INNOVATION FOR A CIRCULAR ECONOMY: LEARNING FROM THE CLEAN GROWTH JOURNEY

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Smart Prosperity Institute

About Smart Prosperity Institute

Smart Prosperity Institute (formerly Sustainable Prosperity) is a national research network and policy think tank based at the University of Ottawa. We deliver world-class research and work with public and private partners – all to advance practical policies and market solutions for a stronger, cleaner economy.
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Written by Stephanie Cairns and Sonia Cyrus Patel
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LIST OF ACRONYMS

BDC	Business Development Bank of Canada
BERD	Business Enterprise Expenditure on R&D
CAP-EPR	Canada-wide Action Plan for Extended Producer Responsibility
CaPSA	Canadian Plastics Science Agenda
CCEA	Chinese Circular Economy Association
CCME	Canadian Council of Ministers of the Environment
CE	Circular Economy
COSME	Competitiveness of Enterprises and Small and Medium-sized Enterprises
CTDS	Clean Technology Data Strategy
EDC	Export Development Canada
ELVs	End-of-Life Vehicles
EPR	Extended Producer Responsibility
EU	European Union
GDP	Gross Domestic Product
HERD	Higher Education Expenditures on R&D
I-EDDEC	Institut de l'environnement, du développement durable et de l'économie circulaire at Université de Montréal
METRR	Marginal Effective Tax and Royalty Rate
NGOs	Non-Governmental Organizations
NISP	National Industrial Symbiosis Programme
NRCan	Natural Resources Canada
OECD	Organisation for Economic Co-operation and Development
OVAM	Openbare Afvalstoffenmaatschappij voor het Vlaams Gewest
PAYT	Pay-as-you-throw
RFPs	Requests for Proposals
SDGs	Sustainable Development Goals
SDTC	Sustainable Development Technology Canada
SMEs	Small and Medium-sized Enterprises
VAT	Value-added Tax
VCAP	Venture Capital Action Plan
VCCI	Venture Capital Catalyst Initiative
WEEE	Electrical and Electronic Equipment

EXECUTIVE SUMMARY

In today's industrial system, more than 90% of materials extracted for the global economy are used only once, then thrown away. This so-called 'linear economy' literally throws away economically valuable materials, while at the same time causing pressing environmental challenges. The 'circular economy' (CE) is an emergent alternative model for the economy, characterized by designing waste out of the system, highly efficient use of resources, and a continuous recirculation of post-consumer materials, while drawing from renewable energy. It is being advanced as a strategy to address not only waste and pollution but long-term resource security and price volatility.

Transitioning towards this circular economy presents both a tremendous innovation challenge and opportunity. It will require changing how we design, manufacture, sell, consume, use, and manage materials, products and services. In turn, it will require new technologies, products, business practices, and approaches to generating economic growth.

Public policy to support a circular economy is still at an emergent phase in Canada. Canada has yet to develop the type of integrated, comprehensive circular economy vision, strategies, and collaboration that are present in many countries. That said, pockets of interest and policy initiatives have been emerging in Canada on the zero plastic waste file, as well as provincially, municipally, sectorally, and in civil society.

This report aims to kickstart a more holistic discussion on the full suite of public policies needed to support innovation for a circular economy in Canada. It explores these policies through insights from experience with clean innovation, and a review of the emerging global menu of circular economy policies. It also highlights gaps that need to be addressed. This report puts forward promising Canadian policies or programs which could readily be adapted and leveraged to support innovation for a circular economy.

The good news is that Canada begins this journey with two strong advantages: the strong set of pre-existing policies and programs to support clean innovation, and the opportunity to learn from international experience.

Canada's support for clean growth and innovation, while currently designed primarily around carbon reduction commitments, **offers a framework for the full suite of public policy support needed to accelerate a circular economy.**

This strong set of policies and programs has emphasized technological innovation, focussing particularly on low-carbon industrial processes, energy sources, and energy efficiency. Innovation needs for a circular economy also include innovations in product design, production processes, supply chain systems, consumption, and business models, and emphasize material efficiency as much as low-carbon. Hence, the **circular economy potentially offers the next tranche of greenhouse gas reductions and a largely missing, but complementary, dimension for Canadian approaches to clean innovation**.

Research into clean innovation has identified four types of government policies that are necessary to most effectively unleash private sector ambition and crowd in private sector investments for change:

- **PUSH policies**: that drive new ideas
- **PULL policies:** that help stimulate market demand for these solutions
- **GROW policies**: that grow ideas into marketable products and services
- **STRENGTHEN policies**: that make the whole innovation system more effective and resilient

This framework informs what would constitute a full suite of public policies to support innovation for a circular economy (*see Figure 1, below*).

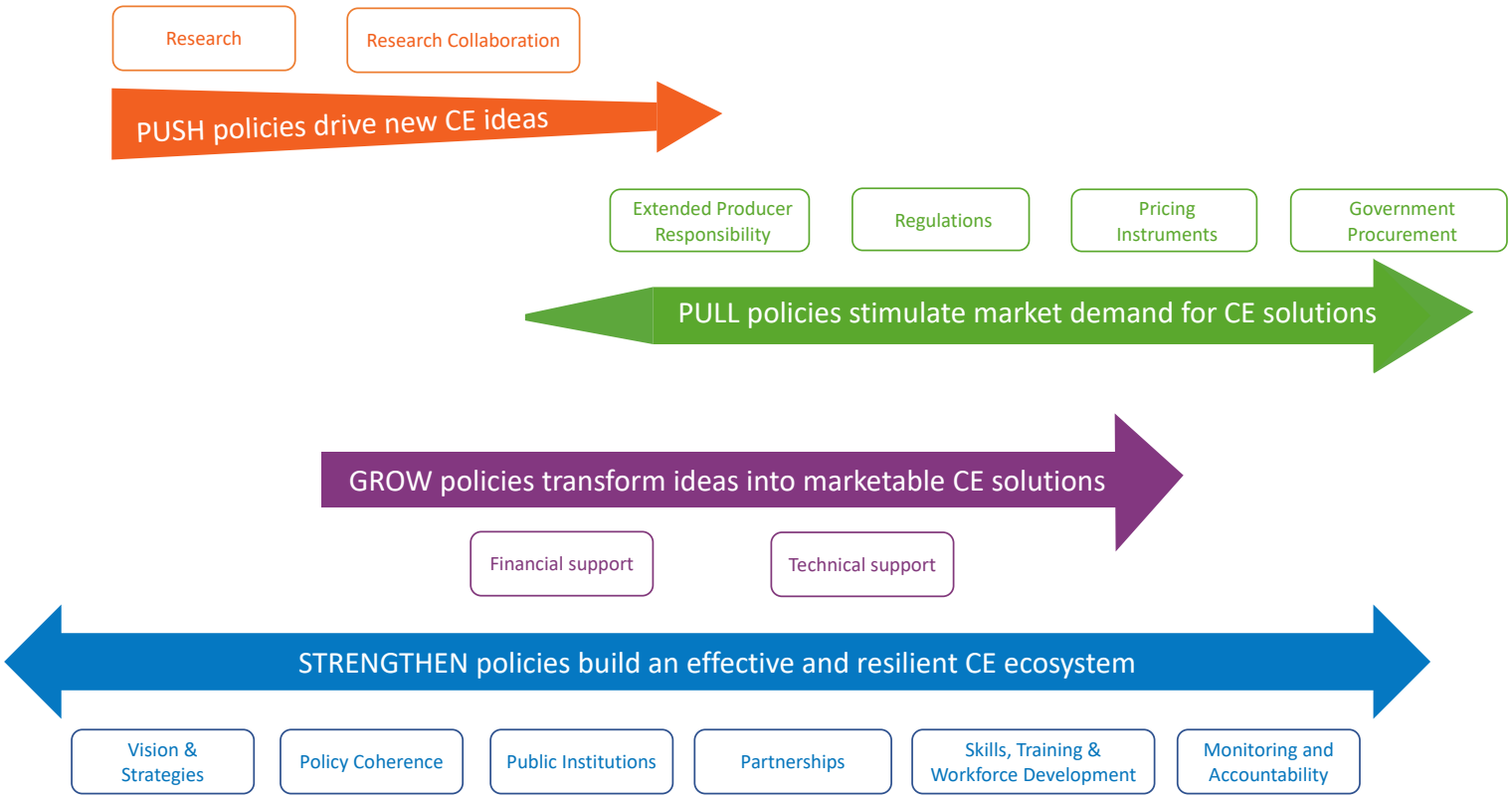


Figure 1: Elements of a full suite of public policies to support circular innovation
(Adapted from original diagram in SPI's Discussion Paper: Canada's Next Edge)

From this, the strengths, opportunities, and gaps for supporting innovation for a circular economy in Canada can be identified:

- PUSH Policies: There are currently few **research programs** in Canada explicitly targeted to the circular economy. This may simply reflect the emergent nature of this topic in Canada. However, a robust set of research and granting programs and institutions, already in place, could be leveraged to support research in this field.

