



# Jurisdictional Scan for Circular Economy

## Final Report

Prepared for: **BC Ministry of Environment**

March 2017

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**Prepared by:**



# PREFACE

In 2016, the Province of British Columbia (i.e., the B.C. Government) released its Climate Leadership Plan (CLP).<sup>1</sup> One element of the CLP is to develop a waste-to-resource strategy for the province of British Columbia, as well as a focus for reducing greenhouse gas (GHG) emissions by diverting organics from landfill.

In line with the CLP, the B.C. Ministry of Environment engaged the Delphi Group in early 2017 to undertake research designed to profile circular economy best practices from leading jurisdictions around the world that could help inform the B.C. Government's waste-to-resource strategy.

The objective of this work was to provide an analysis of circular economy initiatives / actions with respect to their policy effectiveness and impacts, as well as the opportunities and challenges that have arisen from governments taking these actions.

As part of the study, the Delphi Group conducted extensive secondary research on eight leading jurisdictions and their circular economy policies and programs. Jurisdictions covered as part of this study include: Denmark, Finland, Germany, Japan, The Netherlands, Ontario, Scotland, and Sweden. In addition, the Delphi Group consulted with 20 government agencies, industry organizations, policy think-tanks, and other sector experts to gather additional important resources, insights, and data to support the research.

This report provides a summary of the research and analysis undertaken by the Delphi Group as part of the jurisdictional scan for circular economy policy best practices.

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<sup>1</sup> See: <http://climate.gov.bc.ca/>

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## EXECUTIVE SUMMARY

The concept of the “circular economy” goes beyond traditional waste management and material / resource efficiency to look at a transition away from a linear model to encompass a system-wide perspective that is focused on closing resource and material loops, minimizing the input of new, raw materials, and adopting renewable energy as a fundamental source for powering the economy and all of its processes.

There is a much heavier focus on the upstream components of prevention through innovative design, re-use / refurbishment / remanufacturing, and recycling, and looking to minimize incineration and disposal. The focus is not only on “doing more with less” but also on harnessing the full value of the resources (for example, by extending the lifetime of components and materials) and reducing the speed of material transit through the economy.

Circular economies are of growing interest to both the private sector and policy-makers around the globe as both a way to minimize negative impacts on the environment while growing new revenue streams, reducing costs of operation, and increasing competitiveness. In addition, many are increasingly looking at it as a mechanism by which to target reductions in greenhouse gas (GHG) emissions as part of broader climate change policy agendas, through the reduction and/or diversion of organic waste streams (a key focus of this study).

### International Policy Frameworks & Initiatives

At an international level, there are a number of overarching policy efforts focused on driving and enabling a more circular economy, including:

- The UN’s Sustainable Development Goals (i.e., SDG 12 focused on “Responsible Consumption and Production”);
- The G7 “Alliance on Resource Efficiency” and various workshops on related circular economy themes;
- The OECD’s supporting policy guidance documents on resource efficiency and extended producer responsibility (EPR); and
- The European Union’s resource and waste management related policies, including its Circular Economy Package and Action Plan.

### *EU Policy Frameworks*

The European Union’s framework has become increasingly holistic, encompassing various elements that make up a more comprehensive set of circular economy and green economy policy initiatives, including the EU’s Waste Framework Directive (and other EU waste legislation), its Resource Efficiency Roadmap, its Environmental Action Programs, and the broader Circular Economy Package and Action Plan. The EU has also adopted the UN’s SDG 12.3 to halve the per capita food waste at the retail and consumer levels by 2030, a target which is driving the region’s focus on organic waste reduction.

The Circular Economy Package, in particular, aims to improve competitiveness by protecting EU businesses against scarcity of resources and volatile prices, helping to create new business opportunities and innovative, more efficient ways of producing and consuming.

The Circular Economy Action Plan is focused on five priority materials / waste streams (i.e., plastic waste, food waste, critical raw materials, construction and demolition waste, and biomass and bi-based products) across the following areas:

1. Production;
2. Consumption;
3. Waste management;
4. Waste-to-resource; and
5. Innovation.

Flowing out of the Action Plan are various legislations, covering more than 50 initiatives related to circular economy, including a large focus on research and funding / financing mechanisms.

## Best Practice Policies & Programs

A wide range of strategies, policy tools, regulatory approaches, funding, and incentive-based mechanisms have been developed and implemented across leading jurisdictions. Organic waste management efforts figure prominently as key area for action.

### *Comprehensive Strategies*

A growing focus of leading jurisdictions is the use of policy instruments and tools that are being applied under coordinated, broad-based strategies involving cross-sections of government and various ministries in order to maximize the benefits and ensure effective engagement and buy-in with key stakeholders during implementation phases.

Finland and Scotland are two of the best examples of countries examined in this study that have adopted comprehensive circular economy policies designed to encourage innovation and local economic development. Others on the pathway include the Netherlands, Germany, and Denmark.

These countries are increasingly recognizing the importance of holistic circular economy policy frameworks as both relevant to economic and environmental policy. These leading jurisdictions have developed overarching policy frameworks through rigorous engagement across ministries and with other key stakeholders from industry, academia, and non-governmental organizations (NGOs).

### *Upstream Policies Efforts*

Upstream efforts are largely focused on the prevention of waste by maximizing the value of materials and resources; minimizing the need for new raw materials and toxic inputs; growing industry and consumer education and awareness; increasing the focus on reuse, repair, and remanufacturing; and driving circular design and innovation. The table below summarizes relevant policy efforts in leading jurisdictions.

Policy Best-Practices	Overview
<b>Maximizing the Value of Materials &amp; Resources</b>	<ul style="list-style-type: none"> <li>A fundamental principle of the transition toward a more circular economy is one that focuses on maximizing the value of materials and resources through more “closed-loop” processes, and as a way to minimize the need for new raw materials and natural resources.</li> <li>Example policies include Japan’s “Law for the Promotion of Effective Utilization of Resources” (2000), Germany’s “National Raw Material Strategy” (2010); and “Denmark Without Waste – Recycle More Incinerate Less” (2013-2018).</li> </ul>
<b>Decoupling Resources from Negative Impacts</b>	<ul style="list-style-type: none"> <li>Many countries have been placing an emphasis on moving to less toxic environments, including across the EU and, at a country level, Germany, the Netherlands, Sweden, and Denmark (e.g., Denmark’s “Chemicals Action Plan 2014–2017”).</li> </ul>
<b>Strategies for a Bio-based Economy</b>	<ul style="list-style-type: none"> <li>Many leading countries (Denmark, Finland, Germany, France, Scotland, and the Netherlands) have developed bio-economy strategies focused on innovation and developing environmentally-friendly products such as bio-plastics, pharmaceuticals, fertilizers, and other green chemicals.</li> <li>The Netherlands has some of the most significant plans to move towards an entirely bio-based economy in conjunction with circular economy principles and objectives.</li> </ul>
<b>Strategies Focused on Waste Prevention</b>	<ul style="list-style-type: none"> <li>Leading jurisdictions are promoting waste prevention and resource efficiency in the food and drink sectors, as well as in other sectors such as construction materials, electrical equipment, and textiles.</li> <li>Governments have set the conditions and guidelines to encourage businesses, local authorities, and residents to adjust behaviours to drive circular economies.</li> <li>A large focus of these efforts is around targeting industry to address issues further upstream in the design and development phase, as well as through consumer education to increase awareness in order to impact on purchasing behaviours.</li> </ul>
<b>Focus on Repair, Reuse &amp; Remanufacturing</b>	<ul style="list-style-type: none"> <li>These policies are aimed at supporting business models with extended product life such as reparability.</li> <li>Includes extended warranties, incentives for repair, regulations against planned obsolescence, updates / upgrades or spare parts that have to be available for a minimum number of years, and more information for consumers.</li> <li>Leaders include Scotland, France, Flanders, Sweden (e.g., VAT rebate).</li> </ul>
<b>Innovation Funds</b>	<ul style="list-style-type: none"> <li>Many governments are tapping into “innovation funds” (either new or existing) to support research efforts, work with businesses and SMEs to develop new business models and capacity, and drive forward program implementation.</li> <li>Examples include Finland, Denmark, the Netherlands, and Scotland.</li> </ul>
<b>Green Public Procurement</b>	<ul style="list-style-type: none"> <li>Holistic procurement requirements, considering a product’s entire life cycle during the purchasing phase, are being used as a way to increase demand for circular products and services.</li> <li>Denmark and Japan have been leaders here.</li> </ul>



### *Downstream Policies Efforts*

Downstream policy best practices include landfill diversion efforts through the application of landfill bans and waste taxes, progressive recycling and extended producer responsibility (EPR) targets; and waste-to-resource efforts through industrial symbiosis programs. The table below summarizes relevant policy efforts in leading jurisdictions.

Policy Best-Practices	Overview
<b>Landfill Bans &amp; Taxes</b>	<ul style="list-style-type: none"> <li>• Countries with landfill bans (e.g., Nordic countries, Germany, the Netherlands, Austria) and taxation schemes have are at the leading edge.</li> <li>• Have helped to increase recycling and more upstream initiatives.</li> <li>• Some countries have levied waste taxes on materials as well as virgin material taxes on virgin aggregates.</li> <li>• Landfill waste taxation is not considered to have been significantly effective towards prevention, but rather to have incentivized and increased recovery.</li> </ul>
<b>Recycling Efforts &amp; Producer Responsibility</b>	<ul style="list-style-type: none"> <li>• Increasingly aggressive recycling targets and EPR requirements are helping to ensure fewer products and materials end up going to landfill.</li> <li>• Improved sorting and separation is a key to success.</li> <li>• In Finland, funds have been directed to support municipalities with integrating mechanical and/or robotic sorting equipment at recycling facilities (e.g., Viikki Plant).</li> <li>• Ontario is shifting to 100% producer responsibility model to increase innovation, increase the level of service, and reduces costs.</li> </ul>
<b>Industrial Symbiosis Programs</b>	<ul style="list-style-type: none"> <li>• To date, more than two dozen countries around the world have adopted industrial symbiosis programs.</li> <li>• Have been important for general awareness building, internal optimization, and helping companies identify new inter-connections across industries.</li> <li>• Many following the successful NISP model from UK and using SYNERGie software.</li> </ul>

### *Policies & Programs Focused on Organics*

One of the key elements of the focus on organics and food waste policy is targeting the reduction of GHG emissions. However, the food industry differs in many respects from other waste sectors: it is the only sector whose resources (food) to a great extent “disappear” (or whose properties are changed) when it is consumed (eaten), which means there is no extended user phase. This presents unique opportunities and challenges for the food sector related to resource efficiency efforts and the circular economy concept.

Policies and programs focused on organics have put a greater emphasis on targeting the stages of the food system value chain where the largest impacts occur (i.e., during consumption and distribution) through:

1. Upstream waste prevention efforts;
2. Information and awareness campaigns;
3. Improved food reuse and recycling efforts (i.e., separation and collection); and
4. Bioenergy solutions.

Recent efforts in EU include:

- Improved food waste data reporting requirements;
- Awareness and educational campaigns;
- Better date labelling;
- Guidelines to facilitate food donation; and
- Guidelines for valorizing nutrients of food waste for animal feed.

## Key Targets & Policy Impacts

Delphi's research and consultation with leading policy and industry experts suggests that despite the range of efforts to address waste and resource challenges, as well as a number of indicators that have been developed over the last number of years, there is still a lack of governance tools in place for monitoring and measuring how effective international, national, and regional policies are in making the transition to a more circular economy.

That being said, specific impacts in some leading jurisdictions have been quantified with respect to waste generation and diversion, economic and employment impacts, and GHG emission reductions.

### *Impacts on Waste Generation, Recycling & Diversion*

In 2014, 44% of all municipal waste in the EU was recycled or composted. This compares to only 31% in 2004. Total municipal waste generation in European countries declined by 3% in absolute terms between 2004-2014.

There was also an increase in municipal waste generation per person in 16 EU countries and a decrease in 19 countries between 2004-2014. Several of the EU country leaders profiled saw increases of municipal waste per capita between 2004-2014 despite early policy efforts—including Denmark, Finland, and Germany. The Netherlands, the United Kingdom, and Sweden on the other hand saw decreases.

Most of the “circular economy” policies and programs that focus more specifically on upstream elements, including waste prevention, reuse, and remanufacturing, have largely been deployed in the last five years so it will be interesting to monitor changes to MSW generation following the next data reporting period beyond 2014.

### *Economic & Employment Impacts*

A fair amount of micro-economic work underway looking at different business models and their economic impacts on jobs and the economy; some of this work has been extrapolated to macro level. A recent meta-study reviewing 65 studies on employment and the circular economy is found generally positive employment effects as a result of moving towards a circular economy. At a regional level, The EU Circular Economy Package is anticipated to:

- Create 170,000 direct jobs by 2035 through waste management measures;
- Boost GDP by 3% through reduction of total material requirements of up to 20%; and
- Save of €465 (CAD \$651) per household per year by 2020 through energy efficiency and energy efficient products.

Modelling work to date for the most part does not include factors such as the roll-out costs of new policies and innovation so it is currently recognized as having its limitations, particularly with respect to measuring net employment impacts. The OECD is currently working to address this as part of current modeling work anticipated for release in the next 12 months.

### *GHG Emission Reduction Impacts*

Research shows a clear correlation between circular economy policies and climate change reduction efforts and impacts. Scotland stands apart from other jurisdictions by placing a heavy emphasis on measuring and evaluating the success of its zero-waste related policies and programs according to reductions in GHG emissions. To do so, Scotland has developed a unique Carbon Metric tool which has been used to quantify the carbon impact of various waste materials (rather than by using weight alone to calculate GHG emissions as is done in most other jurisdictions). With respect to organics for example, the reduction in household food waste in Scotland between 2009 and 2014 resulted in 140,000 tonnes of CO<sub>2</sub>e reduced.

### **Addressing Barriers & Challenges**

A number of market / economic, technical, and governance barriers and challenges were identified by leading circular economy jurisdictions as part of this research.

#### *Market & Economic Issues*

Challenges	Enablers
<b>Market &amp; economic viability</b>	<ul style="list-style-type: none"> <li>While planning for circular economy infrastructure development, it is key that material flows are modelled to take into account the current market and feedstock quality and availability.</li> <li>Consider potential impact of: planned regulations, taxes and tariffs; planned education and awareness programs for source segregation; and, the market viability of the end-product versus competition.</li> <li>Regulations need the appropriate governance and enforcement mechanisms to further drive markets.</li> </ul>
<b>Lack of market demand for recycled products / materials</b>	<ul style="list-style-type: none"> <li>Education and growing awareness within industry and consumers for the environmental and social benefits of recycled products can have positive results.</li> <li>Procurement practices favouring green or recycled products can help to drive this market.</li> <li>Financial control mechanisms to incentivize innovation, production, distribution, and consumption of such products.</li> <li>Legislation for a more favourable competitive climate (for example, requirements and taxes on imported food versus domestic food) or to enable the production and distribution of recycled or re-used resources (e.g., through EPR programs).</li> <li>Shifting to more service-based approaches can also support the movement away from product ownership to more collaborative consumption or “sharing economy”.</li> </ul>
<b>Too heavy a focus on downstream solutions &amp; waste-to-energy</b>	<ul style="list-style-type: none"> <li>Phasing out landfilling and incineration; the elimination of resources must be limited to only the necessary minimum (e.g., toxic waste, non-recyclables).</li> <li>Countries with invested infrastructure are exploring waste incineration taxes.</li> <li>Efforts are also currently concentrated on the definition of waste to re-categorize the resource streams into various value components.</li> </ul>

### *Technical Issues*

Challenges	Enablers
<b>Lack of source separation resulting in feedstock contamination</b>	<ul style="list-style-type: none"> <li>• With landfill bans in place, a focus on well-functioning separation (with the appropriate number of recycling bins), collection infrastructure, and take-back systems are key.</li> <li>• Supporting segregation programs can ensure cleaner material for processing facilities and end markets.</li> <li>• Education and awareness programs are key for residents and businesses alike.</li> </ul>
<b>Lack of measurement frameworks &amp; effective indicators</b>	<ul style="list-style-type: none"> <li>• A focus on better indicators, data collection, and data comparability to allow benchmarking and the sharing of information and best practices across jurisdictions – can be enhanced by new technology.</li> <li>• The OECD is currently working on new macro-economic modeling that will improve current tools for measuring the economic and employment impacts of the circular economy – results are expected in the next 12 months.</li> </ul>

### *Governance Issues*

Challenges	Enablers
<b>Lack of cross-government coordination</b>	<ul style="list-style-type: none"> <li>• Engaging collaboratively with other levels of government to explore the synergies and roles / responsibilities of holistic and strategic policy-making can maximize the benefits and opportunities.</li> </ul>
<b>Unintended barriers &amp; consequences during the policy transition</b>	<ul style="list-style-type: none"> <li>• A systemic approach to policy making is key, integration resource concerns in all levels of themes of policy interventions.</li> </ul>
<b>Shifting political priorities &amp; internal conflicts</b>	<ul style="list-style-type: none"> <li>• Clearly identifying and communicating the benefits and opportunities of the circular economy and related policies / programs from various perspectives</li> <li>• Broad stakeholder engagement across public, private, and civic stakeholders is helpful to overcoming barriers and driving new policies.</li> </ul>

## Key Considerations

The research undertaken as part of this international jurisdictional scan shows that global leaders, particularly countries in Europe and a smaller number from Asia, are embracing circular economy as both a major environmental and economic opportunity. Overarching considerations are grouped into three-broad areas below as a summary of key findings.

### *1. Cross-government, multi-stakeholder collaboration*

- **Shifting to systems-based thinking:** Given the systems-based thinking required to be most effective, circular economy leaders are adopting an integrated approach that involves cross-government (multiple ministries) and multi-stakeholder cooperation and collaboration.
- **Resource-efficiency across sectors:** In order to drive policy, leading governments have implemented tighter regulations, robust economic instruments, and provided supporting funding with a key objective to drive resource efficiency, innovation, and behavioural changes.
- **Circular economy as an economic policy challenge:** Resource efficiency and circular economy should be treated as an economic policy challenge and integrated into cross-cutting and sectoral policies that consider innovation, investments in infrastructure, and education and vocational training.

### *2. A growing focus on upstream & waste prevention efforts*

- **From waste policy to design and consumption policies:** Waste policy is becoming more about design and consumption policies, with a heavier focus on upstream components, an emphasis on fewer raw resource inputs, waste prevention, and on closing material loops.
- **Regulations to drive resource efficiency:** Regulatory approaches (e.g., landfill bans, waste taxes, and the phasing out of toxic substances from material cycles) have proven important for supporting the transition to more circular approaches.
- **Driving markets with economic instruments:** Programs that act as market drivers and grow the demand for a broad range of recycled products and their components are key to driving circular economies.
- **Education and awareness campaigns:** Education, awareness, and capabilities campaigns that drive behavioural change are essential, targeting both consumers and industry to change consumption and production patterns.
- **Focus on food life cycle efficiency:** Leading countries are now focusing their attention to higher-value uses for residual biomass than incineration for energy purposes, prioritizing waste avoidance and reuse further upstream within the organics and food value chain.

### *3. Implementing robust measurement & enforcement frameworks*

- **Measurable targets with consistent indicators and data collection:** Circular economy leaders are increasingly adopting an integrated approach with measurable targets and good data collected across consistent and useful indicators.
- **Integrating climate action and circular economy approaches:** Some of the most progressive jurisdictions are approaching circular economy as a combined economic and climate change strategy.
- **Maximizing GHG emission reduction potential through modeled pathways:** A select number of leading jurisdictions are collecting and analyzing data on the GHG emission reduction potential from various waste management activities and related technologies in order to inform policy pathways and priorities.
- **Adopting strong compliance mechanisms and enforcement:** Monitoring compliance and enforcing regulations (i.e., through fines, penalties, etc.) are methods by which some jurisdictions are backing up their policy targets to better ensure successful outcomes.

# 1. INTRODUCTION: THE CIRCULAR ECONOMY

Since 1990, global gross domestic product (GDP) has increased 25-fold, driven initially by economic development in Europe and North America, and more recently, in emerging countries including China, India, and Brazil. This economic growth, which has brought with it a higher standard of living, has also resulted in a 10-fold rise in global resource extraction.<sup>2</sup>

By 2030, the world's population is projected to reach 8.5 billion<sup>3</sup>, with the size of the “global middle class” increasing from 1.8 billion in 2009 to 4.9 billion by 2030.<sup>4</sup> This explosive population growth and rising living standards around the world are putting ever increasing pressures on the world's natural resources. Some have estimated that global resource use may double by 2030.<sup>5</sup>

These pressures are increasingly driving a rise in the “circular economy” model. The circular economy concept has its roots in sustainable development, industrial ecology, and ecological economics. The concept goes beyond traditional waste management and material / resource efficiency to look at a transition away from a linear model to encompass a system-wide perspective that is focused on closing resource and material loops, minimizing the input of new, raw materials, and adopting renewable energy as a fundamental source for powering the economy and all of its processes.

The Ellen MacArthur Foundation defines the circular economy as follows:

*“A circular economy is one that is restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times, distinguishing between technical and biological cycles.”<sup>6</sup>*

The circular economy is fundamentally based on the traditional “waste prevention hierarchy”, as illustrated in Figure 1; however, there is a major shift from the concept of “waste” to considering it as a “resource”. There is a much heavier focus on the upstream components of prevention through innovative design, re-use / refurbishment / remanufacturing, and recycling, and looking to minimize incineration and disposal. The focus is not only on “doing more with less” but also on harnessing the full value of the resources (for example, by extending the lifetime of components and materials) and reducing the speed of material transit through the



Figure 1: The traditional “waste prevention hierarchy”.

<sup>2</sup> EEA Circular Economy in Europe – developing the knowledge base. See: <http://www.eea.europa.eu/publications/circular-economy-in-europe>

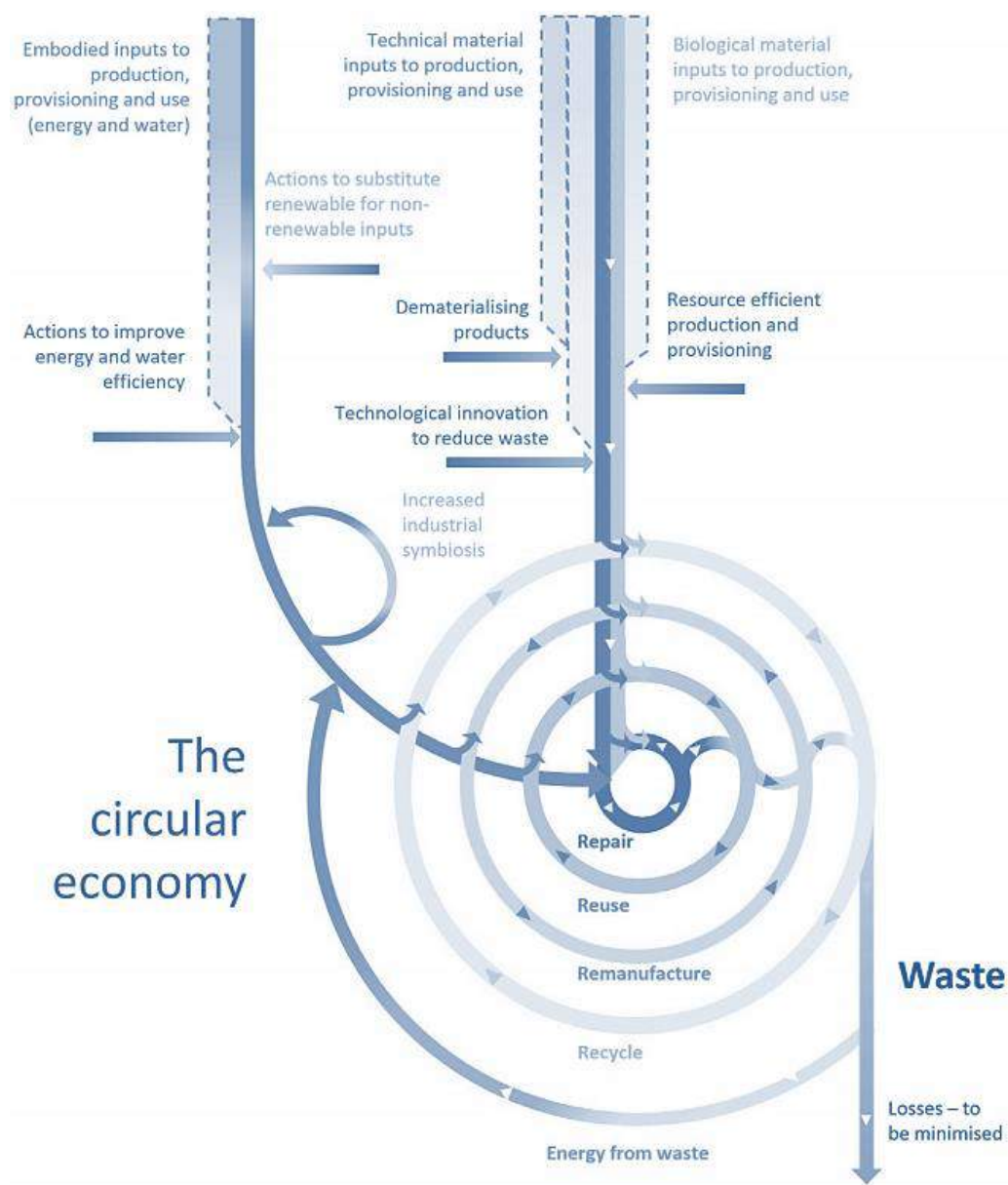
<sup>3</sup> United Nations' estimate, July 2015.

<sup>4</sup> [http://oecdobserver.org/news/fullstory.php/aid/3681/An\\_emerging\\_middle\\_class.html](http://oecdobserver.org/news/fullstory.php/aid/3681/An_emerging_middle_class.html)

<sup>5</sup> EEA Circular Economy in Europe – developing the knowledge base. See: <http://www.eea.europa.eu/publications/circular-economy-in-europe>

<sup>6</sup> See: <https://www.ellenmacarthurfoundation.org/circular-economy>

economy.<sup>7</sup> As such, a circular economy sets out preferential loops where repair and reuse are the “tightest” of resource loops, followed by remanufacturing and recycling (see Figure 2).<sup>8</sup> The ultimate objective is to reduce overall raw materials usage and greenhouse gas (GHG) emissions, which is the growing trend among leading jurisdictions.



Source: European Environmental Agency

Figure 2: Diagram of the circular economy inputs, outputs, and material cycles.

<sup>7</sup> See: <https://stateofgreen.com/files/download/10574>

<sup>8</sup> EEA More from Less – material resource efficiency in Europe report <http://www.eea.europa.eu/publications/more-from-less>



The idea of the circular economy brings with it new business models and opportunities for investment and job creation linked to innovative ways of producing and consuming goods and services. Increasingly, digitalization is allowing consumers to connect in new ways and share available resources and assets. A circular economy therefore has a strong link to the sharing economy, where the focus is on accessing products through services rather than owning them.

From a private sector perspective, companies are rethinking their production processes with the intention of protecting against price fluctuations of materials and resources within their supply chains. Some companies are focused on optimizing and minimizing resource use (e.g., through technological investments and Lean processes). Others are increasing their resource efficiency by using materials from their own production processes or materials from returned products and components (e.g., through take-back-systems and producer responsibility programs). This has resulted in companies starting to design their products and components so that they are easier to repair, re-manufacture, and reuse.

According to the European Commission, more than 80% of a product's environmental impact is determined in the design phase.<sup>9</sup> The design phase is therefore critical when creating new products and minimizing waste further downstream. As such, design efforts need to take account of a wider range of issues than they do within a more linear economy. The design of circular products entails a full lifecycle perspective – integrating a second use phase, take-back systems, design for disassembly, reparability, reusability, and recyclability.

The circular economy also brings new challenges that need to be overcome in terms of addressing societal norms and structural barriers, as well as with developing the supporting policy frameworks, in order to enable the transition. Figure 3 below provides an overview of some of the key enablers of the circular economy.

The food industry, in particular, differs in many respects from other 'waste' sectors and brings with it its own set of challenges and opportunities. It is the only sector whose resources (food) to a great extent "disappear" (or whose properties are changed) when it is consumed (eaten), which means there is no extended user phase. This presents different challenges for resource efficiency efforts. The fact that low prices are still the main consideration for consumers is believed to be one of the main reasons that so much food is thrown away and wasted.<sup>10</sup>

Circular economies are also of growing interest to policy-makers around the globe. In the OECD over the last two decades, there has been a major shift away from disposal to material and energy recovery as a way for governments to save money and generate new revenue streams (see Figure 4).

The concept of a "circular economy" has, in fact, been in use for more than a decade in China, Japan, and Germany. However, the application of the concept by these early leaders has been different in each jurisdiction, with underlying drivers that are unique to their local context.

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<sup>9</sup> [http://www.buildup.eu/sites/default/files/content/Brochure-Ecodesign-Your-Future-15022012\\_0.pdf](http://www.buildup.eu/sites/default/files/content/Brochure-Ecodesign-Your-Future-15022012_0.pdf)

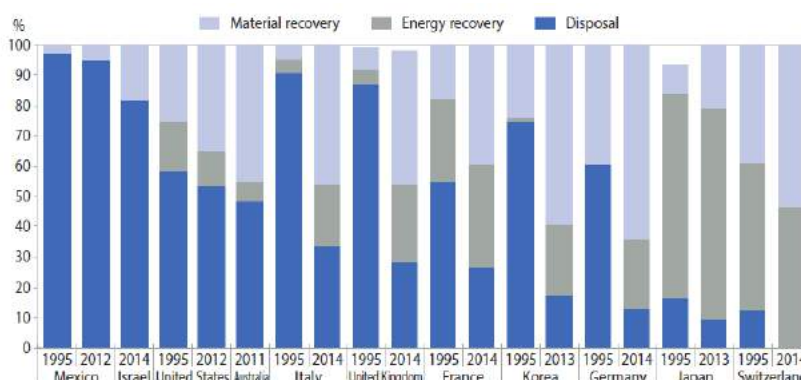
<sup>10</sup> See: <http://www.iva.se/globalassets/info-trycksaker/resurseffektiva-affarsmodeller/201604-iva-rask-rapport3-english-b.pdf>



Key Characteristics	Enabling Factors
<p><i>Less input and use of natural resources</i></p> <ul style="list-style-type: none"> <li>• minimised and optimised exploitation of raw materials, while</li> <li>• delivering more value from fewer materials</li> <li>• reduced import dependence on natural resources</li> <li>• efficient use of all natural resources</li> <li>• minimised overall energy and water use</li> </ul> <p><i>Increased share of renewable and recyclable resources and energy</i></p> <ul style="list-style-type: none"> <li>• non-renewable resources replaced with renewable ones</li> <li>• within sustainable levels of supply</li> <li>• increased share of recyclable and recycled materials that can replace the use of virgin materials</li> <li>• sustainably sourced raw materials</li> <li>• closure of material loops</li> </ul> <p><i>Reduced emissions</i></p> <ul style="list-style-type: none"> <li>• reduced emissions throughout the full material cycle through</li> <li>• the use of less raw material and sustainable sourcing</li> <li>• less pollution through clean material cycles</li> </ul> <p><i>Fewer material losses/residuals</i></p> <ul style="list-style-type: none"> <li>• build up of waste minimised</li> <li>• incineration and landfill limited to a minimum</li> <li>• dissipative losses of valuable resources minimised</li> </ul> <p><i>Keeping the value of products, components and materials in the economy</i></p> <ul style="list-style-type: none"> <li>• reuse of components</li> <li>• value of materials preserved in the economy through</li> <li>• high-quality recycling extended product lifetime keeping the value of products in use</li> </ul>	<p><i>Eco-design</i></p> <ul style="list-style-type: none"> <li>• products designed for a longer life, enabling upgrading, reuse, refurbishment and remanufacture</li> <li>• product design based on the sustainable and minimal use of resources and enabling high-quality recycling of materials at the end of a product's life</li> <li>• substitution of hazardous substances in products and processes, enabling cleaner material cycles</li> </ul> <p><i>Repair, refurbishment and remanufacture</i></p> <ul style="list-style-type: none"> <li>• repair, refurbishment and remanufacture given priority, enabling reuse of products and components</li> </ul> <p><i>Recycling</i></p> <ul style="list-style-type: none"> <li>• high-quality recycling of as much waste as possible, avoiding down-cycling (converting waste materials or products into new materials or products of lesser quality)</li> <li>• use of recycled materials as secondary raw materials</li> <li>• well-functioning markets for secondary raw materials</li> <li>• avoidance of mixing and contaminating materials</li> <li>• cascading use of materials where high-quality recycling is not possible</li> </ul> <p><i>Economic incentives and finance</i></p> <ul style="list-style-type: none"> <li>• shifting taxes from labour to natural resources and pollution</li> <li>• phasing out environmentally harmful subsidies</li> <li>• internalisation of environmental costs</li> <li>• extended producer responsibility</li> <li>• finance mechanisms supporting circular economy deposit systems</li> <li>• approaches</li> </ul> <p><i>Business models</i></p> <ul style="list-style-type: none"> <li>• collaborative consumption</li> <li>• focus on offering product–service systems rather than product ownership</li> <li>• industrial symbiosis (collaboration between companies whereby the wastes or by-products of one become a resource for another)</li> <li>• collaboration and transparency along the value chain</li> </ul> <p><i>Eco-innovation</i></p> <ul style="list-style-type: none"> <li>• technological innovation</li> <li>• social innovation</li> <li>• organisational innovation</li> </ul> <p><i>Governance, skills and knowledge</i></p> <ul style="list-style-type: none"> <li>• education</li> <li>• awareness raising about changing lifestyles and priorities in consumption patterns</li> <li>• participation, stakeholder interaction and exchange of experience</li> <li>• data, monitoring and indicators</li> </ul>

Source: European Environmental Agency

Figure 3: Key characteristics and enabling factors of a circular economy.



