fees may go towards collection of non-packaging items such as household hazardous waste. Finally, many funds and grants are limited to new program start-up and are not available to offset existing program operations.



### CULTURE AND DEMOGRAPHIC IMPACTS

The culture of rural areas may also set the tone for recycling programs. In states with seasonal tourist populations, second homes, or growing populations moving south from other regions, new residents expect to find recycling programs similar to those in their home states. This is especially true in New Mexico, Texas, and North Carolina, where transplants, tourists, or those spending the winter in second homes (e.g. “Winter Texans”) are common. Angel Fire, NM, for example, is a small rural community with a robust recycling program due in large part to the expectations of seasonal residents who swell the town’s population from roughly 1,000 to 10,000 during peak visiting season.

Aside from influencing the type of recycling program present in a community, seasonal residents also shape the quantity and type of materials collected. In Ontario, the “cottage country” area with lots of summer seasonal residents often has more water and soda bottles set out for collection during peak months – a result of a larger population engaging in summer outdoor activities. Similarly, rural Ontario programs collect less newspaper, corrugated containers, and other paper packaging; residents use much of it as fuel in woodstoves and fireplaces in winter. Finally, seasonal residents and tourists can place a financial burden on rural recycling programs because they don’t pay local taxes, leaving the resident population to finance a program for a much larger population.

An area with a large immigrant population typically has lower participation in recycling programs of all kinds, both curbside and drop-off. These groups may not be used to participating in recycling programs and often need educational programs presented in languages other than English, supplemented with a variety of info-graphics. Bi-lingual programs may be more effective in rural areas, where the immigrant population tends to be more homogenous – officials noted that Hispanic populations are “significant” in some rural areas – while urban areas, where the immigrant population tends to be more diverse, are better served by multi-lingual programs.

Several states and counties reported a strong recycling ethic among local residents. These tended to be mostly in northern areas, namely Minnesota, Wisconsin, Chittenden County, Vermont, and Snohomish County, Washington. Sometimes the presence of a college campus or a large outdoor recreational tourist presence led to the high recycling ethic. A telephone survey conducted every few years in Wisconsin routinely finds that over 90% of those interviewed say they both support and participate in recycling.

In Iowa, where many people grew up on farms burning trash, residents are more prone to burn their trash and recyclables. Open burning is perhaps less likely to be used in drier climates where wildfires are common and risks of fires are well-understood. Illegal dumping is also a hurdle for rural recycling programs. New Mexico reported illegal dumping to be a significant problem, even when trash drop-offs are free. There is simply a lot of land and the practice is difficult to police.

### INNOVATIVE IDEAS FOR RURAL AREAS

Most states struggle with funding rural recycling programs and achieving higher recycling rates in rural programs. There are, however, a number of innovative solutions on the table in predominately rural jurisdictions.

The New Mexico “hub and spoke” model was the most referenced innovation in the GreenBlue interviews, with several states interested in learning more and looking forward to initial results. The “hub and spoke” is designed and managed by the New Mexico Recycling Coalition (NMRC), an independent non-profit organization. The model encourages regionalized recycling within the state and attempts to keep transport distances to 60 miles or less. In worst-case scenarios, a community’s transport distance might be 100 miles. This regionalization will reduce driving distances and costs for small communities, as well as making recycling services consistent by encouraging communities to work together.

NMRC is also considering exploring regional partnerships regardless of county or state boundaries. For example, Las Cruces’ recycling is sent to El Paso, Texas, and new regional recycling hubs in New Mexico would like to serve nearby Colorado communities. NMRC has identified existing recycling processing locations (or hubs) to determine which have additional capacity and which do not. Once the existing hubs and capacities are identified, others are sited to fill in the geographic gaps. In effect, this represents a move toward harmonization to create better economies of scale for recycling.

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### Did you Know?

*Seasonal residents, retirees, and tourists often bring a recycling ethic from their home state with them. Those used to participating in recycling have come to expect the same services from small communities that they received in urban or suburban areas.*



In New Mexico, while the state is a partner, NMRC is taking the lead in implementing the hub and spoke model in response to the prioritization of statewide recycling written into the state's Solid Waste Management Plan. NMRC has received federal and private foundation grants and uses the funding to provide technical assistance and makes site visits to the different hub sites, including reaching out to recruit potential new hub locations. Recruitment has involved demonstrating the value of diverting material, building stakeholder consensus within the community, and coordinating work with city, county, and state government employees.

New Mexico is also attempting to establish "equal opportunity recycling." If a community provides curbside trash pickup, curbside recycling must be provided, and if drop-off trash is provided, drop-off recycling bins must be co-located. The practice of "equal opportunity recycling" is already in use in Chittenden County, Vermont.

Using retail locations as drop-off sites is another popular idea. Both Iowa and Snohomish County, Washington advocated this common-sense approach to collecting materials, which brings drop-off sites to places people are already going rather than compelling people to go to drop-off sites. Iowa would like to equip drop-off sites with low-cost carts and trailers, which can easily be attached to personal vehicles and hauled by volunteers to nearby towns where recyclable materials are collected. If staffing drop-off locations is an issue, Texas suggests looking to alternatives such as non-profit groups, Goodwill Industries, volunteers, and civic groups. In light of staffing shortages, Texas also recommends that drop-off locations do not require staffing 24 hours a day, seven days a week; two or three days is enough, as long as some after-work drop-off hours are available.

Still other ideas to improve drop-off recycling arose in the GreenBlue interviews. North Carolina officials want to change recycling drop-offs from source-separated bins to single stream collection to make transport more efficient, though glass may still be collected separately to avoid contamination of other materials. In Ontario, Waste Diversion Ontario and Stewardship Ontario are working together to establish best management practices (BMPs) for collection and sorting. In some rural communities in Ontario, it is cheaper to establish, clean, and maintain common collection areas for residents' recycling bins at the intersections of private roads and municipal roads than it is to buy modified trucks suitable for rural back roads. In South Australia, a long-lasting container deposit program successfully recovers beverage containers included in the program.

Wisconsin; Chittenden County, Vermont; and North Carolina are also working to develop more efficient hauling. In Wisconsin, joint contracting with haulers is becoming more common as municipalities begin to work together. Chittenden County, VT, suggested consolidating collection routes, since several private haulers' routes significantly overlap each other. This would reduce vehicle emissions and generally create a more efficient collection system. In a variation of the hub-and-spoke model, North Carolina would like to establish more transfer stations where single stream

recycling can be collected and then sent to state-of-the-art urban MRFs for sorting. South Australia suggested that transport costs could be reduced by the practice of backhauling.

Nebraska, through a grant to the Product Stewardship Institute, is looking at extended producer responsibility (EPR) for various commodities to increase funding for rural recycling operations, which are typically poorly supported by limited state and community budgets. Market development is another option for increasing rural recycling; Ontario's investment in mixed plastic reprocessing is a good example. Iowa wants to develop a new market for glass by working with the state's Department of Transportation to create a specification for glass to be used in road construction.

### EXTENDED PRODUCER RESPONSIBILITY (EPR)

State and local governments are increasingly aware of EPR for packaging. While EPR is already applied to a variety of products at the state level in the US – such as electronics, carpet, paint, and medical sharps – EPR for packaging has not been implemented in any US state, though it is common across Europe, Canada, and in a number of other industrialized countries and is being considered in some developing countries like Brazil. EPR is especially attractive in the current economic climate, as scarce funding for local and state services forces many communities into a never-ending search for funding, or worse, has already caused some to end recycling collection altogether.

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*Because recycling and waste management is managed on a local level in the US, it is often difficult for neighboring communities to cooperate and achieve economies of scale. In fact, there are often disincentives to cooperate. New Mexico is pilot-testing a hub-and-spoke model in an attempt to coordinate and regionalize recycling collection across the state, reducing transportation distances and increasing the volume of collected materials.*



In general, state and county representatives expressed interest in EPR for packaging as a way to fund both rural and urban recycling. To some, the concept was new, while others were more knowledgeable. Opinions on the best way to run an EPR program were divided. One suggested that the best system would be industry funded and operated, while another felt strongly that municipalities should continue to operate the system and be reimbursed a “fair” amount by industry. An official supportive of packaging EPR stressed the value of a unified recycling system across a large area, including both rural and urban populations. Such a system would bring consistency to material types collected and consumer education and messaging across various “media-sheds,” as well as more effective routing and marketing of collected materials. A system unified by a larger EPR effort has enormous potential for expanding services to all while also reducing overall system costs.