- PULL Policies: These represent the dominant cluster of tools to drive a circular economy both internationally and in Canada. While Canada has initial **regulatory**, **pricing**, **and procurement policies** in place, these are only a fraction of the full suite of PULL policies that could stimulate the market for circular economy solutions. Furthermore, few were designed with explicit circular economy objectives. Many also reside with provincial and local governments, resulting in differences in priorities, regulations, and definitions, that have created an inefficient and fragmented national landscape. So far, policies to pull innovation in the higher strategies of the circular economy—beyond recycling to reuse, reduce, and rethink/redesign—are largely lacking in Canada.

- GROW Policies: There are currently no federal **financial or technical support programs** in Canada targeted specifically to converting ideas into marketable solutions for the circular economy.

- STRENGTHEN Policies: Most of the ecosystem of supporting policies for a circular economy has yet to be built in Canada. This includes those that **create visions and strategies, establish policy congruency and coherence, strengthen public institutions, build partnerships, invest in skills, and ensure monitoring and accountability.** This is not surprising given that Canada has barely begun to consider broader and more integrated public policies for a circular economy.

This analysis points out the gaps in Canada's circular economy agenda and reveals the case for **strong, timely and wide-ranging government action**. Fortunately, current supports for clean growth and innovation offer **a robust initial platform from which to build out many of these policies and programs**. By doing so, public policy to support a circular economy can leverage the two decades already invested in building this ecosystem for clean innovation, which is only now beginning to deliver change at the system level.

With a shift towards a circular economy underway globally, Canada cannot afford to lag in embracing strategies with such potential to reconcile economic growth with ecological limits, boost competitive advantage and create jobs, improve equity and societal well-being, attract green investment, and diversify the economy.

1. INTRODUCTION AND PURPOSE

The circular economy offers a new model for how to sustain human well-being within planetary boundaries, with opportunities to improve competitiveness and economic resilience. It takes inspiration from the natural world, where materials cycle infinitely in one form or other in the ecosystem, and there is no such thing as 'waste'. It looks to deliver deep business value by retaining these resources in the economy.

The transition to a circular economy is a multi-dimensional and complex challenge that requires systemic change, including innovations in technologies, products, and business and socio-cultural practices. Accelerating innovation for a circular economy across all sectors represents a double opportunity for Canada. It can secure competitive economic advantages that grow the economy and create jobs, including access to an increasingly lucrative global market for clean technologies, which is projected to reach $2.5 trillion by 2022.[1] It can support key international commitments, such as the 17 Sustainable Development Goals (SDGs) of the United Nation's 2030 Agenda for Sustainable Development, including SDG 12 that aims to ensure sustainable production and consumption patterns. It can also contribute to the greenhouse gas emission reductions critically required to achieve the 2016 Paris Agreement and Canada's net-zero ambitions.

Globally, the circular economy is still at an emergent phase. With a global shift underway, Canada cannot afford to lag in embracing strategies with such potential to reconcile economic growth with ecological limits, boost competitive advantage and create jobs, attract green investment, improve equity and societal well-being, and diversify the economy. An integrated approach will help to establish Canada among the world leaders in this space.

Accelerating innovation for a circular economy across all sectors represents a double opportunity for Canada. It can secure competitive economic advantages that grow the economy and create jobs.

Canada has yet to develop the type of integrated, comprehensive circular economy vision, strategies, and collaboration present in many countries, although pockets of interest and policy initiatives have been emerging on the zero plastic waste file, and provincially, municipally, sectorally, and in civil society. However, Canada begins this journey with two strong advantages: a strong set of policies and programs to support clean innovation, and the opportunity to learn from international experience.

Both of these point to the critical role of wide-ranging government policies and programs to spur the new ideas, transform these into marketable products and services, create market demand for the solutions, and build an effective and resilient supporting ecosystem for the innovations needed for a circular economy. Yet Canada's nascent conversation on the circular economy agenda reveals a heavy weighting to the regulatory, pricing, and procurement policies which are essential to creating market demand, but are only one dimension of the supports which will be needed. Fortunately, current supports for clean growth and innovation offer a robust initial platform from which to build out other supporting policies and programs. By doing so, public policy to support a circular economy can leverage the two decades already invested in building this ecosystem for clean innovation.

The purpose of this background report is to explore how these can inform innovation for a circular economy. Are elements known to be important for successful clean innovation being overlooked in proposals for a circular economy policy agenda? Can existing Canadian clean innovation policies or programs be readily adapted and leveraged to support innovation for a circular economy?

The report draws equally from extensive work on a framework for government policies for clean innovation (Section 4)[2] and a review of selected national and international literature on public policy instruments to support the circular economy (*Box 4, Section 3.2*). It has three goals:

- *first*, to introduce lessons from research into clean innovation policy needs;
- *second*, to summarize the emerging global menu of circular economy policies and provide leading international and/or Canadian examples of these policies, or identify promising Canadian policies or programs which could readily be adapted and leveraged to support innovation for a circular economy; and
- *third*, to highlight gaps in the Canadian policies for a circular economy, through the lens of clean innovation lessons.

For readers unfamiliar with the circular economy concept, Section 2 of the report begins with an overview of this emerging model for more sustainable economic production and consumption. Section 3 summarizes the types of innovation required to advance a circular economy, and the barriers to these. Some barriers are common to general innovation, some common to innovation targeting improved environmental performance, and some specific to a circular economy. Section 4 then introduces a four-part Framework for Clean Innovation policy, drawing on Smart Prosperity Institute's five years of work on the suite of public policy supports needed to accelerate clean innovation. This Framework provides the structure for Section 5, in which circular economy policies and potentially relevant programs are mapped against this Framework, first at the global, then at the Canadian, level. Section 6 considers potential insights and conclusions from this analysis with reference to the questions outlined above, including preliminary recommendations for accelerating the support for innovation for a circular economy in Canada.

2. THE CIRCULAR ECONOMY

2.1. The Unsustainability of the Current 'Linear' Economy

Much of the prosperity the world enjoys today has been enabled by the extraction of material resources like fossil fuels, biomass, metal ores, and non-metallic minerals. This otherwise welcome, if unevenly distributed, prosperity has come at a high environmental cost: pressuring ecosystems and resulting in climate change and pollution, and irreversibly changing the functioning of major Earth system processes.[3]

Over the last four decades, global material use has not only increased, it has accelerated. It is now expected to reach between 170 and 184 billion tons by 2050, up from 84.4 billion tons in 2015.[4] This growth is largely driven by expanding populations and changing consumption trends: the world's population is set to grow by 28% from today's levels to 9.7 billion by 2050, and up to 3 billion persons are expected to transition from low to middle-class consumption during this period, driving a 71% rise in per capita resource use.[5] And in today's industrial systems, more than 90% of this material is used only once, then thrown away [6] – a design that has been characterized as a 'take-make-waste' linear economy.

This linear economic model has put human well-being and ecosystems at risk. An estimated four* out of nine planetary boundaries have been surpassed, irreversibly changing the functioning of major Earth system processes.[7] Further, as the supplies of non-renewable resources and the regenerative capacity of renewables ones are depleted, there risk being severe economic consequences. Resource supply disruptions, rising and increasingly volatile prices, and supply chain interruptions could potentially put US$25 trillion in global economic growth at risk by 2050.[8]

2.2. What is a Circular Economy?

To decouple growth from resource use, a growing portion of future material demand will need to be met by cycled materials powered by net-zero carbon energy systems. This emerging model, known as the circular economy, draws inspiration from the natural world, where materials cycle infinitely in one form or other in the ecosystem, and there is no such thing as 'waste'. It fosters environmental sustainability while capturing significant economic value from what is now, literally, thrown away.

* Climate change, loss of biosphere integrity, land-system change, and altered geochemical cycles for phosphorus and nitrogen.

In its ideal, a circular economy is a sustainable, productive economic model that is financially, environmentally, and socially sustainable. It is characterized by the highly efficient use of primary and secondary resources, designing waste out of the system, and a continuous recirculation of post-consumer materials while using renewable energy (*Figure 2*). It does this without depleting resources and can be perpetuated indefinitely without any accumulation of waste in the environment.

A growing portion of future material demand will need to be met by cycled materials powered by net-zero carbon energy systems.