Note: The sum of the categories presented here might not add up to 100% because Other recovery and Other disposal treatments are not presented. Germany and Italy: break in time series.

Source: OECD Environment Statistics database (2016), "Municipal waste generation and treatment".

Figure 4: Trends in municipal solid waste management by country.

Policies in China, for example, have more heavily focused on upstream components and the manufacturing supply chain, resembling more closely industrial symbiosis and industrial ecology systems. Such approaches were used on the micro-level (company or single consumer level), the meso-level (e.g., eco-industrial parks), and the macro-level (cities, provinces, and regions).<sup>11</sup>

In Japan, key drivers included a lack of land for waste disposal, as well as a shortage of raw materials that could be sourced domestically, resulting in pressures for greater levels of recycling and waste diversion.

The main focus in the European Union (EU) has been heavily placed on policies promoting efficient and effective waste management, aiming at increasing recycling rates in Europe and potentially harnessing the job creation and other benefits of higher resource circulation in the economy. Some are increasingly looking at it as a mechanism by which to target GHG emissions as part of broader climate change policy agendas, through the reduction and/or diversion of organic waste streams.

The following section provides an overview of the overarching policy frameworks and international efforts that have been emerging in the last few years to support the transition to more circular economies around the globe.

<sup>11</sup> Feng Zhijun, Yan Nailing: Putting A Circular Economy into Practice in China, Sustainability Science, Volume 2, Issue 1, pp 95-101, 2007.

## 2. INTERNATIONAL POLICY FRAMEWORKS & INITIATIVES

At an international level, there are a number of key overarching policy efforts focused on driving and enabling a more circular economy, including the UN's Sustainable Development Goals (which have been embraced by the European Union), the G7/G8 and OECD's supporting policy frameworks, and European Union's circular economy related initiatives, including its Circular Economy Package. These initiatives are profiled below.

### *Sustainable Development Goals*

In September 2015, Heads of State and Government adopted the United Nations' 2030 Agenda for Sustainable Development. This agenda includes 17 Sustainable Development Goals (SDGs) and 169 targets to be achieved by 2030.<sup>12</sup> The SDGs came into force on January 1, 2016.

Climate change, waste reduction, and resource efficiency feature prominently in the SDGs. Goal 12 in particular is focused on "Responsible Consumption and Production" and includes a number of high-level targets, with food waste (SDG 12.3) specifically being identified as a focus and given the following quantifiable goal:

*"By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses."*

The SDGs are to be implemented by all countries and all stakeholders through collaborative partnerships. While the SDGs are not legally binding, governments are expected to take ownership and establish national frameworks for the achievement of the 17 Goals. Countries have the primary responsibility for follow-up and review of the progress made in implementing the Goals, which will require quality, accessible and timely data collection. A monitoring framework is being established, and progress in achieving the goals will be assessed using a set of global indicators. The European Union, in particular, has adopted SDG 12.3 to halve the per capita food waste by 2030.

In addition to the UN's efforts with respect to the SDGs, the United Nations Environment Programme (UNEP) hosts a scientific panel of experts, the International Resource Panel (IRP), that was founded in 2007 with the aim of helping nations use natural resources sustainably without compromising economic growth and human needs.<sup>13</sup> Its Steering Committee includes over 20 governments as well as the European Commission (EC), the OECD, UNEP, and civil society organisations including the International Union for Conservation of Nature (IUCN), World Business Council for Sustainable Development (WBCSD), and International Council for Science (ICSU).

The IRP has released in-depth assessments that have been used to shape public policy frameworks, including on the following topics: decoupling (the concept of separating economic growth from environmental degradation), biofuels, metal stocks, priority products and materials, GHG mitigation technologies, and water efficiency.

<sup>12</sup> See: <http://www.un.org/sustainabledevelopment/development-agenda/>

<sup>13</sup> See: <http://www.resourcepanel.org/>

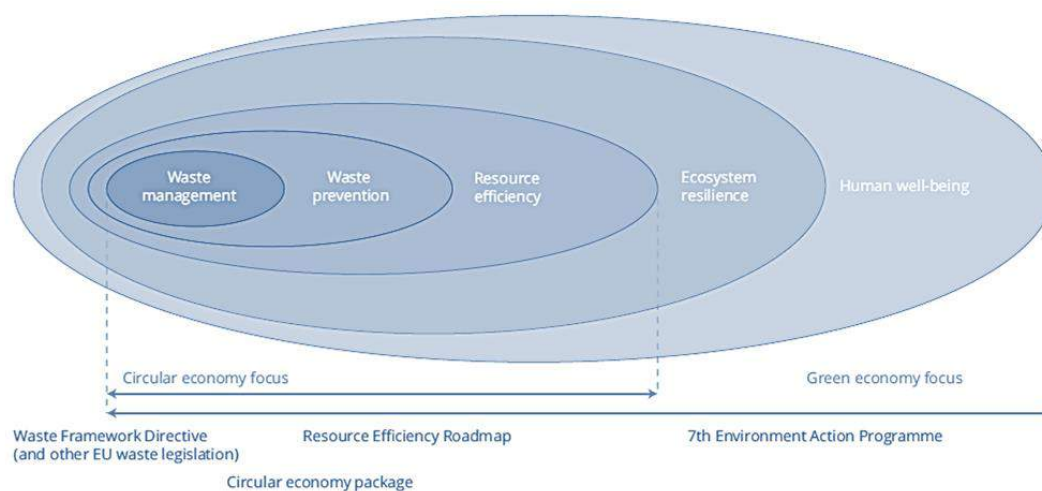
### *G7 Alliance on Resource Efficiency & OECD Policy Guidance*

There have also been a number of initiatives aimed at promoting resource efficiency and circular economy related efforts within the G7/G8 framework and the OECD. At the G7 Leaders' Summit in June 2015, a G7 Alliance on Resource Efficiency was established, which acts as a platform for the sharing of knowledge and for networking. Linked to this effort have been a number of workshops on specific themes related to resource efficiency and circular economy, including topics such as industrial symbiosis (hosted by the United Kingdom<sup>14</sup>), international resource recycling (hosted by Japan<sup>15</sup>), and life cycle concepts in supply chain management (hosted by the United States<sup>16</sup>).

In addition, at the request of G7 leaders in 2015, the OECD developed policy guidance on resource efficiency that covers key trends, extended producer responsibility (EPR), as well as a snapshot of G7 countries and EU initiatives on resource efficiency.<sup>17</sup> The OECD is taking a broad policy perspective on circular economy, focusing on the upstream elements where the novelty lies and on the challenges that will drive the most innovation (i.e., the redesign of the traditional system).

### *European Union Circular Economy Package*

Some of the greatest efforts from an international policy perspective focused on circular economy and waste / resource management have come from the overarching frameworks established by the European Union. As illustrated in Figure 5, the EU framework has become increasingly holistic, encompassing various elements that make up a more comprehensive set of circular economy and green economy policy initiatives, including the EU's Waste Framework Directive (and other EU waste legislation outlined in Figure 6 below), the Resource Efficiency Roadmap, the Environmental Action Plans, and the broader Circular Economy Package and Action Plan.



Source: European Environmental Agency

Figure 5: Waste, resource efficiency, circular economy, and green economy policy focus in Europe.

<sup>14</sup> See: <http://www.international-synergies.com/news/g7-alliance-on-resource-efficiency-industrial-symbiosis-workshop/>

<sup>15</sup> See: [http://www.meti.go.jp/english/press/2016/1117\\_03.html](http://www.meti.go.jp/english/press/2016/1117_03.html)

<sup>16</sup> See: <https://www.epa.gov/smm/g7-alliance-resource-efficiency-us-hosted-workshop-use-life-cycle-concepts-supply-chain>

<sup>17</sup> <http://www.oecd.org/environment/waste/policy-guidance-on-resource-efficiency-9789264257344-en.htm>

Theme	Policy Examples
Energy	<ul style="list-style-type: none"> <li>• Energy 2020: A strategy for competitive, secure and sustainable energy</li> <li>• A policy framework for climate and energy for 2020–2030</li> <li>• Energy Roadmap 2050</li> <li>• European Energy Security Strategy</li> </ul>
Waste and recycling	<ul style="list-style-type: none"> <li>• Waste Framework Directive</li> <li>• Landfill Directive</li> <li>• Packaging and Packaging Waste Directive</li> <li>• Thematic Strategy on the prevention and recycling of waste</li> </ul>
Sustainable management of natural resources	<ul style="list-style-type: none"> <li>• Sixth Environment Action Programme (6EAP)</li> <li>• Thematic Strategy on the sustainable use of natural resources</li> <li>• EU Forest Strategy</li> </ul>
Sustainable consumption and production, and business-oriented initiatives	<ul style="list-style-type: none"> <li>• Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIP) Action Plan</li> <li>• Eco-innovation Action Plan</li> <li>• Industrial Policy for the Globalization Era and Innovation Union</li> <li>• Single Market for Green Products</li> <li>• The Green Action Plan for Small and Medium Enterprises (SMEs)</li> </ul>
Raw materials	<ul style="list-style-type: none"> <li>• Raw Materials Initiative</li> <li>• Strategy on commodity markets and raw materials</li> <li>• European Innovation Partnership on Raw Materials</li> <li>• EU list of critical raw materials</li> </ul>
Resource efficiency	<ul style="list-style-type: none"> <li>• Europe 2020 strategy for smart, sustainable and inclusive growth</li> <li>• Flagship initiative for a resource-efficient Europe</li> <li>• Roadmap to a Resource Efficient Europe</li> <li>• Seventh Environment Action Programme (7EAP)</li> </ul>
Circular economy	<ul style="list-style-type: none"> <li>• Towards a circular economy: A zero waste programme for Europe (2014)</li> <li>• Flanking communications on sustainable buildings, green employment, SMEs</li> <li>• Closing the loop: An EU action plan for the Circular Economy (2015)</li> </ul>

*Source: European Environmental Agency*

Figure 6: Examples of EU policies related to waste management and circular economy.

The EU and Member States are committed to meeting the Sustainable Development Goals (SDG), adopted in September 2015, including the target to halve per capita food waste by 2030, and reduce food losses along the food production supply chains.

One of the established policies that supports the move towards a circular economy is the EU's five-step waste hierarchy established in the 2008 EU Waste Framework Directive, prioritising the prevention of waste generation. The Directive required EU Member States to adopt waste prevention programmes by December 2013, and many countries included measures to foster innovative business models, repair, reuse, and eco-design in their programs.

The concept of a circular economy has gained traction in European policymaking as a positive, solutions-based perspective for achieving economic development within increasing environmental constraints. This is reflected in the European Commission's 7<sup>th</sup> Environment Action Programme (EAP) to 2020, which identifies the "need for a framework that gives appropriate signals to producers and consumers to promote resource efficiency and the circular economy".<sup>18</sup> Moreover, European countries increasingly indicate the circular economy as a political priority.

The central and overarching policy initiative in Europe is the Circular Economy Package and corresponding Action Plan. The Circular Economy Package aims to improve competitiveness by protecting EU businesses against scarcity of resources and volatile prices, help to create new business opportunities and innovative, more efficient ways of producing and consuming.

The EC's "Closing the loop — An EU Action Plan for the Circular Economy", published in December 2015, outlines a new strategy that aims to support the transition to a circular economy in the EU, including efforts to stimulate economic growth and jobs.<sup>19</sup> Emanating out of this Action Plan are various legislations, which cover more than 50 initiatives aimed at leading the EU towards a circular economy.

The Action Plan stresses that business and consumers are the key drivers in the process to moving towards a more circular economy. Local, regional, and national governments and authorities are expected to act as catalysts in this transition, but the EU also has a fundamental role to play in supporting it, by ensuring that the right regulatory framework is in place for the development of the circular economy in the single market.<sup>20</sup>

More specifically, as illustrated in Figure 7, the Action Plan includes five priority material / waste streams (i.e., plastic waste, food waste, critical raw materials, construction and demolition waste, and biomass and bi-based products) with a focus on the following:

- 1) **Production** – Product design and product processes – i.e., Best Available Techniques (BATs), BAT reference documents (BREFs)
- 2) **Consumption** – Green public procurement and promotion of reuse, extended guarantees, durability of products, and consumer information
- 3) **Waste management** – Revised targets, better implementation of waste law (EU directives), and EU funding through waste management
- 4) **Waste-to-Resources** – Standards for boosting the market for secondary raw materials
- 5) **Innovation** – Horizon 2020 and regulatory hot spots for innovators.<sup>21</sup>

Waste policies and targets set at the EU level include minimum requirements for managing certain waste types. The most relevant targets for municipal waste are:

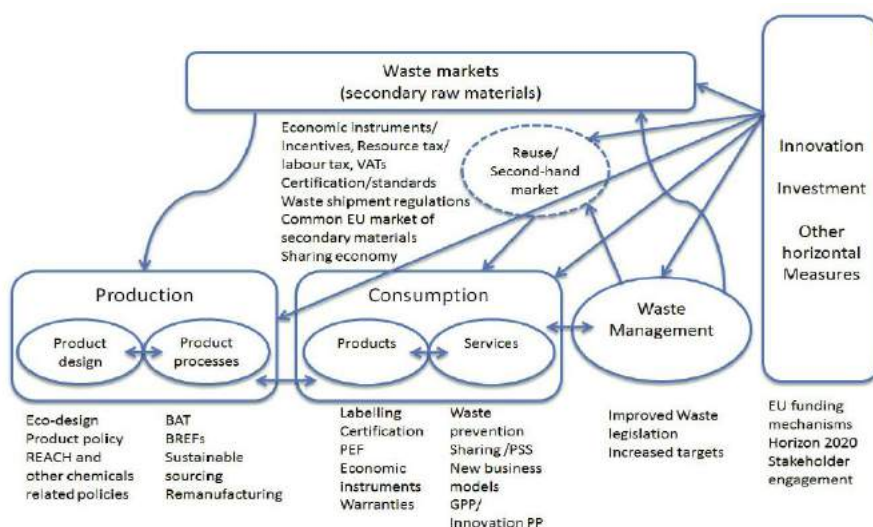
- The Landfill Directive's landfill diversion targets for biodegradable municipal waste;
- The Packaging and Packaging Waste Directive's recycling targets; and
- The Waste Framework Directive's target on recycling and preparing for reuse (more precisely, the target applies to specific types of household and similar waste).

<sup>18</sup> See: <http://ec.europa.eu/environment/action-programme/>

<sup>19</sup> [http://ec.europa.eu/environment/circular-economy/implementation\\_report.pdf](http://ec.europa.eu/environment/circular-economy/implementation_report.pdf)

<sup>20</sup> See: [https://lucris.lub.lu.se/ws/files/18427043/Mistra\\_REES\\_Report.pdf](https://lucris.lub.lu.se/ws/files/18427043/Mistra_REES_Report.pdf)

<sup>21</sup> IBID.



Source: "Policies for Resource Efficient and Effective Solutions" Report (2016), Lund University<sup>22</sup>

Figure 7: Policy landscape according to the EU Circular Economy Action Plan.

From an innovation perspective, the EU's Horizon 2020 research and innovation program is set to invest around €670 million (CAD \$951 million) throughout 2016–2017 into the EU's industry, with the aim of supporting circular economy approaches.<sup>23</sup> Calls were launched in 2016 within the framework of the Public Private Partnerships on "Factories of the Future", "Sustainable Process Industries", and "Bio-based Industries" to help develop and deploy the necessary key enabling technologies to support EU manufacturing across a broad range of sectors.<sup>24</sup>

In addition, the European Commission has partnered with the European Investment Bank to establish the Circular Economy Finance Support Platform, designed to bring investors and innovators together and keep up the momentum in the transition to a circular economy.<sup>25</sup> The platform, launched in January 2017, is expected to enhance the link between existing instruments, such as the European Fund for Strategic Investments (EFSI) and the €24 billion (CAD \$34 billion) InnovFin fund (the EU Finance for Innovators initiative backed by Horizon 2020), and potentially develop new financial instruments for circular economy projects.

The following section drills down deeper on best practice policies and programs based on Delphi's research and consultation efforts on leading jurisdictions.

<sup>22</sup> See: [https://lucris.lub.lu.se/ws/files/18427043/Mistra\\_REES\\_Report.pdf](https://lucris.lub.lu.se/ws/files/18427043/Mistra_REES_Report.pdf)

<sup>23</sup> EEA Circular Economy in Europe – developing the knowledge base <http://www.eea.europa.eu/publications/circular-economy-in-europe>

<sup>24</sup> See: [http://ec.europa.eu/environment/circular-economy/implementation\\_report.pdf](http://ec.europa.eu/environment/circular-economy/implementation_report.pdf)

<sup>25</sup> See: [http://www.sustainablebrands.com/news\\_and\\_views/leadership/libby\\_maccarthy/european\\_commission\\_eib\\_launch\\_new\\_finance\\_platform\\_scale](http://www.sustainablebrands.com/news_and_views/leadership/libby_maccarthy/european_commission_eib_launch_new_finance_platform_scale)



### 3. LEADING BEST PRACTICE POLICIES & PROGRAMS

This chapter profiles some of the leading best practice policies and programs, including comprehensive circular economy strategies as well as more specific upstream and downstream efforts. Organic waste management efforts are discussed at the end, from both a waste prevention perspective as well as more downstream efforts related to biomass-to-energy treatment solutions.

#### Comprehensive Circular Economy Strategies

A key aim of many of the leading jurisdictions in Europe is to develop closed-cycle management system to drive sustainable and resource efficient material flows across the economy. According to the European Environmental Agency:

“Only three countries in Europe — Austria, Finland, and Germany — have dedicated national strategies for material resource efficiency. Two additional countries have dedicated regional strategies—Belgium (Flanders) and the United Kingdom (Scotland).”<sup>26</sup>

Finland and Scotland are two examples that are using circular economy as a key for encouraging innovation and local economic development. Both countries have adopted circular economy policies through rigorous engagement across ministries and with key stakeholder, recognizing the importance of circular economy as an economic policy instrument that can drive GDP and job growth, as well as an environmental policy tool that can reduce the need for raw materials, reduce GHG emissions, and fight climate change.

In Finland, Sitra (a national innovation fund operating directly under Finnish Parliament) has estimated that the circular economy represents an opportunity worth €1.5 to €2.5 billion (CAD \$2.13 to \$3.55 billion) to their domestic economy. In 2016, Sitra produced a strategic, multi-scenario policy paper entitled the “Finnish Roadmap to a Circular Economy 2016–2025”, the Roadmap was assembled with contributions from over 1,000 stakeholders, including several Ministries, private, and public enterprises, municipalities, and academia laying a policy foundation towards circularity.<sup>27</sup> It currently serves as that country’s an overarching, guiding document that is shaping policy.

The Roadmap contains a comprehensive framework across five impact areas:

1. Sustainable food systems;
2. Forest-based loops;
3. Technical loops;
4. Transport and logistics; and
5. Common actions.

In 2016, the Scottish Government released its most recent strategy, entitled “Making Things Last: Circular Economy Strategy for Scotland”. The Strategy’s direction was set by Scotland’s 2010 Zero Waste Plan, which set out a clear path to identifying resources and more sustainable waste management routes, with the objective of retaining materials through increased recycling and that would add value to the local economy through processing, reuse, and remanufacturing.

<sup>26</sup> Source: EEA More from Less – material resource efficiency in Europe report (p.50) <http://www.eea.europa.eu/publications/more-from-less>

<sup>27</sup> See: <http://www.sitra.fi/julkaisut/Selvityksi%C3%A4-sarja/Selvityksia121.pdf>



Making Things Last prioritizes four key areas:

1. Food and drink, and the broader bio-economy;
2. Remanufacturing;
3. Construction and the built environment; and
4. Energy infrastructure.

Scotland's is applying the concept of circular economy as an entirely new system for driving economic development. Making Things Last covers all "loops" of the circular economy, from design, to reuse and recycling. Zero Waste Scotland is the federally-funded agency that is tasked with supporting delivery of the Scottish Government's circular economy strategy and the EU's Europe 2020 growth strategy.

In line with Scotland's Circular Economy Strategy for example, Zero Waste Scotland is working with the construction industry and SMEs to ensure that building designs factor in waste reduction in both new and existing buildings, while encouraging more reuse and recycling at end of life. In addition, specific focus is undertaken to ensure effective source segregation and handling of demolition materials, including wood, to further drive recycling and recovery projects.

Scotland's Circular Economy Strategy addresses how to best manage leakage via energy from waste and landfill while pushing for more efficient upstream activities. In addition, Scotland's Zero Waste Plan and its Waste (Scotland) regulations set out clear source separation goals and efforts to limit organic waste to landfill to ultimately drive energy recovery treatment solutions and composting. The Plan also includes measuring the carbon impacts of material and waste flows to prioritize the efficient use of resources and encourage the greatest environmental and GHG emission reduction outcomes.

Other European countries have been stepping up their leadership as well in the last several years, inspired in part by both the EU's Circular Economy Package and Action Plan, as well as the efforts from neighbouring jurisdictions.

The Netherlands, for example, is showing a growing interest in creating more holistic circular economy frameworks, particularly because they have had the Presidency of the Council of the EU for the last 6 months and have been adding circular economy to the agenda. This has resulted in a number of local initiatives and programs, as well as city-level efforts, including a materials mapping exercise.<sup>28</sup> In the Netherlands, there are three leading policies that have been developed that interlace and intersect on circular economy related objectives:

- A Circular Economy in the Netherlands by 2050;
- National Policy on Green Growth 2015; and
- From Waste-to-Resource.

The "Circular Economy in the Netherlands by 2050" outlines five priority sectors:

1. Biomass and food industry;
2. Buildings and building materials;
3. Plastics;
4. Electronics and scarce materials; and
5. Municipal solid waste.

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<sup>28</sup> See the City of Amsterdam's Circular Economy vision and action plan document here: <http://www.circle-economy.com/wp-content/uploads/2016/04/Circular-Amsterdam-EN-small-210316.pdf>

However, at the national level in the Netherlands, while the overarching policies and programs are coming into place, their implementation has been somewhat slow to take effect due to a lack of buy-in across ministries.

In Germany, the 2015 Circular Economy Act is considered a “reorganization” of that country’s Closed Cycle and Waste Management Act. While circular economy is high on the agenda, the integrated policies are not yet in place, with minimal overarching action and confirmed targets to date. New target-focused policies are currently in development in Germany and a more integrated and unified approach is expected in the medium-term.

### *Cross-governmental Collaboration*

A common element with the most progressive leaders has been the cross-government collaboration leading to a more holistic approach to circular economy policy and program development.

In Finland for example, due in part to the creation of the Roadmap referenced above, the Finnish government put together a “Ministerial Steering Group on Bioeconomy, Circular Economy, and Green Solutions” which formed in late 2016 as a means of identifying and leveraging cross-ministerial efforts. Because of the high-level of government involvement (at the minister level), it is resulting in actionable government initiatives in these areas, including legislation, funds for organizations, and a government implementation plan.

A separate Steering Group on Circular Economy was established in January 2017 by the Minister of Environment and Agriculture and includes six different ministers, covering environment and agriculture, education, transportation, employment, economy, and finance.<sup>29</sup> Based on focus areas outlined in Finland’s national Roadmap, the Steering Group also includes high-level CEOs from various local and multi-national companies discussing practical opportunities that can be addressed alongside government.

In Denmark, the federal government recently created an Advisory Board to come up with concrete recommendations and a vision of Denmark as a functioning circular economy.<sup>30</sup> The Advisory Board has met four times to date and are in the process of finalizing a set of recommendations.

In Scotland, there is extensive cooperation between the Ministry of Environment, the Scottish Development Department, and Scottish Economic Planning Department, with a key focus on reducing material / resource usage and, ultimately, GHG emissions through the application of Scotland’s Carbon Metric (described in more detail later in the next chapter).

In the Netherlands, the new Circular Economy by 2050 Strategy involves multiple ministries that are tasked with delivering associated plans to meet targets and goals set out in the Strategy. The ambition of the Dutch Cabinet is to work across government offices and sectors, with the objective to meet a 50% reduction in raw materials by 2030. It has been recognized that meeting this target will bring significant challenges and can only be met with significant collaboration across ministries and sectors.

In Germany, the Wuppertal Institute was commissioned by the Ministry of Environment to review the National Waste Prevention Program for the German federal government and states. One recommendation coming from the review is for a more integrated approach between ministries (including economy and agriculture) as a major step toward progressive circular economy policy development. The Wuppertal Institute is also recommending a shift in focus with respect to food waste toward the more upstream stakeholders in the agriculture industry and related private sector companies.

<sup>29</sup> See: <http://www.sitra.fi/en/news/circular-economy/new-driver-finlands-growth-strongly-visible-eus-plans-circular-economy>

<sup>30</sup> See: <http://en.horten.dk/News/2016/November/New-Advisory-Board-is-to-advise-the-government-on-a-circular-economy>

Many other countries incorporate material use and resource efficiency in a wide variety of other strategies and policies, including on waste and energy, industrial development, and reform programs, or in national environmental strategies. Some of these more specific best practice efforts are described below, including both upstream and downstream initiatives.

## Upstream Policy Best Practices

Upstream efforts are largely focused on the prevention of waste by maximizing the value of materials and resources; minimizing the need for new raw materials and toxic inputs; growing industry and consumer education and awareness; increasing the focus on reuse, repair, and remanufacturing; and driving circular design and innovation. This section explores some of the upstream policy and program best practices from the jurisdictions that were profiled as part of this research.

### *Maximizing the Value of Materials & Resources*

A fundamental principle of the transition toward a more circular economy is one that focuses on maximizing the value of materials and resources through more “closed-loop” processes, and as a way to minimize the need for new raw materials and natural resources.

Japan was an early leader in this area with its “Law for the Promotion of Effective Utilization of Resources” (2000). The Law, which is central to the Japanese legislative circular economy structure, treats materials as circular goods, covering the entire lifespan of products. Manufacturers are legally required to run disassembly plants, with material recovery mandated by law, turning product disposal into an asset as companies can reuse materials.

In Europe, the EU’s Raw Materials Initiative (RMI) has three pillars, one of which is the circular economy, tying in to the Circular Economy Package.<sup>31</sup> The RMI was created back in 2008 when commodity prices were high and some countries were adopting export restrictions (e.g., Chinese export restrictions on rare metals<sup>32</sup>). The drivers were the rising commodity prices and the overall sense that some were becoming scarce. In a narrow sense, the RMI is looking at urban mining and material recovery from existing stocks.

Many countries have been focused on resource productivity and maximizing the value of materials by putting an emphasis on upstream elements of the waste / resource hierarchy. There is a fair amount of industry competitiveness between countries.

Germany has what may be termed more of an industrial policy. Germany’s “National Raw Material Strategy” (2010) led to the development of its Resource Efficiency Programme, a more comprehensive, two-part circular economy strategy aiming for both reduced and efficient use of raw materials. Part one of the Resource Efficiency Programme (i.e., ProgRess) focuses on reducing Germany’s dependence on primary resources and expanding closed-cycle management.

Material efficiency strategies and programs have also been tailored to specific industry sectors such as construction and mining. For example, Finland’s “Program to Promote Material Efficiency in Real Estate and Construction”, under the Finnish Ministry of Environment, provides a framework that flows out of the EU Waste Directive.

<sup>31</sup> See: [https://ec.europa.eu/growth/sectors/raw-materials/policy-strategy\\_en](https://ec.europa.eu/growth/sectors/raw-materials/policy-strategy_en)

<sup>32</sup> See: [https://en.wikipedia.org/wiki/Rare\\_Earths\\_Trade\\_Dispute](https://en.wikipedia.org/wiki/Rare_Earths_Trade_Dispute)

Key considerations of the framework include:

- The lifecycle flexibility and material efficiency of new construction should be improved;
- A need to implement systematic property maintenance, economical renovation, and recycling of construction waste in renovation;
- Improving the overall material efficiency expertise in the sector;
- Developing waste management to include guidance, reporting, and statistics;
- Ensuring regional availability of services for construction waste management and utilization;
- Improving prerequisites for reuse and recycling of materials, especially wood; and
- Promoting technology for sorting and recycling of construction materials and waste.

In Sweden and Finland, established mining sectors have made it a challenge to introduce the idea of de-materialization, although the idea of “re-mining” (i.e., extracting valuable metals from existing products at their end of life) has become very popular.

In November 2016, the European Commission (EC) recast its Renewable Energy Directive as part of the package on Clean Energy for all Europeans, adopting sustainability criteria for all bioenergy uses. In order to limit pressure on limited biomass resources, the EC proposed that only efficient conversion of biomass to electricity should receive public support, which is expected to facilitate synergies with the circular economy in the uses of biomass and particularly wood, which can be used for a range of products as well as for energy.

In January 2017, the EU offered new guidance on the recovery of energy from waste, a hotly debated topic within the circular economy policy landscape. The guidance advised that recovering embodied energy from within waste and injecting it back in the economy should only be considered as a last option if the waste cannot be prevented, reused, or recycled in the first instance.<sup>33</sup>

Many of the Nordic countries have struggled to move away from waste-to-energy (W2E) solutions from various waste streams due in part to existing infrastructure (more on this particular challenge is covered in Chapter 5). Denmark has developed its “Denmark Without Waste – Recycle More Incinerate Less” (2013-2018) policy, which is focused on reducing the amount of waste incinerated by better exploiting the value and resources contained in the waste, as well as increasing high-quality recycling and decreasing down-cycling as much as possible.