The primary concern voiced by a number of interviewed officials is that EPR for packaging programs would neglect rural areas and attempt to meet recycling targets in urban areas alone. They acknowledged that, in rural areas, the cost of collection may exceed the value of materials collected, and also expressed interest in finding solutions to that problem. One official explained that it would be politically difficult to cut rural services. Another official questioned why residents of rural areas should be treated differently and offered fewer services. Several responses noted that rural collection systems could still be managed efficiently and be profitable, although perhaps not as profitable as urban systems.

There is general agreement that service to rural areas should not be neglected, and respondents offered a variety of options for not only improving the efficiency of rural material collection, but also making it profitable:

- Collect only a subset of materials in rural areas
- Fund drop-off centers and reverse vending machines in away-from-home locations
- Tailor recycling services to rural areas by establishing a specified number of collection points by either area or population
- Create state and regional product stewardship councils and support state and local governments already working towards EPR for packaging

There are also potential hurdles. One official speculated that rural areas might be more interested in an EPR program covering household hazardous waste items that are costly to dispose, rather than one covering recycling for packaging. Another expressed concern that municipal and state needs and roles in recycling could be marginalized by an industry-run EPR system.

### BIGGEST CHALLENGES TO RURAL RECYCLING

When asked to identify and describe the three biggest challenges to rural recycling, the responses of recycling officials, though diverse, clustered around a few topics: infrastructure and efficiency of systems, financial limitations, and geographical limitations.

Seven of ten respondents named “infrastructure and efficiency of systems.” Their descriptions of needs and shortcomings included “[need] more efficient systems – need more backhauling,” “[need] connecting collection with MRF infrastructure,” “inconvenient drop-off centers – both hours of operation and distances,” “lack of sorting and reprocessing infrastructure,” and “need away-from-home collection.”

Six of eleven respondents named “financial limitations”. When asked for the top three challenges, one joking response was “money, money, and money.” Noted financial limitations also included items such as “limited value of materials” and “need funding for investments in infrastructure and also for operations.”

Seven of eleven respondents named “geographical limitations.” Identified barriers to effective recycling included “distance to re-processors,” “transportation,” and “low population density leading [to] higher economic and environmental costs.’

Four respondents named “education and outreach with specific mentions of “open burning mentality” and “need for increasing participation of rural communities in recycling.”

Other reported challenges to rural recycling included:

- Low volume of materials; achieving economies of scale
- Lack of large enough bins
- Availability and maintenance of infrastructure, including bins and serviceable collection trucks
- Litter escaping from bins
- Complexity of packaging (both in terms of material types and multi-material packages)
- Difficulty of increasing rural collection of paper products other than newspaper/magazines and corrugated containers





### SUMMARY

Operating a recycling program in a rural area presents challenges similar to those in urban areas – reducing transportation costs, securing adequate funding, building a recycling constituency – but their respective strategies and solutions are distinctly different.

Density and diversity are the urban program's mixed blessing. Urban programs must collect recycling from multi-unit housing, offices and retail buildings, as well as away-from-home locations, such as pedestrian areas, arenas, and public transportation networks. The volume of materials collected presents sorting and management difficulties. Traffic congestion, meanwhile, adds to hauling costs and can generally undermine the efficiency of urban recycling. High population density, however, makes available large quantities of quality materials in a small area, off-setting the cost of collection and sorting. And the urban tax base provides funding for recycling programs, even in lean times.

Low density presents a different set of challenges, and as far as recycling goes, its blessings may be fewer. Sparsely populated areas produce small quantities of recyclable materials, a shaky foundation on which to build a recycling program. Though rural roads are lightly traveled, they tend to be poorly maintained, and the comparably vast area a rural recycling program must serve means that collecting, sorting and selling small amounts of scrap materials can be prohibitively expensive. The local recycling budget offers little relief; with small populations contributing to the tax base, financing is a chronic problem.

But the future of rural recycling is by no means bleak. The regionalization of recycling systems, as in New Mexico's "hub and spoke model," addresses many of stubborn problems undermining rural recycling. Bringing coherence to the sometimes divergent goals of county and municipal systems, it makes recycling easier for consumers; simplifies collection, sorting and reprocessing; cuts the costs borne by small communities; reduces driving distances for haulers, and, by becoming a source for reliable quantities of materials, creates new markets. Meanwhile, growing support for EPR could make it a powerful vehicle for environmental protection, cost-cutting and market growth in rural states.

Perhaps most important: Innovative leaders working together to design coherent statewide systems, and ultimately a national system, for effective material value recovery.



There is no one-size-fits-all recovery system. Every country or state is different, and there are many ways of achieving success in packaging recovery. However, the most successful systems have structural elements in common. These elements provide a clear foundation upon which to build a packaging recovery system – one that may be tailored specifically to meet the needs of its geography, culture, and population. Building effective material value recovery systems requires clear objectives supported by strong guidance on policy, infrastructure and technology improvement, consumer education, and the economics of the system.

### Policy Guidance

Forward-thinking policy guidance from government (local, state, national, or regional) is a necessary base for successful material value recovery. No systems studied in this research project operated without some type of government legislation that reinforced the priorities of the public sector.

In the EU there has been a strong relationship between policy and material recovery. There, packaging waste data demonstrate a de-coupling of packaging waste and economic growth. During the period 1988 – 2006, while the economy grew at a 40% rate (GDP in Euros), packaging put on the market decreased by 11% (tonnes) and packaging going to landfills decreased by 33% (tonnes) (European Organization for Packaging and the Environment (EUROPEN), 2009). This de-coupling coincided with the implementation of EPR policies across the continent, showing that it is possible to have both a strong economy and an overarching policy to create effective material value recovery systems.

There are a variety of policy tools available that, when considered together, can close gaps in existing recovery systems and organize new ones. Coherent, consistent policies can improve material recovery within jurisdictions, and ideally, reinforce each other. For example, if disposing of packaging waste in a landfill is inexpensive and easy to do, a behavior change toward recycling will not take place, even if a waste hierarchy is recommended or recycled content policies are put into place.

### OVERARCHING WASTE POLICIES

Establishing a waste hierarchy, such as the EU Waste Framework Directive or the US EPA's waste hierarchy, makes it easier to harmonize other policies with a jurisdiction's stated preference on disposal options. Other overarching waste policies, such as the EU Landfill Directive, can be used to define which end-of-life options are considered beneficial. Waste-to-energy is considered a beneficial end-of-life option in the EU, but is not considered beneficial in the US. These decisions have a significant influence on what happens to packaging materials at end-of-life in each country.

### LANDFILL POLICIES AND FEES

In the past fifty years, landfilling has become a default option for municipal solid waste in the US. Creating more beneficial end-of-life options requires new landfill policies with objectives that are clearly understood. Clear policies will answer questions such as: Is the priority diverting material from landfill? Are any materials specifically banned from being disposed of in landfill? In the EU member countries, these two questions are answered by the Landfill Directive. Examples in the US include North Carolina's ban on aluminum cans, plastic bottles, and wooden pallets going to landfill, or Wisconsin's landfill ban on the most common packaging materials.

Another policy defining question: How expensive is it to dispose of waste in a landfill? Raising landfill tipping fees encourages the use of other disposal options. The UK encourages more recycling with an annual ratcheting up of the landfill tax to increase overall landfill disposal costs. In other countries there are policies that require all waste to be "treated" by recycling, composting, or incineration prior to being landfilled to encourage systems to extract all value from the materials at end-of-life. Along with higher landfill tipping fees, implementing a pay-as-you-throw (PAYT) garbage policy reinforces recycling while discouraging landfill disposal. These policies require residents to pay a fee based on the amount of trash they generate, while recycling collection is free. Not coincidentally, in most places with high recycling rates, a PAYT policy is also in effect. Effective PAYT requires enforcement so residents don't throw trash in the recycling bin to avoid residual waste disposal costs.