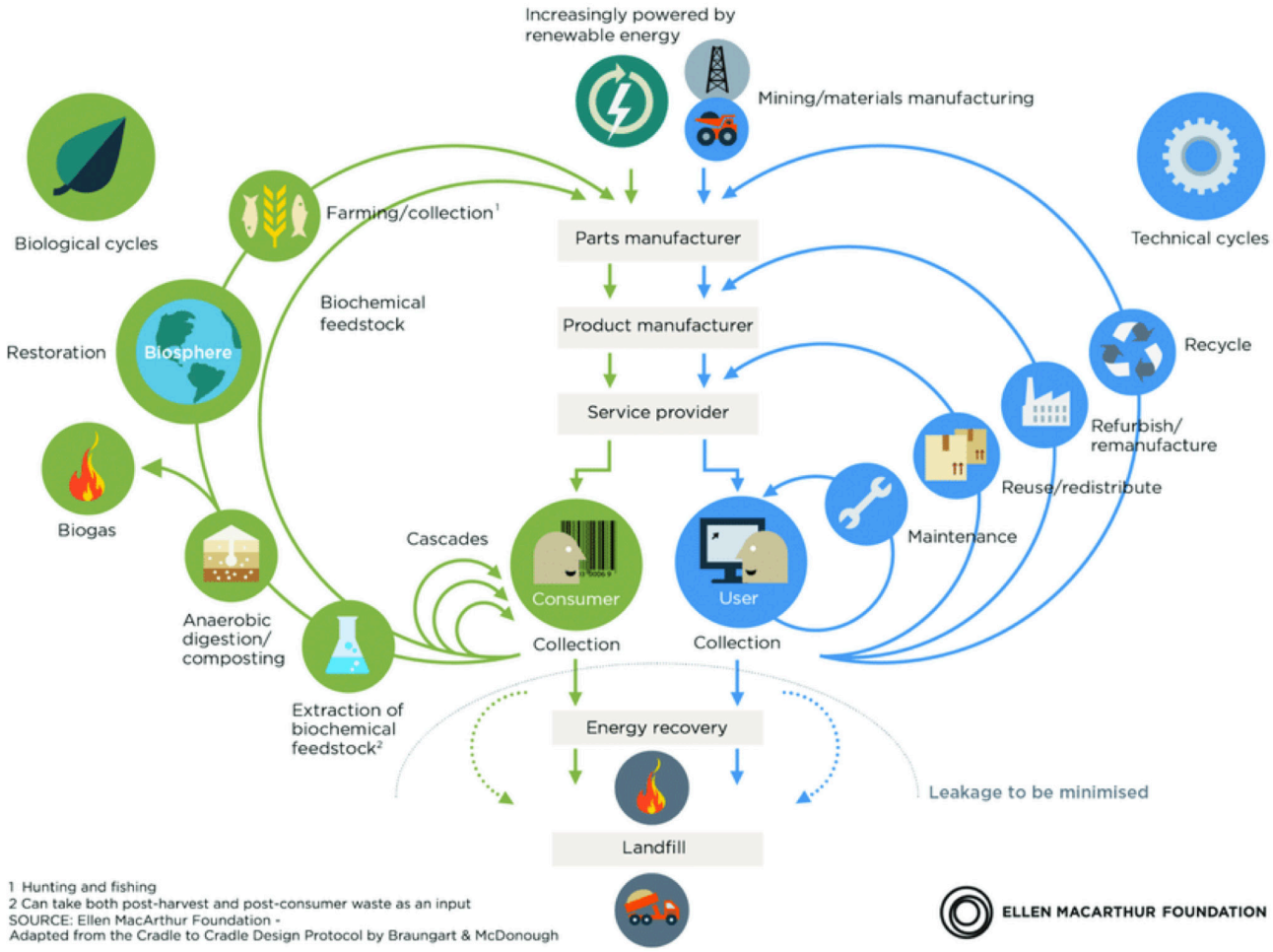


Figure 2: Conceptual Illustration of a Circular Economy

Source: Ellen McArthur Foundation

Box 1

The Foundations of the Circular Economy Model

While the circular economy terminology might be novel, the concept is not. It has a long history and has been gaining traction in mainstream circles since the late 1970s. Its foundation draws from various schools of thought including Sustainable Development, Ecological Transition, Green Economy, Functional Economy, Life Cycle thinking, Cradle to Cradle thinking, Shared Value, Industrial Ecology and Eco-design.[10]

Importantly, the circular economy goes far beyond the traditional 3R's (Reduce, Reuse, Recycle) thinking of waste management. It focuses on managing resources to keep materials and products recirculating in the economy at their highest utility and value through approaches such as rethinking, redesigning, reducing, and reusing (*see Text Box 2*). It also proposes new business models to better enable this, such as platforms for sharing and exchanging products and services, selling the services of products rather than the product itself, and shifting responsibility for the post-consumer stage of a product's life cycle to producers, and manufacturers. New digital, physical, and biological technologies are key enablers for these circular strategies.

Figure 3: Zero Waste Hierarchy

Source: International Zero Waste Alliance

Box 2

Beyond the Traditional Waste Hierarchy

The International Zero Waste Alliance describes a hierarchy of policies and strategies to support a zero waste circular economy, ordered from highest and best to lowest use of materials:[11]

- Rethink and Redesign – anything that stops waste from being produced, from avoiding single-use items to designing waste-free business models.
- Reduce and Reuse – focus on keeping used products in use and preventing them from becoming waste using strategies like remanufacturing and refurbishment.
- Recycling and Composting – support and expand systems to keep materials in their original product loop and to protect the full usefulness of the materials
- Material Recovery – with material and chemical recovery prioritized over energy recovery through incineration.
- Residuals Management – biological treatment and stabilized landfilling as the last option for residual waste after all valuable materials have been reclaimed.
- Unacceptable – disposal options, which have environmental impact such as waste to energy, incineration, landfilling of non-stabilised waste, gasification, illegal dumping, open burning and littering.

Such ambitious strategies for resource efficiency and capturing, reusing, and recycling post-consumer materials could reduce global resource requirements by about one quarter, a critical contribution to meeting rapidly escalating future materials demand.[9]

Box 3

Familiar Examples of the Circular Economy

Examples of the circular economy already exist around us. Many offices lease rather than buy photocopiers to guarantee maintenance from photocopier service providers, and return printer cartridges to these providers to be recycled. Some lighting companies offer circular lighting services – through which building owners don't purchase lightbulbs and fixtures, but instead purchase a service whereby lighting equipment is installed, maintained, and replaced as needed, again ensuring greater longevity of the equipment and increasing rates of re-use, re-purposing, and recycling. Hundreds of such examples have begun to show the promise of circular strategies.

2.3. A Broad Value Proposition

The circular economy's appeal lies in its broad value proposition, which promises benefits for the economy and business competitiveness, as well as solutions for many of the most pressing environmental challenges of our times.

By reducing the risks of price volatility and supply-chain interruption caused by resource scarcity, the circular economy offers the possibility of continued global economic growth. It is estimated that adoption of circular economy models could avoid the loss of up to US$4.5 trillion of global economic growth by 2030 and as much as US$25 trillion by 2050.[12] Other benefits to the economy arise from recapturing value that is otherwise, literally, thrown away. In Canada, for example, plastics with a value of C$7.8 billion are sent to landfill annually due to low recycling rates for plastics.[13]

The ability to deliver deep business value distinguishes circular strategies from many environmental strategies. Circular solutions enable businesses to accelerate growth, enhance competitiveness, and mitigate risks. Businesses of all sizes, industries, and geographies can capitalize on the circular economy. For example, it is estimated that circular solutions such as eco-design, improved material reuse, and more waste prevention could potentially deliver annual net savings of EUR 600 billion to European industry.[14] An equivalent analysis is not yet available for Canada.

The circular economy's emphasis on efficient use of resources, eliminating waste and toxic substances, and renewable energy has cascading benefits for resource security, pollution prevention, energy use and emission reduction, and improving the quality of air, water, and natural habitats. Notably, it has a role in achieving the last tranche of greenhouse gas emission reductions. To date, climate change mitigation strategies have focussed on a transition to low-carbon and renewable energy complemented by energy efficiency. While consistent with a circular economy, these energy-focused measures can only address 55% of emissions. The remaining 45% can be attributed to land use and non-energy industrial emissions. Applying circular economy strategies in just five key areas (cement, aluminum, steel, plastics, and food) could reduce global emissions by 40% in 2050.[15] This potential to contribute additional emission reductions is also revealed in some Canadian studies, although these typically have a narrower focus on recycling and waste management.[16, 17]

The ability to deliver deep business value distinguishes circular strategies from many environmental strategies.

2.4. The Circular Economy in Practice

As businesses and governments globally are recognizing the opportunities offered by a circular economy, many circular practices are growing in prominence and achieving scale. Key applied strategies across the extraction, manufacturing, distribution and use system can be clustered into four broad objectives, identified by the Quebec-based Institut EDDEC (see Appendix A for more detail): [18]

- **Reduce resource consumption:** *ecodesign; responsible consumption and procurement; and process optimization (lean manufacturing)*
- **Intensify product use:** *sharing economy; and short-term renting*

- **Extend the life of products and components:** *maintenance and repair; donating and reselling; refurbishing; and performance economy (product as a service)*
- **Give resources as new life:** *industrial ecology (or symbiosis); material recovery, recycling and composting; and energy recovery.*

New business models are emerging to support these strategies. For example, the World Business Council for Sustainable Development outlines five business models: circular supplies; resource recovery; product life-extension; sharing platfroms; and products as a service.[19]

2.5. A Multi-Level Challenge

As noted above, today only 8.6% of the total material input to the global economy comes from cycled materials.[20] Ambitiously growing this share, in a world designed for a linear throughput of materials, will require a broad change in the policies and business practices that protect the status quo, the culture in which the status quo is embedded, and the larger landscape that shapes the context in which it operates. To generate impact, these interventions need to be mutually reinforcing rather than undertaken in silos.[21]

In the context of a circular economy, the transition will involve changing how we design, manufacture, sell, consume, use, and manage materials, products and services, which, in turn, will require new technologies, new products, new business practices, and new approaches to generating economic growth that is decoupled from environmental degradation. Unlocking these changes can only happen with concurrent changes to cultural norms towards consumption and waste, and to the institutions, infrastructure, policies, and business practices that reinforce current models of linearity.