### *Decoupling Resources from Negative Impacts*

A key consideration for the circular economy is the replacement and “designing out” of toxic chemicals and other harmful substances from end products and across the materials supply chain. Many countries have been placing an emphasis on moving to less toxic environments, including Germany, the Netherlands, Sweden, and Denmark. As one example, Denmark has its “Chemicals Action Plan 2014–2017”, building on the earlier version from 2010-2013.<sup>34</sup> The Action Plan is focused on designing products with less harmful inputs.

In Germany, the country’s Resource Efficiency Program includes a focus on decoupling resource use from negative environmental impacts while reducing overall materials consumption upstream. The program places a particular emphasis on sustainable building and sustainable urban development. The first part the program (i.e., ProgRess), aims to make extraction and the use of natural resources more sustainable by reducing associated environmental pollution as much as possible. It has a number of guiding principles, including viewing global responsibility as a key focus of German national resource policy, making economic and production practices in Germany less dependent on primary resources, and developing and expanding closed-cycle management.

<sup>33</sup> See EC Policy Briefing (January 26, 2017) on “The role of waste-to-energy in the circular economy”: <http://ec.europa.eu/environment/waste/waste-to-energy.pdf>

<sup>34</sup> See: <https://chemicalwatch.com/16984/denmark-sets-2014-2017-chemicals-action-plan>

### *Strategies for a Bio-based Economy*

In line with efforts to maximize the value of resources and minimize toxic materials in the environment, many leading countries have developed bio-economy strategies that are converting bio-based feedstocks to develop environmentally-friendly products such as bio-plastics, pharmaceuticals, and green chemicals.

In Europe, some of the countries with established bio-economy strategies include Denmark, Finland, Germany, France, Scotland, and the Netherlands. These countries are positioning themselves as research and innovation hubs for bio-based products, energy, processes, and services.

France, for example, adopted a set of policies two years ago as part of its broader “Energy Transition Law”<sup>35</sup> that included both circular economy and bio-economy dimensions.<sup>36</sup> In Scotland, York, North Yorkshire, and East Riding have dedicated £10 million (CAD \$16.5 million) to a bio-economy growth fund supporting innovative bio-based businesses.

The Netherlands has some of the most significant plans to move towards an entirely bio-based economy (or bio-economy) in conjunction with circular economy principles and objectives, as the country sees it as a major growth industry in the future. The Dutch have a high carbon footprint compared with other EU countries and, as such, the cornerstone strategy for addressing this is their plans to transition away from fossil-based resources in favour of renewable feedstocks, as well as a shift to 100% renewable energy for powering their economy.

Despite multiple test cases, pilot programs, and significant research efforts across the jurisdictions that have focused on bio-economy as a key strategy, there is recognition for the need to scale up efforts significantly. Widespread deployment is still considered years away and faces considerable costs, technical challenges, and some business resistance, particularly from businesses that profit from the current take-make-waste models.

### *Strategies Focused on Waste Prevention*

The role of waste prevention is considered key to moving to a more resource efficient economy that designs waste out of products and ultimately reduces waste generation. A number of European countries have developed dedicated waste prevention programs. Leading jurisdictions are promoting waste prevention and resource efficiency in the food and drink sectors, as well as in other sectors such as construction materials, electrical equipment, and textiles.

For example, under Scotland’s Zero Waste Plan (released in 2010) and the corresponding Zero Waste Scotland program, Scotland outlines a vision for a zero-waste society and has developed a number of waste prevention programs and provisions specific to organic materials. Finland has developed both its “Programme to Promote Sustainable Consumption and Production – Getting More from Less Wisely” (2012) and its “National Waste Management Plan and Waste Prevention Programme 2016-2030”. Germany has also assembled a “National Waste Prevention Program”.

Other Nordic countries have been progressive on the waste prevention side as well, particularly to address high-consumption rates (some of the highest in Europe on average). In Denmark, the “Denmark Without Waste II – Strategy for Waste Prevention” is focused on:

- Reducing food waste across all sectors of the food value chain;
- Improving resource efficiency in the construction and demolition sector, ensuring hazardous substances are handled properly, and improving knowledge sharing;
- Reducing environmental impacts of textile and clothing production, easing recycling and reuse of textiles, addressing hazardous substances;

<sup>35</sup> See: <https://energytransition.org/2015/07/french-energy-transition-law/>

<sup>36</sup> See: <http://www.nnfcc.co.uk/files/mydocs/Bioeconomy%20Factsheet%20France.pdf>

- Improving the reuse and recycling of electronics and electronic waste, improving product longevity, enhancing circularity of materials used in the sector; and
- Reducing the environmental impacts of and resources used in packaging.

Sweden's Waste Prevention Programme (2014-2018) includes a number of targets for example:

- The amount of waste generated shall be continuously reduced from 2010 onwards;
- The contents of hazardous substances in materials and products shall be reduced;
- The amount of food waste in the entire food chain shall be reduced compared with 2010.;
- The proportion of total sales of textiles made of sales of second-hand goods shall increase compared with 2014;
- Knowledge in the textile sector about the uses and contents of hazardous substances shall be increased compared with 2014;
- Waste generation per built square meter in 2020 will be reduced compared with 2014; and
- By 2020 pre-processors and recyclers of waste electrical and electronic equipment shall have better access to information on composition and hazardous substance content compared with 2014.

In Sweden, most municipalities have some kind of prevention plan included in their overall waste management plans. In most recycling centres, there are also separate streams for larger items that can be re-used, so there are more attempts being given to prevention higher up in the waste hierarchy.

The noted governments have set the conditions and guidelines to encourage businesses, local authorities, and residents to adjust behaviours to drive circular economies. A large focus of these efforts is around targeting industry to address issues further upstream in the design and development phase, as well as through consumer education to increase awareness in order to impact on purchasing behaviours.

### *Focus on Repair, Reuse & Remanufacturing*

Particularly interesting is the set of policy measures that aim to support business models with extended product life such as reparability. These can include tools such as extended warranties, updates / upgrades or spare parts that have to be available for a minimum number of years, and more information for consumers when they buy products such as related to the availability of parts and the cost of the lifespan of the product.

Several leading jurisdictions are using a combination of regulation and incentives to drive a focus on repair, reuse, and remanufacturing in an effort to extend the life cycle of products. These legislative initiatives and economic instruments are designed to foster a marketplace where it makes less sense for consumers to throw out broken items and to incentivize the repairs industry, in turn, creating domestic employment opportunities. Preparation for reuse and repair is generally employment-intensive and, in Europe, is often in the hands of craftsmen and small companies, creating jobs at the local level.

In Germany for example, reuse is receiving much greater attention under its new National Strategy on Sustainable Development than it did previously, with the recognition that behavioural and lifestyle changes are essential and must be prioritized to affect change. In France, manufacturers and retailers are obliged to inform consumers about the period for which spare parts will be available and manufacturers are obliged to provide the repair sector with spare parts.

As part of Zero Waste Scotland, the “Revolve re-use quality standard” was introduced in 2012.<sup>37</sup> The standard certifies businesses that reach criteria for selling environmentally-conscious products. Shops are tested on customer care, shop layout, how they prepare goods for re-use, testing of goods and health and safety. Scotland also launched the Scottish Institute for Remanufacture, one of only four such initiatives in the world.<sup>38</sup> The Institute creates a market for reuse, repair, and remanufacturing through funding initiatives that drive innovation.

In terms of incentives, both Flanders and Sweden are offering tax breaks for product and equipment repair. In Sweden, a value-added tax (VAT) rate reduction was introduced in 2016 from 25% to 12% on repairs and can be applied to a range of product repairs, including bikes, shoes, and certain electronic equipment, allowing people to claim back a portion of their income tax on the labour cost of repairing appliances.<sup>39</sup> While they are part of Sweden's efforts to reduce GHG emissions, the policy has the potential to enable disruptive business models like the sharing economy and maker movements.<sup>40</sup>

### *Innovation Funds Supporting Research & Implementation*

As described earlier in this report, many countries are viewing the circular economy model as a business opportunity linked closely to their national and regional innovation agendas. To support research efforts and drive forward program implementation, many governments are tapping into “innovation funds” – either new funds specifically purposed for circular economy or as part of their broader innovation agendas where funds already exist.

Regarded as one of the most innovative countries in Europe, Finland has two funds which have been actively supporting growth of their circular economy. The first one, TEKES, is the Finnish Funding Agency for Innovation and is the most important publicly-funded expert organization for financing research, development, and innovation in Finland. Every year, TEKES finances roughly 1,500 business research and development projects, and almost 600 public research projects at universities, research institutes, and universities of applied sciences. TEKES has had several funding programs focused on better material resource efficiency. A couple examples include:

- **The Green Growth program (2011–2015):** A program aimed at driving energy and material efficiency within production and service supply chains over the entire life span of products, and to supporting new innovations, especially on the boundaries between sectors.
- **Save the Food project:** A pilot scheme to establish the feasibility of sharing left-over food and groceries between the inhabitants of a housing cooperative.

The TEKES innovation fund has also been useful for creating new ecosystems to support SMEs around the circular economy discussion, as well as connecting them with some of the larger, more established firms to explore new opportunities within the system.

The second major innovation fund in Finland is Sitra, which is a 50-year old fund worth €850 million (CAD \$1.2 billion). With approximately 150 employees, Sitra was set up as an independent organization under Finnish parliament as a “think-do” tank. In 2014, Sitra started working on the topic of circular economy and has since identified significant business opportunities for Finland, as well as led the country's Circular Economy Roadmap development (as described earlier). There are currently 10 people at Sitra working on the topic of circular economy and related catalytic projects.

<sup>37</sup> See: <http://www.revolvereuse.com/quality-standard>

<sup>38</sup> See: <http://www.zerowastescotland.org.uk/content/going-growth-remanufacture>

<sup>39</sup> See: <http://circulatenews.org/2016/09/sweden-give-tax-breaks-repairs/> and <https://www.fastcoexist.com/3063935/sweden-wants-to-fight-our-disposable-culture-with-tax-breaks-for-repairing-old-stuff>

<sup>40</sup> The **maker movement** is a trend in which individuals or groups of individuals create and market products that are recreated and assembled using unused, discarded or broken electronic, plastic, silicon or virtually any raw material and/or product from a computer-related device. See: <https://www.techopedia.com/definition/28408/maker-movement>



An example is Sitra's research on nutrient cycling, which helped to inform their understanding of circulation within the food system.<sup>41</sup> Sitra is also hosting the World Circular Economy Forum in Helsinki in June 2017.<sup>42</sup>

In Denmark, the Fund for Green Business Development or "Green Transition Fund"<sup>43</sup>, which was administered by the Danish Business Authority (DBA) between 2013-2015, saw €7.3 million (\$10.2 million CAD) invested into 33 projects under six circular economy related themes:

- Development of new green business models;
- Product innovation and re-design of products;
- Promotion of sustainable materials in product design;
- Sustainable transition in the textile and fashion industry;
- Lowering food waste; and
- Sustainable bio-based products based on non-food mass.

The Fund gave DBA a chance to connect with 400 companies in support of "greening" their business models, as well as provided a grant in the form of counselling to support Denmark's industrial symbiosis program (more on industrial symbiosis later in this chapter).

In Scotland, grant money is being used to grow the zero-waste sector through initiatives such as the £18 million (CAD \$29.6 million) Circular Economy Investment Fund managed by Zero Waste Scotland and funded by the EU. The Fund will provide competitive calls for circular-designed projects and services and support companies in devising and implementing circular economy business models within their product processes and supply chains. In addition, a key objective of the Fund is to promote the development of innovative technologies, products, and services to support a more circular economy domestically.

In the Netherlands, a deal between the government and the Dutch business community, local authorities, and NGOs seeks to realize a 100% circular economy. In 2016, €27 million (CAD \$38 million) was set aside to help improve waste separation and drive recycling.<sup>44</sup> Under this approach, discarded products are to be seen as valuable raw materials rather than waste. The money will also fund new innovations to make products easier to recycle.

### *Green Public Procurement as a Driver of Circular Economy*

The impact of public procurement on the transition to a circular economy could be significant as government purchasing goods and services from the private sector can make up a fairly large percentage of economic activity in some jurisdictions. In the Europe Union for example, public procurement is estimated at 19% of GDP.

The integration of holistic procurement requirements are being used as a way to increase the demand for circular products and services, as well as drive innovation, as the product's entire life cycle is considered during the purchasing phase. Leading jurisdictions have set green procurement policies that monitor and measure sustainability and circular economy criteria across their supply chain.

Denmark has been a leader in the green public purchasing space. In 2006, the Ministry of Environment and Food came together with Danish regions and municipalities to form the Partnership for Green Public Procurement (GPP). The Partnership for GPP have integrated green goals into their procurement policies around 11 specific product groups. Criteria include recyclability, number of chemicals, product lifespan, and total cost of ownership – elements considered

<sup>41</sup> See: <https://www.sitra.fi/julkaisut/Selvityksi%C3%A4-sarja/Selvityksia104.pdf>

<sup>42</sup> See: <https://www.sitra.fi/en/events/world-circular-economy-forum-2017/#programme>

<sup>43</sup> See: <http://nordicinnovators.com/green-transition-fund>

<sup>44</sup> See: <https://www.hollandtradeandinvest.com/latest/news/2016/september/15/the-netherlands-switches-to-circular-economy>



essential for the transition to a circular economy. The partnership's total volume of procurement is significant at €5 billion (CAD \$7.1 billion).<sup>45</sup>

In addition, Denmark established a Forum for Sustainable Procurement in 2010 as a knowledge hub and networking organization for greening procurement. In 2015, one of the topics for which the Forum developed actions and communications was the circular economy. The Danish Environmental Protection Agency (EPA) and the Capital Region are engaged in a Horizon 2020 project on greening public procurement, with the Danish EPA responsible for developing a tool on the circular economy in a public procurement context.<sup>46</sup>

In 2016, the European Commission published new Green Public Procurement criteria for office buildings, for roads, and for computers and monitors. These can be used by public authorities on a voluntary basis, and include requirements relevant to the circular economy. For example, computers and monitors have to be designed so that they can be repaired with commonly available tools and that batteries can be easily replaced; and the possibility to upgrade them is rewarded.

Outside of Europe, Japan has also been using public procurement as a tool to support the circular economy. The “Law on Promoting Green Purchasing” (2000) obligates that governmental entities buy certain “green” products. In some cases, this law has actually helped to create the threshold demand necessary for manufacturers to begin producing products with higher reclaimed or recycled content at a profitable level. Similar laws have also been enacted in South Korea and Taiwan.<sup>47</sup>

## Downstream Policy Best Practices

Downstream policy best practices include landfill diversion efforts through the application of landfill bans and waste taxes, progressive recycling and extended produce responsibility (EPR) targets; and waste-to-resource efforts through industrial symbiosis programs.

### *Landfill Bans & Taxes*

As of 2016, the share of biodegradable municipal waste ending up in landfills is limited in the EU to less than 35% of 1995 levels. The objective is to encourage alternatives to waste disposal (such as recycling) and drive resource efficiency upstream. However, most EU countries are behind the current targets and 16 member states have, in fact, obtained derogations.<sup>48</sup>

Leading countries that have successfully implemented landfill bans (e.g., Nordic countries, Germany, the Netherlands, Austria) as well as taxation schemes have achieved very positive results, with impacts driving increased recycling and more upstream initiatives. Germany, for example, credits its first major step toward a more circular economy as its ban on landfill disposal of untreated household wastes and general waste from industry in 2005, initially imposed due to a lack of landfill space. This critical step provided significant opportunities for waste incineration and energy from waste solutions.

<sup>45</sup> See: <https://www.ellenmacarthurfoundation.org/case-studies/denmark-public-procurement-as-a-circular-economy-enabler>

<sup>46</sup> Source: <http://www.eea.europa.eu/publications/more-from-less>

<sup>47</sup> See: [http://www.igpn.org/DL/Green\\_Purchasing\\_The\\_New\\_Growth\\_Frontier.pdf](http://www.igpn.org/DL/Green_Purchasing_The_New_Growth_Frontier.pdf)

<sup>48</sup> See: <http://www.europarl.europa.eu/news/en/news-room/20170120STO59356/waste-more-ambitious-targets-towards-a-circular-economy>

In Sweden, the decreasing quantities of organic waste going to landfill is attributed to the first energy crisis in 1975-1978 where high oil prices had a major economic impact on the country. At the time, a major focus was placed on finding alternatives to oil. Sweden invested in a large network of district heating systems, using high subsidies to incentivize their development through the 1980s and 1990s. This, in turn, encouraged a landfill ban in 2002 on combustibles (e.g., forestry residuals), and later, in 2005 on organic waste as a source of feedstock for these district energy systems.

Some countries, including Sweden and the Netherlands, have levied virgin material taxes on virgin aggregates like sand and gravel, which have been effective for material recovery from constructing demolition for example.<sup>49</sup> Differentiated waste streams are taxed based on whether the resource has recyclable value; residual waste with no further use, for example, is taxed lightly. The tax is designed to induce behaviour change. Applying a relatively small amount of money to every tonne has proven to have a large impact that redirects users to other feedstocks.

In Finland, a waste tax is applied on materials going to landfill, which has been slowly increased since 1996:

- €15 (\$21 CAD)/t in 1996
- €23 (\$32 CAD)/t in 2003
- €30 (\$42 CAD)/t in 2005
- €40 (\$56 CAD)/t in 2011
- €50 (\$70 CAD)/t in 2013 (current rate)

Many attribute the tax to the decreasing municipal solid waste (MSW) going to landfill in Finland; from 2005 to 2010, MSW to landfill decreased from 59% to 45%. In general, Finland's landfill waste taxation is not considered to have been significantly effective towards prevention, but rather to have incentivized and increased recovery (from both recycling and energy perspectives).

### *Recycling Efforts & Producer Responsibility*

Increasingly aggressive recycling targets and EPR requirements are helping to ensure few products and materials end up going to landfill. Improved sorting and separation is a key to success.

In Japan, recycling has become the cultural norm. With well-established recycling laws, the public is generally supportive, willing to oblige and cooperate with local governments to help with impressive requirement around sorting of materials. The city of Kamikatsu, as one example, is well known for its zero-waste efforts, including the separation of waste into 34 categories for recycling and treatment.<sup>50</sup> This is certainly an exception to the norm around the world; it would be a stretch to expect North American households to be as disciplined with respect to the implementation of as many recycling and waste separation categories.

In Europe, Germany has long been a strong example of material efficiency and recycling policy and best practice; the country boasts one of the highest recycling rates in the world at 62%. In 2015, the Circular Economy Action Plan set a common 65% recycling target on municipal waste by 2030, a target which all EU countries are accountable to.

The construction (and demolition) sector has typically one of the largest volumes of material use. In Denmark, for example, it accounts for up to one-third of total waste, making it a top priority in the pursuit of material efficiency and circular resource loops. The Danish government's policy, "Towards a Stronger Construction Sector" outlines a number of initiatives to improve resource efficiency and reuse construction products.

<sup>49</sup> DG Environmental News, November 17, 2011, article: "Taxes on natural resources reduce use of raw materials". Source: [http://ec.europa.eu/environment/integration/research/newsalert/pdf/262na1\\_en.pdf](http://ec.europa.eu/environment/integration/research/newsalert/pdf/262na1_en.pdf)

<sup>50</sup> See: <http://www.businessinsider.com/kamikatsu-japan-produces-zero-waste-2016-7>

Efforts include a focus on demolition and the separation of priority materials, stimulating market demand for recyclable and reusable materials, as well as a number of preventative measures such as limiting harmful chemicals in products and processes used in buildings and building materials and supporting eco-friendly building construction.

In Finland, funds have been directed to support municipalities with integrating mechanical and/or robotic sorting equipment at recycling facilities. One example is the Viikki Recycling Plant where robotics is allowing the plant to function fully automatically, maximizing the utilization rates of construction waste material.<sup>51</sup>

Producer responsibility is an additional tool that many government agencies and municipalities are embracing as a way to reduce landfill needs and shift costs of recycling programs to manufacturers. Ontario has moved aggressively in this direction as part of its new “Strategy for a Waste Free Ontario: Building the Circular Economy”, which is expected to be finalized during the first quarter of 2017.

The Strategy is divided into two key parts. The first part of the Strategy is outlined in the “Resource Recovery and Circular Economy Act”, which sets the overarching direction of both the Act and upcoming Strategy and establishes a new competitive producer responsibility program. The Strategy will eventually seek to empower and incentivize producers to implement programs that foster product design innovation, reuse, and remanufacturing. It will also include recycling targets and fees based on the sales of products and material components, making the new strategy explicitly outcome-based.

The second part, the Waste Diversion Transition Act, replaces the Waste Diversion Act of 2002. Under the Waste Diversion Transition Act, the Ontario provincial government’s circular economy policy will essentially place the full cost and environmental responsibility on producers with respect to the collection, sorting, and treatment of recyclables and waste. This will be an important shift from current monopolized Industry Funding Organization (IFO) schemes towards a more competitive system that will encourage an unlimited number of Producer Responsibility Organizations (PROs). Competition is expected to increase innovation, increase the level of service, and reduces costs. There is no confirmation from the Ontario Ministry of Environment and Climate Change with respect to timelines on the transition to competitive schemes at present but it is expected to be rolled out between 2017 and 2020.

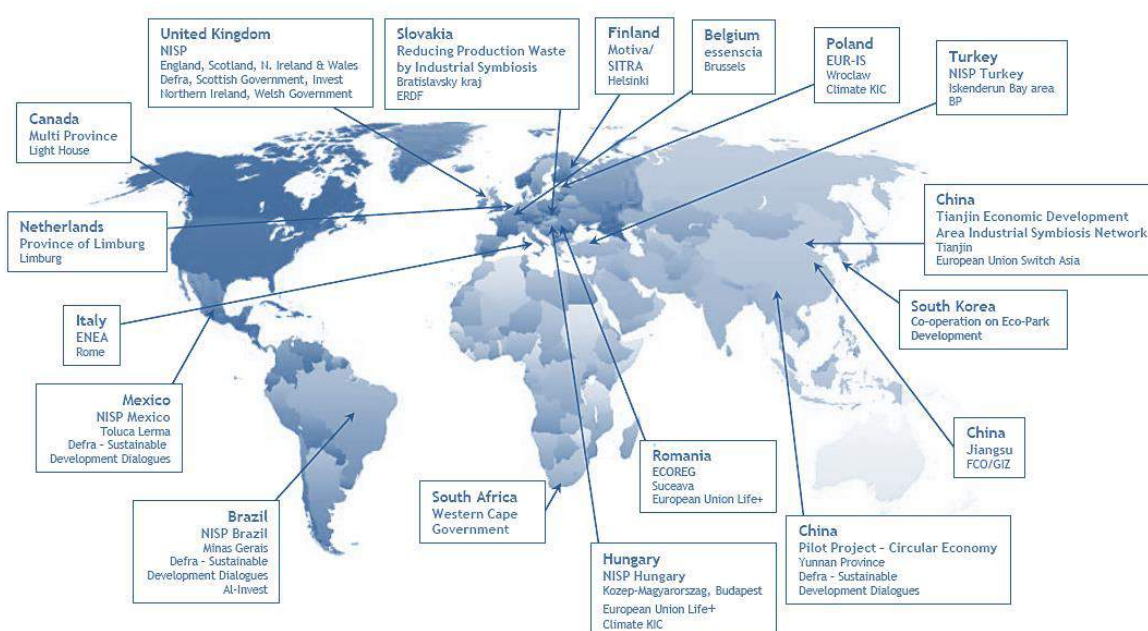
Ontario’s newly formed Resource Productivity and Recovery Authority (RPRA), which has evolved from Waste Diversion Ontario (WDO), will have compliance and enforcement authority, including the bandwidth to audit both producers and stewardship programs. Regulations will eventually further define the RPRA’s role; in the longer-term, the vision may include upstream programs to drive resource productivity and innovations using an outcome-based approach.

### *Industrial Symbiosis Programs*

Industrial symbiosis is a waste-to-resource model that is designed to optimize under-used or under-valued resources (including energy, water, waste, and logistics) by helping companies identify symbiotic partnerships that recognize the value of a company’s by-products and assisting it in making connections with companies in other industry sectors and across traditional value chains. To date, more than two dozen countries around the world have adopted industrial symbiosis programs, including those showcased in Figure 8 below.

The National Industrial Symbiosis Programme (NISP) in the United Kingdom is considered the first and one of the most successful national programs. The NISP program was launched in 2005 by the U.K. government in England and is currently run by the Birmingham-based company International Synergies. The network currently has more than 15,000 participating companies.

<sup>51</sup> See: <http://www.smartnclean.fi/projects/viikki-recycling-plant>



Source: International Synergies

Figure 8: Industrial symbiosis programs around the world.

Evaluation of the U.K. NISP program shows that it has enabled its members to divert 47 million tonnes of waste from landfill, generated €1.7 billion (CAD \$2.4 billion) in new revenues, saved €1.2 billion (CAD \$1.7 billion) in costs, created and safeguarded more than 10,000 jobs, and reduced 42 million tonnes of CO<sub>2</sub>e.<sup>52</sup>

Many of the other industrial symbiosis programs have worked directly with International Synergies and/or its proprietary software called SYNERGie, which provides a facilitated approach to brokering waste re-use. SYNERGie captures company information, including their resource input requirements and waste outputs. Today, the SYNERGie software hosts resource information from 30,000 companies across 22 countries on 6 continents. Its successor, SYNERGie 2.0, is under development through EU Horizon 2020 project SHAREBOX.

While most industrial symbiosis programs have been launched at the national level with government support, several regional examples have also been successful. In Denmark, the Green Industrial Symbiosis program was an initiative started through the Danish Green Transition Fund under the Danish Business Authority and included both federal and regional government support. It was a collaboration between the five regions who assisted with company outreach and matchmaking, using the U.K. NISP framework and database software.

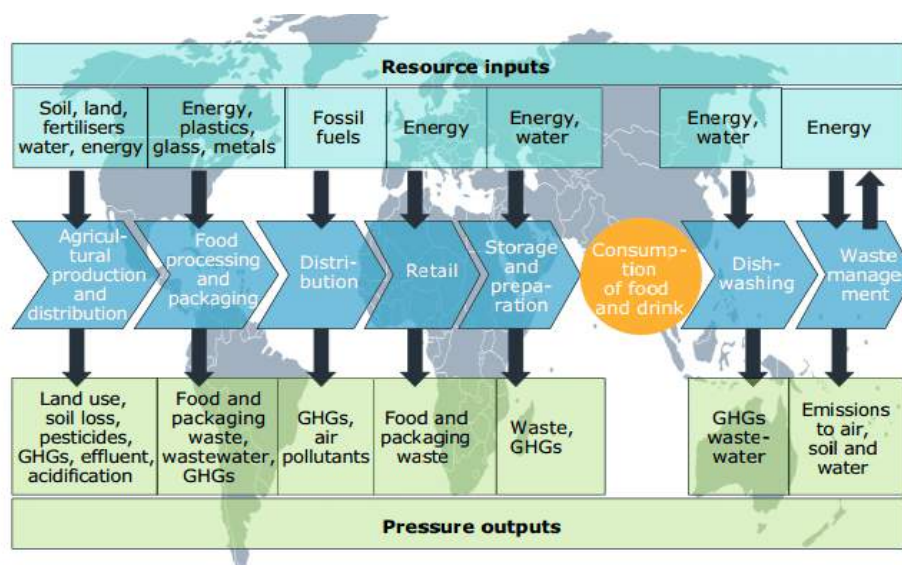
The Finnish Industrial Symbiosis System (FISS), launched in 2013 by Sitra and Motiva, has been rolled out regionally and now includes 350 companies. FISS has resulted in general awareness building amongst companies with respect to resource use and internal optimization while also helping companies identify new inter-connections between their industries and others. The focus now is on the implementation of specific project opportunities.

<sup>52</sup> Data provided by Peter Laybourne, International Synergies, and British Consul-General (2017).

## Policies & Programs Focused on Organics

The topic of food waste and its prevention has received growing interest and attention in recent years on the policy agenda. One of the key elements of the focus on organics and food waste policy is targeting the reduction of greenhouse gas (GHG) emissions.

As illustrated in Figure 9, resource inputs at various stages of the food system value chain can have a direct impact on GHG emissions as an output. This includes during agricultural production and distribution, food processing and packaging, distribution, storage and preparation, and during consumption and waste management.



Source: European Environmental Agency's 2014 "Environmental Indicators" Report.<sup>53</sup>

Figure 9: Simplified overview of the key elements of the food system.

It is estimated that reducing consumer food waste globally could save between USD \$120 billion and \$300 billion (CAD \$162 billion and \$404 billion) per year, and up to 0.2% in GHG emissions by 2030, according to a 2015 report by the U.K.'s Waste & Resources Action Programme (WRAP) and the Global Commission on the Economy and Climate. To achieve this, a 20%-50% reduction in consumer food waste is required. As such, policymakers in leading jurisdictions are actively targeting a reduction in food waste as an area of focus to lower GHG emissions and fight climate change.

### European Union

In Europe, the most recent estimates of food waste levels suggest that 70% of EU food waste arises in the household, food service, and retail sectors, with production and processing sectors contributing the remaining 30%.<sup>54</sup>

Policies and programs have put a greater emphasis on targeting the stages of the food system value chain where the largest impacts occur (i.e., during consumption and distribution) through various mechanisms that include waste prevention efforts, information and awareness campaigns, food reuse and recycling, and bioenergy solutions.

<sup>53</sup> See: <http://www.eea.europa.eu/publications/environmental-indicator-report-2014>

<sup>54</sup> FUSIONS, 2016 <http://www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf>



A number of policy measures have been explored by the EU over the last several years, including:

- **Improving food waste data reporting requirements** through EUROSTAT, including standardization of methodologies for calculating food waste quantities to ensure comparability, improve target setting, and track progress on food waste prevention efforts.
- **Date labelling coherence** to improve the clarification and standardization of EU-mandated food date label applications (such as “best before”, “best before end”, “use by”, as well as voluntary labels such “display until” dates) to reduce food waste produced due to date label confusion or perceived inedibility.
- Efforts to regulate and incentivize **better food waste separation and improved collection** efforts.
- **Targeted awareness campaigns**, largely geared towards households and the general public.<sup>55</sup>

A number of food waste prevention and awareness building programs have been developed across the EU, some of which are summarized in Appendix B.

The European Commission’s recently amended its Waste Directive to include a target to halve food waste by 2030, in line with the UN’s Sustainable Development Goal target 12.3. To help support the target, the EC has established a platform dedicated to food waste prevention. The EU Platform on Food Losses and Food Waste (FLW) aims to define the measures needed to prevent food waste, share best practices, and evaluate progress made over time.<sup>56</sup>

The FLW is gathering 70 members representing public authorities (member states, European Free Trade Association countries, EU bodies, and international organizations) and all participants along the food value chain (including food banks and other NGOs). The platform met for the first time at the end of November 2016 and discussed key deliverables of the Circular Economy Action Plan on food waste, including the main elements to be considered in developing a methodology to measure food waste consistently across the EU. The methodology will be utilized by member states to fulfil reporting obligations related to food waste laid down in the European Commission’s legislative proposal to revise the Waste Framework Directive. At the same time however, the EC’s target to halve food waste by 2030 has not yet broadly converted into concrete targets adopted by all countries.

Additional recent efforts include preparation of EU guidelines to facilitate food donation, including addressing legal and operations barriers for both donors and receivers, as well as more detailed guidelines for valorizing the nutrients of former food to be used as animal feed, reducing waste and food that would have previously been burned or landfilled.