### RECYCLED CONTENT

Policy decisions can positively affect the recovery of materials by creating markets for recycled content. Requiring government purchases to favor products that contain recycled content, such as office paper, is one example. Another option is to require a minimum recycled-content level for manufacturers in the jurisdiction. California has minimum recycled content requirements for any glass containers or fiberglass manufactured in the state. An evidence-based demonstration supporting both the economic and environmental benefits of using recycled content will help avoid irrational policy requirements like those most recently seen in support of the corn-based ethanol industry.

### DEVELOPMENT OF LOCAL SECONDARY MARKETS

Policy decisions may be designed to encourage the local economy by assisting local reprocessors. One way is to ease permitting regulations for facilities, such as industrial composters, so they can locate their facilities near population centers that provide food waste and compostable packaging feedstock. Another option is to require or encourage that bales of collected scrap materials be sold within the state or in nearby jurisdictions, This assures reprocessors of a steady supply of material, should they choose to locate a plant in that jurisdiction. In addition, more local reprocessing means reduced transportation costs and fuel needs.



### EXTENDED PRODUCER RESPONSIBILITY: FUNDING FOR COLLECTION, SORTING, AND REPROCESSING INFRASTRUCTURE

According to the Product Stewardship Institute, product stewardship is “a policy that ensures that all those involved in the lifecycle of a product share responsibility for reducing its health and environmental impacts, with producers bearing primary financial responsibility. Extended Producer Responsibility (EPR), a central tenet of product stewardship, is a policy approach in which the producer’s responsibility for their product extends to the post-consumer management of that product and its packaging”(Product Stewardship Institute, 2011).

Perhaps one of the biggest policy questions on recycling is how to reliably fund and invest in collection, sorting, and reprocessing infrastructure. While many options exist to provide infrastructure funding, all EU member countries and many of the Canadian provinces have passed mandatory EPR legislation that legally establishes the concept of EPR and obligates the packaging industry to take back the packaging they place on the market. This obligation moves the financing for packaging reuse, recycling, or recovery to the packaging industry and away from local government. One advantage of this type of policy tool is that, if done carefully, it levels the playing field for all members of the packaging industry: no company is left at a competitive disadvantage, because all are equally obligated to participate in the program to fund packaging recovery. In the case of the EU, it took many years of iterative modifications to achieve this. In the most efficient cases of EPR implementation, the government establishes the take-back obligation, levels the playing field, and sets targets, but then steps back to allow the packaging industry to achieve the targets as it sees fit.

There are several ways that mandatory EPR can apply: individual responsibility, collective responsibility, or even through the use of taxes. Companies may choose to individually take back their packaging or fund collection infrastructure. Alternatively, companies may choose to band together to fulfill their take-back obligations as a group. One way the take-back obligation has been collectively met is with the creation of stewardship organizations like Fost Plus, Duales System Deutschland (DSD), and Stewardship Ontario. Obligated stewards transfer their take-back obligation along with the necessary funds to the stewardship organizations. The money received by the stewardship organization funds the collection, sorting, and reprocessing of designated packaging materials along with consumer education, which fulfills the stewards’ take-back obligation. A packaging tax is another example of a funding mechanism for recycling infrastructure. The Netherlands, for example, imposes a tax on packaging producers, roughly one-third of the proceeds of which funds recycling infrastructure and the fulfillment of take-back obligations.

Voluntary extended producer responsibility programs for packaging have been ineffective; free riders tend to take advantage of the companies voluntarily participating in the system. In essence, voluntary participation in funding a common system becomes a competitive disadvantage. Some companies that have voluntary take-back programs for only their products’ packaging can avoid free riders, but this option is not a common practice. Most frequently it is seen with reusable packaging, like milk bottles at a local dairy, but also exists in some small boutique retail settings.

### Infrastructure: Collection Bins and Sorting Technology

A recycling system is only as good as its infrastructure. Efficient collection systems; advanced hauling, sorting and reprocessing technology; and ready access to markets offer reliable opportunities for the recovery of high-value materials. Preserving the embodied value of materials, good infrastructure turns waste management into resource management. The current infrastructure, however, does not yet support a sustainable, environmentally beneficial flow of high quality materials.

#### STATUS QUO INFRASTRUCTURE IS A BARRIER TO EFFECTIVE RECOVERY SYSTEMS

The current infrastructure is a barrier to an effective recovery system for packaging materials. In the United States, the local responsibility for waste management has resulted in an uncoordinated patchwork of practices. Differences abound in materials collected, collection bins, collection frequency, hauling and sorting equipment, and access to secondary markets and reprocessors. Instead of operating on the local level, the material recovery system in the US needs to be coordinated on a state or national level to cost-effectively capture more valuable materials.

#### BEST PRACTICE: MULTI-BIN SYSTEM

Curbside collection bins are the primary means to collect residual waste, recyclable materials, and organic waste. Some systems provide multiple bins for recyclable materials. Perhaps the most common system in the US is a two-bin system: trash and recycling. Some forward-thinking municipalities have implemented a three-bin system, requiring residents to separate trash, recycling, and organic waste. Occasionally, compostable packaging is included in curbside organics collection programs. However, the findings of the systems studied suggest that in order to achieve an efficient material recovery system that makes the best use of and results in the highest value for collected materials, a system must include at least four bins: residual waste, organics, and two recycling bins. The two recycling bins would be designated either for glass and all other packaging, or paper and all other packaging. In the most efficient systems, five bins are used, with three of the bins designated for recycling glass, paper, and all other packaging.

#### POPULAR BUT PROBLEMATIC: SINGLE-STREAM COLLECTION

Single stream recycling collection is gaining in popularity across the US. In this type of collection, all recyclable material is put in the same bin and sorted later at a MRF. While this type of collection makes participation easy for the public, allows for automated collection, lowers collection costs, and increases the amount of recyclable material collected, it also greatly increases the contamination of all materials and leads to more wear and tear on sorting equipment (Kinsella & Gertman, February 2007). Single stream collection also decreases the quality and often the value of the sorted materials.

## Road Map | Vision for an Effective Material Value Recovery System



The practice of single stream optimizes local collection based on local considerations (typically cost) instead of optimizing recycling systems for quality of recovered materials, economic efficiency, and environmental benefit. This trade-off is an important consideration when evaluating the costs and infrastructure of a recycling system. Collecting the most material possible is a valid goal, but extra funding will be required to expand and upgrade sorting infrastructure in order to continue to produce clean, high quality materials. If this doesn't happen, contaminated materials that can't find a market may end up being relegated to lower-value uses or landfilled, which is completely contrary to the premise of recycling (Morawski, 2009).

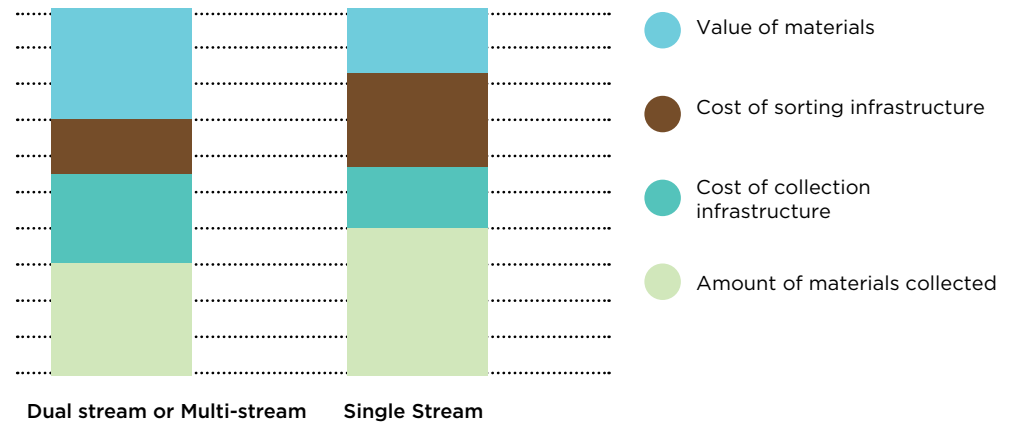
The recycling of corrugated containerboard is a good example. Corrugated containerboard has the highest collection rate of any packaging material in the US. Most of the collection occurs through commercial streams (e.g. back of retail store), but it is also collected in single stream curbside programs. Interviews done with mills as part of *Closing the Loop: Design for Recovery Guidelines for Paper Packaging* indicated that bales coming from single stream MRFs are often so contaminated that yields of useful fiber are lower and the amount mills must send to landfill is increasing. In effect, many single stream programs are pushing waste management costs further downstream to the reprocessors. Similar problems were reported by reprocessors of other materials as well. Alternatively, reducing the types of materials collected and requiring the public to do some pre-sorting can make the MRF's job easier and produces cleaner, higher value materials.