In short, transitioning towards a circular economy presents both a tremendous innovation challenge and opportunity, at multiple levels of the socio-technical system.

3. INNOVATION NEEDS FOR A CIRCULAR ECONOMY

3.1. Types of Innovation for a Circular Economy

Broadly, the Organisation for Economic Co-operation and Development (OECD) describes innovation as the implementation of a new or significantly improved product (good or service), a new marketing method, or a new organizational method in business practices, workplace organization or external relations.[22] Innovation has two components – invention and diffusion. Invention describes the art of creating novelty and is typically the result of investment in R&D, followed (in the case of new products or technologies) by development, demonstration, and deployment. Diffusion, on the other hand, describes the process of adaptation of knowledge, technologies, or other inventions in the marketplace.[23]

This description focuses heavily on business/technology innovation. However, innovation for a circular economy also requires policy innovation. Smart investment and smart policy by governments, at every level, can be designed to encourage and crowd in private initiative and investment to drive innovation for a circular economy. Public investment should seek to leverage private investment, while public policies should spur private sector ambition and remove barriers that impede private investment in circular innovation.

Innovation for a circular economy can simultaneously deliver social, environmental and economic benefits. Such innovation has different names in different geographies, including environmental innovation, eco-innovation, sustainable innovation, green innovation, and clean innovation—the last is the preferred nomenclature in North America.

This innovation can be advanced in all sectors of the economy: from traditional resource sectors to manufacturing to services. It can also take various forms: it can be a new good or service, process, organizational change, or marketing method in a company. It can be also a wider change with systemic implications for economy and society, such as new urban designs, new transportation systems, or new production-consumption models based on services. The range of this innovation is described in Table 1, adapted from the work of the Eco-Innovation Observatory.[24]

Table 1: Types of Innovation

Types of Circular Innovation	Description
Technological innovation	Creating new technologies for extracting, producing, recycling and reusing resources. Examples of technical innovations include cleaner manufacturing technologies, pollution control technologies, renewable energy technologies, waste management technologies etc.
Product design innovation	Creating new product designs that reduce the overall impact of the product on the environment and minimize the material input over the product's life cycle. Design changes allow for recovery options like repairing, maintenance, remanufacturing, recycling and cascading use of components and materials.
Process innovation	Creating new processes that reduce material use, emissions and hazardous substances thereby lowering risks and saving costs across the production processes. Examples of changes in processes are refurbishment by replacing or repairing components that are defective, including the update of products; or disassembly and recovery at the component, material and substance level among others.
Organizational innovation	Creating new methods and management systems reorganization that support closing the loops and increasing resource efficiency. Examples of organisational innovation are new business models like industrial symbiosis; or new collection and recovery schemes for valuable resources like Extended Producer Responsibility.
Social innovation	Creating new behavioral and lifestyle changes that promote a circular economy. Examples of social innovation include sharing models (appliances, cars); or collaborative consumption (homes, garden tools).
System innovation	Creating new systems with completely new functions that reduce overall environmental impact. Examples of systemic innovation include new transports systems, smart cities etc.

Innovation for a circular economy improves environmental performance; reduces the consumption of natural resources; and decreases the release of harmful substances across the whole life-cycle, including the design, use, re-use, recycling, and disposal phases of products, materials, and services related to them. By taking a life-cycle perspective, such innovation goes beyond reducing the input of resources into a single product, to endeavor for overall better use of resources to deliver certain utility of services, such as light, shelter, and mobility. In some cases, this holistic perspective may mean increasing input of resources in one stage of the life-cycle, such as the production stage, if this substantially improves utility and durability or reduces resource use over the lifetime of the new product or approach.[25]

3.2. Barriers to Innovation for a Circular Economy

Innovation in general, and innovation that aims to solve environmental problems in particular, is prone to the consequences of market failures. Innovation for a circular economy also faces further barriers, that impede the proliferation of new ideas and new research, obstruct access to capital, dampen market demand, or weaken and fragment the larger system needed for success.

While businesses and civil society have a role to play in tackling these obstacles, government retains a critical role in creating

the enabling conditions for a circular economy by correcting market failures, removing barriers, and providing incentives to stimulate circular innovation.

3.2.1. Market Failures Hampering Innovation

Two prominent market failures have been identified as hampering innovation that targets improved environmental performance, broadly. Together, these present a double market failure. Only governments can fix these market failures. For markets to work effectively, public policy must concurrently address both:[26]

- **Knowledge spillover market failure**, common to all innovation: It takes place in the early stages of research and development. During this stage, when researchers discover something new, their findings and knowledge may, at least in part, 'spillover' to benefit other researchers, firms, or sectors. As a result, they may be unable to capture the full value of their discoveries. This well-documented market failure leads to an under provision of research and development. As a result, innovation takes place at a lower than optimal level.[27]

- **Environmental externality market failure**, particular to innovation for bettering environmental performance: Typically, the prospect of profits attracts investors and businesses to finance the commercialization of new ideas and inventions. In the case of innovation for improved environmental performance however, many of the benefits produced, such as lesser pollution and greenhouse gas emissions, have no market value because markets don't price most environmental costs and benefits. In other words, there is little market demand, resulting in little profit incentive to invest in or develop such solutions.

Box 4

Policies for a Circular Economy - Reports Reviewed

Circle Economy 2017: **Policy Levers for a Low-Carbon Circular Economy**[28]

Delphi Group 2017: **Jurisdictional Scan for Circular Economy**[29]

Ellen MacArthur Foundation 2015: **Delivering The Circular Economy: A Toolkit for Policymakers**[30]

European Environmental Agency 2019: **Paving the Way for a Circular Economy: Insights on Status and Potentials**[31]

The Natural Step Canada 2017: **Circular Economy Innovation Lab: Circular Economy Overview**[32]

The Organisation for Economic Co-operation and Development 2019: **Waste Management and Circular Economy in Selected OECD Countries**[33]

The Research Group on Globalization and Management of Technology (Polytechnique Montréal), in collaboration with the Institut de l'environnement, du développement durable et de l'économie circulaire at Université de Montréal (I-EDDEC) 2018: **Circular Economy In Quebec: Economic Opportunities and Impacts**[34]

World Business Council for Sustainable Development 2018: **Circular Policy Action Brief**[35]

World Business Council for Sustainable Development 2019: **Policy Enablers to Accelerate the Circular Economy: Scaling up Actions Across Regions and Stakeholders**[36]

3.2.2. Barriers Specific to Innovation for a Circular Economy

Barriers specific to a circular economy were identified through a scan of nine influential international and national reports (*Box 4*). They are summarized in Table 2 below and described in more detail in Appendix B.

Table 2: Barriers to a Circular Economy

Barrier Type	Barrier Examples
Barriers to the generation of new circular economy ideas	• lack of research • lack of circular design • technology
Barriers to converting circular economy ideas into marketable solutions	• capital intensity • difficulty in securing capital
Barriers to stimulating market demand for circular economy solutions	• tilted playing field • insufficient demand for goods • insufficient or unreliable supply of materials and energy • imperfect information • supply chain coordination • unintended consequences of existing regulations • implementation and enforcement failures
Barriers to building an effective and resilient circular economy	• myopic planning • non-collusive collaboration • capabilities and skills • data and metrics • policy incongruency • uncertainty • ingrained behavior and attitudes

4. LEARNING FROM THE CLEAN INNOVATION JOURNEY: THE FRAMEWORK OF PUSH, PULL, GROW, STRENGTHEN POLICIES

The transition to a circular economy will require a wide range of government action. This is justified given the scale of the opportunity, the urgency for action, and — most importantly — the presence of numerous market failures and barriers which, if left unaddressed, will hinder Canadian performance as it relates to the circular economy.

The transition to a circular economy will require a wide range of government action.

Such support is not unprecedented in Canada. The ongoing clean innovation policy agenda in Canada offers rich experience to draw from and build on.

The Clean Innovation Framework summarized below was developed to inform how public policies can drive clean innovation.*, [37] It identifies four types of government policies for most effectively unleashing industry initiatives for change: PUSH policies (to spur new ideas), PULL policies (to help create market demand for these solutions), GROW policies (to grow ideas into marketable products and services), and STRENGTHEN policies (to make the whole innovation system more effective and resilient).