### *The Netherlands*

At the country level, Dutch policy in the area of food waste is some of the most developed in the EU. One notable action taken by the Dutch government was a €3.13 million (CAD \$4.38 million) Small Business Innovation Research project specific to food waste. The program ran from 2010–2014 and provided funding for feasibility studies to stimulate innovation in three areas:

1. Food waste prevention to avoid food losses in the agri-food supply chain due to losses in quality, as a result of which food is thrown away by consumers or other supply chain members;
2. Maintaining food waste streams meant for human consumption in agri-food supply chains for human consumption; and
3. Transforming food waste streams into food products for human consumption by reprocessing and remanufacturing.

<sup>55</sup> See: [http://ec.europa.eu/environment/eussd/pdf/bio\\_foodwaste\\_report.pdf](http://ec.europa.eu/environment/eussd/pdf/bio_foodwaste_report.pdf)

<sup>56</sup> See: [https://ec.europa.eu/food/sites/food/files/safety/docs/fw\\_eu-actions\\_flw-platform\\_tor.pdf](https://ec.europa.eu/food/sites/food/files/safety/docs/fw_eu-actions_flw-platform_tor.pdf)

There is also a Dutch Task Force on Circular Economy in Food that is drawing on insights gained from the European REFRESH (Resource Efficient Food and dRink for the Entire Supply cHain) program. By the end of 2017, the Netherlands, led by the Ministry of Economic Affairs, is planning to publish a national strategy to collectively achieve a circular economy in food; an economy in which food waste does not exist and agriculture / residual food streams are re-used in a resource efficient manner with an attempt to retain the value of raw materials.

### *The United Kingdom*

In the U.K., the Waste and Resources Action Program (WRAP) was established in 2000 and has a focus on three areas, including food waste.<sup>57</sup> Its 2007 “Love Food Hate Waste” campaign targeting consumers has been identified as a leading awareness building program.

To address the high amount of food waste, England has developed a Food Waste Recycling Action Plan that includes a focus on five themes and 16 action items linked to indicators that are designed to boost food waste recycling.<sup>58</sup> The themes are:

- **Developing the business case** – It is hoped that understanding the ‘whole system costs’ of food waste recycling can inform the decisions and choices of those involved with food waste recycling.
- **Optimizing food waste collections** – Food waste collectors to know how to design and deliver services that are efficient and maximize the amount of food waste collected for recycling.
- **Communicating with householders and commercial food waste producers** – Well designed and easy to understand food waste communication materials are essential for clearly explaining how to recycle food waste, and why.
- **Ensuring quality as well as quantity** – Focuses on better separation, recognizing that contaminated food waste can significantly compromise the processing of food waste. It can also reduce the value of the compost and digestate outputs, as well as the available markets for them.
- **Making contracts work** – Using contractual mechanisms can incentivize food waste collectors to maximize the amount of food waste they collect for recycling.

Scotland has also been taking a progressive stance on food waste. Waste regulations established in 2011, for example, required that businesses (including restaurants and cafés) which produced over 50 kilograms of food waste weekly were targeted to drop to 5 kilograms per week by 2016 and had to segregate food waste separately for collection.

### *Denmark*

The issue of food waste in Denmark is of such high importance that it forms part of the Prime Minister’s political agenda. Consumer and business education are also a top priority across all of Denmark’s food waste programs. The Stop Wasting Food movement (implemented in 2010) has been embraced by the public in general and has been the subject of over 18,000 news and research articles. Other interesting programs in Denmark include:

- **Stop Food Waste:** a program aimed at schools to encourage both students and teachers to come up with new ideas and strategies to minimize food waste;
- **ReFood Label:** a program aimed at cafes and restaurants that awards recognition for food waste prevention; and
- **Charter on Less Food Waste:** a voluntary initiative involving 19 major stakeholders, including government ministries, restaurants, supermarket chains, and hotel chains.

<sup>57</sup> <http://www.wrap.org.uk/about-us/our-plan>

<sup>58</sup> See: [http://www.wrap.org.uk/sites/files/wrap/A\\_Food\\_Waste\\_Recycling\\_Action\\_Plan\\_For\\_England\\_0.pdf](http://www.wrap.org.uk/sites/files/wrap/A_Food_Waste_Recycling_Action_Plan_For_England_0.pdf)

As part of its involvement in a case study by the Ellen MacArthur Foundation as part of that organization's „Toolkit for Policymakers“, Denmark's food and beverage processing industry was examined. Opportunities were highlighted for the creation of more bio-refineries, tying in the national agenda around bio-economy, new technology, and innovation for developing high-value products from the waste streams produced by the food and beverage processing industry.<sup>59</sup>

### *Japan*

In Japan, large quantities of food waste have been an issue in the production, processing, and consumption phases due to a particular cultural preference for freshness. In 2000, the “Act on the Promotion of the Recycling of Recyclable Food Resources” (i.e., Food Recycling Act) was enacted with a view to ensuring the effective use of food resources and reducing the disposal of food waste. The Food Recycling Act defines basic rules regarding the control and reduction of food waste generation by different entities as well as the recycling and thermal recovery of useful food waste (recyclable food resources). The Act also mandates that measures be taken to promote the recycling of food resources by food-related business operators in every area including manufacturing, wholesale, retail, and the restaurant industry.

The Food Recycling Act also created a system for registering business operators that manufacture fertilizers and stock feed by using recyclable food resources as raw material, as well as a system to implement recycling programs by food-related business operators, recycling operators, and farmers, to use fertilizers and stock feed obtained from such recycling programs. Users of these systems are eligible for preferential measures specified in related regulations in order to efficiently recycle food waste, such as preferential procurement of authorized products.

### *Organics & Bioenergy Production*

Finally, many countries are addressing organic waste streams by developing policies that put an emphasis on the extraction of energy from this waste stream. The Danish government's ‘Energi 21’ Plan, for example, sets out integrated solutions for energy, waste management, and nutrient redistribution, and provides support for biogas development as part of its policy target to meet 35% of the country's energy needs from renewable sources.

According to the Swedish Environmental Protection Agency, by 2018, at least 50% of food waste from households, institutional kitchens, shops, and restaurants must be sorted and processed biologically (which includes both composting and digestion) so that organic nutrients are utilized, with at least 40% treated in such a way that energy is also recovered. This target can be achieved through, for example, digesting at least 40% of food waste and composting at least 10%. Both centralized composting and home composting are included as part of the target, provided the compost is used in such a way that the nutrients can be captured and utilized.

The biogas chain is important in Sweden. Biogas is used as a petrol gas (bio-fuel) in both passenger vehicles and public transit buses. It is considered a somewhat unique situation in Sweden because the electricity system is already relatively low-carbon from nuclear, hydro, and wind power so biogas is used as a vehicle fuel rather than for electricity generation. There is also a tax exemption (i.e., VAT rebate) on biogas for use in buses. Fertilizer that comes out of the biogas process is used by the agriculture sector as an eco-friendly product.

Germany's policy focus on organics is largely tied to its interest in bioenergy, as outlined in its National Biomass Action Plan and the Action Plan for the Industrial Use of Biomass, released in 2009. These Plans quantified the biomass share in meeting current energy demand, and identified available reserves. They also included goals and policies to reduce GHG emissions, including the intention to set biofuel quotas based on their net reduction of GHG emissions.

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<sup>59</sup> See p. 102:  
[https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation\\_PolicymakerToolkit.pdf](https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_PolicymakerToolkit.pdf)



In addition, Germany passed the Renewable Energy Sources Act in 2009, which created incentives for the recycling of silage and unused organic waste in particular. At the same time, the Renewable Energy Heat Act came into effect, which used a Market Incentives Program (MAP) to require owners of newly constructed buildings to use renewable energy to meet a portion of their heat requirements, including bioenergy.

In Scotland, the low population, large land mass, and active fishing and farming industries, has resulted in the deployment of significant anaerobic digestion and compost infrastructure. However, biomass-to-energy solutions are still largely dependent on subsidy systems in place, including feed-in-tariffs, grants, and other subsidies.

Japan has also placed an emphasis on bioenergy production from organic waste, with considerable incentives for anaerobic digestion. A lot of investment by federal government has taken place with respect to research and supporting the technology for processing organic and food waste. There are now more than 100 biogas plants across Japan, due in large part to subsidization from the Ministry of Agriculture.

## In Summary

What is clear from the information presented in this chapter is that a wide range of strategies, policy tools, regulatory approaches, funding, and incentive-based mechanisms have been developed and implemented by leading jurisdictions in order to advance a more circular economy – albeit to varying degrees of success, as will be explored in the following chapter.

What appears to be the growing focus of leading jurisdictions is that these policy instruments and tools are increasingly being applied under coordinated, broad-based strategies that involve cross-sections of government and involvement from various ministries in order to maximize the benefits and ensure effective engagement and buy-in with key stakeholders during implementation phases.

The OECD in its Policy Guidance for Resource Efficiency has summarized a number of these “best practice” policy instruments that can be applied at different stages of a product’s lifecycle in order to maximize resource efficiency and minimize waste streams (see Figure 10).

	Economic instruments	Regulatory instruments	Environmental labelling and information schemes	Voluntary approaches	Public financial support
<b>Extraction</b>	Taxes on virgin materials	Bans, restrictions on mining of minerals	Good mining practices	Agreements on managing environmental impacts of mining	Tax breaks on exploration, mining
<b>Design</b>	Advance disposal fees	LCA-based standards, take-back requirements, standards e.g. for durability	Environment technology verification schemes	Research partnerships	Tax breaks, grants for R&D
<b>Production</b>	Product taxes or charges	Emission or performance standards	Advisory services for SMEs	Agreements to develop more efficient, less polluting production methods	Soft loans to SMEs
<b>Consumption</b>	Deposit refund schemes; pay-as-you-throw pricing for waste collection systems	Product restrictions or bans	Labelling and certification schemes	Behaviourally-informed interventions (nudges)	Grants for the purchase of eco-labelled products or services
<b>Recycling</b>	Tax differentiation between virgin and recycled materials	Standards for recycled materials	Platforms to match supply of and demand for secondary raw materials	Agreements to create hubs promoting industrial symbiosis	Tax breaks, grants for research on recycling, industrial symbiosis
Waste disposal	Landfill and incineration taxes; tradeable landfill permits	Bans, restrictions on landfill	Information on dismantling products	Voluntary take-back schemes	Grants, soft loans to construction waste disposal facilities

Source: OECD's "Policy Guidance on Resource Efficiency" report (2016).<sup>60</sup>

Figure 10: Examples of policy instruments applied at different stages of the product lifecycle.

<sup>60</sup> See: <http://www.oecd.org/environment/waste/policy-guidance-on-resource-efficiency-9789264257344-en.htm>

## 4. KEY TARGETS & POLICY IMPACTS

This chapter explores some of the measured and, in some cases, anticipated impacts from various circular economy related policies and programs within leading jurisdictions—in particular, impacts on:

1. Waste generation, recycling, and diversion rates;
2. Economic factors such as investments, GDP, and employment; and
3. Greenhouse gas (GHG) emissions reductions.

Delphi’s research and consultation with leading policy and industry experts, however, suggests that despite the range of efforts to address waste and resource challenges, as well as a number of indicators that have been developed over the last number of years (outlined later in this chapter), there is still a lack of governance tools in place for monitoring and measuring how effective international, national, and regional policies are in making the transition to a more circular economy. More on this aspect is covered in Chapter 5 which focuses on some of challenges.

### Impacts on Waste Generation, Recycling & Diversion Rates

#### *European Union*

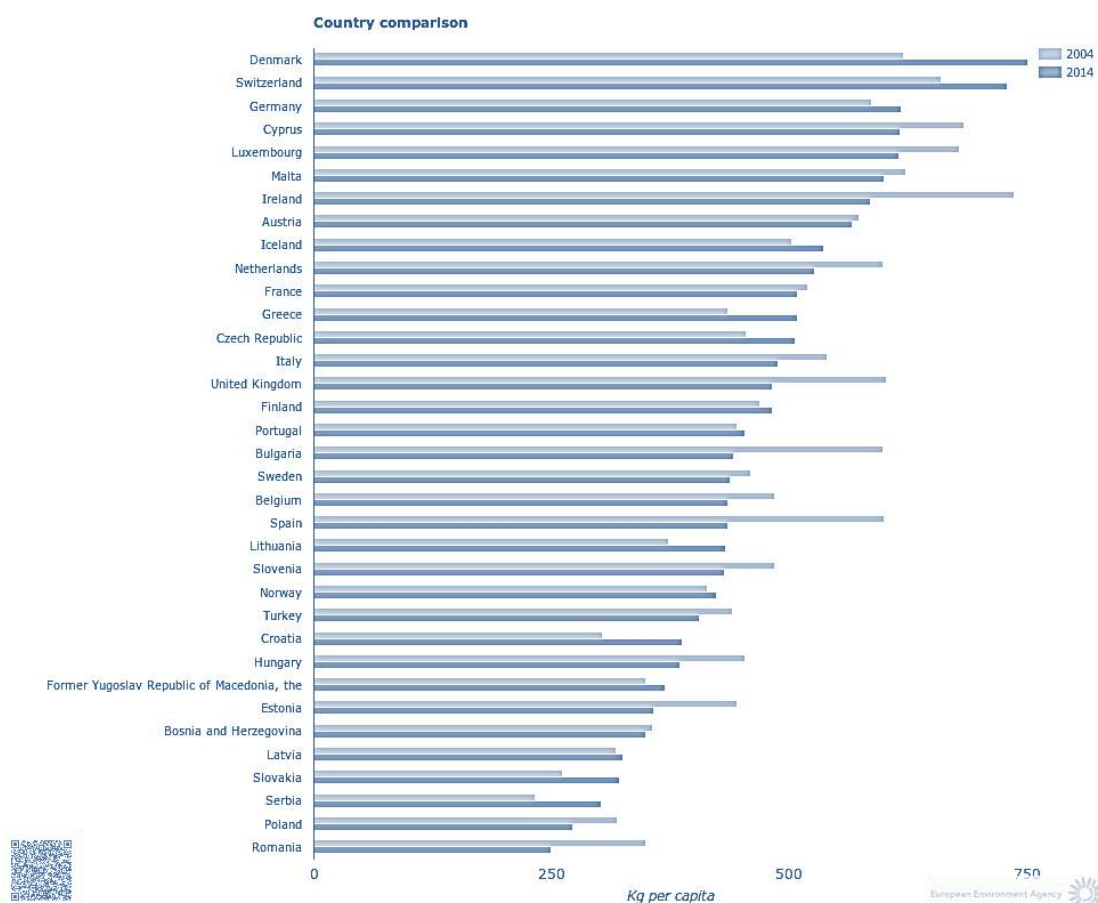
In 2014, 44% of all municipal waste in the EU was recycled or composted. This compares to only 31% in 2004. In reality, total municipal waste generation in European countries declined by 3% in absolute terms and average generation per person by 7% from 2004 to 2014.<sup>61</sup> In addition, the rate of municipal waste landfilling for the European Union member countries fell from 49% in 2004 to 34% in 2014. Increasing recycling rates and declining rates of landfilling are clearly linked. Usually, landfilling declines much faster than the growth in recycling, as waste management strategies mostly move from landfill towards a combination of recycling and incineration, and in some cases also mechanical–biological treatment. That being said, the European improvements have been linked to less focus on disposal and more focus on waste prevention and recycling.

However, there has been no uniform trend across countries and the performance of individual countries has varied. In Austria, Belgium, Denmark, Germany, the Netherlands, Norway, Sweden, and Switzerland, virtually no municipal waste is sent to landfill. By contrast, Cyprus, Croatia, Greece, Latvia, Malta, and Turkey still landfill more than three-quarters of their municipal waste.<sup>62</sup> There was also an increase in municipal waste generation per person in 16 EU countries and a decrease in 19 countries between 2004 and 2014 (see Figure 11).

Several of the country leaders profiled in this report in fact saw increases of municipal waste per capita between 2004 and 2014 despite early policy efforts—including Denmark, Germany, and Finland. The Netherlands, the United Kingdom, and Sweden on the other hand saw decreases. However, it should be noted that most of the “circular economy” policies and programs that focus more specifically on upstream elements, including waste prevention, reuse, and remanufacturing, have largely been deployed since 2014 so it will be interesting to note changes to MSW generation following the next data reporting period.

<sup>61</sup> See: <http://www.europarl.europa.eu/news/en/news-room/20170120STO59356/waste-more-ambitious-targets-towards-a-circular-economy>

<sup>62</sup> Source: EEA Circular Economy in Europe – developing the knowledge base <http://www.eea.europa.eu/publications/circular-economy-in-europe>



Source: European Environmental Agency

Figure 11: Municipal waste generated per person in 35 European countries (2004 and 2014).

Additional observations from the EU with respect to the effectiveness of policy instruments include:

- Most countries have developed more than two national waste management plans between 2004 and 2014, but their recycling performance differs greatly. There is no systematic difference in performance between countries with national plans and countries with only regional plans.
- Many countries use 'pay-as-you-throw' schemes (i.e., fees based on the weight or volume of the waste as an economic incentive for households to recycle their waste). Their level of implementation varies greatly by country and within countries. However, all countries with recycling rates above 45% employ a similar system of sorts, while most countries with recycling rates below 20% do not use them, indicating that pay-as-you-throw schemes are an effective instrument that drives recycling up.
- All the countries that show landfill rates well below the EU-28 average of 28% have either banned landfill of biodegradable or mixed municipal waste, or implemented a ban combined with a landfill tax of at least €30 / tonne (CAD \$42.6 / tonne).<sup>63</sup>

<sup>63</sup> Source: <http://www.eea.europa.eu/themes/waste/municipal-waste>

Additional factors identified that may contribute to higher recycling rates in the EU include: the level of wealth (there is a correlation factor of 0.65 between GDP per person and the recycling rate); environmental awareness levels; waste management tariffs; and stringent implementation of waste management legislation.<sup>64</sup>

By 2020, member states are expected to be recycling or composting over 50% of waste. In 2015, the European Commission proposed new, stricter targets for municipal waste of 60% recycling and preparing for reuse by 2025 and 65% by 2030. Countries can choose between four different methods to monitor their progress towards the Waste Framework Directive target on recycling and preparing for reuse.<sup>65</sup>

### *Germany*

With no active landfills in Germany, the country is a strong example of a material efficiency driven (yet widely downstream) approach to circular economy development. As the result of Germany's downstream focus, the country boasts one of the highest recycling rates in the world at 62%. In addition, an increase of its raw material productivity increased by 49% between 1994 and 2014. This productivity improvement was mainly attributed to a 31% reduction in raw construction material use.

### *Sweden*

Compared to rest of the EU, Sweden has much higher targets on recycling and less landfill than many other countries, which has been a main target for the last 50 years. Approximately 50% of MSW is recycled (material recycling), including biological recycling through both anaerobic digestion and composting. Forty-nine percent goes into waste-to-energy and less than 1% goes into landfill.

### *Denmark*

With source separation initiatives, landfill bans, and landfill taxes, over the past 20 years, the majority of Danish waste has been recovered. Between 1994 and 2011, Denmark's recycling rate went up from 55% to 61%; the incineration rate went up from 21% to 29%; and the percentage of landfilled waste dropped considerably from 22% to 6%.<sup>66</sup> Within the organics waste stream, the Stop Wasting Food program in Denmark has resulted in a nation-wide food waste reduction of 25% between 2010 and 2016—with an estimated value worth DKK 4.4 billion (CAD \$836 million).

### *Japan*

In Japan, the recycling rate for recyclable food resources has continued to increase since 2000, when the Food Recycling Act was enacted, rising from 29% in 2000 to more than 85% today. Although the recycling rate in the food manufacturing industry is generally high, the recycling rate for recyclable food resources becomes lower in the order of wholesale food, retail food, and the restaurant industry. One of the reasons for this is that waste sorting becomes more difficult in the lower reaches of the food distribution chain.

As a major manufacturing nation, Japan has put a policy focus on the recycling of metals and other key manufacturing inputs. As a result, the country currently recycles more than 98% of its metals. Japan's appliance recycling laws as another example ensures that a great majority of electrical and electronic products are recycled; of these appliances, 75% to 90% of the materials they contain are recovered. Many of these materials go back into the manufacturing of the same type of product.

<sup>64</sup> Source: <http://www.eea.europa.eu/themes/waste/municipal-waste>

<sup>65</sup> Source: <http://www.eea.europa.eu/themes/waste/municipal-waste>

<sup>66</sup> See: <http://www.internationallawoffice.com/Newsletters/Environment-Climate-Change/Denmark/Plesner/Government-sets-out-new-strategy-for-Denmark-without-waste>

## Economic Targets & Impacts

Modelling the economic impacts of policy efforts can be challenging, particularly when looking at the direct, net benefits on GDP and employment. For example, recycling efforts have created new jobs in the form of people collecting, transporting, and sorting recycled materials, however, there are fewer people working at landfill sites as a result.

There has been a fair amount of micro-economic work looking at different business models and their economic impacts on jobs and the economy. Some of this micro-economic analysis has been extrapolated to the macro level. However, current modeling is crude in this area and existing models have to be adjusted substantially in order to examine the multiple, varied, and inter-connected processes within the circular economy system. They also do not include factors such as the roll-out costs of new policies and innovation so are recognized as having limitations.

Regardless, Delphi's research has uncovered a number of estimates from various programs in leading jurisdictions, as well as several research pieces which forecast projected economic impacts of circular economy initiatives.

### European Union

Considering only downstream elements around waste management and related services, the economic impact is already significant in most leading jurisdictions. For example, it is estimated that Germany's waste sector is worth \$40 billion and employs approximately 1,000,000 workers. However, considering more comprehensive and upstream policies and program efforts, the economic opportunities and impacts are even greater.

Recent international studies have demonstrated that the circular economy can drive economic growth significantly. A meta-study reviewing 65 studies on employment and the circular economy found generally positive employment effects as a result of moving towards a circular economy. That being said, the studies mainly addressed energy and material savings; studies on employment effects of sharing, recycling, and further approaches are scarce.<sup>67</sup>

In the 2015 study "*Growth within: A circular economy vision for a competitive Europe*", developed in partnership by the Ellen MacArthur Foundation, the McKinsey Center for Business and Environment, and the new environmental-economics branch of the Deutsche Post Foundation, new evidence was provided that a circular economy, enabled by the technology revolution, would allow Europe to grow resource productivity by up to 3% annually.<sup>68</sup> This would generate a primary-resource benefit of as much as €0.6 trillion (CAD \$0.85 trillion) per year by 2030 to Europe's economies. In addition, it would generate €1.2 trillion (CAD \$1.7 trillion) in non-resource and externality benefits, bringing the annual total benefits to around €1.8 trillion (CAD \$2.56 trillion) compared with today.

At a regional level, the EU Circular Economy Package is anticipated to generate significant benefits to both member and non-member countries in Europe on the order of:

- The creation of 170,000 direct jobs by 2035 through waste management measures;
- Savings of €465 (CAD \$651) per household per year by 2020 through energy efficiency and energy efficient products;
- A reduction in total material requirements of up to 20%, leading to an estimated 3% boost to GDP; and
- A net savings to businesses of up to €600 billion (CAD \$840 billion) or 8% of annual turnover through better eco-design, improved material reuse, and more waste prevention.

<sup>67</sup> Horbach, J., Rennings, K., and Sommerfeld, K., 2015. Circular Economy and Employment. See: [https://sunstiftungsfonds.files.wordpress.com/2015/06/ce\\_employment\\_13052015.pdf](https://sunstiftungsfonds.files.wordpress.com/2015/06/ce_employment_13052015.pdf)

<sup>68</sup> Find the report here: <http://www.mckinsey.com/business-functions/sustainability-and-resource-productivity/our-insights/europes-circular-economy-opportunity>

In the last four years, the Ellen MacArthur Foundation has carried out additional detailed economic modelling for a number of sectors including the fast moving consumer goods, medium-life complex goods, and plastic packaging sectors. The Ellen MacArthur Foundation also modelled ten circular economy opportunities across five of the most promising sectors for Denmark as part of its case study work and its policy toolkit. This modelling found that, relative to a business as usual scenario, by 2035 Denmark could achieve an increase in GDP of between 0.8% and 1.4%, create between 7,000 and 13,000 new jobs, and increase net exports by 3% to 6% by fully embracing a more circular economy in these areas.<sup>69</sup>

Club de Rome has estimated that material efficiency related efforts offer some of the greatest potential for leaders in this space. Economic modelling suggests that more than 50,000 new jobs in Finland and Sweden, more than 100,000 in the Netherlands, more than 200,000 in Spain, and more than 300,000 jobs in France could be created in this area.<sup>70</sup> These leading countries are also well-positioned as net exporters of material efficiency technologies, practices, and models, with expected increases to GDP of between 1% and 2%. In addition, jobs in this area are considered to be more permanent in nature due to the shift in ratio of goods-to-services where services will dominate in the future.

At a city-level, a study by Circle Economy on Amsterdam's circular economy potential identified the construction and organic waste chains as potential drivers of the transition away from the current linear model, with the following economic benefits:

- Implementation of material re-use strategies have the potential to create €85 million (CAD \$121 million) of value per year within the construction sector and €150 million (CAD \$213 million) of value per year with more efficient organic residual streams; and
- Increased productivity levels have the ability to add up to 700 additional jobs in the building sector and 1,200 additional jobs in the agriculture and food processing industry.<sup>71</sup>

In a study by the Green Alliance and WRAP titled "Employment and the circular economy: Job creation in a more resource efficient Britain", it was revealed that by 2030, on the basis of the current development path, the circular economy could create over 200,000 gross jobs and reduce unemployment by about 54,000.<sup>72</sup> In addition, the study highlighted that the circular economy can bring greater economic stability through increased resource security and new business and employment opportunities.

It is also recognized that different types of jobs and skill sets maybe relevant under a more circular economy. For example, labour-intensive strategies, such as the preparation and sorting of products and materials for reuse or recycling, would mainly yield jobs for low-skilled people; medium-skilled jobs are expected to be created in closed-loop recycling and remanufacturing, and high-skilled jobs in bio-refining.<sup>73</sup>

### Scotland

A fair amount of economic analysis has been done in Scotland around its zero-waste targets and related programs. Through waste avoidance and segregation measures, it is estimated that Scotland has decreased its food waste by 37,000 tonnes per year since 2009 (5.7% overall), saving households £90+ million (CAD \$148+ million) a year.

<sup>69</sup> See: [https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation\\_PolicymakerToolkit.pdf](https://www.ellenmacarthurfoundation.org/assets/downloads/publications/EllenMacArthurFoundation_PolicymakerToolkit.pdf)

<sup>70</sup> See: <https://www.clubofrome.org/wp-content/uploads/2016/03/The-Circular-Economy-and-Benefits-for-Society.pdf>

<sup>71</sup> See: <http://www.circle-economy.com/case/developing-a-roadmap-for-the-first-circular-city-amsterdam/>

<sup>72</sup> Link here: <http://www.green-alliance.org.uk/resources/Employment%20and%20the%20circular%20economy.pdf>

<sup>73</sup> Source: EEA Circular Economy in Europe – developing the knowledge base <http://www.eea.europa.eu/publications/circular-economy-in-europe>



Scotland's zero-waste targets for example are expected to boost the economy by £180 million (CAD \$296 million) by 2025. Early analysis has suggested that action across eight manufacturing sub-sectors could result in annual cost savings of £0.8-1.5 billion (CAD \$1.32-\$2.47 billion) in Scotland. An analysis of ten consumer goods categories, including clothes and food, revealed potential annual cost savings of £1.5 billion (CAD \$2.47 billion).

Remanufacturing is currently valued at £1.1 billion (CAD \$1.81 billion) and employs approximately 17,000 people in Scotland. By 2020, the Scottish Institute of Remanufacture estimates that the remanufacturing sector could grow by a further £620 million (CAD \$1.02 billion), and create up to 5,700 new jobs given current collaborative efforts and program support.<sup>74</sup> Implementing the full host of circular economy policies by 2030, Scotland is estimated to experience 0.7% in net job creation.

An interesting study from 2015 examined Scotland's beer, whisky, and fish industries and their linkages to circular economy and bio-economy. A few case studies found in this report give an indication of the scale of the potential economic impact of Scotland moving further toward a bio-economy:

- **Celtic Renewables** technology applied to all malt whisky draff would generate an estimated £100 million (CAD \$165 million) of value from the various biofuel and chemical products including the residue suitable for animal feed.
- **Beans4Feeds** has indicated a total value to Scotland of £65 million (CAD \$107 million), of which an estimated £9.5 million (CAD \$15.6 million) would accrue to Scottish farmers) from replacement of imported soya products with Scottish grown bean protein for aquaculture feeds and provision of other animal feeds.
- **CellsUnited** has estimated that if all Scotland's salmon processing waste could be processed using their technology, the added value would exceed £300 million (CAD \$493 million) from sales of the protein food supplement alone, plus additional value for the separated salmon oil and the residue used as fertilizer.<sup>75</sup>

## GHG Impacts

Research shows a clear correlation between circular economy policies and climate change reduction efforts and impacts. Delphi's review of leading circular economy jurisdictions revealed varying levels of data on greenhouse gas (GHG) emissions linked to waste management policies and programs across the jurisdictions that were investigated. Research on Japan, for example, suggests that quantifying GHG impacts from waste management and circular economy efforts is not a high-priority at the moment under the current government.

### European Union

In Europe, while climate action and GHG emission reduction efforts are a relatively high priority, less efforts have been put toward quantifying the GHG reduction impacts of waste management and circular economy related policies and programs, with the exception of a few leading countries including Germany, Denmark, and the U.K. / Scotland.

That being said, the European Commission estimates that waste prevention, eco-design, re-use, and similar measures could bring net savings of €600 billion (CAD \$853 billion), or 8% of annual turnover, for businesses, while reducing total annual GHG emissions by 2%-4%.<sup>76</sup> The EU's Circular Economy Package alone is estimated to potentially deliver a reduction of 600 million tonnes of CO<sub>2</sub>e between 2015 and 2035.<sup>77</sup>

<sup>74</sup> See: <http://www.zerowastescotland.org.uk/content/going-growth-remanufacture>

<sup>75</sup> See: [http://www.zerowastescotland.org.uk/sites/default/files/ZWS645%20Beer%20Whisky%20Fish%20Report\\_0.pdf](http://www.zerowastescotland.org.uk/sites/default/files/ZWS645%20Beer%20Whisky%20Fish%20Report_0.pdf)

<sup>76</sup> See: [http://europa.eu/rapid/press-release\\_MEMO-15-6204\\_en.htm](http://europa.eu/rapid/press-release_MEMO-15-6204_en.htm)

<sup>77</sup> See: <http://www.europarl.europa.eu/legislative-train/pdfs/legislative-train-schedule-theme-new-boost-for-jobs-growth-and-investment-06-2016.pdf>

A shift from recycling to refurbishing light commercial vehicles, where collection rates are already high, could save material inputs by €6.4 billion (CAD \$9.1 billion) per year (about 15% of material budget) and €140 million (CAD \$199 million) in energy costs, reducing GHG emissions by 6.3 million tonnes of CO<sub>2</sub>e.

At the country level, Germany has seen GHG emissions from the waste sector fall approximately 72% between 1990 and 2015.<sup>78</sup> In England, between 2010 and 2015, WRAP's food waste reduction initiatives are estimated to have reduced GHG emissions by nearly 50 million tonnes.<sup>79</sup>

In Denmark, food waste was reduced by 25% between 2010 and 2016. At current food waste levels of 720,000 tonnes per year, it can be assumed that a total of 5 million tonnes of food waste has been avoided. General calculations indicate that 1 tonne of food waste may generate 1.9 tonnes of CO<sub>2</sub>e emissions if not composted, digested, or incinerated. As such, it is estimated that food waste reductions have avoided 9.5 million tonnes of CO<sub>2</sub>e emissions. Going beyond organics, the Ellen MacArthur Foundation has estimated that by 2035, Denmark could reduce its carbon footprint by 3%-7%<sup>80</sup> through a focus on the ten areas and five sectors outlined in their Policy Toolkit document.