It is universally true in all of the systems researched that the cleaner the collected materials, the more valuable they are to reprocessors and the more revenue they will generate. Consider the materials collected in container deposit programs. Managers of recycling systems requiring the public to perform additional sorting of any kind (at drop-off, curbside, or in container deposit programs) reported that their collected scrap material is consistently in high demand, even in periods of economic downturn when other systems' lower quality co-mingled material sits unsold in warehouses.

This is demonstrated by the difficulties faced by Coca-Cola's joint-venture bottle-to-bottle recycling facility in Spartanburg, South Carolina. The Spartanburg facility represented an investment of more than \$40 million dollars and shut down after only two years of operation, citing lack of feedstock supply and resulting recyclate not suitable for bottle applications due to contamination (Verespej, 2009). The plant uses bales of PET that come from typical curbside recycling programs as feedstock, but the bales were too dirty and contaminated for successful reprocessing. The plant had to close for extensive re-tooling of the sorting and cleaning equipment in order to handle the types of materials and contamination found in bales of curbside material (Verespej, Coke Says Its PET Recycling Plant Will Be Operating This Summer, 2011).

Although clean, high quality materials are always in demand on the market, local governments do not necessarily have the interest, experience, or incentive to consider the commodity value or end use of materials. The consequences of a single stream system can shift the burden further downstream to the waste management and reprocessing industries that sort the materials and may or may not use them as the feedstock for new products. The following chart demonstrates these hypothetical tradeoffs.

HYPOTHETICAL RECYCLING COLLECTION COSTS MODEL



Of course, the goal of most programs is to provide the best service for the lowest cost, thereby reducing the overall cost of the system. But in general, a change in one variable will mean corresponding changes for the other variables. It is a question of determining at which point along the chain to invest effort and money: Collection or sorting and reprocessing?

A deeper exploration of these trade-offs and best practices for single-stream collection is provided in the 2007 report, *Single Stream Recycling Best Practices Implementation Guide* by Kinsella and Gertman. They recommend that communities (or those responsible for recycling collection, such as a stewardship organization) determine their goals for the materials and write the goals and related objectives into the contracts made with collectors and processors (Kinsella & Gertman, February 2007). These objectives might include quality specifications for materials, along with incentives for both haulers and MRF operators who meet those specifications. If material is collected through a single stream collection program, the MRF processing this material must be equipped to handle the characteristics of single stream material delivered. In fact, the recycling system is just that: a system. All participants in the system must work together for all to benefit.

Ensuring the quality of recycled materials starts with collection bins. As previously discussed, glass is challenging due to its breakability. Broken glass presents problems for paper recyclers, harming papermaking equipment. Glass broken during single stream collection and sorting is not sorted by color and, from the perspective of the glass industry, is often of too poor quality to be recycled in container glass plants. An obvious bin-related solution to getting clean and high value materials is to separate glass collection from the other materials in a separate curbside bin or through the use of drop-off or neighborhood bring sites. This solves the problem of glass contaminating other materials and also provides a clean, high-quality source of cullet for use in glass plants. Drop-off bins for glass allow for easy color-sorting, as well.



Other best practices include a separate paper collection to include printed paper and packaging. This may be via a separate curbside collection or a drop-off site. Some communities in Ontario take this two-bin curbside approach, combining glass, plastic, and metals in the second container. This practice keeps the fiber clean and glass-free, though it doesn't completely solve the sorting issues with glass at the MRF.

Removing both glass and paper from the recycling bin, as in the Belgian and German models, leaves the MRF to sort only metals, plastics and other lightweight packaging (multi-laminate cartons), reducing the sorting burden.

### SORTING TECHNOLOGY AT MRFs

Sorting technology at MRFs ranges from state-of-the-art optical equipment to extremely basic manual labor. Clearly, intensive manual labor and hand-picking do not support an efficient, cost-effective recycling system. Although it is expensive to install, automated technology is more accurate, faster, and safer to use. Labor-based MRFs do provide thousands of jobs across the US, but working conditions are dramatically different depending on the sorting facility. In new facilities that make use of optical sorting equipment, employees conduct quality control functions. In older facilities that rely on hand sorting, the work can be difficult, dirty, and repetitive. Some facilities visited during research noted high employee turnover rates, and one facility used some prison labor to sort recyclables. Automated sorting technology provides a better option.

Sorting technology at MRFs is improving, thanks to optical equipment and other technology improvements. Optical equipment can use infrared or laser technology to identify materials and colors. Though not perfect in practice due to contamination in recycling bins, optical technology can produce bales of high quality materials with the appropriate quality of inputs and can be "taught" to recognize problem packaging or new packaging that may be introduced in the future. Optical sorting works particularly well in systems like those in Belgium or Germany, where glass and paper are pre-sorted by the public and the equipment must only sort plastics, metals, and drinks containers.

The most up-to-date MRFs remove plastic bags and films immediately after breaking them open to prevent them from binding equipment. They also pass materials by multiple optical sorting machines that use both positive and negative sorting techniques. For example, in a three-part optical sorting process, all plastics may first be removed from other materials, then sorted into various plastic resin types, and finally, color-sorted once more.

### OTHER BENEFICIAL END-OF-LIFE OPTIONS: INDUSTRIAL COMPOSTING INFRASTRUCTURE

There is a growing market for compostable packaging, especially for use with food and beverages. This type of packaging is typically not collected for recycling, because recyclers do not want to handle food and beverage contamination. However, because of its use with food,

compostable packaging can be collected with an organics collection program. For this reason, a combination of anaerobic digestion and industrial composting is the logical end-of-life option for this type of packaging, which would otherwise be sent to landfill. However, in the US, these facilities are not yet widespread.

While recycling infrastructure in many countries is funded by the packaging industry, this is not true for the anaerobic digestion and industrial composting industries. Packaging is a small fraction of what is sent to industrial composting facilities: food and yard waste make up the bulk of organics collected. Determining the responsible party for food or yard waste is not easy, unlike branded items such as packaging. Due to their small overall contribution to organics, the compostable packaging industry cannot shoulder the full burden of financing effective organics collection and processing.

Both anaerobic digestion and industrial composting can play a significant role in diverting organic waste from landfill. Anaerobic digestion operations generate methane to be converted to electricity that can be sold back to the electricity grid, and the digestate can then be composted to make another product. Composters make money by charging tipping fees for organic waste and by selling finished compost product. Compostable packaging is not inherently valuable to composters. It doesn't add nutrient value to the compost, and can cause composters difficulties if it does not break down quickly enough. Digestion and composting facilities typically agree to accept compostable packaging only as long as it brings them additional food waste, a much-desired feedstock (GreenBlue, 2010). To do this, composters must tailor their practices and buy equipment to handle compostable packaging, which can be expensive. On the other side of the equation, manufacturers and users of compostable packaging are frustrated by their product's negative end-of-life reputation. They would like to have a beneficial end-of-life option for their packaging in the same way that traditionally recyclable packaging can be sent for recycling.

Under an ideal material value recovery system, all types of packaging, including non-recyclable packaging, would have a well-thought out available end-of-life destination. This is not the case for most compostable packaging, even within EPR systems that efficiently manage traditionally recyclable packaging. An innovative proposal suggests that stewardship fees paid within an EPR system for placing compostable packaging on the market could be designated specifically towards digestion and composting infrastructure, operations, communications, and market development (Antler, 2011). While these funds will certainly not fully fund anaerobic digestion and industrial composting infrastructure, they could be put towards upgrades and modifications to existing collection and processing equipment to enable facilities to more easily accept and process compostable packaging. This would solve two problems: it would create a beneficial, non-landfill end-of-life option for compostable packaging and be a source of funding to help composting facilities process packaging. This option is relevant to those jurisdictions where waste-to-energy plays little or no part in an integrated waste management strategy.