* This Clean Innovation Framework was informed by over five years of research, including a conference, two workshops, in-depth studies, and over 40 interviews with a broad cross-section of Canadian and international experts in clean innovation. It was launched by the 29 Smart Prosperity Leaders in 2018.

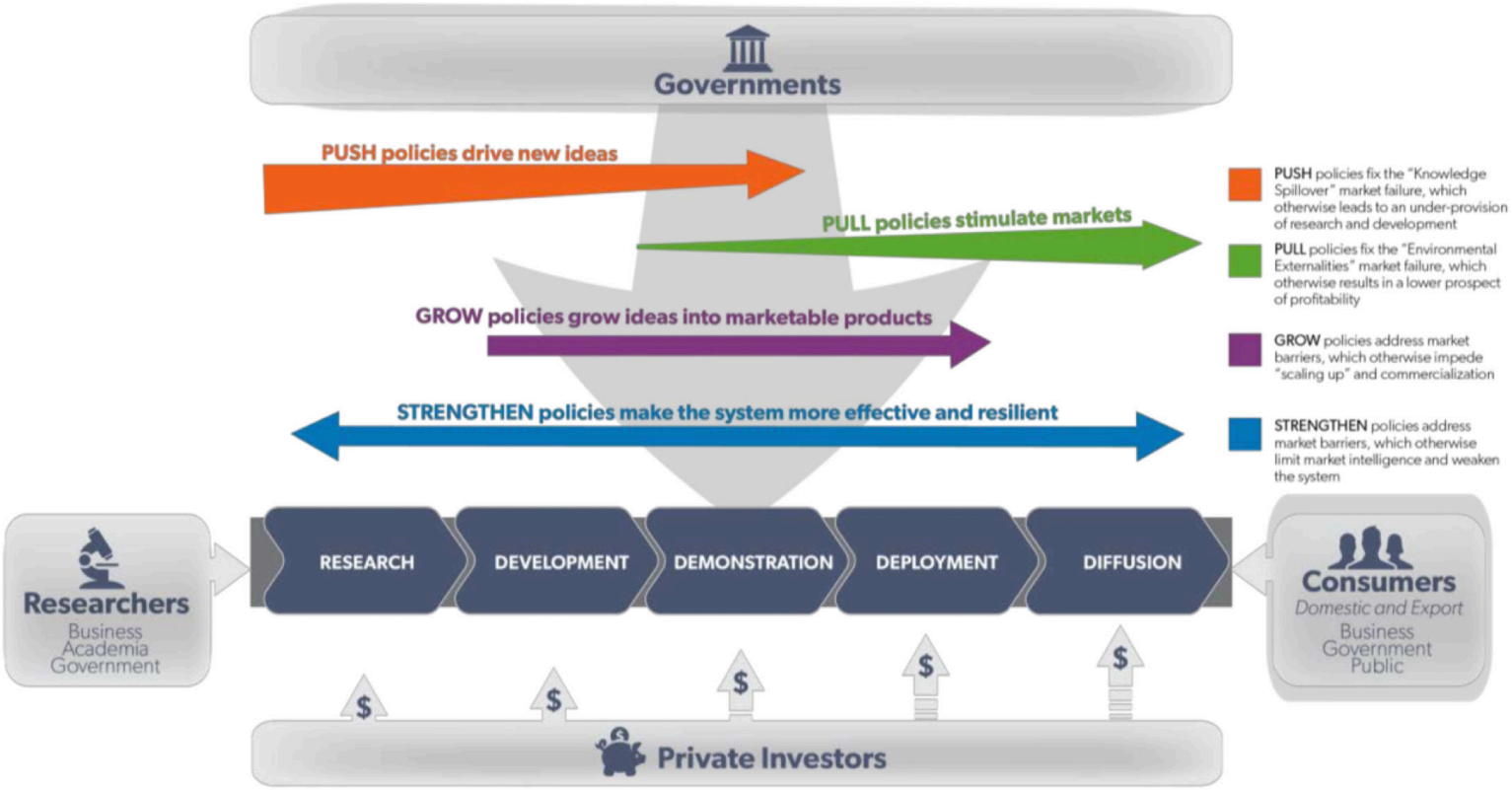


Figure 4: The Clean Innovation Model

Source: Smart Prosperity Institute

PUSH policies focus on the early stages of innovation and generate ideas that carry though to later stages. They generally do one of two things. One, incentivize private research initiatives, either through direct incentives (e.g. tax credits) or by helping firms capture the economic returns from that research (e.g. through intellectual property rights). Or two, supplement private research with public research through funding for government labs and universities.

PULL policies are particularly important in the commercialization phase of innovation. They generate market demand for innovations which might otherwise not appear profitable given that there is little market reward for solving problems (like pollution) that firms and households do not pay for in the first place (i.e., considered environmental externalities).

PUSH and PULL policies work best when applied simultaneously.[38] However, they are not sufficient. Two additional types of government support are required to completely encompass the innovation ecosystem.

GROW policies are the bridge between PUSH and PULL. They help take promising innovations from the R&D stage to the point where they are ready for market entry. They help entrepreneurs and firms secure financial and non-financial support required to turn their ideas into demonstration products and services and then scale up their solutions to meet market demand.

Finally, **STRENGTHEN policies** support the system as a whole. Government intervention to bolster this system includes: defining a clear vision and translating it into strategies, strengthening public institutions, building parternships, investing in new skills, identifying and measuring key performance indicators and metrics, enriching the policy mix and ensuring accountability and continuity.

5. PUBLIC POLICY NEEDS FOR INNOVATION FOR A CIRCULAR ECONOMY

Globally, governments striving for a circular economy have introduced varying policies based on their economic, environmental, and cultural contexts, sometimes economy-wide, sometimes on a sector or product- specific basis, or sometimes place-based in cities and communities. A broad-based menu of public policies for a circular economy has emerged (*see Appendix C, drawn from the scan of reports listed in Box 4*).

Domestically, Canada has yet to develop an integrated national policy framework to support the uptake and diffusion of the circular economy, although pockets of interest and fragmented policy development have emerged. This interest has been primarily on an issue-specific basis (e.g., zero plastic waste, food waste), and provincially, municipally, sectorally, and in civil society.

Although Canada lags behind many countries in circular economy policies, it begins this journey with the strong advantage of a strong set of policies and programs to support clean innovation. While these have focused mainly on low-carbon innovation, and arguably favor technological innovation over the other types of innovation listed in Table 1, with some adaptation, they could readily be leveraged to provide the foundation for innovation for a circular economy.

Although Canada lags behind many countries in circular economy policies, it begins this journey with the strong advantage of a strong set of policies and programs to support clean innovation.

Section 5 of this report is organized into the PUSH – PULL – GROW – STRENGTHEN structure of the Clean Innovation Framework (*Section 3*). For each of these policy clusters, it aims to:

1. *first*, introduce lessons from clean innovation research to inform policies required to accelerate the transition towards a circular economy;

2. *second*, summarize the emerging global menu of circular economy policies and illustrate these with leading international and/or Canadian examples, or identify promising Canadian programs which could readily be adapted and leveraged to support innovation for a circular economy; and

3. *finally*, highlight gaps in the Canadian policies for a circular economy, through the lens of the clean innovation framework.

This section blends the Clean Innovation Framework, the policies for a circular economy listed in Appendix C, and a scan of Canadian circular economy policies and promising government programs identified through open source and media channels. This information is supplemented with insights gained from interviews with 32 private sector stakeholders conducted by Smart Prosperity Institute in 2018.[39] The discussion of Canadian policies and programs focuses primarily on the federal government and is illustrative rather than comprehensive. It does not address policies and programs at the provincial/territorial and local government levels, which also play a critical role in Canadian waste management and economic development.

5.1. PUSH Policies – Driving New Ideas

5.1.1. Lessons from the Clean Innovation Journey

Innovation begins with research. Academics, entrepreneurs, business, and government, all contribute to the generation of intellectual property which gets refined through subsequent stages of innovation before potential commercial success. PUSH policies aim to drive new ideas and support the earliest stages of innovation.

These policies are crucial to kickstart the innovation chain because evidence suggests that innovation geared towards better environmental outcomes is more at risk of knowledge spillover market failure (*see section 3.2.1*) than other forms of innovation.[40] This is due to the interdisciplinary nature and broad applicability of such innovation, which results in applications and benefits for multiple sectors, driving economic growth, and environmental benefits beyond the innovation's initial scope.