### Scotland

Scotland stands apart from other jurisdictions by placing a heavy emphasis on measuring and evaluating the success of circular economy programs according to reductions in GHG emissions. This approach covers the entire economy and takes a holistic view, rather than only focusing on downstream (waste) or upstream (manufacturing) operations.

The pillar of this approach is Scotland's Carbon Metric tool, introduced in 2011 by the Scottish Government's Department for Environment, Food, and Rural Affairs. The Carbon Metric is the first of its kind, and quantifies the carbon impact of a more circular economy by measuring the carbon impact of various waste materials rather than by weight alone (since GHG emissions vary by material). As an example, the reduction in household food waste between 2009 and 2014 in Scotland resulted in 140,000 tonnes of CO<sub>2</sub>e reduced.

Looking forward, Scotland's zero-waste targets are expected to reduce GHG emissions by almost 40 million tonnes of CO<sub>2</sub>e (MtCO<sub>2</sub>e) between 2015 and 2025. The carbon impacts of Scotland's new Circular Economy Strategy, which modelled data from the Carbon Metric tool using a territorial accounting approach, found that a more circular economy could reduce territorial emissions by 11 MtCO<sub>2</sub>e per year by 2050 when compared to the business as usual scenario, and 21 MtCO<sub>2</sub>e less than the 2012 baseline. Under consumption accounting, savings would be 57.7 MtCO<sub>2</sub>e and 1.2 MtCO<sub>2</sub>e respectively. The strategy is anticipated to deliver annual waste carbon savings of 26% (3.3 MtCO<sub>2</sub>e) in 2025 based on a 2011 baseline of 13.9 MtCO<sub>2</sub>e.

Scotland is currently studying the next phase for the Carbon Metric tool and want it to become the foundation of the country's economic strategy—the tool is currently being integrated into the Scottish Government's Climate Action Strategy to help meet its climate targets.

<sup>78</sup> Source: UBA-Emissionsdaten

<sup>79</sup> See: <http://www.wrap.org.uk/>

<sup>80</sup> Carbon footprint is measured as the change in global carbon dioxide emissions divided by 'business as usual' Denmark carbon emissions. A carbon dioxide emission reduction of 3%-7% based on Denmark's carbon footprint in 2014 for example would equal a reduction of between 1.22 MtCO<sub>2</sub>e and 2.84 MtCO<sub>2</sub>e.

## Measurement Frameworks & Indicators

Measuring the impacts from circular economy and waste management initiatives requires the establishment of consistent definitions and frameworks, relevant indicators, and good data. In terms of definitions, the UNEP IRP distinguishes different ways in which the term “resource efficiency” is used, and provides the following definitions. These definitions are consistent with the definitions used by the OECD.<sup>81</sup>

- **Resource productivity:** the amount of economic output per unit of resource input. Resource productivity may also be expressed as material or energy productivity. The calculation of resource productivity combines an output expressed in monetary terms and resource input measured in physical terms. It is analogous to the concept of labour productivity.
- **Resource intensity:** the inverse of resource productivity. It measures the amount of resources required to produce a unit of output.

The EU as a region and a number of countries globally have been working on elements of monitoring frameworks, as well as indicators across multiple levels to help facilitate policy development, measure environmental performance and policy effectiveness, and benchmark countries, products / sectors, and programs, in order to improve investments and decision-making.

Dozens of indicators have been developed across categories that include material flow accounting, waste reduction, energy and carbon, water and land use, and economic indicators (see Figure 12).

Indicator Category	Sample Indicators
<b>Material Flow Accounting</b>	Resource Productivity (GDP/DMC) Direct Material Consumption (DMC) Direct Material Input (DMI) Domestic Extraction Raw Material Consumption (RMC)
<b>Waste Generation &amp; Reduction</b>	Source Segregation (% of waste or tonnes) Waste Generation (tonnes) Waste Collected (tonnes) Waste Recycled / Treated (% of waste or tonnes) Waste Diversion (% of waste or tonnes) Waste Landfilled / Disposed (% of waste or tonnes) Waste (tonnes) per capita
<b>Energy &amp; Carbon</b>	Energy from Waste (BTU / kWh, mWh) Energy Consumption Energy Efficiency Use of Renewables GHG Emissions
<b>Water &amp; Land Use</b>	Water Intensity Water Use / Supply & Recovery Land Use Value of Ecosystem Services
<b>Economic</b>	Gross Domestic Product (GDP) Job Creation

Source: The Delphi Group

Figure 12: Indicators used to measure circular economy and waste management activities.

<sup>81</sup> Source: <http://www.oecd.org/environment/waste/policy-guidance-on-resource-efficiency-9789264257344-en.htm>

The Ellen MacArthur Foundation has also established a unique indicator-based tool to measure how effective a company and/or its products are in making the transition from linear to more circular models.<sup>82</sup> The developed indices consist of a main indicator, the “Material Circularity Indicator”, measuring how restorative the material flows of a product or company are, and “complementary indicators” that allow additional impacts and risks to be taken into account.

Examples for complementary risk indicators include material price variation, material supply chain risks, material scarcity, and toxicity. Complementary impact indicators can include, for example, energy usage and CO<sub>2</sub> emissions. The indicators can be used as a decision-making tool for designers, but can also be used for other purposes such as internal reporting, procurement decisions, and the rating or evaluation of companies.

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<sup>82</sup> See: <https://www.ellenmacarthurfoundation.org/programmes/insight/circularity-indicators>

## 5. ADDRESSING BARRIERS & CHALLENGES

This chapter identifies a number of the key market / economic, technical, and governance barriers and challenges that were identified by the leading circular economy jurisdictions as part of this research. In some cases, the challenges are shared amongst multiple jurisdictions while, in others, they are unique to the individual markets. Potential solutions and enablers are also identified and examples are provided for reference to where special efforts have been made to address and overcome the challenges.

### Market / Economic Issues

#### Market Challenge #1: Market & economic viability

**Overview:** The circular economy can be held back by a lack of commercially viable technology and, at times, distorted by subsidies on downstream options that can create barriers to solutions or options further upstream. Although a technological solution may be confirmed as a sustainable treatment solution, some jurisdictions have experienced challenges in terms of market readiness and related economic barriers. This can mean a lack of feedstock on the supply side, a lack of enabling infrastructure, a lack of enforced regulatory drivers and/or economic instruments in place, or a lack of end-product competitiveness.

#### **Solutions / Enablers:**

- A phased planning approach to materials management should be undertaken.
- While planning for circular economy infrastructure development, it is key that material flows are first modelled to take into account the current market and feedstock quality and availability, as well as the potential impact of planned regulations, taxes and tariffs, the impact of planned education and awareness programs for source segregation and, most importantly, the market viability of the end-product versus competition.
- It is also imperative that regulations include the appropriate governance and enforcement mechanisms to further drive markets.
- Accordingly, government can consider the economic, social, and environmental value of subsidization and other incentives.

#### **Examples:**

- In Japan, more than 100 biogas plants have been deployed due to subsidization by the Ministry of Agriculture. For the most part, plants are not economical on their own and are facing additional challenges since the price of oil has declined.
- In Germany and the Netherlands, biomass is a large market, however, the emphasis on some waste-to-energy technologies is not economically sustainable because biomass is not competitive with wind and solar, even though the government is providing grants and subsidies to support.
- There is currently a push from government to reduce subsidies on biomass waste-to-energy facilities, although some still view it as a critical technology alternative to coal in terms of its GHG emission reduction potential.

## Market Challenge #2: Lack of market demand for recycled products / materials

**Overview:** Many industries have been historically focused on down-cycling and disposal and have yet to create the take-back programs or account for the re-integration of recycled materials in the design and remanufacturing stages of their products. There is also often non-alignment between actors within and across value chains (e.g., between producers and recyclers) to improve cross-cycle and cross-sector performance.

For example, in the construction industry, companies have focused on demolition and disposal of construction materials; significant re-alignment is required in order to recognize the embedded value contained within 'waste' materials. It is also important to stimulate the market demand for some of these materials. For example, if reclaimed wood is not high enough in quality, then there is little economic incentive to recycle it compared to incineration.

The food industry differs in many respects from other 'waste' sectors. It is the only sector whose resources (food) to a great extent 'disappear' (or whose properties are changed) when it is consumed (eaten), which means there is no extended user phase. This presents different challenges for resource efficiency and recycling efforts. The fact that low prices are still the main consideration for consumers is believed to be one of the main reasons that so much food is thrown away and wasted.

With respect to electronics recycling, reuse, and repair, the current model in most countries (with the exception of Japan) does not return recovered materials to the OEM. In addition, for many electronics the idea of 'planned obsolescence' to stimulate the purchase of new products creates additional marketing related issues.

In addition, consumer perceptions can impact on the demand for products. Challenges include consumer reluctance around purchasing food past the 'best before' date, purchasing textiles and clothing with high or total recycled material content, and generally embracing the circular use of materials, nutrients, and resources without perceiving the goods and services as sub-standard or tainted.

### **Solutions / Enablers:**

- Many recognize that programs are in the early days with respect to influencing consumer choices around circular economy concepts. Education and growing awareness levels within industry and consumers for the environmental and social benefits of recycled products can have positive results. This could include better product labeling programs (e.g., food expiry dates) for sustainable consumption of products and material resources.
- Market forces that favour one product or material over another might trigger material innovation and substitution of products or material inputs to industry. Procurement practices favouring green or recycled products can help to drive this market. The shift to more 'service-based' approaches can also support the movement away from product ownership to more collaborative consumption or 'sharing economy' efforts.
- Mechanisms are needed in many cases to grow the commercial opportunities for resource-efficient products and create markets. These could include financial mechanisms to incentivize innovation, production, distribution, and consumption of such products.
- Another option is legislation for a more favourable competitive climate (for example, requirements and taxes on imported food versus domestic food) or to enable the production and distribution of recycled or re-used resources (e.g., through EPR programs).

### **Examples:**

- Zero Waste Scotland has identified insufficient demand for some outputs, such as low-grade textiles and digestates, as a key issue and has been working with industry and consumers to try and improve the quality of sorting and collection streams.

- In Japan, the connection with upstream components remains weak – despite the separation and processing of recycled materials, there is a lack of market demand for these materials to get them back into the waste stream. Between 2007-2011 when commodity prices were high for nickel, chrome, platinum, and oil, companies had a better business case for recycling. However, since commodity prices have fallen, it is harder to develop this business case and has resulted in a down-scaling of recycled / repurposed materials.
- In Finland, Sitra has developed a new focus area to support consumer uptake and growing market demand called Resource Wise Citizen.
- In Sweden and Flanders, VAT tax rebates have been developed to incentivize the repair industry and create jobs, targeting a range of consumer products from bicycles to kitchen appliances.
- In Denmark and Japan, green public procurement efforts have been resulting in positive impacts for growing the market demand and competitiveness of circular economy related and recycled products.
- France has developed a law to combat “planned obsolescence” for appliances.<sup>83</sup>

### Market Challenge #3: Focus on downstream solutions & waste-to-energy

**Overview:** Capital investments in recycling and incineration-based infrastructure, as well as district energy / CHP systems (particularly in the Nordic countries), is making it a challenge for many jurisdictions to move away from policies that favour waste-to-energy and other downstream solutions to investments in recycling programs, sorting infrastructure, waste prevention, and upstream options. Sorting and recycling technology providers are often left looking internationally for export opportunities and to undertake business development.

In terms of the circular economy and organics / food waste management, leading jurisdictions recognize the order of priority should be material recycling and value-add product development (e.g., to produce animal feed and fertilizers) before waste-to-energy treatment options (i.e., incineration, biogas production, etc.). However, in many countries, this is not the order of priority at the moment.<sup>84</sup>

In some countries (e.g., Germany, Sweden, and Denmark), there is more infrastructure capacity than waste, which is resulting in the import of waste streams from other parts of Europe to fuel the infrastructure. From an environmental and GHG reduction perspective, however, this practice may be encouraging other countries to not deal with their waste management issues domestically.

The actual ‘definition’ of waste is part of the issue. Once a resource stream is defined as ‘waste’, then it is collected under the responsibility of the municipal waste authority who has control. Because the municipality will often source revenues from the incineration and/or import of waste, it can be a challenge to move away from this model.

#### **Solutions / Enablers:**

- Phasing out of landfilling and incineration; the elimination of resources must be limited to only the necessary minimum (e.g., toxic waste, non-recyclables).
- Countries with invested infrastructure are exploring waste incineration taxes to try and limit the amount of waste going to energy treatment options in favour of more upstream priorities.
- Policies are shifting at the EU level toward more value add products, waste prevention efforts, and on eco-design.
- Efforts are also currently concentrated on the definition of waste to re-categorize the resource streams into various value components, although it remains a challenge to find the optimal solution.

<sup>83</sup> See: <http://www.sgs.com/en/news/2015/07/built-to-last-a-law-in-france-to-combat-planned-obsolescence-for-appliances>

<sup>84</sup> See: <http://resource.co/article/european-commission-warns-incineration-could-hamper-circular-economy-11632>



**Examples:**

- In Japan in the late 1990s, the federal government enacted various recycling laws and brought in measures such as taxes to address concerns about declining landfill space. The Food Waste Recycling Law for example resulted in a fair amount of investment by federal government into research and technology related to anaerobic digestion and fermentation for biogas. Today, despite having strong educational campaigns by federal government, a fair amount of organic waste still enters the system; potentially due to the collection systems working so well (i.e., it is too easy to send organics to the incineration plant which is out of town and people not overly aware or concerned about it). In addition, most companies and local governments are focused on the biogas / fermentation efforts due to the subsidization.
- In Germany, while the National Raw Material Strategy and the National Research Strategy BioEconomy 2030 highlight the recycling of secondary raw materials, overall Germany's circular economy plans emphasize energy from waste solutions. However, Germany's mature energy from waste industry is expected to become a less viable option as the government seeks to further develop and pressure upstream circular economy, resource efficiency, and waste prevention policies and programs.
- In Sweden, the 290 municipalities have full responsibility for household waste. Politicians in some municipalities have to decide on recycling schemes although conflicts of interest can arise when they also sit on the boards of the local waste authorities which favour incineration due to the local revenues generated. Sweden currently has a government committee working on analysis of waste incineration and the possibility to introduce the incineration tax.<sup>85</sup> The committee is due to give its report in June 2017.
- In Denmark, all 97 of the country's municipalities have made significant capital investments into district waste-to-energy incineration plants which rely on municipal waste as a feedstock. The plants supply roughly 20% of the nation's district heating and 5% of its electricity. To address the issue, the Danish government has imposed a moratorium on construction of any new incineration plants.
- Norway introduced an incineration tax, but dropped it after 11 years in 2010 as waste flowed over the border into Sweden, where it could be processed cheaply due to the lack energy recovery taxes. Finland is also exploring a tax on waste incineration because of concerns over high levels.
- In the U.K. in 18 months ending March 2015, over £160 million (CAD \$263 million) of taxpayers' money was invested into waste-to-energy generating plants. Current government subsidies make it cheaper for business to convert food waste to energy or soil. In contrast, no subsidies exist to promote the redistribution of edible food therefore much of it is being diverted to energy plants. The UK Parliament has been considering legislative action to address this issue as a "food waste crisis".<sup>86</sup>

<sup>85</sup> See: <http://www.endswasteandbioenergy.com/article/1397473/sweden-considers-waste-incineration-tax>

<sup>86</sup> See: <http://www.independent.co.uk/news/uk/home-news/food-waste-ban-government-efra-real-junk-food-project-wrap-inquiry-a7319141.html>

## Technical Issues

### Technical Challenge #1: Lack of source separation resulting in feedstock contamination

**Overview:** A great deal of waste streams (including organics) are not being effectively separated and collected at their sources of origin. As a result, issues exist with contamination, making it a challenge to effectively extract the value out of various waste streams and cost effectively recycle and repurpose them back into their material loops. For example, bio-waste (i.e., organics) is recognized as a key area for development with respect to driving the bio-economy and related solutions (from energy to chemicals), however, source separation is key for quality processing.

#### **Solutions / Enablers:**

- Agencies are working towards understanding the amount of materials in residual waste and planning to develop further policies to drive better source segregation.
- With landfill bans in place, a focus on well-functioning separation (with the appropriate number of recycling bins), collection infrastructure and take-back systems are key.
- Source segregation education and awareness programs are also key for residents and businesses alike.
- Such segregation programs can ensure cleaner material for processing facilities and end markets.

#### **Examples:**

- In implementing Waste Scotland Regulations on Organics (2014), the biggest issue for operators was the contamination of feedstocks. The U.K.'s WRAP program and Zero Waste Scotland have been investing in better separation infrastructure to support these efforts.
- In the Netherlands, significant efforts are being made to focus on the separation of organics and food waste streams to support its bio-economy strategy.
- In Germany, to ensure clean material, segregation at source is done in four different bins in front of every house: paper waste, organic waste (kitchen and yard waste), packaging and plastics (recyclable materials), and residual waste (everything else that is not fitting in one of the other bins, like sanitary waste, rubber, etc.). Germany's segregation rate reached a level of 50% to 70% over the last 30 years and is one of the key drivers of resource efficiency.<sup>87</sup>

### Technical Challenge #2: Lack of measurement frameworks & effective indicators

**Overview:** There is recognition across most leading jurisdictions for the need to develop better measurement frameworks and indicators, especially on material loops that consider remanufacturing, repair, reuse, and the sharing economy. Most countries lack the governance and metrics required to measure progress towards the targets that have been set. While measuring DMC is relatively standard across Europe for example, there is interest in looking at raw material consumption.

With respect to measuring the economic impacts, many recognize the challenges of linking broader circular economy efforts to employment gains and losses. The EU has been exploring this area for the last two years but continues to struggle with what data to measure and track.

<sup>87</sup> See: <https://grasshopperfiles.wordpress.com/2015/04/30/segregation-at-source-in-germany/>

**Solutions / Enablers:**

- There are currently plans being developed to better monitor and measure performance across the EU, as well as in most of the leading countries that were investigated – particularly on better indicators, data collection, and data comparability to allow benchmarking and the sharing of information and best practices across jurisdictions.
- Club of Rome has done some work on measuring employment impacts; however, it is difficult to figure out net job effects because some sectors benefit while others are negatively impacted.
- The OECD is currently working on new macro-economic modeling that will improve current tools for measuring the economic and employment impacts of the circular economy – results are expected in the next 12 months.
- There is also a growing interest with skill sets and transferability, for example, in the area of remanufacturing.

**Examples:**

- In Germany, metrics have been emphasized in earlier plans, particularly the National Biomass Action Plan and the Action Plan for the Industrial Use of Biomass, but a lack of indicators for actually achieving the targets outlined in the Resource Efficiency (ProgRes) and Sustainable Consumption programs, as examples, are creating challenges to actually realizing progress.
- In Denmark, pilot projects are being explored to investigate better ways to measure raw material consumption.

## Governance Issues

### Governance Challenge #1: Lack of cross-government coordination

**Overview:** Advancing a more circular economy requires a transitional approach to the business as usual, engaging within government (across ministries) and with other levels of government (regional, municipal, etc.). A key challenge often experienced by jurisdictions is a lack of integration or alignment between various and sometimes competing strategies, policies, and programs. Municipalities acting independently is also a challenge to the achievement of a more circular economy, particularly as they are often more directly involved with the waste management service providers and often act as the waste management authorities.

**Solutions / Enablers:**

- A systemic approach to policy making is key, involving multiple ministries (economic development, finance, environment, innovation, agriculture, labour etc.).
- Engaging collaboratively with other levels of government to explore the synergies and roles / responsibilities of holistic and strategic policy making can maximize the benefits and opportunities.

**Examples:**

- In Germany, although there are a variety of circular economy related plans and initiatives in place, the efforts have been developed with minimal coordination amongst other government departments outside of the Federal Ministry for the Environment, which has created some challenges around program implementation and lessened the potential for maximizing spin-off benefits. Currently, the Wuppertal Institute has been engaged to address the integration issue in order to deliver multi-departmental planning.

- In Denmark, there are 98 municipalities and all have different systems for municipal waste management, resulting in ongoing challenges around streamlining, particularly for household waste. The national authority requires that a waste management scheme exists, but does not mandate how to design or implement the scheme. This has created many different schemes, which causes challenges for better quality sorting and recycling since it's not standardized. It has also made the implementation of a single, trans-municipal waste management strategy highly challenging in Denmark.
- In Japan, the utilization of upstream materials and upcycling / remanufacturing belongs to Ministry of Economics, Trade, and Industry (METI) while collection, separation, and incineration resides within the purview of the Ministry of Environment; there is a lack of coordinated procedures at present to connect the resources and materials to the upstream / demand side – this is an important area that Japan is looking to address going forward.

## Governance Challenge #2: Unintended barriers & consequences during the policy transition

**Overview:** Existing policies and their lack of alignment can often result in barriers to adopting more circular economy approaches. Making changes to regulations to remove these barriers and create better alignment can be very time and resource intensive. In addition, the adoption of new policies can have unintended consequences across the sector or impact on results such as recycling and diversion rates in ways that were not anticipated.

### **Solutions / Enablers:**

- A systemic approach to policy making is key, integration resource concerns in all levels of themes of policy interventions.

### **Examples:**

- In Denmark, the federal government has acknowledged that the existing regulatory framework imposes barriers to green business models and circular material flows. Stakeholder engagement and cross-government efforts are helping to identify existing barriers and address them as part of efforts implement new policies and streamline regulations in areas such as green public procurement and material / resource separation.
- In Japan, the Specified Home Appliance Recycling Law (SHAR) when it was enacted in 1998 produced unintended consequences such as illegal dumping. Recycling regulations since then have sought to avoid the SHAR experience by imposing a front-end fee structure for recycling.

**Governance Challenge #3: Shifting political priorities & internal conflicts**

**Overview:** Policies and programs are often subject to shifting political priorities and conflicting support from industry (i.e., lobbying against change) if the opportunities and benefits are not equally shared. This in turn can create challenges around the development of both new policies as well as the continuity of existing programs, impacting on longer-term, strategic efforts to advance a more circular economy and engage with the private sector.

**Solutions / Enablers:**

- Leading jurisdictions have found it important to clearly identify and communicate the benefits and opportunities of the circular economy and related policies / programs from various perspectives by working collaboratively with all stakeholders whenever possible.
- A broader stakeholder engagement across public, private, and civic stakeholders is key to overcoming barriers and driving new policies.

**Examples:**

- In Denmark, the Green Business Fund which existed from 2013-2015 and supported a number of circular economy related programs, including Denmark's industrial symbiosis and green business model transition program for SMEs was cancelled by the current federal government because it has a different focus and involvement with businesses (i.e., they are more focused on regulation and not direct investment).
- In Japan, political support for taking aggressive climate action and linking it to waste management efforts has been low since the 2011 tsunami in and the closing of nuclear power plants has created internal conflict / push back around the country's low-carbon strategy. The current opinion of business and government is less supportive of GHG emission reductions as a key driver to invest in waste reduction.
- In Germany, the Ministry of Economics is resistant to some circular economy approaches, actively blocking regulations to drive more mandatory resource efficiency in order to protect producers (e.g., with respect to car component recycling).

## 6. KEY CONSIDERATIONS

The research undertaken as part of this jurisdictional scan for circular economy shows that global leaders, particularly countries in Europe and a smaller number from Asia, are embracing circular economy as both a major environmental and economic opportunity. Key considerations and best practices being applied by leading jurisdictions as it relates to developing a waste-to-resources strategy and supporting the broader transition to a more circular economy are summarized below, including a particular emphasis on using circular economy to reduce GHG emissions.

### 1. Cross-government, multi-stakeholder collaboration

#### *Shifting to systems-based thinking*

The circular economy is not a continuation of the take-make-dispose model but rather is allowing for policy innovation that requires new regulations, incentives, and policy instruments be applied across the entire economy in order to shift the market. It requires different thinking and can be disruptive to some industry sectors and conventional waste management approaches.

Given the systems-based thinking required to be most effective, circular economy leaders are adopting an integrated approach that involves cross-government (multiple ministries) and multi-stakeholder cooperation and collaboration. Integration between policy levels and policy domains, as well as within and across value chains, is proving essential.

#### *Resource-efficiency across sectors*

In order to drive policy, leading governments have implemented tighter regulations, robust economic instruments, and provided supporting funding with a key objective to drive resource efficiency, innovation, and behavioural changes. This, in turn, is expected to drive sustainable production and consumption across the economy.

Material resource efficiency and waste management are increasingly viewed as closely related topics, indicating an opportunity to address both themes together, through for example, the recovery of secondary materials. Important considerations include the identification and analysis of resource flows by material stream and by industry sector, with efforts targeting the identification of synergies across industries (i.e., waste-to-resource models such as industrial symbiosis).

#### *Circular economy as an economic policy challenge*

The economic impact and related net benefits from the adoption of circular economy efforts (in terms of job creation and new investments) is potentially significant. As a result, in many leading countries, circular economy policies and frameworks are being led from a strategic perspective by the ministries of innovation, business, and/or economic development in combination with those in government focused on environmental and resource management mandates.

Resource productivity strategies have been undertaken by jurisdictions such as Germany in order to drive economic growth and employment. Circular economy and resource productivity strategies help achieve efficiency gains and secure adequate supplies of material resources to the economy, while at the same time limiting the adverse environmental impacts associated with their extraction, processing, use, and disposal.<sup>88</sup>

<sup>88</sup> Source: <http://www.oecd.org/environment/indicators-modelling-outlooks/MFA-Guide.pdf>

As per the OECD's Policy Guidance on Resource Efficiency produced for G7 Leaders, resource efficiency and circular economy should be treated as an economic policy challenge and integrated into cross-cutting and sectoral policies that consider innovation, investments in infrastructure, and education and vocational training.<sup>89</sup> Mixes of policy instruments should be applied so as to provide a coherent set of incentives for resource efficiency along the product value chain.

## 2. Focusing on upstream & waste prevention efforts

### *From waste policy to design and consumption policies*

Achieving a circular economy will require a transition that will not happen overnight as there is a need for new infrastructure, regulatory approaches, and behavioural shifts. Creating a circular economy requires fundamental changes throughout the value chain, from product design and technology to new ways of preserving natural resources (extending product lifetimes), by turning waste into resources (through improved recycling processes), encouraging new modes of consumer behaviour and norms, incenting new business and financing models, and providing the supportive education / training programs.

Waste policy is becoming more about design and consumption policies, with a heavier focus on upstream components, an emphasis on fewer raw resource inputs, waste prevention, and on closing material loops. Eco-design is becoming a baseline for driving circular economy and the creation of products that last longer, are more efficient, are made for disassembly and remanufacturing, and increasingly focused on service delivery rather than on traditional "product ownership" models.

### *Regulations to drive resource efficiency*

Regulatory approaches (e.g., landfill bans, waste taxes, phasing out of toxic substances from material cycles, etc.) have also proven important for supporting the transition to more circular approaches in countries such as Germany, Denmark, Sweden, and the Netherlands. Producer responsibility and tighter regulations in this regard are being applied in places such as Ontario in order to help meet both environmental and social objectives.

### *Driving markets with economic instruments*

Programs that act as market drivers and grow the demand for a broad range of recycled products and their components are key to driving circular economies. Economic instruments and market mechanisms include policies and programs such as green public procurement, incentives that encourage upstream industries such as repair and remanufacturing (e.g., tax breaks and subsidies in Sweden), and innovation funds and grants (e.g., the Circular Economy Fund in Scotland, the Green Transition Fund in Denmark, and Sitra in Finland) that can support industry and SMEs with the development of green and circular economy business models, R&D efforts and the development of high-value products using repurposed materials, and GHG emission reduction efforts and the elimination of organic / food waste.

### *Education and awareness campaigns*

Education, awareness, and capabilities campaigns that drive behavioural change are essential, targeting both consumers and industry to change consumption and production patterns. Awareness programs seek to influence a range of behaviours and are designed to target waste prevention, drive resource efficiency, and recover value across product life cycles.

<sup>89</sup> Source: OECD Policy Guidance on Resource Efficiency (June 2015): <http://www.oecd.org/environment/waste/policy-guidance-on-resource-efficiency-9789264257344-en.htm>



For residents, awareness campaigns are focused on waste prevention and source segregation while awareness campaigns for businesses are increasingly focused on the opportunities, particularly with respect to innovation in products, processes, and service design. Awareness and capability development efforts to drive circular economy related innovation amongst the private sector is most notable in Scotland, Denmark, and Finland.

### *Focus on food life cycle efficiency*

Given that up to one-third of all food produced in the world ends up as waste, it is key that both policies and regulations strongly encourage resource efficiency across food life cycles in order to limit both waste and GHG emissions. Some suggest that up to 0.2 billion CO<sub>2</sub>e can be saved through food resource efficiency measures.<sup>90</sup> A key step towards climate change mitigation can be undertaken by implementing prevention measures to reduce the amount of food that is wasted at various stages in the supply chain—in agriculture, transport, storage, and consumption.

Better infrastructure to support improved material segregation and collection (i.e., reverse supply chains) is allowing for cleaner materials and new products and services, with an engaged private sector active with innovative business models and targeting new market opportunities. Leading countries are now focusing their attention to higher-value uses for residual biomass than incineration for energy purposes; prioritizing waste avoidance and reuse further upstream within the organics and food value chain (e.g., value-added products within the bio-economy).

## **3. Establishing robust measurement, monitoring & enforcement frameworks**

### *Measurable targets with consistent indicators and data collection*

Circular economy leaders are increasingly adopting an integrated approach with measurable targets and good data collected across consistent and useful indicators. The measurement of material flows and resource productivity positions governments to set baselines and action plans to drive circular economy policies. Progress towards these targets complement other climate change related initiatives with respect to energy, water, and land usage.

### *Integrating climate action and circular economy approaches*

Some of the most progressive jurisdictions (e.g., Scotland) are approaching circular economy as a combined economic and climate change strategy. In Germany, some have suggested that addressing GHG emission reductions through circular economy approaches could actually be more effective at fighting climate change than GHG and renewable energy / energy efficiency related policies and initiatives in isolation. These jurisdictions are demonstrating that an integrated “Climate Action Plan” and “Circular Economy Strategy” are very much complementary.

Promoting actions across key sectors including construction and buildings, energy / transportation, textiles, and organics / food are resulting in the greatest impacts from resource productivity, waste diversion, and GHG emission reduction perspectives. The Ellen MacArthur Foundation Policy Toolkit has been designed specifically to help support regions and/or government agencies in the selection of the most impactful sectors, helping to quantify benefits within these sectors and identify existing policy barriers.<sup>91</sup>

<sup>90</sup> See: <https://www.theguardian.com/environment/2015/feb/26/world-leaders-urged-to-tackle-food-waste-to-save-billions-and-cut-emissions>

<sup>91</sup> EMF Policy toolkit: <https://www.ellenmacarthurfoundation.org/publications/delivering-the-circular-economy-a-toolkit-for-policy-makers>

### *Maximizing GHG emission reductions through modeled pathways*

A select number of leading jurisdictions are collecting and analyzing data on the GHG emission reduction potential from various waste management activities and related technologies. Scotland's Carbon Metric for example has been helpful with efforts to quantify and measure the potential GHG emission reduction impacts from circular economy and waste management policies and programs in that country.

In addition, the OECD has assessed the role of municipal solid waste (MSW) management practices and technologies on GHG emissions and their potential reduction impacts.<sup>92</sup> OECD's modeling showed that recycling and source reduction provide the highest reduction in GHG emissions per metric tonne of MSW diverted.