## Consumer Education and Behavior

Setting up the most efficient collection practices and investing in state-of-the-art recycling infrastructure won't actually increase material recovery if the public does not participate. Although the primary focus of this report is recycling infrastructure, it would be remiss to ignore the direct link between the success of material recovery systems and public education on recycling, composting, and the value of packaging materials.

### PUBLIC EDUCATION CAMPAIGNS

Without exception, the packaging recycling systems researched all allocated a portion of annual revenue to public education campaigns. Representatives of multiple stewardship organizations stated that this investment is on-going; the task of educating consumers is never done. This is especially true in countries that are destinations for tourists and immigrants or in countries where multiple languages are spoken. Recycling rates may drop if the message is not brought to consumers on a regular basis. Without reminders, people tend to forget the value of recycling or think that the "problem of recycling" has been solved and their participation is no longer required.

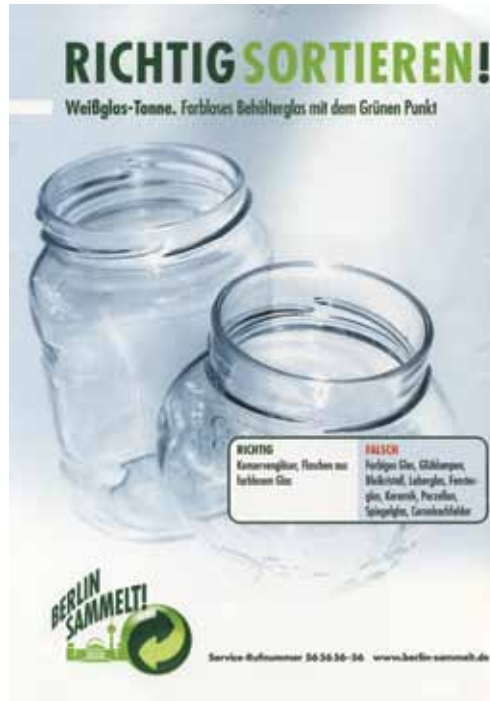
Consumer education campaigns may include flyers distributed via mail or to new residents when recycling bins are delivered; poster advertisements at bus and metro stops; ad spots on television, consumer-facing websites and social media outlets, and more. Websites inform the public about what materials and packaging formats they can recycle based on postal code or municipality and provide further education about why recycling is important. They also provide transparency for how collected materials are reprocessed. (Websites in countries with product stewardship organizations often serve a dual purpose by including special industry member-only sections, which can reduce costs and paperwork by encouraging web-based reporting and tracking by obligated stewards.)

In Belgium, Fost Plus targets its education budget on posters, TV spots, and print ads (Fost Plus, n.d.[e]). It also promotes on-the-go recycling collection programs at special events and a teaching curriculum for primary and secondary schools (Fost Plus, n.d.[d]). Targeted information is also used in urban areas and for residents of multi-unit buildings (Fost Plus, 2011a).

In Germany, public education campaigns for material recovery are run by municipalities. The dual systems each pay their share of education funds to the municipalities, roughly 1.25 Euros per



An ad on an organics hauling truck in Vienna reminding consumers to participate in organics collection.



(Right) Berlin Sammelt! produced educational posters informing consumers about what to put in each recycling bin.



person per year (U. Denison, personal communication, July 7, 2011). Berlin Sammelt! conducts public education recycling campaigns in Berlin. Because of the city's large immigrant population, Berlin Sammelt! created targeted ad campaigns to reach out to Turkish and Arabic speakers. Educational materials are also produced in English, French, Croatian, Polish, Russian, Serbian, and Spanish (Berlin Sammelt!, n.d.).

Sometimes public education is more complex. Seeking ways to reach out to Berlin's Turkish and Arabic populations, Berlin Sammelt! identified household matriarchs as the primary influencers and educators. But those household matriarchs were difficult to reach. Due to cultural practices that differed from German norms, these women were not often in public to see the recycling campaign messages. So Berlin Sammelt! developed a home-based "train-the-trainer" program that teaches recycling basics to Turkish and Arabic women, who in turn pass on the information to their families, friends, and neighbors (S. Berg, personal communication, November 11, 2008).

### LABELING FOR RECOVERY

On-package labels are another way to tell consumers what they should do with their package when they are done using it. Comprehensive recovery labels exist in Europe, but no such label exists in the US. Instead, the many existing packaging recovery labels are confusing, inconsistent across material types, and regularly applied to only certain packaging materials or package components.

While it is not possible to prove that the use of a recycling label increases recycling, it provides, at a minimum, another avenue for conveying the credible information and transparency that consumers need and increasingly demand. All pertinent information need not be on the label; a web address could connect user to a site that would provide consumers additional information on packaging, recycling in general, and recycling in their in their community.

Ideally, the label would be tailored to a specific geographical jurisdiction to coordinate with that jurisdiction's material recovery system. However, this typically works best at a national or even multinational regional level (such as the EU), as brand owners and retailers cannot easily or cost-effectively create different packaging for each city, county, or state where a product is sold. In the US, GreenBlue's Sustainable Packaging Coalition (SPC) has developed a harmonized recycling label for the US that may be used to meet this need. The SPC's label is consistent and relevant for all packaging materials and complies with the Federal Trade Commission guidance. Consumers can learn more at [www.how2recycle.info](http://www.how2recycle.info). (For a more in-depth treatment of package recycling labeling, please see GreenBlue's *Closing the Loop: Labeling for Package Recovery*.)

### Economics and Financing

Packaging is made from a wide variety of different materials, often in combination. While all packaging is technically recyclable, not every package is economically recyclable. The cost of collecting, sorting, and reprocessing packaging waste is not insignificant, especially if new infrastructure is required. Depending on how a system is structured, costs potentially included in an effective closed-loop material recovery system may include some combination of curbside and on-the-go recycling bins or bags; collection trucks; transportation costs; labor wages; construction and maintenance of material recovery facilities, landfills, waste-to-energy incinerators, and industrial composting facilities; public education campaigns; data tracking and reporting; operation of a stewardship organization; and more.

The costs associated with recycling have been increasing in the U.S., and currently, local government must bear the cost. With the recent severe state and local budget crises, municipalities are increasingly searching for alternate funding sources for recycling programs. They need to ensure that the funding for recycling services is sustainable. Other countries address funding limitations by placing financial responsibility for material recovery on the packaging industry in the form of extended producer responsibility.

To have a successful closed loop material value recovery system, the economics must make sense. Materials need to be recovered and processed in adequate quantities at reasonable costs, there must be viable markets for recycled materials, and funding for recycling must be sustainable.

### SUSTAINABLE FINANCING AND OPERATIONAL CONTROL OF SYSTEM

As in an EPR scheme, if the packaging industry is obligated to contribute to or pay completely for the recovery of packaging waste, then the industry must be able to have control over the costs of the system. It can do this by determining how the system operates; setting best practices, including what types of materials are collected, collection frequency, and quality standards; and specifying ownership of the collected materials.

However, capital investments, such as MRFs, bins, or trucks, may have already been made by private companies or local governments. Under an EPR system, if a stewardship organization takes over operating the material recovery activities, the industry must collaborate with local governments to find the best way to deal with any stranded assets.



### POLICY AND INFRASTRUCTURE CHOICES HAVE COST IMPLICATIONS

#### Value of materials and available sorting infrastructure determines costs

Decisions about which materials are to be collected have cost implications, either to the collection, sorting, and reprocessing infrastructure, or in disposal costs for end-of-life infrastructure such as landfills, waste-to-energy incinerators, or composting facilities. Representatives of the waste management industry have stated that materials are not collected unless an end market for them exists, and no new end market will develop without a consistent supply of materials, creating a vicious cycle. The more types of materials collected, the more sorting will be required, either by the public or by material recovery facilities. Though requiring a significant initial investment, optical sorting equipment allows for material to be sorted more quickly and accurately than hand-sorting. Paper, glass, and plastics can be sorted from each other and into finer grades using this type of equipment.