Canada's research strength lies in its publicly supported and internationally renowned research institutions. These carry out research and development in collaboration with academics, private partners and international counterparts. In 2018, the government committed to investing nearly $4 billion into Canada's research system to support the work of researchers and provide them access to the tools and facilities required. Canadian universities and polytechnic institutions also play a critical role in generating research and development. Canada's Higher Education Expenditures on R&D (HERD) as a share of GDP has consistently been well above the OECD average.[41] However, in Canada, private investment in R&D has generally been lacking. Canada's Business Enterprise Expenditure on R&D (BERD) as a share of GDP is well below its OECD peers and has continued to fall since its peak in 2001, standing at 0.82% in 2016.[42]

Encouragingly, when it comes to technology for environmental markets,* Canadian firms are investing well.[43] Cleantech companies spent 11.3% of their revenue on R&D in 2016, a rate second only to firms in health care, biotechnology, and the pharmaceutical industry.[44] Yet that research is not translating into marketable outcomes at scale: between 2000 and 2011, environmental technology patents applications in Canada increased by only 16%, compared to the 78% increase in OECD countries taken together.[45] Canada's share of global technology patent applications has also consistently fallen: in 2016, Canada filed 1.53% of global environmental technology patents- down from 1.79% in 2010 and 2.44% in 2005.[46]

5.1.2. PUSH Policies for a Circular Economy

These public policies include those that stimulate government-funded, academic, and business research, as well as those that stimulate research collaboration.

While the literature mentions research and development as an implicit requirement to achieve circular economy strategies, it is under-recognized as a mainstream policy tool required to drive the circular economy (*see list, Appendix C*). Where mentioned,[47] the emphasis is on academic research, for example, materials and bio-sciences research to inform policy and business

* Environmental markets include Upstream Sectors (biorefinery products, power generation), Downstream Sectors (energy infrastructure/smart grid, energy efficiency/ green building, industrial processes & products, extractive processes & products, transportation, recycling- recovery & remediation) Water and Agriculture Sectors (water & wastewater, agriculture)

decisions related to the circular economy, or economic research to study how the circular economy might change the way the economy functions.

Nonetheless, at the international level, jurisdictional leaders on the circular economy agenda are investing in circular economy research. The foremost example is the European Commission's Horizon 2020's final Work Programme .[48]

In Canada, there has been very little specific investment explicitly identified as circular economy research, despite substantial investments in research more generally. Canada does not have dedicated government research institutions or programs with explicit, broad circular economy goals. It does however have ongoing research programs that could contribute to meeting circular objectives. One example is the 'Mining Value from Waste' pilot project run by CanmetMINING within Natural Resources Canada (NRCan), which aims to develop technologies to extract value and reduce liability from tailings by recovering valuable metals and using the wastes as resources in other applications.[49] Another example is recent federal funding directed towards the bioeconomy. In 2019, the federal government announced an investment of $7 million to the Biomass Cluster under the Canadian Agricultural Partnership. This cluster aims to drive innovation and help improve technologies for processing agricultural biomass, including waste material, for the production of cleaner bioenergy, and other bio-based products.[50]

Canadian universities also have yet to fully dive into circular economy research: one bibliometric study ranks Canada as only 19th internationally based on the number of articles and citations on the circular economy.[51] One notable exception has been the Institut de l'environnement, du développement durable et de l'économie circulaire (Institut EDDEC). Operating from 2014-2020 by three Montreal Universities, it convened stakeholders, specialists, researchers, and students to shape a circular economy implementation model in the province of Quebec. Nascent programs are also emerging at the Ivey School of Business and the University of Ottawa's Smart Prosperity Institute. Further, given the circular economy's strong value proposition to businesses, the private sector might be expected to play a large role in early-stage research.

Research collaboration is the fourth cluster of PUSH policies. This is particularly important for a circular economy, which given its systemic nature necessitates joint efforts by researchers, technology centers, industry and SMEs, the primary sector, entrepreneurs, users, governments, and civil society. The Canadian Plastics Science Agenda (CaPSA), announced in 2019, is one example of strong research collaboration intention between federal departments and agencies, other levels of government, academia, industry, non-governmental organizations, Indigenous groups, and international organizations with the aim to improve plastics science.

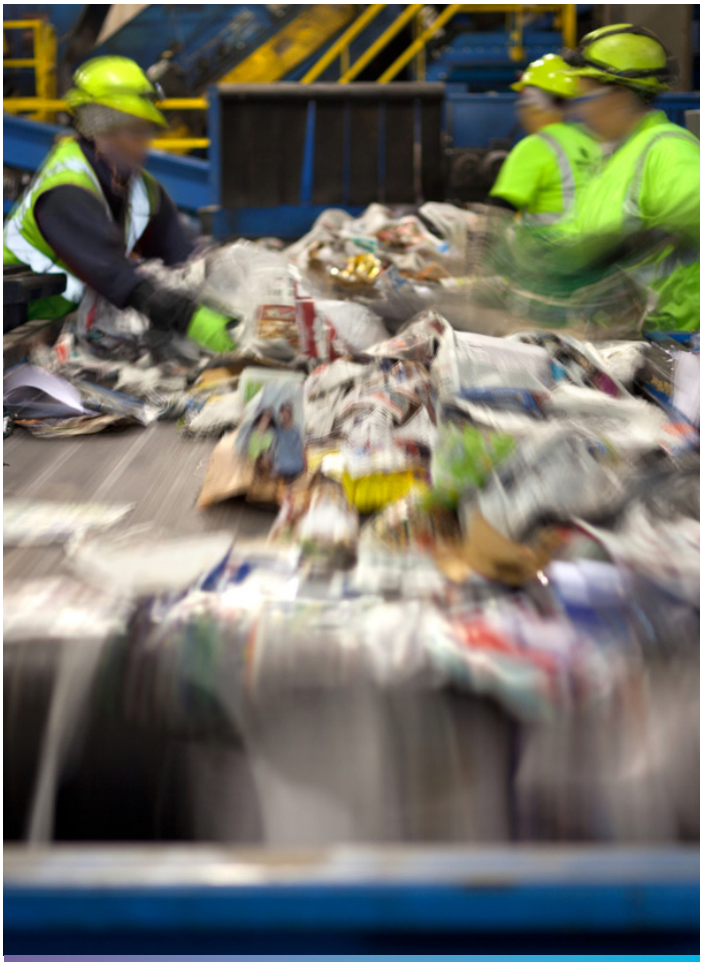
Spotlight: The European Commission's Horizon 2020 investment in circular economy innovation

From 2018-2020, the European Commission's Horizon 2020 program invested nearly € 1 billion into research, innovation, and financing of circular economy projects and initiatives, with an aim to become global leaders in technological, regulatory, social and business-model innovation. In 2020 alone the programme invested over € 400 million including €20 million for upcycling plastics of food and drinks packaging and € 97 million for sustainably using and re-using raw materials and water in industrial production.

5.1.3. Observations – PUSH Policies for Innovation for a Circular Economy in Canada

There are currently few research programs in Canada explicitly targeted to the circular economy. This may simply reflect the emergent nature of this topic in Canada. However, a robust set of research and granting programs and institutions, already in place, could be leveraged to support research in this field.

Industry representatives interviewed in 2018 echoed this deficiency. They pointed to the need for more research funding in circular economy technologies and materials –for example in identifying new uses for post-consumer materials or materials for recycling materials such as mixed fiber types; more independent research into the benefits and impacts on the circular economy at the economy-wide and firm level; and research on successful circular economy policies and initiatives in other jurisdictions.[52]



5.2. PULL Policies – Stimulating Market Demand for Market-Ready Solutions

5.2.1. Lessons from the Clean Innovation Journey

Markets do not reflect the full cost of environmental damage. Because firms and households do not pay these costs, there is little profit incentive to develop innovations that mitigate the damage. This environmental externality market failure makes any innovation targeting improved environmental performance fundamentally different from other kinds of innovation.

Policies in this category stimulate market demand for environmental solutions through tools such as regulations, pollution pricing, and procurement. While the primary goal of such policies is to solve an environmental problem, they also incentivize innovation. Further, if such innovation can bring down the cost of achieving environmental objectives they also create competitive advantages.

These policies can play a key role in creating the right market signals and providing certainty. Real-world experience of implementing these policies has demonstrated the importance of designing these policies in a manner that effectively supports both environmental outcomes and innovation. OECD research on this topic has found that environmental policies that drive innovation share key features including stringency, flexibility, predictability, incidence, and depth. [53]

When designing policies, it is equally important to ensure that they don't unintentionally hinder innovation. Rigid compliance can discourage innovation approaches and practices, while prescriptive policies that focus on lowest short-term cost can impede solutions that might have lower costs (and environmental impact) in the longer run.

Across sectors, Canada has deployed a range of regulations to foster clean innovation (e.g vehicle efficiency standards, energy efficiency standards, etc.). However, as the Economic Strategy Table on Clean Technology report notes, many current regulations are based on old standards and processes, creating significant barriers to innovation, growth, commercialization, and adoption of Canadian clean technologies. [54]

Canada has historically seen a low use of environmental taxation compared to other OECD countries. Like most OECD member countries, taxes on energy use are the largest source of environmentally related tax revenue, representing about 76% of the revenue.[55] This includes federal and provincial excise taxes on energy products, and taxes and royalties on natural gas, petroleum and coal products.[56] The Pan-Canadian Framework on Clean Growth and Climate Change includes a two-part carbon pollution pricing system - an output-based pricing trading system for large industry and a regulatory charge on fuel. However, ongoing fossil fuel subsidies, estimated at over $3 billion annually from federal and provincial governments,[57] undercut these price signals. Canada, along with other G7 members, has committed to "the elimination of inefficient fossil fuel subsidies" by 2025.