### *Adopting strong compliance mechanisms and enforcement*

Finally, monitoring compliance and enforcing regulations (i.e., through fines, penalties, etc.) are ways that leading jurisdictions are backing up their policy targets to improve the chances for achieving successful outcomes. Ontario's new Resource Productivity and Recovery Authority is a good example of an organization recently launched to ensure circular economy best practice policies and programs are implemented effectively. This, in turn, is requiring adequate government funding, resources, and personnel to drive enforcement and compliance activities.

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<sup>92</sup> Source: <http://www.oecd.org/env/waste/50034735.pdf>

# APPENDICES

## Appendix A: List of Organizations Consulted

The following companies, government agencies, and industry organizations provided important resources, insights, and/or data to support this research.

- **Danish Business Authority**
- **Danish Environmental Protection Agency**
- **Danish Ministry of Environment and Food**
- **Finnish Ministry of the Environment**
- **Sitra (Finland)**
- **Germany Federal Environmental Protection Agency**
- **The Wuppertal Institute for Climate, Environment, and Energy (Germany)**
- **National Institute for Environmental Science (Japan)**
- **Dutch DNA Biotech**
- **Ontario Ministry of Environment and Climate Change**
- **Ontario Resource Productivity and Recovery Authority (RPRA)**
- **The Ellen MacArthur Foundation**
- **Organisation for Economic Cooperation and Development (OECD)**
- **European Environment Agency (Belgium)**
- **VITO NV (Belgium)**
- **BlindSpot Think Tank (United Kingdom)**
- **Zero Waste Scotland**
- **Avfall Sverige (Sweden)**
- **Swedish Environmental Protection Agency**
- **Swedish Ministry of Environment**

## Appendix B: Food Waste Reduction Programs in the EU

Country	Initiative	Policy / Regulation / Program	Description
<b>Austria</b>	Food is Precious <sup>93</sup>	Awareness building program	<p>A general awareness raising campaign run by the Ministry of Agriculture, Forestry, Environment and Water about the issue of food waste and what various stakeholders can do to prevent it. The aim was for a 20% reduction by the end of 2016.</p> <p>The Ministry reports that up to 157K tonnes of food waste is lost each year worth up to €300 (\$420 CAD) per household.</p> <p>United Against Waste<sup>94</sup> is a foodservice sector initiative (under the Food is Precious program) also aimed at raising awareness of food waste and identifying potential cost savings</p>
<b>Denmark</b>	<p>Stop Food Waste<sup>95</sup></p> <p>ReFood Label<sup>96</sup></p> <p>Charter on Less Food Waste<sup>97</sup></p>	<p>Program</p> <p>Industry best practice</p> <p>Voluntary agreement</p>	<p>The Stop Food Waste project has since 2010 resulted in nation-wide reduction of food waste of 25% to 2016 valued at over €59M (\$83M CAD). It is a nation-wide movement headed by popular television and chef personality Seline Juul<sup>98</sup></p> <p>The ReFood label is a “seal of approval” campaign that awards recognition and official designation to foodservice operators taking significant strides on food waste prevention</p> <p>Including the Danish Ministry of the Environment, the CLFW had 19 signatories representing large corporations including foodservice operators of all sizes, grocery chains, franchises, hotels, and more</p>

<sup>93</sup> Source: <https://www.bmlfuw.gv.at/english/agriculture/food/Foodisprecious.html>

<sup>94</sup> Source: <https://united-against-waste.at/>

<sup>95</sup> Source: <http://www.stopspildafmad.dk/inenglish.html>

<sup>96</sup> Source: <http://www.refood.dk/en/rfdk/services/label/>

<sup>97</sup> Source: <http://www.stopspildafmad.dk/inenglish.html>

<sup>98</sup> Source: <http://www.selinajuul.com/>

<b>Finland</b>	Program to Promote Sustainable Consumption and Production - Save the Food	Pilot Project Program	<p>Climate Lunch<sup>99</sup>: a low-as-possible CO2 impact meal in served in public canteens (Mealess Mondays, only local/seasonal produce, sustainably procured)</p> <p>Lunchie<sup>100</sup> and ResQClub<sup>101</sup> mobile apps created as a result of the Save the Food that connect consumers to food service operators with high potential for leftovers (buffets, institutional kitchens) sold at discount prices after peak meal service</p> <p>License to Eat<sup>102</sup>: a lunchtime event serving 6,000 lunches made from ingredients of rescued food from markets and grocery stores prepared by chefs and culinary students</p>
<b>Germany</b>	<p>Research &amp; Development</p> <p>Think.Eat.Save</p>	<p>German Ministry of Food &amp; Agriculture</p> <p>European Initiative</p>	<p>Article<sup>103</sup> outlining the German government's research on smart packaging, best before dates, and supermarket food disposal bans</p> <p>Germany participates in the Europe-wide Think.Eat.Save<sup>104</sup> campaign of the Safe Food Initiative, a partnership between UNEP, FAO and Messe Dusseldorf.</p> <p>One of the projects that came out of the TES program was Foodsharing<sup>105</sup> a food rescue and re-distribution operation in Germany, the United States, and Switzerland.</p>
<b>Ireland</b>	Reduce Food Waste <sup>106</sup>	Awareness Building Program	<p>RFW is an awareness and enabling initiative funded under the EPA National Waste Prevention Program aimed at reducing or eliminating fees and taxes incurred from waste handling, removal, and treatment. RFW is also a step-wise program for households to identify behaviour changes to reduce food waste and increase savings.</p> <p>Less Food Waste, More Profit<sup>107</sup>: a hospitality sector program to reduce food waste as a means of improving profitability (the program came about from the EPA's Green Hospitality Awards<sup>108</sup> program)</p>

<sup>99</sup> Source: <http://lcafood2014.org/papers/238.pdf>

<sup>100</sup> Source: <https://lunchie.fi/en/>

<sup>101</sup> Source: <https://resq-club.com/>

<sup>102</sup> Source: <http://portal.savonia.fi/amk/en/about-savonia/saa-syoda-license-eat-event>

<sup>103</sup> Source: <https://www.euractiv.com/section/agriculture-food/news/germany-plans-smart-packaging-to-cut-food-waste/>

<sup>104</sup> Source: <http://www.thinkeatsave.org/index.php/about>

<sup>105</sup> Source: <https://foodsharing.de/statistik>

<sup>106</sup> Source: <http://www.zerowastescotland.org.uk/Looking-For-Ways-To-Reduce-Food-Waste>

<sup>107</sup> Source: <http://www.foodwaste.ie/web-images/Food-Waste-Prevention-Guide.pdf>

<sup>108</sup> Source: <http://www.ghaward.ie/>

<b>Japan</b>	Food Recycling Act <sup>109</sup>	Legislation	Implemented in 2001 and updated in 2007, the FRA sets out minimum targets for food industries to divert surplus useful food as raw materials for animal feed and fertilizers, to recycle food through conversion (ie. carbonization of fats and oils into fuels), and to reduce final waste quantities through incineration, composting, dehydrating, or fermentation
<b>Northern Ireland (UK)</b>	Government	Legislation	Food Waste Regulations (2015) <sup>110</sup> in Northern Ireland (United Kingdom) prohibits landfilling of food waste and mandates the separate collection and subsequent treatment of food waste from both households and businesses.
	STOP Food Waste	Program	STOP Food Waste <sup>111</sup> is a cross-cutting initiative designed to educate the public and private sectors about the costs, both financial and ecological, of the scale of Ireland's food waste. Includes a 5-step Food Waste Challenge <sup>112</sup> aimed at households. Estimates on annual food waste in Northern Ireland are 1M tonnes at a cost of €1B (\$1.4B CAD)
	Foodcloud	Online resource	An online app <sup>113</sup> that connects over 1,000 food industry partners to over 3,000 charities in the UK and Ireland. Suppliers upload data about food available to donate, charities receive notification then collect it and distribute to registered families.
<b>The Netherlands</b>	Food Battle	Project	Developed by the University of Wageningen, the Food Battle – Don't Throw Away Food <sup>114</sup> project aims to raise awareness of food waste and give consumers tips to minimize it. An online tracking application pits groups in three categories against each other to see who can reduce their food waste the most.
	Share Your Meal	Public initiative	Share Your Meal <sup>115</sup> : A website to assist households with sharing their home-cooked meals. Initiated in Utrecht by a small neighbourhood group who commonly shared meals and leftovers, within one year the website had 40K users.
	Kromkommer	Business case	Kromkommer <sup>116</sup> : a movement, a business, and a sharing platform aimed at saving fresh produce that is considered un-sellable due to cosmetic flaws, deformities, or other

<sup>109</sup> Source: [http://nett21.gec.jp/ECotowns/data/et\\_c-08.html](http://nett21.gec.jp/ECotowns/data/et_c-08.html)

<sup>110</sup> Source: <http://www.netregs.org.uk/legislation/northern-ireland-environmental-legislation/future-legislation/new-duties-for-food-businesses-in-northern-ireland/>

<sup>111</sup> Source: <http://www.stopfoodwaste.ie/food-we-waste/how-much-we-waste/>

<sup>112</sup> Source: <http://www.stopfoodwaste.ie/food-we-waste/challenges/>

<sup>113</sup> Source: <http://food.cloud/how-foodcloud-works/>

<sup>114</sup> Source: <https://www.wur.nl/en/project/FoodBattle-Dont-throw-food-away-1.htm>

<sup>115</sup> Source: <https://www.thuisafgehaald.nl/>

<sup>116</sup> Source: <http://www.kromkommer.com/>

			appearance-related issues. The business side manufactures several consumer lines of soups using un-sellable produce.
<b>Poland</b>	Don't Waste Food, Think Green	Awareness Building & Food Sharing Program	The Federation of Polish Food Banks and FoRWaRd published a report <sup>117</sup> indicates that the FPFb feeds over 1M people per year, and they collected 7.43 tonnes of food through cooperation with the food industry.
	FoRWaRd	Training and development	FoRWaRd <sup>118</sup> is a trans-European free online training platform for food service workers to learn skills, strategies, and ideas on food waste prevention and food re-purposing (sellable but may otherwise be disposed of).
<b>Portugal</b>	Menu Dose Certa	Awareness Building Program	Menu Dose Certa <sup>119</sup> was created by the regional waste management company LIPOR. The core of project supported restaurants to prepare menu items with appropriate serving sizes to minimise food waste and save money. The project resulted in waste reduction of up to 77% and was replicated in several other restaurants and school canteens.
	Re-Food	Citizen initiative	Re-Food <sup>120</sup> is a volunteer-driven organization that rescues food from foodservice operations. Operators notify Re-Food when they have surplus food; it is picked up and brought to centres for grading, sorting, and boxing into family packs then delivered to families in the system. Started as one volunteer on a bike in a seven block area of Lisbon, today there are 24 centres flowing through thousands of meals per day.
	Zero Desperdicio (Waste)	Citizen initiative	The Zero Waste <sup>121</sup> program also aims to take previously discarded food (left-over from batch cooking, buffet leftovers, closed-date products, etc.) and re-distribute to those in need.

<sup>117</sup> Source: <http://foodrecoveryproject.eu/wp-content/uploads/2012/11/Regional-report-Poland.pdf>

<sup>118</sup> Source: <http://foodrecoveryproject.eu/>

<sup>119</sup> Source: [http://ec.europa.eu/environment/waste/prevention/pdf/MenuDoseCerta\\_Factsheet.pdf](http://ec.europa.eu/environment/waste/prevention/pdf/MenuDoseCerta_Factsheet.pdf)

<sup>120</sup> Source: <http://www.re-food.org/en/how-it-works/practical-action>

<sup>121</sup> Source: <http://www.zerodesperdicio.pt/>



<b>Serbia</b>	Neighbourhood Hangar	Citizen initiative	Every day in Serbia thousands of people pick through garbage bins in search of food, clothing, and anything of value. The Neighbourhood Hangar <sup>122</sup> simply involves hangars installed on garbage bin signs so anyone disposing of still-edible food or other viable items hang it up instead of putting in the bin thereby reducing contamination.
<b>Scotland (UK)</b>	Zero Waste Scotland	Resource	Zero Waste Scotland <sup>124</sup> is an agency dedicated to reducing waste across several sectors but food waste has the greatest priority with resources to households to help them curb food waste through better planning, smart shopping, and basic recipes. ZWS report on Scottish government announcement to reduce food waste by 33% by 2025 <sup>125</sup> .
	WRAP <sup>123</sup> Love Food Hate Waste Scotland	Program	LFHW <sup>126</sup> is a consumer education program that offers easy ways for households to reduce food waste, provides menu planning, shopping tips, and other step-wise programs like canning and jarring aimed at household food waste reduction
	Fareshare	Business case	Fareshare <sup>127</sup> recovers surplus food from suppliers, manufacturers, distribution centres, retailers and stores, at the rate of about 10.8 tonnes per year.
	OLIO	Citizen initiative	OLIO <sup>128</sup> is a free food sharing app connecting neighbours with each other and with local businesses to ensure surplus food gets eaten
<b>Spain</b>	More Food, Less Waste (In Spanish)	Strategy	The More Food, Less Waste <sup>129</sup> strategy aims to reduce food waste and losses across the entire food supply chain, from agriculture, to food processing and distribution, consumption in households and the hospitality sector, and finally by deriving value from food waste.  The strategy includes studies and research to understand where, how, why and what type of food loss and waste, as well as activities such as promoting and sharing best

<sup>122</sup> Source: <https://www.facebook.com/Kom%C5%A1ijski-%C4%8Diviluk-Neighborly-Hanger-1516144225273730/>

<sup>123</sup> Source: <http://www.wrap.org.uk/>

<sup>124</sup> Source: <http://www.zerowastescotland.org.uk/Looking-For-Ways-To-Reduce-Food-Waste>

<sup>125</sup> Source: <http://www.zerowastescotland.org.uk/content/new-research-shows-scale-scotland%E2%80%99s-food-waste-challenge>

<sup>126</sup> Source: <https://scotland.lovefoodhatewaste.com/>

<sup>127</sup> Source: <http://www.fareshare.org.uk/wp-content/uploads/2016/10/How-FareShare-Works-V2-October-2016.png>

<sup>128</sup> Source: <https://olioex.com/>

<sup>129</sup> Source: [http://www.mapama.gob.es/imagenes/es/Libro%20estrategia%20desperdicio\\_baja\\_tcm7-271306.pdf](http://www.mapama.gob.es/imagenes/es/Libro%20estrategia%20desperdicio_baja_tcm7-271306.pdf)

			practices, analysing and reviewing regulation, and promoting the development of new technologies. The implementation period runs over three years.
<b>Sweden</b>	Government	Reports	The Swedish National Food Agency <sup>130</sup> released a comprehensive report examining the impacts of a supply-chain wide 20% reduction in food waste in the period 2010 – 2020, including financial benefits, CO2 avoidance, soil and agricultural benefits, and marine and ocean health benefits.
	Personality	Annica Triberg	One of Sweden's most recognizable cookbook authors and chefs published a cookbook "100 ways to save food <sup>131</sup> " with recipes, tips, and ideas how to re-purpose leftovers and prevent waste.
		Less Waste More Food	The LWMF <sup>132</sup> 2013 – 2015 campaign about reduction of food waste in Sweden jointly managed by the Swedish National Food Agency, Environmental Protection Agency, and the Board of Agriculture
<b>United Kingdom</b>	Industry Best Practice / WRAP	Hospitality and Food Service Agreement	The voluntary HSFA was launched in 2012 with the target of reducing food and packaging waste to 5% of 2012 baseline levels and to increase the rate of food and packaging waste recycling and recovery (through digestion or composting) to 70%. Results were published in early 2017. <sup>133</sup>
	Real Junk Food Project	Industry Best Practice	The RJFP <sup>134</sup> warehouse-based food supermarket specializing in food recovery and waste avoidance. RJFP accepts donations from supermarkets, local allotments, cafes, food banks, and caterers. Shoppers pay 'what they can' or take food in exchange for volunteer hours.

<sup>130</sup> Source: <https://www.livsmedelsverket.se/globalassets/english/food-habits-health-environment/food-environment/report-summaries-from-the-swedish-food-waste-reduction-project-2013-2015-oktober-2016.pdf>

<sup>131</sup> Source: <http://www.bokrecension.se/9174293591>

<sup>132</sup> Source: [https://www.livsmedelsverket.se/globalassets/english/food-habits-health-environment/food-environment/slv\\_faktablad\\_matsvinn\\_eng\\_web.pdf](https://www.livsmedelsverket.se/globalassets/english/food-habits-health-environment/food-environment/slv_faktablad_matsvinn_eng_web.pdf)

<sup>133</sup> Source: <http://www.wrap.org.uk/content/hospitality-and-food-service-agreement-taking-action-waste>

<sup>134</sup> Source: <http://www.telegraph.co.uk/news/2016/09/21/look-inside-the-uks-first-food-waste-supermarket/>

## Appendix C: Innovative Models & Public–Private Partnerships

Public and private co-operation is crucial for challenges into opportunities at a national, regional and global level. Circular economies are highly business driven: many companies are already moving towards more circular business models because it has proven to be sound business strategy that facilitates access to new markets, drives innovative solutions and saves production costs.

A circular economy demands new ways of thinking and new ways of co-operating, both within and across sectors, in order to minimize the environmental footprint throughout the value chain, but also to develop new and innovative partnerships and solutions. A specialized form for partnership is an industrial symbiosis, where companies partner up so that one company's by-product can be used as a resource input in the other companies' production, turning one company's residue into another company's resource.

### Private Sector Leadership

Jurisdiction	Program / Initiative Name	Synopsis
USA	US Materials Marketplace <sup>135</sup>	A collaboration project between the US Business Council for Sustainable Development, World Business Council for Sustainable Development, and Corporate Eco Forum to scale up business-to-business materials reuse across the US. This marketplace facilitates company-to-company industrial reuse that support the culture shift to a circular, closed-loop economy.
USA	Cropmobster <sup>136</sup>	An online platform enabling community-based exchanges within the food and agricultural space with the intention of building out a "farm-to-fork" economy in the San Francisco Bay area; examples include farmers posting un-sellable crops which alert composters or animal husbandries
USA	Food Cowboy <sup>137</sup>	A location-based app that connects people and businesses with surplus food to donate to charities or community groups in close proximity to the donator or along the donator's travel route
North America, Chile, Middle East	Agriprotein Technologies <sup>138</sup>	A company that grows protein foods for animal feeds made out of fly larvae fed with organic wastes creating insect-based protein meal, extracted fat, and soil conditioner.
Canada	Enterra <sup>139</sup>	Insect-based protein feeds for livestock and organic natural fertilizers from larvae grown on organic wastes typically discarded or composted.

<sup>135</sup> Source: <http://materialsmarketplace.org/#about>

<sup>136</sup> Source: <https://sfbay.cropmobster.com/>

<sup>137</sup> Source: <http://www.foodcowboy.com/>

<sup>138</sup> Source: <http://www.agriprotein.com/>

<sup>139</sup> Source: <http://www.enterrafeed.com/process/>

Jurisdiction	Program / Initiative Name	Synopsis
Denmark	WeFood <sup>140</sup>	A supermarket that sells surplus food otherwise discarded by other retailers
	Rub & Stub <sup>141</sup>	A restaurant specializing in meals from recovered / surplus foods
	Too Good to Go <sup>142</sup>	An app that connects diners with food service operators for end-of-day discounts
	Vigga <sup>143</sup>	An award-winning business model where parents of infants and toddlers can rent/lease organic clothing for short-term use, exchanging items as babies rapidly grow out of their clothing
	GoMore <sup>144</sup>	An online platform for people offering rides in their cars or renting their cars to other users
Finland	Kesko Oy <sup>145</sup>	One of Finland's largest grocer retail chain participates in several waste reduction programs including Food Waste Week and a cross-sector collaboration on increasing recycling and reducing packaging waste. Their aim is to attain zero landfill.
Japan	Okadkyu Food Ecology Centre <sup>146</sup>	Businesses using more closed-loop systems for restaurant food waste including both organic wastes from food preparation and cooking, as well as meal scraps, reprocessing into animal feed and fertilizers.

<sup>140</sup> Source: <https://donate.danchurchaid.org/wefood>

<sup>141</sup> Source: <http://spisrubogstub.dk/en/about/>

<sup>142</sup> Source: <http://toogoodtogo.dk/>

<sup>143</sup> Source: <http://www.vigga.us/in-english/>

<sup>144</sup> Source: <https://gomore.dk/>

<sup>145</sup> Source: <http://www.kesko.fi/en/media/news-and-releases/news/arkisto/Responsibility/An-ambitious-target-for-recycling-zero-landfill-waste/>

<sup>146</sup> Source: [http://www.jwnet.or.jp/en/iwc/7\\_0910.html](http://www.jwnet.or.jp/en/iwc/7_0910.html)

## Public-Private Partnerships & Research Initiatives

Jurisdiction	Program / Initiative Name	Synopsis
Flanders	PlanC	Plan C <sup>147</sup> is the circular economy hub in Flanders, Belgium: connecting, challenging and enabling entrepreneurs and organisations to make it happen. Plan C is one of the three pillars of the Flanders' Materials Programme <sup>148</sup> an ambitious long-term vision working on material efficiency development, policy research, actionable projects. The other two pillars are the Flanders Policy Research Centre for Sustainable Materials Management (SuMMA) <sup>149</sup> and the Flanders' Materials Programme Agenda 2020 <sup>150</sup> .
	European Topic Centre on Waste and Materials in a Green Economy <sup>151</sup>	European Topic Centre on Waste and Materials in a Green Economy involves executing a 4-year contract for analysis and reporting on existing policies in EU and potential new policy developments, examining CE indicators and calculating economic impacts of CE / Green Economy, and engaging in scientific aspects involving universities, co-funded scientific projects, and consultancies.
Sweden	Mistra REES <sup>152</sup>	The Resource-Efficient and Effective Solutions (REES) 4-year program is based on circular economy thinking run by a consortium of leading Swedish universities, large and small companies, and community stakeholders. The program's vision is to advance the transition of the Swedish manufacturing industry towards a circular and sustainable economy.
	RE:Source – Strategic Innovation Program <sup>153</sup>	RE:Source is a Strategic Innovation Program implemented by the Swedish Energy Agency, Vinnova and Formas, as a high-level research and innovation investment project focusing on resource minimization and waste. One objective of RE:Source is to improve Sweden's international competitiveness on waste and resource technologies.
	Swedish Research Council (Formas): Circular and	Formas has issued calls <sup>155</sup> for research in the areas of forest raw material and biomass and the opportunities and challenges of transitioning to a biobased economy. Formas also published Swedish Research and Innovation Strategy for a Bio-based Economy <sup>156</sup>

<sup>147</sup> Source: <http://www.plan-c.eu/en>

<sup>148</sup> Source: <http://www.vlaamsmaterialenprogramma.be/english>

<sup>149</sup> Source: <https://hiva.kuleuven.be/en/research/research-projects/policy-research-centre-sustainable-materials-management-summa>

<sup>150</sup> Source: [http://www.vlaamsmaterialenprogramma.be/sites/default/files/atoms/files/VMP\\_ENG\\_brochure\\_150PPI.pdf](http://www.vlaamsmaterialenprogramma.be/sites/default/files/atoms/files/VMP_ENG_brochure_150PPI.pdf)

<sup>151</sup> Source: <http://www.scp-centre.org/our-work/etc/>

<sup>152</sup> Source: <https://sitecore-www.it.liu.se/en/research-activities/mistra-rees>

<sup>153</sup> Source: <http://resource-sip.se/om-resource/resource-in-english/>

<sup>155</sup> Source: <http://www.formas.se/en/financing/calls-for-proposals/forest-raw-material-and-biomass>

<sup>156</sup> Source: [http://www.formas.se/PageFiles/5074/Strategy\\_Biobased\\_Ekonomi\\_hela.pdf](http://www.formas.se/PageFiles/5074/Strategy_Biobased_Ekonomi_hela.pdf)

	biobased economy <sup>154</sup>	
	Vinnova <sup>157</sup>	Vinnova is Sweden's innovation agency with the mission to promote sustainable growth by improving the conditions for innovation and funding needs-driven research, including a mandate to examine opportunities and limitations in industrial symbiosis to achieve circular collaborations <sup>158</sup> between 2016 – 2019.
	University of Borås – Swedish Centre for Resource Recovery <sup>159</sup>	The SCRR has research groups collaborating on four key areas: biotechnology, combustion and thermal processes, polymer technology and simulation and modeling. The goal is to develop new materials and functional polymers from surplus material and waste, and thermochemical conversion of biomass and waste-derived fuels to produce heat, power and fuels.
	Royal Swedish Academy of Engineering Sciences (IVA)	IVA is a member-driven organization comprised of 1,300 Swedish and elected foreign fellows plus a 200 member IVA Business Executives Council which includes decision makers from business, industry, academia, research institutes, government agencies, and NGOs. In 2016 IVA published the report Resource Efficiency: Policy Development Towards 2025 <sup>160</sup> which had contributions from dozens of experts across several sectors.
Denmark	Ellen MacArthur Foundation	The Danish EPA and Danish Business Authority have had a joint membership with the Ellen MacArthur Foundation Circular Cities Network <sup>161</sup> ; Denmark was selected as the showcase country for EMF's Delivering the circular economy: a toolkit for policymakers, one of the most comprehensive circular economy studies of all time
Finland	CIRCWASTE <sup>162</sup>	A multi-stakeholder project conducting demonstrations, pilot projects, and trial studies with the aim of proving concepts and developing real-world applications of circular material flows and waste reduction/elimination. There are 19 cases that focus on areas of municipal waste, industrial waste and bi-products, construction waste, soils and contaminated lands, and food systems.
Netherlands	University of Wageningen	The UofW has an extensive dossier <sup>163</sup> of food waste projects, research papers, articles, helpful hints, and industry collaborators including FUSIONS <sup>164</sup>

<sup>154</sup> Source: <http://www.formas.se/Documents/Strategy%20-%20Biobased%20Economy.pdf>

<sup>157</sup> Source: <http://www.vinnova.se/en/About-Vinnova/>

<sup>158</sup> Source: <http://www.regeringen.se/regeringsuppdrag/2016/08/uppdag-att-stodja-utvecklingen-av-cirkulara-affarsmodeller-och-industriell-symbios/>

<sup>159</sup> Source: <http://www.hb.se/en/Research/Areas/Swedish-Center-for-Resource-Recovery/>

<sup>160</sup> Source: <https://www.iva.se/globalassets/info-trycksaker/resurseffektiva-affarsmodeller/201604-iva-rask-rapport3-english-b.pdf>

<sup>161</sup> Source: <https://www.ellenmacarthurfoundation.org/programmes/government/circular-cities-network>

<sup>162</sup> Source: [http://www.syke.fi/en-US/Research\\_Development/Research\\_and\\_development\\_projects/Projects/CIRCWASTE\\_Towards\\_Circular\\_Economy\\_in\\_Finland](http://www.syke.fi/en-US/Research_Development/Research_and_development_projects/Projects/CIRCWASTE_Towards_Circular_Economy_in_Finland)

<sup>163</sup> Source: <http://www.wur.nl/en/Dossiers/file/Dossier-Food-waste.htm>

<sup>164</sup> Source: <http://www.wur.nl/en/Expertise-Services/Research-Institutes/food-biobased-research/Show/Working-towards-a-50-percent-drop-in-food-waste.htm>

	Netherlands Enterprise Agency	<p>Between 2010 and 2014 the NEA executed a €3.13M (\$4.38M CAD) Small Business Innovation Research project specific to food waste. The program ran 2010 – 2014 and provided funding for feasibility studies on three topics:</p> <ul style="list-style-type: none"> <li>• Food waste prevention- to avoid food losses in the agri-food chains due to losses in quality</li> <li>• Maintaining/keeping of food waste streams meant for human consumption in agro-food chains for human consumption.</li> <li>• Transforming food waste streams into food products for human consumption by reprocessing and remanufacturing</li> </ul>
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## Municipal Initiatives

Jurisdiction	Program / Initiative Name	Synopsis
Japan	Eco Town Program	The Eco Town Program <sup>165</sup> , created in 1997, introduced the zero waste concept where any waste generated from an industry sector was to be utilized as material in another sector thus establishing an environmentally harmonized socio-economy in the local community. Eco Town Plans created by towns, cities, or business unions are submitted to the prefectural government for review and endorsement after which the Ministry of Environment, and Ministry of Economy, Trade, and Industry would provide comprehensive and multi-faceted support
Finland	Skye Carbon Neutral Municipalities Project <sup>166</sup>	The Carbon Neutral Municipalities project (HINKU) brings municipalities, businesses, citizens and experts together to create and carry out solutions to reduce greenhouse gas emissions. When launched in 2008, five municipalities committed to an 80% reduction in greenhouse gas emissions from 2007 levels by 2030. Since then, several new municipalities have made the same commitment – there are a total of 34 municipalities in the HINKU program.
	Finnish Sustainable Communities (FISU)	The FISU <sup>167</sup> project consists of eight municipalities who are participating in measurement studies of per capita CO2 emissions, material losses, and overall ecological footprint, to raise awareness of citizens and businesses, and to work towards having a 'resource wise' population.

<sup>165</sup> Source: [https://www.env.go.jp/en/recycle/manage/eco\\_town/index.html](https://www.env.go.jp/en/recycle/manage/eco_town/index.html)

<sup>166</sup> Source: <http://www.hinku-foorum.fi/en-US>

<sup>167</sup> Source: <https://translate.google.ca/translate?hl=en&sl=fi&u=http://www.fisunetwork.fi/&prev=search>



Scotland	Zero Waste Towns	Zero Waste Scotland <sup>168</sup> offers communities funding and resource assistance to attain town-wide targets to 2024 of 70% household recycling rate and 33% reduction in waste food. The ZWS Resource Efficient Circular Economy Accelerator Program help implement the ideas.
Various	ARC+ <sup>169</sup>	ARC+ is the Association of Cities and Regions for sustainable Resource Management. It is an international network yet mostly centered on European countries. ARC's projects are primarily around policy, public awareness and communications, research and strategy.
Various	Ellen MacArthur Foundation Circular	The EMF is an organization on the forefront of circular economy thinking and strategy. The Circular Cities Network <sup>170</sup> was formed as a platform for knowledge exchange between pioneering cities where they can learn from each other's mistakes and challenges, and showcase success stories. There are 12 cities in the Network including Vancouver, BC.

<sup>168</sup> Source: <http://www.zerowastescotland.org.uk/content/can-your-town-become-zero-waste-town>

<sup>169</sup> Source: <http://www.acrplus.org/index.php/en/about-acr/about-us>

<sup>170</sup> Source: <https://www.ellenmacarthurfoundation.org/programmes/government/circular-cities-network>

## Appendix D: Jurisdictional Profiles

### Denmark

#### 1. Leading Strengths & Characteristics

Denmark is widely regarded as one of the most advanced countries in the world in the implementation of circular economy policies, programs, and activities. Denmark is a long-standing member of the CE100, a global platform intended to build Circular Economy capacity, managed by the Ellen MacArthur Foundation, the preeminent global authority on circularity, who also published an exhaustive case study on Denmark's potential for attaining a fully circular economy.

The Danish Business Authority took top prize in the 2015 "Circulars Awards" in the Circular Economy Cities/Regions categories. These awards are an initiative by the Forum of Young Global Leaders and part of the World Economic Forum; they were created to identify and celebrate organizations that are advancing circular economy models into practical applications.

Much of Denmark's legislation around material efficiency and environmental protection has been influenced by European Union policies and programs flowing out of the EU Action Plan for the Circular Economy.

The Environmental Protection Act is the national legislation under which other directives and sub-policies fall. Another key piece of legislation, passed in 2015, is the Danish Climate Change Act with aims to create an academically based Climate Council, generate an annual climate change policy report for parliament, and to establish national greenhouse gas reduction targets.