Sometimes, tough choices have to be made with regard to which materials or packaging formats are collected. The recovery systems in Belgium and Germany illustrate this point. In Germany, all plastics are collected for recycling. The Germans would like to maximize the quantity of plastic collected and the types of plastics they recycle. However, this requires expensive sorting equipment and often there are no secondary markets for the finely sorted plastic fractions. By contrast, in Belgium, only plastic bottles and flasks are collected for recycling. The Belgians argue that their policy is easy for consumers to understand and that it recovers only the most valuable types of plastic for reprocessing. Why spend more money collecting and sorting all types of plastics than would be received from selling them. In addition, Belgium easily meets its plastic recycling target with its “bottle-only” collection. This has proven to be a more efficient and less expensive option for them.

#### Disposal policies determine infrastructure and end-of-life costs

Will those materials not collected for recycling be disposed of in landfills? If so, it's important to remember that landfills are not free: construction, operation, greenhouse gas emissions, and on-going long-term maintenance and remediation costs must all be considered landfill costs.

Incineration with energy recovery appears to be a better option. Many European countries have established waste-to-energy facilities and the infrastructure needed to take advantage of the electricity and steam heat they generate. There is a coordinated landfill ban on untreated municipal solid waste, and if a material does not get recycled, by default it is sent for energy recovery. In other words, the landfill ban policy dictates the end-of-life fate of non-recyclable packaging.

An important feature of this policy is a requirement for achieving a high minimum recycling target. Without this coordinated policy, there is a danger that valuable materials will bypass recycling collection and be sent directly to incineration, a lower rung on the waste management hierarchy.

#### Collection method affects costs

The method of collection also has cost implications. Will materials be collected in one bin and sorted later? Or will some materials be collected separately, like glass collection in Belgium and Germany? One method requires more sorting costs, the other more hauling costs. Material value may also be affected by collection method: cleaner, separated materials are worth more to reprocessors, providing more revenue to the system.

### CAPITAL INVESTMENTS

If capital investment is required, who should pay for it? In most cases, public or private sector waste management companies and reprocessors will make the investments and equipment upgrades, as long as they can be certain that they have a chance to bid on a fair public tender process. The Closed Loop Recycling facility for plastic outside of London, England, was able to come online only after receiving a guarantee from retailers that they would purchase Closed Loop's recycled-content plastic at the same price as virgin plastic. An established sustainable material recovery system reassures the private sector that investment in better equipment or services will be rewarded.

As discussed in the Austria profile, capital costs for construction of a new incinerator with energy recovery are considerable, especially for a large facility with an emphasis on strict emissions controls. In the case of MVA Pfaffenau facility in Vienna, Austria, capital costs were approximately 200 million euros, but sale of both electricity and heat amount to approximately 8 million euros per year (Dr. H. Allgeuer, personal communication, March 26, 2010). Note that to maximize the plant's value, infrastructure must be in place in the area in order to capitalize on the cogenerated steam heat that can be harnessed for heat and hot water. However, despite the value provided in steam heat and electricity, the capital costs plus on-going operating and maintenance costs prove that it is impossible to finance a new facility based solely on the sale of energy. The value of the waste disposal function of an incinerator (once landfills are not able to be used) must also be added to the equation.





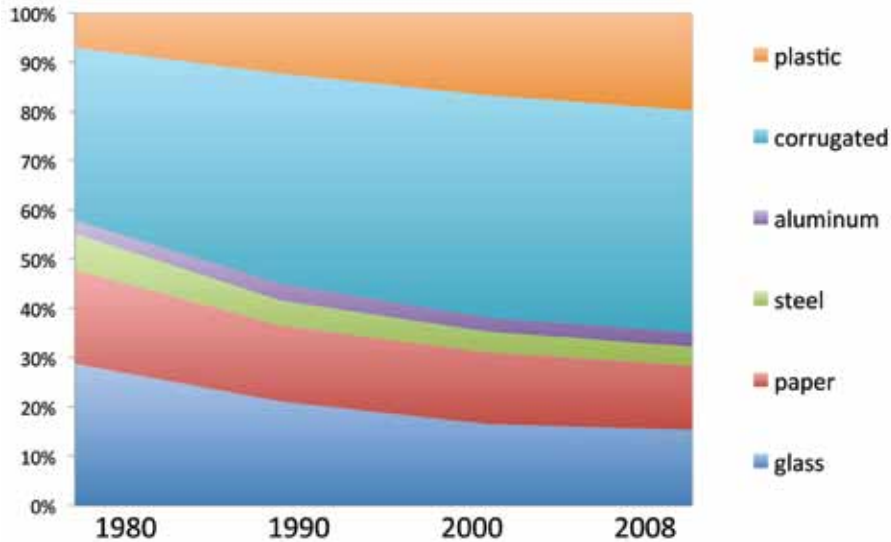
How might California develop an effective, statewide, material value recovery system? How can the state drive change and provide clear, comprehensive guidance on recycling policy, infrastructure and technology, public education, and economics? To be sure, material recovery in California has a strong foundation, but what overarching goals and specific strategies will further define and improve the effectiveness of the existing system? While GreenBlue uses a systems approach to map pathways to sustainability, there is certainly no one, single way to get there. In California, where challenges and complexities abound, the route may well be a scenic one.

**POLICY GUIDANCE**

To begin, policy must determine a practical balance between environmental and economic considerations. For example, where policy emphasizes the efficiency and cost-effectiveness of recycling it also needs to define responsible strategies for managing the growing portion of packaging waste that is non-recyclable.

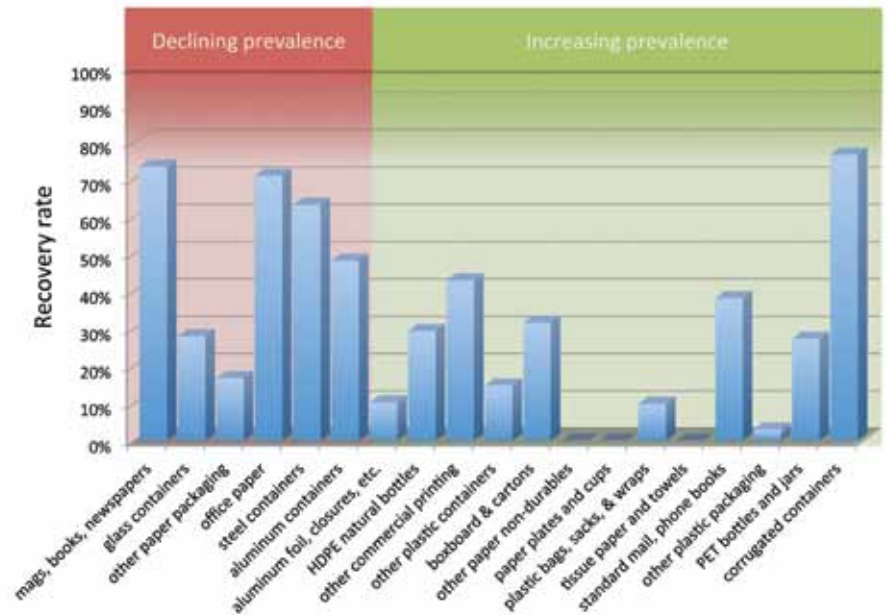
Striking that balance is an increasingly important. The future of packaging is a move towards light-weighting traditionally recyclable materials and making use of lightweight flexible packaging that is currently non-recyclable. The material selection decisions made by the packaging industry are increasingly based on a life-cycle perspective rather than one based purely on recyclability. This trend means more non-recyclable packaging is being used, which has implications for collection, sorting, and reprocessing. The Coca-Cola joint venture bottle-to-bottle plant in Spartanburg, SC, had difficulty with contamination in bales, but also because it was difficult to sort light-weighted PET flakes from films and paper using traditional technology (Verespej, Coke Says Its PET Recycling Plant Will Be Operating This Summer, 2011). The current U.S. system, like California's, places emphasis on recycling the traditionally recyclable materials, but does not offer feasible recovery solutions for the increasing quantity of non-recyclable materials.

**Changes in materials used for packaging**



(U.S. Environmental Protection Agency (USEPA), 2009) Over the past three decades, traditionally recyclable packaging materials like glass and steel are becoming less prevalent in favor of plastic packaging.

**How has the recovery of recyclables changed '90-'08?**



(U.S. Environmental Protection Agency (USEPA), 2009) The US does a relatively good job of recovering the traditionally recyclable materials now declining in prevalence. New packaging materials that are currently not recyclable are becoming more prevalent in the municipal solid waste stream.