Canada also introduced a federal Policy on Green Procurement in 2006 and updated it in 2018. This requires the federal government to integrate environmental considerations into the procurement process including planning, acquisition, use, and disposal, in the context of achieving value for money by taking into account actors such as cost, performance, availability, quality, and environmental performance. A 2012 evaluation of this policy revealed that despite significant progress, there were still obstacles to achieving its potential. These included

difficulty in determining which products are green due to quickly changing definitions, inconsistent reporting activities, and balancing achieving environmental outcomes with other procurement objectives.[58] Another recent study concluded that sustainability integration in public procurement is still only superficial. Of the 50 Requests for Proposals (RFPs) analyzed, it found that 22% of RFPs had absolutely no mention of sustainability whatsoever; only 12% of RFPs included sustainability as an independent consideration in the evaluation; and no RFPs integrated sustainability into the evaluation with a weighting of greater than 10%.[59]

5.2.2 PULL Policies for a Circular Economy

Regulations - Extended Producer Responsibility

Extended Producer Responsibility (EPR) is considered a regulatory cornerstone of the transition to a circular economy. It includes a broad spectrum of models (*Figure 5*): Full EPR, where producers are assigned full financial and physical responsibility for managing their products at their end-of-life; Partial EPR, jointly financed/managed by consumers, government, and industry; and Product Stewardship, typically funded by consumers and assigning no direct responsibility to producers.[60]

Despite a lack of data on the performance of EPRs, evidence suggests that EPR tools have contributed to a decrease in the volume of waste destined for final disposal, increased rates of recycling, and relieving pressures on public budgets.[61] Yet product stewardship and shared EPR programs have done little to encourage innovation that improves environmental performance and circularity. Full EPR programs, being less prescriptive, should in theory create incentives for producers to innovate and improve the whole supply chain from design to manufacturing to post-consumer waste management. The recent rise of service-based business models has given rise to proposals for a new concept for an enhanced form of EPR called Product Ownership. In this model, producers would be or fully act like owners of their products during and after the use of the product by customers and thus be responsible for them at the end of their lives. It is posited this would create a stronger incentive to innovate solutions that minimize the cost of waste management and promote a circular economy.[62]

Sustainability integration in Canadian public procurement is still only superficial.

Most OECD countries and many emerging economies have EPR programs and policies in place, with the number steadily been increasing since the early 2000s. All Member States of the European Union have EPR schemes on packaging, batteries, End-of-Life Vehicles (ELVs), and Electrical and Electronic Equipment (WEEE). A number of Member States have additional schemes for products such as tires, graphic paper, oil, and medical waste.[63]

Extended producer responsibility is also an instrumental part of Canada's waste management policy toolkit. Product Stewardship programs, some started as early as the 1980s, have proven to be effective in diverting materials from landfill and increasing the amount of materials recycled and reused. Quebec's tire recycling program, for example, increased the amount of material recycled by 20% between 2015 and 2017.[64] Alberta relies solely on the Product Stewardship model and is the only province without an EPR program.

Over the past decade, other provinces and territories have been transitioning towards Full EPR in accordance with the Canada-wide Action Plan for Extended Producer Responsibility (CAP-EPR), and the 2009 Canada-wide Strategy for Sustainable

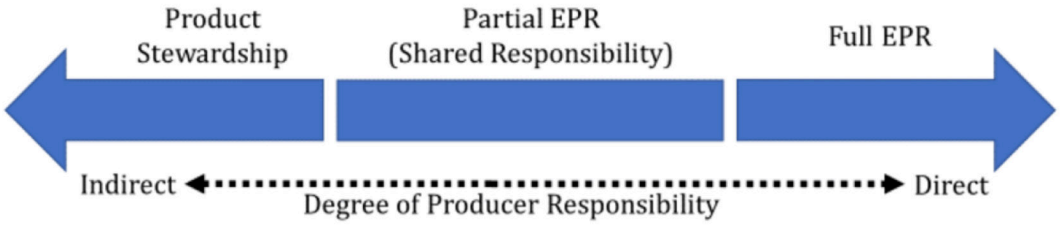


Figure 5: Extended Producer Responsibility Spectrum

Source: Arnold, J. (2019). Extended Producer Responsibility in Canada

Packaging. Nine provinces have made significant progress in implementing Phase 1 programs for packaging and printed paper, electronics and electrical products, mercury-containing products, household hazardous and special wastes, and automotive products. Implementing Phase 2 has not been as smooth: programs for construction and demolition waste, furniture, textiles and carpet, appliances, and ozone-depleting substances were to have been completed by 2017, but little progress has been made aside from a select few pilot projects and studies.[65]

In response to the 2018 Canada-wide Strategy on Zero Plastic Waste, the CCME is also developing guidance to help provinces create consistent EPR policies for plastics, with the ambition to establish a harmonized, pan-Canadian approach for a common set of materials. To date provinces have implemented their own programs, resulting in a patchwork of product stewardship, partial EPR, and full EPR programs, covering different materials and use different definitions, reporting mechanisms, and governance structures. Further, existing EPR programs in Canada have not been designed for environmental improvements in products necessary for a circular economy.

Other Regulations

Regulations are a key circular economy policy tool, encompassing both new regulations to promote circular innovation, and reviews of existing regulatory frameworks that may unintentionally hamper circular economy activity. A regulatory approach is most appropriate in applications where consumers are insensitive to price changes, or where swift action is required.

The most common types of regulations address waste management. These include landfill bans (prohibiting materials such as organics, recyclables or hazardous waste from being landfilled); restrictions on the quantity of solid waste collected from households (e.g. bag limits); prohibitions on the sale or use of certain materials (e.g., plastic bags or single-use plastics); mandatory recovery of waste from specific sectors (e.g., construction and food); bans on waste exports (which can incentivize more domestic recycling); regulations to reduce the use or better control hazardous substances (which increase the amount of waste with potential for recovery); and regulations aimed at increasing resource efficiency.[66]

Regulations to stimulate eco-design are also fundamental to the circular economy policy toolkit since over 80% of a product's environmental impact is determined at the design stage. Product regulation addresses product design, material content, labeling, or warranties. These should consider a full life-cycle, including the second use phase, take-back systems, design for disassembly, reparability, reusability, planned obsolescence, and recyclability. Standards can require a certain proportion of recycled and renewable material in new products. Product labeling can be a communication and product differentiation tool to shift consumer preferences towards more circular products. Regulations to extend product warranty periods or coverage and thereby extend the service life of products can also incentivize consumer uptake and encourage repair over replacement.

Internationally, several countries have implemented landfill bans, either for specific waste streams or more broadly for municipal solid waste, as part of efforts to improve recycling and recovery. The European Union bans the landfilling of tires and waste batteries and accumulators.[67] Jurisdictions including France, Kenya, Taiwan, and Zimbabwe have also banned certain types of single-use plastics. An example of the management of hazardous substances is EU legislation on end-of-life vehicles, which bans the use of several hazardous materials in automobiles (lead, mercury, cadmium, and chromium), to improve their recyclability.[68]

Canada, despite a robust waste management and blue box system, ranks highest out of 17 countries for the amount of municipal solid waste it generates.[69] Landfill disposal bans are only now emerging at both the provincial and local levels. Nova Scotia leads, with disposal bans on 21 items that have a designated diversion stream. Metro Vancouver passed a similar regulation in 2016. The same year, Ontario proclaimed its Waste Free Ontario Act, comprising the Resource Recovery and Circular Economy Act and the Waste Diversion Transition Act. This legislation, which aims to increase resource recovery and move the province towards a circular economy, will shift Ontario to a Full EPR model for end of life management of products and packaging. In 2020, the federal government announced it would ban six harmful single-use plastics by 2021 including – grocery checkout bags, straws, stir sticks, six-pack rings, plastic cutlery and food takeout containers made from hard-to-recyle plastics. This complements over 10 federal acts, regulations, and agreements already in place that prevents plastic waste and marine litter.

Pricing Instruments

Pricing instruments, such as taxes and user fees, stimulate market demand for circular innovation by establishing a price for environmental damage. Because they allow the firms and households impacted, the flexibility to take actions that best suit their situation, they are considered more cost-effective than regulation. They also generate revenue that can be used to generate further economic benefits.[70] Key pricing tools for a circular economy are:

- Taxes and fees on waste disposal (both landfill and incineration), which incentivize both waste prevention and increased waste recovery.
- Differentiated pricing for different materials going to landfill and varying volumes of waste (for instance, higher prices for materials that cost more to manage or have a high recycling potential). [71]
- Product taxes and fees to discourage the use of virgin materials and products such as single-use plastics.
- Tax incentives to encourage more repair, reuse, and recycling activities.