Denmark has two key government-wide initiatives to address the high amount of per-capita waste and to promote a more circular approach to resources, materials, and food/organics:

- Denmark Without Waste – Recycle More Incinerate Less
- Denmark Without Waste II – Strategy for Waste Prevention

Denmark is also a global leader in anaerobic digestion as a treatment for organic waste. The Danish government's 'Energi 21' plan sets out integrated solutions for energy, waste management and nutrient redistribution, and provides support for biogas development as part of its policy target to meet 35% of the country's energy needs from renewable sources.

## 2. Key Circular Economy Targets

Denmark has a relatively high level of material consumption next to the European average in terms of materials used per person or Domestic Material Consumption (DMC). The country sits at 20.1 tons of material/person in Denmark, which is 154% of the EU 28 average. Resource productivity (measured as GDP/DMC) comes to roughly 2.22€/KG (\$3.11 CAD/KG) while the EU 28 average sits at 1.87€/KG (\$2.62 CAD/KG) placing Denmark at 110% of the average.<sup>171</sup>

In 2016, total consumption of material per capita was more than 20 tons and municipal waste of 747 kg per inhabitant every year. This places Denmark as one of the highest per capita users of resources and one of the largest producers of municipal waste in the world. It is estimated that for every consumer product purchased for DKK 1,000 (\*\$190 CAD), an average of 9 kg of household waste is generated.

Food waste reduction is one of the top priorities in Denmark. At present:

- Avoidable food waste in households amounts to roughly 260K tons per year corresponding to 24% of total household waste
- The service sector generates roughly 227K tons of food waste
- Primary production sectors produce 100K tons of food waste
- The food industry (food processing & production) 133K tons
  - Total annual food waste 720K tons annually

Denmark has an ambitious long-range national target for waste reduction and material recovery, looking to get household recycling up to 50% by 2022 (today that rate is roughly 23%).

Near term targets for 2018 are to:

- Improve organic waste recovery from the service sector to 60%
- Increase collection of waste electronics from the service sector to 75%
- Improve packaging material recovery from the service sector to 70%
- Achieve 65% collection of waste electronics and 55% of batteries across all streams
- Improve shredder material recovery to 70%
- Achieve 80% recycling of phosphorous from sewage sludge across all streams
- Attain 25% energy recovery from garden waste across all streams

<sup>171</sup> Current exchange rate as of February 7, 2017, is €1 = \$1.40 CAD. Current exchange rate is DKK 1 = \$0.19 CAD

### 3. Leading Policies & Legislation

Policy/Program/Strategy	Date	Summary	Impact Area
<b>Denmark Without Waste – Recycle More Incinerate Less</b>	2013 - 2018	<ul style="list-style-type: none"> <li>• Reduce the amount of waste incinerated by better exploiting the value and resources contained in the waste</li> <li>• Decrease the environmental impacts of waste</li> <li>• Increase high quality recycling / decrease down-cycling</li> <li>• Improve public-private collaboration on waste management</li> </ul>	General, Downstream
<b>Denmark Without Waste II – Strategy For Waste Prevention</b>	2015 - 2027	<ul style="list-style-type: none"> <li>• Reduce food waste across all sectors of the food value chain</li> <li>• Improve resource efficiency in the construction and demolition sector, ensure hazardous substances are handled properly, and improve knowledge sharing</li> <li>• Reduce environmental impacts of textile and clothing production, ease recycling and reuse of textiles, address hazardous substances</li> <li>• Improve the reuse and recycling of electronics and electronic waste, improve product longevity, enhance circularity of materials used in the sector</li> <li>• Reduce environmental impacts of and resources used in packaging</li> </ul>	General, Downstream, Upstream

The Danish government has earmarked significant funds and investment pools to support circular economy research, development, and application including:

- **Fund for Green Business Development**, which was administered by the Danish Business Authority from 2013-2015, saw €7.3M (\$10.2M CAD) invested in 33 projects related to six themes:
  - Development of new green business models
  - Product innovation and re-design of products
  - Promotion of sustainable materials in product design
  - Sustainable transition in the textile and fashion industry
  - Less food waste
  - Sustainable bio-based products based on non-food mass
- The **Danish Green Investment Fund** with lending power of DKK 5 billion (\$947M CAD) is an independent state loan fund with the purpose of supporting economically viable projects that support sustainable development in the areas of
  - Environmental savings
  - Renewable energy sources
  - Resource efficiency
- The **Danish Eco-Innovation Programme (MUDP)** DKK 81 million (\$15.34M CAD) has the purpose to support development and application of new environmental and resource efficient solutions addressing prioritized environmental challenges; this programme rests on three pillars:
  - The Subsidy Scheme – funding for development, testing, and demonstration of new technology that creates a foundation for higher environmental standards and/or comply with existing regulation using smarter technologies

- Innovation Partnerships – cooperation and dialogue between private companies, knowledge institutions, and authorities on creating new, better, and/or cheaper environmental solutions as well as addressing future national and international regulation
  - International Environmental Cooperation – demonstrate Danish companies' leading solutions to foreign partners and targeted export markets
- The **Green Development and Demonstration Programme (GUDP)**: DKK 211 million (\$40M CAD) under the Ministry of Food, Agriculture and Fisheries, and the Danish AgriFish Agency, requires applicants to present business cases in the form of innovative and concrete products, novel processes or new knowledge which are commercially viable and may subsequently be sold to consumers or enterprises; applications must demonstrate how the project contributes to the food industry and considers 1) Sustainability, 2) Efficiency, and 3) Value Enhancement
- **Partnership for Green Procurement**: a set of purchasing policies aimed at supporting businesses with circular business models by leveraging the buying power of the national and municipal governments worth roughly DKK 50 million (\$9.5M CAD) per year and 17% of total national public procurement.

## Finland

### 1. Leading Strengths & Characteristics

Finland is one of the most active Nordic countries developing Circular Economy programs, policies, and practices. In Finland, the circular economy is increasingly seen as opening up business opportunities that are linked to their national and regional innovation objectives.

With a highly distributed population and comparatively large land mass, Finland has been among the highest per-capita consumers of materials in the world for the last several decades.<sup>172</sup> In 2014, Finland topped the EU in use of materials per person (DMC) for a total of 170 million tonnes. This works out to 31.1 tonnes DMC/person, putting Finland at 238% of the EU average (13.1 tonnes) and #1 in Europe. Finland also has the 11<sup>th</sup> largest ecological footprint in the world.

This has been somewhat attributed to the steep material intensity of the vast number of roadways required to connect municipalities, cities, and towns, and the high proportion of forestry and logging, primarily used for paper (Finland supplies paper to over 100 million people annually). A focus on bioeconomy, underpinned by forestry, is a key strategy in Finland as it is strongly connected to natural resource efficiency and material loops. One of the six pillars of the Finnish Roadmap to Circular Economy are Forest Loops as economic and resource drivers of a fully circular economy.

Finland's resource productivity measurement sits at €1.10/kg (\$1.54 CAD/kg) which comes in at 55% of the EU average (€1.87/KG, \$2.62 CAD/kg).<sup>173</sup> This may be attributed to a large inventory of natural resources, the export of material intensive goods (i.e., paper), and geographic conditions including the cold, northern climate and coastal waters.

The primary focus on Finland's CE programs are to reduce the well-above-average amounts of material consumption through various efficiency-enhancing technologies but also through waste prevention. While there are several programs currently in play – the two most important national programs are:

- Towards a Recycling Society – A National Waste Plan for Finland 2016
- National Waste Management Plan and Waste Prevention Program 2016-2030

Sitra, an arms-length policy agency, research partner, and innovation fund, published a strategic-level multi-scenario policy paper which included contributions from over 1,000 stakeholders including several Ministries, private and public enterprises, municipalities, and academia working together to lay a policy foundation towards circularity:

- Finnish Roadmap to a Circular Economy 2016 – 2025

In terms of food waste, one of the priority Roadmap areas is Sustainable Food Systems which emphasizes food efficiency and nutrient recovery. The topic of food waste is significant in Finland: at the household level between 120K and 160K tonnes of food goes to waste annually, making up the largest share of the nation's annual total food waste which is between 250K and 320K tonnes. Food service institutions make up 75K – 85K and retail 65K–75K tonnes per year. As such, household education is top priority across all food-waste related projects.

<sup>172</sup> To compare two similar Nordic countries by population, Finland has roughly 5.5 million citizens while Denmark has just over 5.4 million. Finland's landmass covers 333,400 km<sup>2</sup> while Denmark covers 42,900 km<sup>2</sup>. This puts Finland's population intensity at 16.5 pp/km<sup>2</sup> compared to Denmark's 126 pp/ km<sup>2</sup>. At the same time, GDP/person is close between the countries at €30,000 (\$42,000 CAD)/person in Finland and €34,200 (\$47,880 CAD)/person in Denmark. The sharp contrast in population density coupled with very close GDP/person indicates that Finland may have a steeper road to a fully Circular Economy (CE) than Denmark.

<sup>173</sup> Note: €1 = \$1.40 CAD at current exchange rates.

## 2. Circular Economy Targets:

Key targets of relevance to BC as laid out in Finland's National Waste Plan (2016) include:

- Stabilizing the amount of municipal waste to 2000 – 2002 levels (2.3–2.5M tonnes annually) and then ensure a downwards trend by 2016;
- Ensuring that 50% of all municipal waste is recycled as material and 30% used as energy, with not more than 20% landfilled
- Cutting consumer and store-level food waste by 50%
- Enforcing a ban on recyclable waste going to landfill (enacting laws by 2050)
- Ensuring that at least 70% of all construction waste will be used as material and energy
- Ensuring that 90% of all sludge generated in rural areas is treated in wastewater treatment plants and the remaining 10% sent to biogas plants at farms. Tighter legislation on wastewater emissions in rural areas will probably increase the amount of sludge generated outside built-up areas.
- Ensuring that at least 5% of the gravel and crushed stone used in earthworks comes from waste generated by industry and mineral extraction
- Striving for 100% of all municipal sludge to be recovered, either to be used as energy or for soil conditioning
- Ensuring that all manure generated in connection with rural businesses is recovered, with 10% of this amount (2.1M tonnes) treated in biogas plants at farms, and recover at least 10% of sludge in rural areas for treatment

## 3. Leading Policies & Legislation

Policy / Strategy / Program	Date	Summary	Impact Areas
National Waste Management Plan and Waste Prevention Programme  (This policy is still under development with no definitive targets at present)	2017	Seven goals to achieve key targets by 2030: <ul style="list-style-type: none"> <li>• Waste management is part of the Finnish CE</li> <li>• Production and consumption are both resource efficient and create new job opportunities</li> <li>• Waste is diminished and recycling has reached new heights</li> <li>• Markets for recycled materials and products are working well</li> <li>• Recovery of valuable materials is efficient</li> <li>• Harmful substances are removed being replaced by less harmful ones</li> <li>• Quality research and pilot projects will inform future decisions and waste management is generally high</li> </ul>	All, primarily upstream
Towards a Recycling Society – The National Waste Plan for 2016	2016	<ul style="list-style-type: none"> <li>• Preventing waste through improved material efficiency</li> <li>• More efficient recycling</li> <li>• Promoting the management of hazardous substances from the waste point of view</li> <li>• Reducing the harmful climatic impacts of waste management</li> <li>• Reducing the health and environmental impacts of waste management</li> <li>• Improving and clarifying the organization of waste management</li> <li>• Developing expertise in the waste sector</li> <li>• Putting trans-frontier waste shipments on a safe and well-managed basis</li> </ul>	Upstream, downstream

National Material Efficiency Programme	2013	<ul style="list-style-type: none"> <li>• The Programme includes 8 specific measures.</li> <li>• Research &amp; Education: launch a joint research programme for the promotion of material efficiency</li> <li>• Company tools for developing material efficiency: establish a national operating model to accelerate industrial symbiosis as a three-year trial</li> <li>• Legislation and seamless administration: launch projects for easing and clarifying environmental permits</li> <li>• International and EU influence; anticipate international material efficiency policy and influence EU policy</li> </ul>	Upstream
Programme to Promote Sustainable Consumption and Production – Getting More From Less - wisely 2012	2012	<p>An update to the “Getting More and Better from Less” 2005 framework with similar yet more modern objectives:</p> <ul style="list-style-type: none"> <li>• Reduce environmental impacts and GHGs from households and the public sector</li> <li>• Use the state and municipalities to set examples and create preconditions for more sustainable solutions</li> <li>• Promote smart energy and comfortable living</li> <li>• Enhance high quality food without waste</li> <li>• Increase smooth and environmentally friendly transportation</li> </ul>	All
Finnish Bioeconomy Strategy	2014	<p>Four key strategic goals:</p> <ul style="list-style-type: none"> <li>• Create a competitive operating environment for bioeconomy growth</li> <li>• Foster new business models through risk financing, bold experiments, and cross-sector collaborations</li> <li>• Develop a strong competency base through training, education, and research</li> <li>• Ensure accessibility and sustainability of biomass resources to well-functioning raw material markets</li> </ul>	Bioeconomy
Programme to Promote Material Efficiency in Real Estate and Construction	2012 – 2020	<p>A framework flowing out of the EU Waste Directive with some measures already in progress and others to be implemented by 2020</p> <ul style="list-style-type: none"> <li>• The lifecycle flexibility and material efficiency of new construction should be improved</li> <li>• Implement systematic property maintenance, economical renovation, and recycling of construction waste in renovation</li> <li>• Improve the overall material efficiency expertise in the sector</li> <li>• Develop waste management to include guidance, reporting, and statistics</li> <li>• Ensure regional availability of services for construction waste management and utilization</li> <li>• Improve prerequisites for reuse and recycling of materials, especially wood</li> <li>• Promote technology for sorting and recycling of construction materials and waste</li> </ul>	Construction sector



## Germany

### 1. Leading Strengths & Characteristics

Resource efficiency, the heart of Germany's circular economy approach, is seen as a major initiative to reduce environmental pollution and tackle climate change. It is also perceived as a strategic topic for innovation, growth, and improving the competitiveness of the German economy. As such, circular economy is reflected as a main objective of a variety of government policies. These policies, and a host of associated targets, are summarized in this document. However, one of Germany's key challenges in terms of adopting circular economy is the lack of integration between these strategies and other ministries on a federal level. Germany also lacks the governance and metrics required to clock progress towards the targets that have been set. That being said, there are currently plans being developed to better monitor and measure performance.

Despite these drawbacks, circular economy practices in Germany are a strong example of a material efficiency driven yet widely downstream approach to circular economy development. As the result of Germany's downstream focus, the country boasts one of the highest recycling rates in the world at 62%. That being said, Germany's mature energy from waste industry is expected to become a less viable option as the government seeks to further develop and pressure upstream circular economy, resource efficiency and waste prevention policies and programs.

Circular economy and resource efficiency policies in Germany are driven by a few key goals:

- Decoupling of resource use from negative impacts
- Securing raw material supply / making the German economy more independent of raw material imports
- Increasing the use of bioenergy
- Creating metrics for the circular economy

The first major step for Germany's entry into the circular economy sphere was the ban on landfill disposal of untreated household wastes or general waste from industry in 2005, initially imposed due to a lack of space. This critical step provided significant opportunities for waste incineration and energy from waste solutions.

In addition, Germany passed the Renewable Energy Sources Act in 2009, which created incentives for the recycling of silage and unused organic waste in particular. At the same time, the Renewable Energy Heat Act came into effect, which used a Market Incentives Program (MAP) to require owners of newly constructed buildings to use renewable energy to meet a portion of their heat requirements, including bioenergy.

Bioenergy was the major focus of 2009 policy, which also included the release of the National Biomass Action Plan and the Action Plan for the Industrial Use of Biomass. This Plan quantified the biomass share in meeting current energy demand, and identified available reserves. It also includes goals and policies to reduce greenhouse gas emissions, including the intention to set biofuel quotas by net GHG reductions. The Plan also emphasizes the importance of sustainable supply chains, with provisions that intensified bioenergy use in Germany must not compromise food supply in developing countries.

Germany's circular economy approach is mainly driven by broader EU strategies, in particular the Circular Economy Strategy. In 2015, the EU's Circular Economy Action Plan set a common 65% recycling target on municipal waste which Germany is accountable for. In addition, in January 2017, the EU offered new guidance on the recovery of energy from waste, a hotly debated topic with circular economy experts. The guidance advised that in a circular economy, when waste cannot be prevented, reused or recycled, recovering the energy within the waste and injecting it back in the economy is the next best environmental and economic option.

Germany's waste management legislation is based on European laws, German Federal laws, and regional laws, and has a heavy focus on incineration / energy from waste due to a lack of landfill space. The main pillar of waste management legislation is the Closed Substance Cycle and Waste Management Act (updated in 2012). The landfill ban and growth in incineration subsequently led to an under capacity at facilities, which ultimately had to be filled through the importing of waste from the UK. Experts believe that incineration has deterred Germany from further improvement with respect to recycling rates.

By 2011, Germany published two key strategies to deepen their circular economy efforts including the National Raw Material Strategy (2010) and the National Research Strategy BioEconomy 2030 (2011). The two strategies expanded the existing circular economy related plans to include the recycling of secondary raw materials. The 2030 Strategy also provided a high-level vision that included turning Germany into a research and innovation hub for bio-based products, energies, processes and services. The Raw Material Strategy led to the development of the Resource Efficiency Programme, a more comprehensive, two-part circular economy strategy aiming for both reduced and efficient use of raw materials.

Part one of the Resource Efficiency Programme, ProgRess, focuses on reducing the pollution associated with the extraction and use of natural resources as much as possible, including reducing Germany's dependence on primary resources and expanding closed-cycle management. The second part of the program is a five-part strategy that focuses on each step of the value chain, from raw material supply to resource efficiency in production, to steering consumption and resource efficiency. The main focus of the program is to decouple resource use from negative environmental impacts while reducing overall materials consumption upstream. The program places a particular emphasis on sustainable building and sustainable urban development and resource efficiency of products in ICT.

More recent activity includes the actions from the 2012 Circular Economy Act (Reorganising the Law on Closed Cycle Management and Waste). The Act encourages that the entire life-cycle of the waste be taken into account with respect to the impact on human health and the environment. The following is to be considered by organizations with respect to life cycle management; the expected emissions; the degree of the conservation of natural resources; the energy to be consumed or yielded and the accumulation of harmful substances in products, in waste for recovery or in products made from such waste. The document also focuses on the separation of waste for recovery and includes a "mixing ban" in order to foster quality feedstock. In addition, the Act requires that organics isis collected separately, and allocates government funding to retrofit existing composting facilities with a fermentation stage as of January 2015.

## 2. Key Circular Economy Targets

Key cross-policy circular economy targets for Germany include:

- Double material productivity by 2020 vs. 1994 figures.
- Double the share of bioenergy in Germany's energy supply by 2020
- Increase the share of renewable energy in electricity production to at least 30 percent by 2020
- Increase the share of renewables-generated heat from the 6.6 percent (2009) to 14 percent by 2020.
- Increase the share of biofuels in overall fuel consumption to 7 percent of net greenhouse gas reductions by 2020 (equivalent to approximately 12 percent energy content).
- Germany's gas demand to be met by 6 percent biomethane by 2020 and 10 percent by 2030

## 3. Leading Policies & Legislation

The policies referenced above are summarized in table below.

Policy/Strategy/Program	Date	Summary	Impact Area
<b>Closed Substance Cycle and Waste Management Act</b>	2010	The main pillar of Germany's waste management legislation, which makes industry and the commercial sector responsible for the recovery of waste	General
<b>2015 Circular Economy Act – "reorganizing" the Closed Cycle and Waste Management Act</b>	2012	<p>The objective of the Act:</p> <ol style="list-style-type: none"> <li>1. to the prevention of waste</li> <li>2. to the recovery of waste</li> <li>3. to the disposal of waste</li> <li>4. to the other activities of waste management</li> </ol> <p>Also, in 2015, as of 2015 is required to be transferred to a public waste management organization must be collected separately. The government is funding efforts to retrofit existing composting facilities with a fermentation state.</p>	General
<b>Renewable Energy Sources Act</b>	2009	Includes the introduction of silage bonus and landscape maintenance bonus, and an increase in the basic payments paid under the Renewable Energy Sources Act for facilities with capacities of up to 150 kW	Organics
<b>Renewable Energy Heat Act</b>	2009	Places owners of newly constructed buildings under obligations to use renewable energy to meet a portion of their heat requirements (includes bioenergy)	Organics

<b>National Biomass Action Plan / Action Plan for the Industrial Use of Biomass</b>	2009	Compliments the EU Biomass Action Plan. Quantifies the biomass share in meeting current energy demand, identifies available reserves. Describes Germany's strategies towards promoting bioenergy	Organics
<b>National Raw Material Strategy</b>	2010	Includes a mix of instruments to support industry in achieving a safe, secure and sustainable supply of raw materials. Focus areas are the sustainable extraction and processing of raw materials and returning secondary raw materials in waste to the resource cycle.	Upstream, General Impact
<b>National Research Strategy BioEconomy 2030</b>	2011	Overview of bioeconomy research in Germany, provides a vision for a sustainable bio-based economy which ensures the global supply of food and generates high-value products from renewable raw materials. Includes a strategic goal for Germany to become a dynamic location for research and innovation.	Organics
<b>Resource Efficiency Program</b>	2012	The first part, ProgRess, aims to make extraction and use of natural resources more sustainable and to reduce associated environmental pollution as far as possible. It has four guiding principles, including viewing global responsibility as a key focus of German national resource policy, making economic and production practices in Germany less dependent on primary resources, and developing and expanding closed-cycle management. The second part of the program dives into circular economy goals for each of five parts of the entire value chain.	General Impact

## Japan

### 1. Leading Strengths & Characteristics

As a result of escalating environmental problems during the last quarter of the twentieth century, Japan has been actively pursuing a more circular economy, starting with the broad-based recycling law, the “Law for the Promotion of Effective Utilization of Recyclables”, enacted in 1991. The key drivers to Japan’s circular economy push have been:

- The country’s high population density and limited landfill space, due in part to its mountainous terrain, forcing the Japanese to find alternatives to landfill as early as the 1950s and to shift away from incineration in the 1990s, following concerns about dioxins;
- The fact that the country has been a major industrial producer but has very limited domestic access to raw materials, metals, and mineral resources, making remanufacturing and recycling attractive; and
- The Japanese business culture which emphasizes collaboration, the result of which has been a comprehensive approach, both to measurement and to action.

Additional key overarching policies that were enacted starting in 2000, include:

- The Basic Law for a Sound Material-Cycle Society;
- The Basic Law for Establishing the Recycling-based Society; and
- The Law for the Promotion of Effective Utilization of Resources.

In the Fundamental Plan for Establishing a Sound Material-Cycle Society, the government explicitly set numerical targets for resource productivity (entrance), the recycling rate (circulation), and the final waste disposal amount (exit), to promote the full-scale development of a more circular economy. The “Law for the Promotion of Effective Utilization of Resources” treats materials as circular goods, covering the entire lifespans of products. Manufacturers are legally required to run disassembly plants, with material recovery legally mandated, turning product disposal into an asset as companies can reuse relevant materials.

The Japanese recycling system is set up based on three key features:

- **Consumer-friendly collection:** Producer responsibility and the system for collecting equipment, electronics, and appliances for recycling at the end of their lifecycles is so comprehensive and easy to use that it is harder not to recycle them. It is routine across Japan, making it well understood and widely used.
- **Consumers pay fees up front:** Similar to British Columbia, the cost of transport and recovery for equipment, electronics, and appliance recycling is paid for at the point of purchase, meaning that the customer does not have any disincentive to participate when a product comes to the end of its life. Penalties for illegal dumping or tipping are also stiff.
- **Recycling infrastructure is co-owned:** As mentioned above, the law requires consortia of manufacturers to run disassembly plants, ensuring they directly benefit from recovering materials and parts. Companies therefore invest for the long-term in recycling infrastructure. Because they own both manufacturing and recovery facilities, companies send product designers to disassembly factories and put prototypes through the disassembly process to make sure that materials are easy to recover at the end of a product’s life cycle.

The Japanese system is based on incentivizing everyone to do the right thing. The Japanese model has been summarized by some as ‘honesty, with incentives’ and serves to reinforce public spiritedness. Comprehensiveness and collaboration are, in fact, at the heart of the Japanese system. Manufacturers have been focused on using more recycled materials and making longer-lasting products that are easier to repair and recycle.

Beyond the private sector, the public also plays an active part with respect to the separation recyclables, paying direct recycling fees, and holding companies to account when necessary. With well-established recycling laws, recycling has become the cultural norm and the public is generally supportive, willing to oblige and cooperate with local government to help with impressive requirement around sorting of materials. Some municipalities, have gone to extremes; the city of Kamikatsu, for example, is well known for its zero-waste efforts, including the separation of waste into 34 categories for recycling and treatment.

The result of applying a broad set of laws and policies, combined with existing cultural norms in Japan, has been extraordinary recycling rates, with the country landfilling less than 5% of its waste and recycling 98% of its metals. Japan's appliance recycling laws ensure that the great majority of electrical and electronic products are recycled, with an estimated 75%–90% of the materials they contain being recovered. Many of these materials go back into the manufacture of the same type of product in a true “closed-loop” or circular economy process.

### Organics & Food Waste

With respect to organic waste, large quantities of food waste have been an issue in the production, processing, and consumption phases due to a particular cultural preference for freshness in Japan. In 2000, the “Act on the Promotion of the Recycling of Recyclable Food Resources” (i.e., Food Recycling Act) was enacted with a view to ensuring the effective use of food resources and reducing the amount of food waste that was being sent to landfill.

The Food Recycling Act defines basic rules regarding the control and reduction of food waste generation by different entities as well as the recycling and thermal recovery of useful food waste (recyclable food resources). The Act also mandates that measures be taken to promote the recycling of food resources by food-related business operators in every area including manufacturing, wholesale, retail, and the restaurant industry.

The Food Recycling Act also created a system for registering business operators that manufacture fertilizers and stock feed by using recyclable food resources as raw material, as well as a system to implement recycling programs by food-related business operators, recycling operators, and farmers, to use fertilizers and stock feed obtained from such recycling programs. Users of these systems are eligible for preferential measures specified in related regulations in order to efficiently recycle food waste.

Due to the Food Recycling Act, the recycling rate for recyclable food resources has continued to increase, rising from 29% in 2000 to more than 85% today. Although the recycling rate in the food manufacturing industry is generally high, the recycling rate for recyclable food resources becomes lower in the order of wholesale food, retail food, and the restaurant industry. One of the reasons for this is that waste sorting becomes more difficult in the lower reaches of the food distribution chain.

Japan has also placed an emphasis on bioenergy production from organic waste, with considerable incentives for anaerobic digestion. A lot of investment by federal government has taken place with respect to research and supporting the technology for processing organic and food waste (i.e., anaerobic digestion / fermentation for biogas). There are now more than 100 biogas plants across Japan, due in large part to subsidization from the Ministry of Agriculture.

## 2. Key Circular Economy Targets

To monitor the development of a sound material-cycle society (i.e., circular economy) in Japan, the Fundamental Recycling Plan defined three indicators that represent different dimensions of the material flow, namely:

- A **resource productivity indicator** measuring material use as a proportion of GDP;
- A **cyclical use rate indicator** of materials in the economy, measured by the material reused as a proportion of total material used by the economy (recycling or circulation rate); and
- An **output indicator**, measuring how much waste is ultimately landfilled (final disposal amount).

These material flow indicators have associated targets, as outlined below. Japan supplements these with a host of sector-specific measurements, for which there are sometimes industry specific targets.

<i>Indicator</i>	<b>2000</b>	<b>Target 1<sup>st</sup> Plan (FY 2007)</b>	<b>Target 2<sup>nd</sup> Plan (FY 2012)</b>	<b>Target 3<sup>rd</sup> Plan (FY 2020)</b>
<i>Resource Productivity</i>	248,000 yen / tonne	390,000 yen / tonne	420,000 yen / tonne	460,000 yen / tonne
<i>Cyclical Use Rate (Recycling Rate)</i>	56 million tonnes	28 million tonnes	23 million tonnes	17 million tonnes
<i>Output / Final Disposal Amount</i>	10%	14%	14-15%	17%

Japan also measures indicators of societal effort toward a circular economy, looking at the size of the market for rental and leasing of goods, the amount of reusable packaging sold, the number of local authorities that charge for residual waste collection, and even the sales of disposable items such as chopsticks as a proxy for the proportion of the population that uses reusable chopsticks.

In terms of food waste, new recycling targets were set in 2015, to be reached by 2019, as follows:

- **Food manufacturers and processors:** 95% (up from 85% that was outlined in 2007 revisions to the Act)
- **Food wholesalers:** 70% (equal to the same target as was outlined in 2007 revisions to the Act)
- **Food retailers (e.g., supermarkets):** 55% (up from 45% that was outlined in 2007 revisions to the Act)
- **Restaurants:** 50% (up from 40% that was outlined in 2007 revisions to the Act)

Despite the number of recycling and resource efficiency related laws in Japan, it is the implementing regulations rather than the framework legislation that set specific and enforceable targets. Japanese regulations have been criticized as too timid and as lacking effective enforcement mechanisms.