A goal of optimizing waste management with a focus on traditionally-recyclable materials leads us to the system we currently have: lower cost, single stream collection and high volume, low quality materials. Similarly, a container deposit program has a clear goal of collecting beverage containers and a clear definition of packaging that falls into that category. However, it is not a viable option for recovering the approximately 85% of packaging (by weight) that does not include beverage containers. In many areas, the economics of operating a container deposit program within a broader packaging recovery effort have proven to be costly, or unclear, at best.

**Clear goals.** California's current policy goal is to divert 50 percent of waste from landfill. This goal will lead to a different result than a goal of optimizing recycling rates or cost-effectively recovering high quality materials. The landfill diversion goal implies that a coordinated system should be in place to monitor and raise recycling rates of all packaging materials, along with a policy of diverting organic waste to anaerobic digestion or composting facilities. California's per capita disposal rate was 4.5 pounds per day in both 2009 and 2010, a period of economic downturn. Many municipalities are struggling to finance recycling and composting programs and are considering reducing or eliminating these services. When the economy rebounds, per capita solid waste generation will certainly go up without a greater emphasis on local landfill diversion programs to achieve the diversion goal.

**End-of-life options.** The end-of-life options defined as "beneficial" influence the development of integrated waste management systems. With diversion from landfill as a target, California could take the lead of Ontario and promote investment in anaerobic digestion and industrial composting infrastructure. This would help divert organic waste from landfill, and adding anaerobic digestion capacity would generate renewable energy. Source reduction and recycling are the only two other possibilities for landfill diversion, unless California reconsiders waste-to-energy facilities as a beneficial end-of-life option. Waste-to-energy facilities are not the disposal option of choice for easily recyclable packaging. They do allow for energy recovery from the increasingly common, flexible, non-recyclable packaging, and are the only non-landfill disposal option for those materials.

**Overarching policies and extended producer responsibility.** Without any extended producer responsibility legislation in place, it is difficult to compare the California system to those systems in Europe or Canada. Even the Australian system's voluntary Australian Packaging Covenant makes a comparison difficult because it is backed up by NEPM regulation. The geographic proximity of several Canadian provinces with packaging EPR programs and the overall influence of the greater North American market suggest that the Canadian systems are the most likely to influence California's recycling system in the future.

**Market development.** California's Recycling Market Development grant program is critical to creating new markets that can use collected packaging materials to make new products, strengthening local economies. Many other countries and states are using this type of program to invest in local infrastructure, such as Ontario's and the UK's investments in mixed plastic reprocessing facilities. While they don't have specific requirements to keep materials in the country, many European programs unofficially promote the reprocessing of materials in-country or at least within the EU. Unfortunately, California's Recycling Market Development grant program is currently suspended due to lack of funds.

### INFRASTRUCTURE, COLLECTION BINS, AND SORTING TECHNOLOGY

Infrastructure to collect, sort, and reprocess packaging materials in ways that preserve their quality and create opportunities for their most valuable and beneficial re-use remains uneven in the United States. State-of-the-art systems exist alongside older systems, and there is no effort to standardize them for economic efficiency. Determining and implementing best practices, including which materials, at a minimum, are collected by all systems (both rural and urban), and standardizing bins and trucks will make collection more efficient. This will also lead to sorting efficiencies by tailoring and matching the sorting equipment and capacity of MRFs to the materials collected by the recycling programs in their waste-sheds.

**Geography.** Geographically, Australia and Ontario are both similar to California and the US in the urban-rural split. Australia and California share the strong pull of the Asian export market on collected materials, though demand from Asia for raw materials now reaches around the globe. Each faces the challenge of collecting materials not only in urban areas, but also rural ones. While collection programs in California's rural areas will likely be different than those in urban areas, the state can still promote best practices and optimize the economic benefits of serving less densely populated jurisdictions. As the hub-and-spoke model has shown, getting local governments to work together to develop regional solutions can promote better economic benefits for all.

**Collection Bins and Practices.** Many countries, such as Belgium, Germany, and Switzerland have standardized or are in the process of standardizing collection practices nationally. Ontario and Victoria, Australia, are both working towards harmonization of bin types, materials collected, and best management practices for recycling collection. Harmonization creates a more efficient recycling infrastructure and reduces consumer confusion about what can be recycled. Collecting the same materials in away-from-home bins and curbside bins would be a simple step toward harmonization.



Though state-level harmonization can present valuable and efficient recycling options, California has not moved in that direction. Harmonization would be supported by an analysis of materials and markets determining those materials that are not only easy to collect and recycle, but also easy to sell. Not every piece of packaging is appropriate for recycling, and it is important to avoid incurring high collection and sorting costs for materials with little market value.

Compared to recycling systems governed by EPR, the collection and sorting infrastructure in California is not uniformly as modern and state-of-the-art. Along with standardizing the types and formats of materials collected, stewardship organizations in countries like Germany and Belgium have decided that sorting is easier and the resulting material quality is best with a three-bin recycling system (glass, paper, everything else), plus residual waste. Some California communities have implemented a three-bin system (single-stream recycling, organics, trash). In order to truly minimize contamination, glass should also be collected in separate bins, creating a four-bin system.

For beverage containers, a significant opportunity for increasing glass recovery in California lies in adding beverages to the CRV program. Like Ontario, British Columbia, and other programs, adding wine and spirits to the program would help recover a significant amount of glass while also providing more high quality cullet for the state's glass manufacturing facilities.

**Sorting Technology.** California should be promoting the technology to recover the highest value materials and encourage their use and reprocessing in the state. In general, however, MRF technology in the US is less modern than European facilities, and hand sorting is common. In Belgium, Fost Plus owns the designated packaging materials that are collected as part of their EPR system and is interested in profiting from their sale. This gives them a national perspective and an incentive to fund investments in optical sorting equipment and to favor MRFs that install optical sorting equipment that produces high quality bales of material. Hand-sorting is used in these countries rarely and only as a quality control check at the MRFs. As demonstrated by Belgium, the goal of improving sorting technology cannot be realized without a functioning EPR system and standardization of collected materials and bins.



*Swiss public education poster encouraging recycling and against ocean litter.*

### CONSUMER EDUCATION AND BEHAVIOR

California's citizens have come to the state from many other locations. In general, Californians are known for having a "green" ethic about many issues. Public education campaigns can build on green ethics and play a larger role in encouraging recycling and composting. All programs researched for this report noted the need for continuous funding for education. This is especially true in California, where education programs must reach a large, diverse population, many of whom are non-English speakers or speak English as a second language. As in Berlin, California's diversity suggests the need for a variety of multi-lingual strategies, campaigns, and educational materials, and therefore considerable funding for education.

A recycling label for packaging could help communicate to consumers about recycling opportunities in their communities. The SPC's label could meet this need in the US as the OPRL label does in the UK. The SPC label is designed for industry use, but California could strengthen its effectiveness by publicly supporting the goals of the SPC label. The state could also work together with local communities to provide more on-line information on what can be recycled in each community.

### ECONOMICS AND FINANCING

Packaging recovery systems need sustainable financing to work efficiently. Few are well-funded today. Current difficulties facing municipal recycling systems include rising costs, less recyclable packaging, and poor coordination, which prohibits economies of scale. Municipalities across the US are stretched to the limit paying for recycling and waste disposal costs.

Facing budget shortfalls, many California municipalities have already taken matters into their own hands, independently banning certain types of packaging. State legislation to implement EPR for packaging in California has been introduced multiple times without success. In the absence of a state or national level EPR program, it is conceivable that some municipalities will attempt to pass their own municipal-level programs, which are unlikely to be coordinated with each other.

The costs of an effective material value recovery system are largely determined by waste policies; the type, quantity and quality of materials collected; infrastructure; and the market value of reprocessed materials. Each influences the others.

Consider, once again, recycling in the EU. There, waste policies strongly define the goals, structure, and operations of the entire system, and therefore its costs and financing. For example, EU waste policies eliminate landfills as an end-of-life destination for packaging waste, diverting material flows to recycling or to incineration with energy recovery. Those particular, standardized material flows determine and help to regulate infrastructure, costs, markets and investment.