### 3. Leading Policies & Legislation

Policy/Program/Strategy	Date	Summary	Impact Area
<b>Basic Environment Law</b>	Enacted in 1993	<ul style="list-style-type: none"> <li>• A major pollution control law</li> <li>• The Law provides details about basic national policy concerning the environment.</li> <li>• The Law was revised from the Basic Law for Environmental Pollution Control and was added to the formation of the environmental conservation society and the global environmental protection without consideration of borders or generations as a basic policy.</li> </ul>	General, Overarching
<b>Basic Act for a Sound Material-Cycle Society</b>	Enacted in 2000; revised in 2003, 2008 & 2013	<ul style="list-style-type: none"> <li>• The law provides a clear vision for a sound material-cycle society, which is designed to reduce natural resource consumption as well as environmental impact.</li> <li>• It also presents basic principles for the establishment of a sound material-cycle society, including legally determining the order of priority for resource recycling and waste management (1. generation reduction; 2. reuse; 3. recycling; 4. thermal recovery; and 5. proper disposal).</li> <li>• The Act puts a greater focus on upper 2 “Rs” and high-tech horizontal recycling).</li> <li>• In the Fundamental Plan for Establishing a Sound Material-Cycle Society (Fundamental Recycling Plan), which was stipulated to be formulated in the Basic Recycling Act, the government explicitly set numerical targets for resource productivity (entrance), the recycling rate (circulation), and the final waste disposal amount (exit), to promote the full-scale development of a sound material-cycle society.</li> </ul>	All, Upstream & Downstream
<b>Basic Law for Establishing the Recycling-based Society</b>	Enacted in 2000	<ul style="list-style-type: none"> <li>• Became the foundation of Japan’s circular economy initiatives.</li> <li>• This framework law amended the 1991 recycling law mentioned in section 1 above.</li> </ul>	All, Downstream
<b>Law for the Promotion of Effective Utilization of Resources</b>	Enacted in 2000	<ul style="list-style-type: none"> <li>• The Law is central to the Japanese legislative circular economy structure, coming from the 2000 Basic Law for Establishing the Recycling-based Society and the 1991 recycling law that were brought together.</li> <li>• The Law, which treats materials as circular goods, covers the entire lifespans of products.</li> <li>• The Law lays out clear responsibilities for (1) Businesses, (2) Consumers, (3) the National Government, and (4) Local Governments.</li> <li>• Manufacturers are legally required to run disassembly plants, with material recovery legally mandated, turning product disposal into an asset as companies can reuse relevant materials.</li> </ul>	All, Upstream & Downstream



<b>Food Recycling Law</b>	Enacted in 2000; revised in 2007	<ul style="list-style-type: none"> <li>• The Food Recycling Act defines basic rules regarding the control and reduction of food waste generation by different entities as well as the recycling and thermal recovery of useful food waste (recyclable food resources).</li> <li>• The Act mandates that measures be taken to promote the recycling of food resources by food-related business operators in every area including manufacturing, wholesale, retail, and the restaurant industry.</li> <li>• The Act also created a system for registering business operators that manufacture fertilizers and stock feed by using recyclable food resources as raw material, as well as a system to implement recycling programs by food-related business operators, recycling operators, and farmers, to use fertilizers and stock feed obtained from such recycling programs. Users of these systems are eligible for preferential measures specified in related regulations in order to efficiently recycle food waste.</li> </ul>	Food waste sector, Downstream
<b>Law for Promotion of Sorted Collection and Recycling of Containers and Packaging</b>	Enacted in 1995; revised in 2006	<ul style="list-style-type: none"> <li>• Designed to ensure sorted collection of waste containers and packaging (which account for some 60% by volume of municipal solid waste), recycle them, reduce refuse and efficiently use resources.</li> <li>• Includes glass containers, PET bottles, and other metal, paper, and plastic containers and packaging.</li> <li>• Outlines the responsibilities of consumers, municipalities, and businesses.</li> </ul>	Packaging waste, Downstream
<b>Specified Home Appliance Recycling Law</b>	Enacted in 2001; revised in 2008	<ul style="list-style-type: none"> <li>• Established a system to properly recover end-of-life (EoL) home appliances and efficiently recycle them so that they can be reborn as raw materials.</li> <li>• The Law divides the roles of home appliance manufacturers, retailers, and consumers.</li> <li>• Consumers are asked to cooperate by paying a collection and transport fee and a recycling fee when disposing of EoL home appliances.</li> </ul>	Appliances, Upstream & Downstream
<b>Green Purchasing Law</b>	Enacted in 2000	<ul style="list-style-type: none"> <li>• A Law obligating governmental entities to buy certain “green” products.</li> <li>• In some cases, this law has helped to create the threshold demand necessary for manufacturers to begin producing “green” products at a profitable level.</li> </ul>	Public procurement, Upstream
<b>Construction Material Recycling Law</b>	Enacted in 2002	<ul style="list-style-type: none"> <li>• Aims to promote sorting and recycling of waste concrete, asphalt, and other materials of the specified size or larger are sorted and demolished at the construction site and resulting wastes are recycled.</li> </ul>	Construction sector, Downstream
<b>End-of-Life Vehicle Recycling Law</b>	Enacted in 2002; implemented in 2005	<ul style="list-style-type: none"> <li>• The Law constructs a new recycling system, preventing illegal dumping, reducing final disposal, and making full use of recyclable resources and reusable parts.</li> <li>• The Law also defines role sharing among and responsibilities of automobile-related</li> </ul>	Vehicles, Upstream & Downstream

		businesses. Car owners are required to pay ELV recycling fees.	
<b>Top Runner Program</b>	Introduced in 1999	<ul style="list-style-type: none"> <li>• One of the most highly regarded Japanese circular economy initiatives.</li> <li>• The Program is narrow in scope, covering products and services that use energy.</li> <li>• It employs a combination of economic and command-and-control policies, and its enforcement mechanisms are somewhat unconventional, employing, for example, the “name and shame” device.</li> <li>• In general, the government selects the “top” product in a given product category and mandates that its energy efficiency characteristics as the baseline requirements for all products in the same category by a specific date.</li> <li>• By and large, the Program has been a demonstrable success.</li> </ul>	Appliances, electronics & other equipment, Upstream

## The Netherlands

### 1. Leading Strengths & Characteristics

The Netherlands is one of the OECD's best performers in the area of waste management, having successfully achieved progressively ambitious targets while keeping charges at relatively low levels. The country is in a good position to capitalize on circular economy opportunities: it has good infrastructure, major ports and airports, and leading businesses in the areas of agri-food, bio-based chemicals, high-tech systems and materials, logistics, creative industries, and recycling.

With a relatively small land mass of roughly 42,000 square kilometers and population of about 17 million, it has a population density of a whopping 404 people/square kilometers. Resource productivity is €3.68/KG (\$5.15 CAD<sup>174</sup>) which is 186% of the European average while material use per person (DMC) is 10.3 tons/per person at 79% of the EU average. These measurements are indicative of an import-dependent economy with the majority of primary and raw materials coming in from other countries.

Like Germany, material resource efficiency is at the heart of circular economy policies in the Netherlands with a focus on four key areas:

- Securing raw materials
- Employment growth
- A reduction in environmental impact
- Sustainable use and restoring of natural capital

The Dutch held a third of the European Council's current presidency trio (shared with Malta and Slovakia) from January 1st to June 30th 2016. One of the top priorities of the Presidency was to develop forward-looking policy on climate and energy which focused on circular economy in the Netherlands and throughout Europe; the EU Action Plan for the Circular Economy has been implemented at both the European Union and the Netherlands national level. There are three leading policies the Netherlands has developed that interlace and intersect on CE objectives:

- National Policy on Green Growth 2015 (NPGG)
- From Waste to Resource (FWTR)
- A Circular Economy in the Netherlands by 2050 (CEN 2050)

All three of these policies build off each other and create frameworks for immediate actions, mid-term actions, and long range goals.

NPGG establishes mid-range objectives for government action to stimulate CE across four policy pillars (smart use of market incentives; an incentivizing framework with legislation that promotes dynamism; innovation; and the government as a network partner). The two core principles of the NPGG are to shift the Netherlands to a bio based economy, and to consider waste as a resource.

FWTR addresses the current situation by implementing measures to shift immediate behaviours for waste prevention and for capture of the greatest value possible out of waste that is generated. Finally, CEN 2050 is a far-reaching vision that sees the Netherlands operating in an entirely circular economy, and includes a mid-term objective of reducing the use of all primary raw materials (fossil, metals, minerals) by 50% by 2030.

<sup>174</sup> Based on exchange rate of €1 = \$1.40 CAD used throughout this report

A bio-based economy is the cornerstone of Circular Economy in the Netherlands by 2050 framework out of which flow numerous policies, agendas, plans, and working groups. The focus on bioeconomy means all raw materials and products must remain in cycles as long and at as high a grade as possible, and that raw materials must be utilized to the greatest extent possible, making high-quality use of biomass and recycling residues. The goals are to be:

- Reducing the use of and replacing fossil resources by sustainably produced biomass;
- Developing and implementing new production and consumption methods that lead to improvements; and deviations from the trend in the use of biomass and food.

Since 1995 the Netherlands has had a landfill ban on all biodegradable and combustible materials which has given rise to a significant waste-to-energy sector. At the same time, biodegradable solid waste (BSW) has continued to be landfilled due to provincial operators' ability to grant exceptions to the ban. However there are signs of improvement: from 2006 through 2010 the amount of BSW landfilled has dropped from just under 30% (measured as a percentage of the amounts generated in 1995), to 5% where it has remained stable since 2010.

The Dutch government has issued a number of policies to address the problem of food waste, including some hard targets. For the period of 2009 – 2015 that target was to reduce food waste by 20%, and the current-future target 2015 – 2030 is to reduce it an additional 30%.

In January 2017 the “Dutch Task Force on Circular Economy in Food” was launched. A collaboration between the Ministry of Economic Affairs, Wageningen University & Research, and the Sustainable Food Alliance, the 25 member Task Force will be producing a national strategy and road map in the second half of 2017 with additional goals, measures, and objectives with both long-term and short-term actions.

## 2. Key Circular Economy Targets

Under the CEN 2050 program, the Netherlands aims to reduce raw material consumption by 50% by 2030 and by 100% by 2050. Along the way there are several incremental targets:

### Waste Reduction Targets

In the Netherlands many waste-related targets relate to EU directives, including the Waste Framework Directive, the Packaging Directive and the WEEE (Waste Electrical and Electronic Equipment) Directives. The targets of most relevance are:

- residual household waste should amount to less than 100 kilograms per person per year by 2020 and less than 30 kilograms by 2025
- at least 75 % of household waste (including bulky waste) should be collected separately by 2020
- at least 75 % of the waste produced by small companies, offices, stores and services should be collected separately by 2020
- at least 95 % of construction and demolition waste should be recycled by 2015
- At least 85 % of industrial waste should be recycled by 2015
- by 2022, no more than 5 million tonnes of residual waste is allowed to be incinerated or sent to landfill (in 2012 the figure was 10 million tonnes)

### Food Waste

The Dutch government has six actions in the area of food waste to meet the current goal of reducing it by 30% from 2015 to 2030:

- Transparency: clarity on waste figures through monitoring
- Stimulating innovation and research
- Raise awareness among the consumers and strive for behavioural change through public information campaigns
- Better understanding of and adaptation of regulation on food dating and labeling
- Stimulating food donation
- Addressing the problem of food waste in the EU and worldwide

The Dutch Task Force on Circular Economy in Food will draw on insights gained from the European REFRESH program. REFRESH (Resource Efficient Food and dRink for the Entire Supply cHain) involves 12 European countries and China, working toward the Sustainable Development Goal 12.3 of halving food waste per capita at both the household and retail levels.

One notable action taken by the Dutch government was a €3.13M (\$4.38M CAD) Small Business Innovation Research project specific to food waste. The program ran 2010 – 2014 and provided funding for feasibility studies on three topics:

- Food waste prevention- to avoid food losses in the agri-food chains due to losses in quality, as a result of which food is thrown away by consumers or other chain members
- Maintaining/keeping of food waste streams meant for human consumption in agro-food chains for human consumption.
- Transforming food waste streams into food products for human consumption by reprocessing and remanufacturing

### 3. Leading Policies & Legislation

Policy/Program/Strategy	Date	Summary	Impact Area
<b>National Policy on Green Growth</b>	2013 updated in 2015	<p>Five Pillars</p> <ol style="list-style-type: none"> <li>1. Smart use of market incentives</li> <li>2. Incentivizing framework that promotes dynamism</li> <li>3. Innovation</li> <li>4. Government as a network partner</li> <li>5. International trade and aid</li> </ol> <p>Across Eight Domains</p> <ul style="list-style-type: none"> <li>• Circular Economy: from waste to resource</li> <li>• Bio based economy</li> <li>• Agriculture and food supply</li> <li>• Sustainable, affordable, reliable energy supply</li> <li>• Ambitious climate policy</li> <li>• Energy efficient built environment</li> <li>• Sustainable transportation</li> <li>• Sustainable use of water</li> </ul>	Upstream

<b>A Circular Economy in the Netherlands by 2050</b>	2016	<p>The 5 economic sectors to drive circular economy in Netherlands are:</p> <ul style="list-style-type: none"> <li>• Biomass and food</li> <li>• Construction sector</li> <li>• Plastics</li> <li>• Manufacturing industry</li> <li>• Consumer goods</li> </ul>	Upstream
<b>National Waste Management Plan</b>	2002 – 2012  Updated  2009 – 2017 with targets to 2021	<p>The NWMP has three overarching components:</p> <ul style="list-style-type: none"> <li>• Policy framework</li> <li>• Sector plans</li> <li>• Capacity plans</li> </ul> <p>And five incentive areas:</p> <ul style="list-style-type: none"> <li>• Enforcement of current legislation</li> <li>• Financial instruments</li> <li>• Separation of collection</li> <li>• Stringent standards</li> <li>• Effective communication</li> </ul>	Downstream
<b>From Waste to Resource</b>	2014	<ul style="list-style-type: none"> <li>• Identifying, sustainably managing and utilizing natural capital</li> <li>• Focusing the design and development of products on circularity</li> <li>• Increasing and disseminating knowledge about the circular economy and making it practicable</li> <li>• Encouraging resource-free business operations</li> <li>• Turning chains into cycles</li> <li>• Developing financial and other market incentives</li> <li>• Making consumption and procurement circular</li> <li>• Gearing waste policy to the circular economy and improving waste collection and recycling (a two-fold aim)</li> <li>• Developing indicators and metrics that quantify the transition to a circular economy</li> </ul>	Upstream & Downstream
<b>Biomass Vision 2030</b>	2016	<p>Objectives:</p> <ul style="list-style-type: none"> <li>• Increase the share of renewably produced biomass</li> <li>• Support investments in energy efficient technologies</li> <li>• Stimulate biobased materials</li> </ul> <p>Actions:</p> <ul style="list-style-type: none"> <li>• Facilitate cross-sector collaborations aimed at high level biobased business cases</li> <li>• Support private initiatives that create commodities from residues</li> <li>• Facilitate collaboration between minor timber companies and emerging wood use sectors</li> <li>• Support development of revenue models for biomass cycles by area organizations</li> </ul>	Downstream

<b>Dutch National Raw Materials Agreement</b>	2016 - 2017	An agreement between 180 signatories to shift the Dutch economy to one that operates on reusable raw materials, which flows out of the overarching CEN 2050 framework on the topics of food, plastics, manufacturing, construction, and consumer goods. Signatories include the Ministry of Infrastructure and Environment (MIE), the Ministry of Economic Affairs (MEA), the Association of Dutch Municipalities, the Association of Interprovincial Authorities, innovative start-up companies, financial institutions, trade unions, and environmental organizations. To support these agreements, the MIE is making available €27M (\$37.8M CAD) for improved waste separation processes to be implemented to ensure discarded products are reused as valuable raw materials. This money will also be used to fund new innovations aimed at improving the recycling capability of products	All
<b>REBus (Resource Efficient Business Models) operated by WRAP</b>	2015 - 2020	An initiative that assists with developing, implementing, and refining business models with a high degree of resource circularity in the attempt to achieve a 15% savings in both costs and resources. The program is focused on five industries: <ul style="list-style-type: none"> <li>• IT</li> <li>• Office furniture</li> <li>• Construction</li> <li>• Textiles</li> <li>• Catering/food service</li> </ul>	Upstream

## Ontario

### 1. Leading Strengths / Characteristics:

Ontario is in the midst of finalizing a new circular economy strategy, the “Strategy for a Waste Free Ontario: Building the Circular Economy” and received final public comments on the draft at the end of January 2017.

The final Strategy will be released on the heels of the 2016 Waste Free Ontario Act and is expected for completion during the first half of 2017. The Waste Free Ontario Act is considered a major step to help fight climate change by reducing greenhouse gas (GHG) emissions that results from the landfilling of products that could otherwise be recycled or composted.

The Act and the Strategy have three key aims:

- Increase resource productivity and reduce waste
- Enable an efficient and effective recycling system.
- Create conditions to support sustainable end-markets.

Key goals include:

- Zero waste
- Zero emissions from the waste sector

The proposed Strategy’s zero waste specific goals appear to be downstream specific and waste management centric relative to other jurisdictions. That being said, regulations that are in development are intended to drive circular economy and resource productivity best practices.

The long-term aim is to increase resource productivity and reduce waste by making Ontario businesses more innovative; however, a detailed approach is not depicted in the Strategy document. The Strategy will eventually seek to empower and incentivize producers to implement programs that foster product design innovation, reuse, and remanufacturing. It will also include recycling targets and fees based on the sales of products and material components, making the new strategy explicitly outcome-based. General waste diversion strategies that are proposed include disposal bans, enhancing generator requirements, and developing and implementing an Organics Action Plan.

The Strategy can be divided into two key parts. The first part, the Resource Recovery and Circular Economy Act, sets the overarching direction of both the Act and upcoming Strategy and establishes a new competitive producer responsibility program. The second part, the Waste Diversion Transition Act, replaces the Waste Diversion Act of 2002. The ultimate objective of the Act is to implement a more outcome based approach that would divert more waste from landfills, create jobs, and help fight climate change while encouraging more producer responsibility.

Implementing the Strategy for a Waste Free Ontario is expected to cost approximately \$20-30 million. While no government funding has been specifically allocated towards it to date, regulatory requirements are expected to push investments forward.



### Shifting to Full Producer Responsibility

The shift to more producer responsibility is at the center of the waste management transition in the province. In 2002, Ontario established the Waste Diversion Act (WDA), which has now been replaced by the Waste Diversion Transition Act (part of the Waste Free Ontario Act) 2016. The WDA created four waste diversion programs. The programs are: blue box waste (paper and packaging), municipal hazardous or special waste, used tires, and waste electrical and electronic equipment. Each program is operated by an industry funding organization (IFO). Under the WDA, producers of waste theoretically paid for 50% of the annual share of the costs for their waste. In reality, producers through the IFOs frequently paid less and costs were pushed on to municipalities which caused multiple legal disputes.

Under the Waste Diversion Transition Act, the Ontario provincial government's circular economy policy will essentially place the full cost and environmental responsibility on producers with respect to the collection, sorting, and treatment of recyclables and waste. This will be an important shift from the monopolized IFO schemes towards a competitive system that will encourage an unlimited number of Producer Responsibility Organizations (PROs). Competition is expected to increase innovation, increase the level of service, and reduces costs.

There is no confirmation from the Ministry of Environment and Climate Change with respect to timelines on the transition to competitive schemes. However, industry insiders have suggested the following timelines for regulations rolling-out:

- MHSW – 2017
- WEEE – 2018
- Tires – 2018
- Blue Box – 2019/2020

### Organics Action Plan

The Organics Action Plan, which is planned for completion by the end of the year, will align with Ontario's climate change strategy and economy-wide GHG emissions reduction targets. It will consider the entire supply chain, including pre-consumer and post-consumer organic wastes. The Plan will likely include a focus on source solutions, composting, and energy from waste, and include the recovery of organic waste in high-rise and multi-residential dwellings. Outcomes and data will be monitored and measured by the RPRA and will include third-party monitoring, audits, and transparency through public reporting.

The Organics Action Plan (OAP) is seeking to have less food waste going to disposal as a means of reducing GHG emissions associated with growing, manufacturing, transporting and disposing of food. The OAP will further seek to align with the government's Climate Action Plan, and is seriously considering promoting biogas produced from organic waste as a renewable source of energy that reduces the need for fossil fuels.

### The Resource Productivity and Recovery Authority

The Strategy fosters a clear focus on data governance, targets and performance monitoring and measurement of recycling targets. The Waste Free Ontario Act transforms Waste Diversion Ontario to become the Resource Productivity and Recovery Authority (RPRA), which will serve as a source to compile data from generators and service providers while acting as a compliance and enforcement agency with the authority to audit and financially penalize non-compliance. Organizations will have to report to the RPRA performance metrics such as tonnes of waste supplied, collected, and recycled.

## **2. Key Circular Economy Targets**

The Strategy for a Waste Free Ontario sets forth the following relevant waste diversion targets:

- 30% general diversion by 2020, 50% by 2030 and 80% by 2050; and
- 40% diversion of organics by 2025 and 60% by 2035 (Ontario's Climate Change Action Plan).

### 3. Leading Policies & Legislation

Policy / Strategy	Date	Summary	Impact Area
<b>Strategy for a Waste-Free Ontario: Building the Circular Economy</b>	Under stakeholder consultation	The aim of the strategy is to encourage resource efficiency and GHG reduction in order to protect the environment, make Ontario businesses more competitive through extended product life cycle thinking, and drive product innovation.	General Impact
<b>Organics Action Plan</b>	Under stakeholder consultation	The Organics Action Plan is being developed through the Strategy for a Waste-Free Ontario. It will broadly aim to divert organic waste from landfill by identifying and filling infrastructure capacity and gaps, harmonizing regulatory, non-regulatory, and voluntary programs, and introducing performance measures.	Organics
<b>Waste Free Ontario Act</b>	2016	Contains two acts: The Resource Recovery and Circular Economy Act to set overarching provincial direction and establish a new competitive producer responsibility program, and The Waste Diversion Transition Act, to replace the Waste Diversion Act 2002.	General Impact
<b>Waste Diversion Act</b>	2002	Establishes the four existing waste diversion programs in Ontario: blue box waste (paper and packaging), municipal hazardous or special waste, used tires, and waste electrical and electronic equipment. Each program is operated by an industry funding organization (IFO). The act has been replaced by the Waste Diversion Transition Act 2016.	General Impact

## Scotland

### 1. Leading Strengths & Characteristics

Scotland stands apart from other jurisdictions by placing a heavy emphasis on measuring and evaluating the success of circular economy programs according to reductions in greenhouse gas emissions. This approach covers the entire economy and takes a holistic view, rather than only focusing on downstream (waste) or upstream (manufacturing) operations. The pillar of this approach is Scotland's Carbon Metric, introduced in 2011 by the Scottish Government's Department for Environment, Food and Rural Affairs. The Metric is the first of its kind, and quantifies the carbon impact of a more circular economy.

The circular economy strategy is upheld by a few key pieces of legislation. The first circular economy strategy emerged in 2013, titled 'Safeguarding Scotland's Resources,' and set out an approach to resource efficiency. Its headline action was the Resource Efficient Scotland program. The Scottish Government released its most recent strategy, 'Making Things Last: Circular Economy Strategy for Scotland,' in 2016. Making Things Last prioritizes four key areas:

1. Food and drink, and the broader bio-economy
2. Remanufacture
3. Construction and the built environment
4. Energy infrastructure

Finally, Making Things Last covers all 'loops' of the circular economy, from design to reuse to recycling, and addresses how to best manage leakage via energy from waste and landfill. In line with the metric-oriented approach of the Scottish government, the Plan includes measuring the carbon impacts of waste to prioritize the recycling of resources which offer the greatest environmental and climate change outcome.

Preceding the food waste reduction target was Scotland's Zero Waste plan (released in 2010), and the corresponding Zero Waste Scotland program. The Plan constitutes Scotland's vision for a zero-waste society, including the development of waste prevention programs and provisions specific to organic materials. The Zero Waste Plan, along with Waste (Scotland) regulations, set out clear source separation goals and efforts to limit organic waste to landfill to ultimately drive energy recovery treatment solutions and composting. Zero Waste Scotland is funded by the Scottish Government's Circular Economy Strategy and the EU's Europe 2020 growth strategy. Zero Waste Scotland overall programme budget is approximately £25M.

### 2. Key Circular Economy Targets

Key targets that Scotland's Circular Economy Strategy aim to achieve are 70% recycling/composting and preparing for re-use of all waste, to send no more than 5% of all waste to landfill, and to set a food waste reduction goal of 33% by 2025.

According to the 2011 Waste Regulations, businesses including restaurants and cafés which produce over 50kg of food waste weekly were targeted to drop to 5kg per week by 2016 and must segregate food waste separately for collection.

### 3. Leading Policies & Legislation

Policy / Strategy	Date	Summary	Impact Area
<b>Making Things Last: Circular Economy Strategy for Scotland</b>	2016	Sets out priorities for moving towards a more circular economy – where products and materials are kept in high value use for as long as possible. Making Things Last includes a commitment to explore Extended Producer Responsibility Schemes for tires, furniture and mattresses	General Impact, Upstream*
<b>Zero Waste Plan</b>	2010	Sets out the Scottish Government's vision for a zero-waste society. This vision describes a Scotland where all waste is seen as a resource; waste is minimized; valuable resources are not disposed of in landfills, and most waste is sorted, leaving only limited amounts to be treated.	Organics
<b>Scotland's Carbon Metric Tool</b>	2011	Takes a Life Cycle Approach to measuring the environmental impact of a range of materials and products in a systematic and holistic manner, considering emissions of a range of greenhouse gases associated with extraction of raw materials, processing, manufacture, transport and disposal.	General Impact
<b>Revolve Reuse Quality Standard</b>	2012	The Revolve program is a re-use quality standard that stands for quality, reliability and professionalism. To achieve certification a shop should commit to high standards.	Upstream
<b>Scottish Institute for Remanufacture (SIR)</b>	2015	Stimulates and co-funds projects that address industry challenges and enable companies to increase reuse, repair and remanufacture in their operations.	Upstream
<b>Resource Efficient Scotland</b>	2013	The Resource Efficient Scotland programme offers free advice and technical support as well as the sharing of best practices and new technologies to help companies embed resource efficiency in their operations.	Upstream
<b>Policy Statement, Zero Waste Regulations</b>	2011	The regulations have been introduced gradually, beginning in 2013 and continuing until 2020. They included regulations to segregate and separate key recyclable materials at the source, a ban on mixing separately collected recyclable materials, a ban on landfilling key recyclable materials, and a ban on waste disposed of to landfill based on organic content. The regulations were implemented through a joint implementation program with Zero Waste Scotland and SEPA.	Organics

<b>Waste Regulations</b>	<b>Scotland</b>	2014	Builds on the 2011 waste regulations. Sets food waste targets for businesses and mandates that all organizations operating in Scotland present glass, metal, paper and cardboard for recycling.	Organics
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## Sweden

### 1. Leading Strengths & Characteristics

By 2030, Sweden plans to become a completely fossil-fuel free country through major investments and scaling of renewable energy technologies, and replacing fossil-based fuels with biobased and renewable sources. Like all countries in the European Union, Sweden is tied to the European Commission's (EC) policies around waste, GHG emissions, and other binding environmental legislation which impacts the areas of energy, waste, and environmental targets. Since the mid-1990s, Sweden has been one of the few industrialized countries to demonstrate a successful decoupling of economic growth from GHG emissions: growing its economy while simultaneously reducing GHG emissions levels.

Sweden's GHG emissions are among the lowest in the EU and OECD. In 2014, Sweden's GHG emissions totaled 55.8 million tonnes of CO<sub>2</sub>e, compared with 71.8 million tonnes in 1990, showing a 22% reduction. Meanwhile, Sweden's GDP grew 58% during this time period, seemingly representing a model for successful decoupling.

With respect to environmental protection and material/resource efficiency, Sweden has four overarching policies:

- The Swedish Environmental Code
- Sweden's 16 Environmental Quality Objectives
- From Waste Management to Resource Efficiency: Sweden's Waste Plan 2012 – 2017
- Sweden's Waste Prevention Program (SWPP)

Sweden has some of the highest rates of recycling and waste diversion in the world thanks to strict legislation and stiff taxes on landfilling. At present, 49% of all materials are recycled at either the household, commercial, or industrial level, and roughly 49% of all waste brought to municipal facilities is incinerated for energy and/or district heating resulting in ~2% being landfilled.

The current situation has resulted from close to two decades of increasing legislation and taxes on waste: in 1999 Sweden introduced a tax on municipal solid waste destined for landfill at the rate of 250 SEK / tonne <sup>175</sup>(\$37.50 CAD), and by 2006 the tax had reached 435 SEK / tonne (\$65.25 CAD). Over the same timeframe the amount of municipal solid waste sent to landfill dropped from 22% (of total MSW) in 2000 to 1% by 2006 showing a distinct correlation between high taxes and improved waste diversion.

In 2012 Sweden adopted the European Environment Agency's Waste Framework Directive which encourages upstream improvements in product design and safety, and the general objective of preventing waste in the first place.

In terms of the consumption of materials and economic indicators, Sweden sits over most of the EU averages. The primary economic indicator is GDP per person which sits at €33,700 GDP/person (\$47,180 CAD) and is 123% of the EU average. Material use indicators (DMC, or Domestic Material Consumption) sits at 224 million tonnes per year which works out to 23.1 tonnes/person in Sweden. This is 176% of the EU average (13 tonne/person). This high relative rate can mainly be attributed to a large mining and mineral sector in Sweden which is exceptionally material intensive.

Conversely, their resource productivity (a highly simplified measurement of cost per kilogram of material consumed) is €1.70/KG (CAD \$2.38/kg) sits at 88% of the EU average. This low resource productivity measurement indicates a

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<sup>175</sup> Financial calculations are based on the current exchange rate of €1 = \$1.40 CAD and SEK 1 = \$0.15 CAD

successful decoupling of resource use to GDP growth where the rate of consumption of resources is less than the rate of GDP growth in the country.

Sweden has become one of the world's technology leaders in waste-to-energy and district heating (particularly from incineration), as well as bio-based industries. The country currently draws at least 22% of its total power supply from bioenergy derived from the forestry sector, which is directly linked to waste-to-energy and a significant component of Sweden's economy. Sweden's distinction as a leader in incineration does not come without issues however (discussed further later in this short report).

## 2. Key Circular Economy Targets

Under the national Waste Plan and Waste Prevention Program, food waste targets include:

- By 2018, at least 50% of food waste from households, canteens, shops and restaurants shall be collected separately and treated biologically to secure the recovery of nutrients, of which 40% is treated in a way that also energy is recovered (typically incineration or conversion to biogas).

Milestone targets proposed by the Swedish Environmental Protection Agency in the 2012 – 2017 National Waste Plan:

- There shall be an action plan for reduced food wastage in the primary food production sector by 2016
- Food waste shall be reduced by at least 20% by 2020 compared to 2010 throughout the entire food value chain (except for primary production).

Other targets for waste reduction, CO2 emissions, and other environmental mitigation goals are outlined in subsequent sections.

## 3. Leading Policies & Legislation

Policy/Program/Strategy	Date	Summary	Impact Area
<b>Swedish Environmental Code</b>	Adopted in 1998	<ul style="list-style-type: none"> <li>• Human health and the environment are protected against damage and detriment, whether caused by pollutants or other impacts;</li> <li>• Valuable natural and cultural environments are protected and preserved;</li> <li>• Biological diversity is preserved;</li> <li>• The use of land, water and the physical environment in general is such as to secure a long term good management in ecological, social, cultural and economic terms; and</li> <li>• Reuse and recycling, as well as other management of materials, raw materials and energy are encouraged with a view to establishing and maintaining natural cycles</li> </ul>	All

<b>Generational Goal</b>	Implemented in 2002	A high level policy that seeks to hand over to the next generation a society in which major environmental problems have been solved without increasing environmental and health problems outside of Sweden	All
<b>Sweden's Environmental Objectives</b> <b>16 Quality</b>	2012	<ol style="list-style-type: none"> <li>1. Reduce Climate Impact</li> <li>2. Clean Air</li> <li>3. Natural Acidification Only</li> <li>4. A non-toxic Environment</li> <li>5. A Protective Ozone Layer</li> <li>6. A Safe Radiation Environment</li> <li>7. Zero Eutrophication</li> <li>8. Flourishing Lakes &amp; Streams</li> <li>9. Good Quality Groundwater</li> <li>10. A Balanced Marine Environment, Flourishing Coastal Areas and Archipelagos</li> <li>11. Thriving Wetlands</li> <li>12. Sustainable Forests</li> <li>13. A Varied Agricultural Landscape</li> <li>14. A Magnificent Mountain Landscape</li> <li>15. A Good Built Environment</li> <li>16. A Rich Diversity of Plant and Animal Life</li> </ol>	All
<b>Sweden's Waste Plan – From Waste management to Resource Efficiency</b>	2012 - 2017	<p>Priority Areas:</p> <ul style="list-style-type: none"> <li>• Waste management within the construction and engineering sector</li> <li>• Household waste</li> <li>• Resource efficiency in the food-chain</li> <li>• Waste treatment</li> <li>• Illegal export of waste</li> </ul>	Downstream
<b>The Swedish Waste Prevention Program</b>	2014 – 2018	<p>Quantitative targets:</p> <ul style="list-style-type: none"> <li>• The amount of waste generated shall be continuously reduced from 2010 onwards</li> <li>• The contents of hazardous substances in materials and products shall be reduced</li> <li>• The amount of food waste in the entire food chain shall be reduced compared with 2010.</li> <li>• The EPA has been mandated by the government to develop a numerical target for textile and textile waste</li> <li>• The proportion of total sales of textiles made of sales of second-hand goods shall increase compared with 2014</li> <li>• Knowledge in the textile sector about the uses and contents of hazardous substances shall be increased compared with 2014</li> <li>• Waste generation per built square meter in 2020 will be reduced compared with 2014</li> <li>• By 2020 pre-processors and recyclers of Waste Electronics and Electronic Equipment (WEEE) shall have better access to information on composition and hazardous substance content compared with 2014</li> </ul>	Downstream