In California, and in the U.S. in general, clear policy could bring similar order, and some regularity, to divergent costs, markets, and investments. Universal standards and priorities would set consistent guidelines and best practices for managing material flows, from collection to reprocessing, which would help determine, and plan for, the kinds and costs of infrastructure improvements. If a decision is made to collect only a subset of all packaging for recycling, there are costs associated with managing the remaining packaging. If quantity of materials is emphasized over quality, that will lead to a lower-cost, single stream recycling system that produces lower-value materials.

### SUMMARY OF RECOMMENDATIONS

California can choose from a wealth of best practices, detailed in the country and state profiles, to improve its already strong packaging recovery efforts. Both California and other US states seeking to improve packaging recovery efforts have a considerable advantage over other jurisdictions, as all of these options have already been tested by and are in use in systems around the world. This summary of recommendations is provided so that California and other US states may take full advantage of the hard-won experience of others while tailoring an effective material recovery system that will work for the US.

1. Take a systems approach: consider all materials, all packaging formats, and all end-of-life options.
2. Start by determining the system's goal: recovery of materials, quality of materials, environmental benefit, diversion from landfill, targets, development of local secondary markets, etc.
3. Ensure underlying policies are coordinated and not working against each other, creating conflicting incentives.
4. A sustainable financing model is needed to alleviate the financial burden on local governments.
5. For best material quality and value, a four-bin system (or more) is preferred.
6. Standardize the materials collected and collection method across a state or country so collection and sorting infrastructure can also be standardized. This creates a more efficient system. Collect and sort only the materials that make sense economically.

7. Invest in new sorting technology (including optical sorting technology) at MRFs and in market development for recycled materials.
8. Apart from recycling, supplemental waste management options allow for system optimization. Look to advances being made in anaerobic digestion and industrial composting to find beneficial end-of-life option for food waste and compostable packaging. Re-evaluate the use of waste-to-energy technologies for materials that are not economically recyclable and for which landfill is currently the only option.
9. Collect state-wide data on access to recycling as well as rate of recycling for all materials and packaging formats to ensure targets are reached and enforceable.
10. Consumer education is an on-going requirement for success. A good recovery label can help.

It remains difficult for most countries around the world to build effective systems for material value recovery, especially of packaging waste. Meeting the challenges of developing sustainable material flows is often a question of priorities. If a society truly values the embedded economic and environmental investment in the materials it uses and stewards its natural resources well, those priorities should lead to systemic change and turn traditional waste management into resources management. A true systems approach, with clearly defined objectives, looking broadly at all materials, end-of-life options, and stakeholders, is the only way this can be achieved. A focus on only one type of material, one recovery method, one part of the packaging supply chain, or one part of the state will simply not be able to create the kind of change necessary to capture the material and economic value of the packaging materials we use on a daily basis.

Unfortunately, there is no blank slate for packaging recovery in the US. Change is never easy, especially when there is substantial and vested interest in the status quo. Competition for scarce resources in the future will force change. The question becomes how to work together to build a well thought-out system today by remodeling what is in place instead of accepting the default option of a less deliberate system when a moment of crisis occurs.

For this to occur in the US, the packaging industry will need to work with local and state governments and the public to secure a consistent means of financing resource recovery that is shared between producers and consumers of packaging. There are no shortages of best practices and case studies to use in shaping an improved US packaging recovery system, and a case can be made for the adoption of the best characteristics of any number of systems. While Belgium is often praised for having the most efficient and cost-effective recycling systems, comparisons with Australia and Canada, with our shared geography and culture, may be more useful. While we need better infrastructure, especially in rural areas, infrastructure improvements alone will not be enough. The key to solving systemic problems is a combination of on-going financing, modern infrastructure, political leadership, public education and outreach, and effective public policy.

The research done for this project demonstrates that there is no one-size-fits-all recovery system. Every country is different, and there are many ways of achieving success in packaging recovery. The EU is a good example. The recycling performance of the various EU countries is currently a continuum, and there are as many different systems as there are countries. It is worth noting that in recent years, the EU's Green Dot organizations are beginning to consider a higher level of harmonization, based on best practices developed across Europe and around the world. It is most critical that the U.S. packaging industry begin a conversation on harmonization with the 50 states.

The vision of this document is a harmonized, efficient, cost-wise system that effectively recovers the value of all packaging materials across the US. It will not happen overnight and it will certainly not be perfect, but that vision can still guide our discussions, policy-making, and investments in making better use of our natural resources.

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*There is no need for the US to “recreate the (packaging recovery) wheel” when it comes to material recovery systems. Studying these systems as they operate in other countries can only benefit the US by providing a valuable road map indicating which paths to take and which to avoid.*

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Scout Recycling Center, Green Fields, South Australia

Visy Pulp & Paper Mill, Campbellfield, Victoria

Visy MRF, Smithfield, New South Wales

Global Renewables Eastern Creek facility, New South Wales

## Road Map | Site Visits and Interviews

### Austria

**Helmut Allgeuer**, Project Leader, Wiener Kommunal-Umweltschutz-Projektgesellschaft MBH  
MVA Pfaffenau (Waste-to-energy facility)

### Belgium

**Philippe Alen**, Quality & Control Manager; **Steven Boussamaere**, Operations Manager; **Johan Goossens**, Director, Business & Marketing; **Sylvie Meekers**, Director of Quality, Control & Prevention; **Henri Meiresonne**, Managing Director; and **William Vermeir**, Deputy General Manager; Fost Plus

**Julian Carroll and Virginia Janssens**, EUROPEAN

**Joachim Quoden**, Director, Pro Europe

Veolia Recycling Material Recovery Facility (PMD waste)

### California

**Vicky Castle**, Grant Manager, Recycling Grants Unit, CalRecycle

**Hieu Le**, Market Information Section, CalRecycle

### Canada

**Catherine Abel**, Director Stakeholder Relations & Sustainability Programming, Stewardship Ontario

**Chris van Rossem**, Manager, Research and Policy, Waste Diversion Ontario

### Germany

**Helmut Schmitz and Ursula Denison**, DSD (Duales System Deutschland)

**Boris Ziegler**, Media Relations, Tönsmeier Dienstleistung

**Torsten Heisler**, Operations Manager, AWT Abfall- und Wertstoff-transport GmbH

**Sabine Berg**, Leader, Berlin Sammelt!

Tönsmeier Material Recovery Facility, Oppin, Germany

### Switzerland

**Daniel Frischknecht and Rolf Varis**, IGORA

**Markus Sidler**, Dietiker Metallhandel

Dietiker Metallhandel (scrap metal depot)

Neighborhood collection depot, Zurich

### UK

**Joshua Sharman**, FM Sector, Key Account Manager, WRAP

**Dee Moloney**, Director and Hugh Smith, Program Manager; London Remade

**Robert Dvorak**, European Projects Manager, Nextek Limited

**Jane Bickerstaffe**, Director, INCPEN

**Nick Cliffe**, Project Manager, Closed Loop Recycling

Closed Loop Recycling, Dagenham

### Rural Recycling Interviews: US, Canada, South Australia

**Sherry Arcaro**, Director of Blue Box System Optimization, Stewardship Ontario

**English Bird**, Executive Director, New Mexico Recycling Coalition

**Steve Danahy**, Supervisor, Waste Planning and Aid Unit, Nebraska Department of Environmental Quality

**Leslie Goldsmith**, Comprehensive Planner, Iowa Department of Natural Resources, Land Quality Bureau

**Garth Hickie**, Product Stewardship Team Leader, Minnesota Pollution Control Agency

**Seigo Jackson**, Principal Planner, Snohomish County, Washington

**Vaughan Levitzke**, Chief Executive, Zero Waste South Australia

**Cynthia Moore**, Recycling Program Coordinator, Recycling and Solid Waste Section, Bureau of Waste & Materials Management, Wisconsin Department of Natural Resources

**Scott Mouw**, Section Chief, Community and Business Assistance Section, Division of Environmental Assistance and Outreach, North Carolina Department of Environment and Natural Resources

**Rachel Perry**, Executive Director, CTRA-Cooperative Teamwork & Recycling Assistance (formerly Central Texas Recycling Association)

**Nancy Plunkett**, Waste Reduction Manager, Chittenden County Jurisdiction for the Chittenden Solid Waste District (CSWD), Vermont

**Theresa Stiner**, Environmental Specialist Senior, Iowa Department of Natural Resources, Land Quality Bureau