International examples of taxes and user fees initiated specifically to support circularity include Sweden's reduced value-added tax (VAT) on repairs for a range of products,[72] and China's VAT policy which offers tax refund opportunities for products containing recycled content.[73]

The use of waste pricing is limited in Canada. Households typically pay a flat rate for waste collection through property taxes or as a monthly fee. Recently, a growing number of municipalities are adopting pay-as-you-throw (PAYT) programs that charge households directly for the waste they generate, and some are introducing fees on selected single-use plastics. Disposal pricing is on the whole more transparent for the commercial sector (including large buildings, institutions, and industry), as they are charged by landfills based on their weight or type of waste. In most cases, the fee is set at a lower than optimal level which does not reflect the full cost of landfilling. In some cases, provincial policies are providing the impetus for full-cost pricing in municipalities. Legislation in British Columbia, for example, requires all regional districts to charge fees that reflect the full cost of the service.[74]

However, specific pricing tools such as these are considered insufficient for systems-level change. The Organisation for Economic Co-operation and Development, International Monetary Fund, World Bank, European Commission, and International Labour Organisation have all called for a holistic rethinking of our current approach to taxation, to 'tax less what you want more of', by shifting from labor taxes towards a tax on resource-use and consumption (including carbon emissions, fossil fuels, water, waste, and metal). Economic modeling done in 2016 found that shifting taxes from labor to pollution and resource-use in the European Union could increase GDP levels by 2%, create 6.6 million jobs and cut carbon emissions by 8.2% over a five-year period ending 2020.[75]

Spotlight: Sweden's reduced VAT tackles throwaway culture

In 2016, Sweden cut the rate of the value-added tax (VAT) on repairs to a wide range of products from 25% to 12%, and further allows half the labor cost of repairs on major appliances to be claimed back from personal income tax.

Historically, Canada has not used environmental taxation, with the notable exception of recent carbon taxes. Further, when deployed, tax incentives have favored the use of primary materials over secondary ones. While research on this is not recent, the marginal effective tax rates on the scrap and waste sector were found to be higher than the mining sector, and final products using recycled materials taxed more heavily on average than those using virgin materials. The largest difference was for metal products.[76] Comparing the marginal effective tax and royalty rate (METRR) for mining relative to other sectors, Canada's mining industry is favorably treated both by provincial mining-taxes and the corporate income tax system. [77]

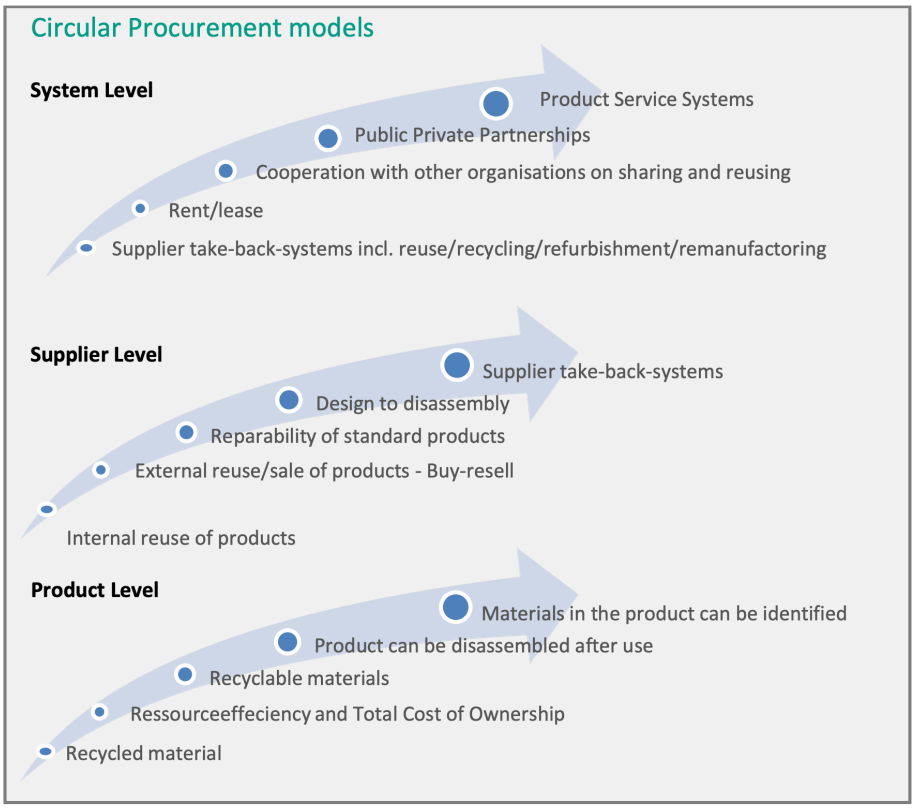


Figure 6: Circular Procurement Models

Source: SPP Regions: Regional Networks for Sustainable Procurement

Government Procurement

Accounting for an average of 12% of GDP in OECD countries,[78] public procurement offers a powerful public policy tool for encouraging the circular economy. Circular procurement, and the closely related practices of green procurement and sustainable procurement, emphasize the need for purchasing decisions to contribute to closed energy and material loops within supply chains. At the same time, procurement emphasizes minimizing, and in the best case avoiding, negative environmental impacts and waste creation across the whole life-cycle.[79] Such practices offer double benefits: allowing governments to lead by example, and to offer a test-bed for new innovations, helping their growth and attracting private investments. They can further encourage and influence industry and consumers to use environmentally preferable goods and services.

Circular procurement models can target the circular economy at different levels (*Figure 6*). The first is a 'systems-level' offering different contractual models to the purchasing organization. This ranges from supplier take-back agreements to product service systems.

In supplier take-back agreements, the supplier returns the product at the end of its life in order to re-use, remanufacture or recycle it. In product service systems, the contract provides both services and products, such as a lighting contract wherein the supplier provides the light fixtures, the repairs, and the replacements. At the 'supplier level' suppliers build circularity into their own systems and processes to meet circular procurement criteria in the products and services they offer. The 'product level' is similar but is focussed on product design, for

Spotlight: The Danish Partnership for Public Green Procurement

In 2006, the Danish government launched a coalition of governmental bodies called the Partnership for Public Green Procurement with joint procurement goals emphasizing circular economy criteria such as the use of non-toxic chemicals, extended product lifespan, and the cycling of biological and technical materials. Today this partnership accounts for 17% of all public procurement in Denmark. In 2013, the Finnish government announced it would allocate 1% of the total value of public procurement to sustainable environmental and energy solutions

example buying goods with recyclable or recycled materials or those which can be disassembled after use. [80]

Internationally, most EU member states have National Action Plans which outline actions and support measures for green or sustainable public procurement.

While circular procurement elements have not yet found explicit mention in the recently amended policy on green procurement in Canada, public procurement was a priority action area of 2019 Phase 1 of the Canada-Wide Action Plan on Zero Plastic Waste, which committed government to develop guidelines and tools for government procurement practices to green operations and reduce plastic.[81]

Some provincial and city-level governments have also initiated the practice of integrating green, sustainable, and circular principles into their purchasing decisions. The City of Toronto in particular has committed to adopting circular procurement as a major tool to achieve its aspirational goal of becoming a circular city. To this end, it developed a Circular Economy Procurement Implementation Plan and Framework in 2018, to support an eventual development of an evidence-based Circular Economy procurement policy. [82]

5.2.3 Observations – PULL Policies for Innovation for a Circular Economy in Canada

PULL policies present the dominant cluster of tools to drive a circular economy. Canada already has initial regulatory, pricing, and procurement policies in place. However, these are only a fraction of the full suite of PULL policies that could stimulate the market for circular economy solutions. Furthermore, few were designed with explicit circular economy objectives.

Modernization and harmonization of Canada's current mix of product stewardship, shared EPR, and full EPR programs, each with varying scopes and structures, offers the greatest regulatory opportunity for supporting a circular economy in Canada. An effort to do this for products and packaging is now underway through the CCME, catalyzed by the Canada-wide Strategy on Zero Plastic Waste. Industry representatives interviewed in 2018 emphasized the need for harmonization among product stewardship and EPR programs across the country. At the same time, they expressed their preference for goal-based, flexible regulations such as EPR, that create positive incentives and allow for industry innovation on how to meet those regulations over a command and control approach. They cautioned, however, that careful thought must be given to the incentives created by different EPR models. For example, where municipal governments manage recycling programs, there is no incentive for them to keep materials in Canada and available for Canadian circular use.

Policies to pull innovation in the higher strategies of the circular economy—beyond recycling to reuse, reduce, and rethink/redesign—are largely lacking in Canada.

Policies to pull innovation in the higher strategies of the circular economy—beyond recycling to reuse, reduce, and rethink/redesign—are largely lacking in Canada.

Industry representatives also called for a regulatory review of "brown tape" that is creating friction for green solutions such as policies designed for other public policy priorities (e.g. food safety), or based on outdated views (e.g. virgin/new materials have superior performance), or with other models of ownership and use in mind (e.g. parking bylaws).

Apart from recent progress on a pan-Canadian price on carbon, Canada's use of other environmental pricing instruments has historically been limited, although this is changing with growing numbers of PAYT programs for household waste and fees on single-use plastics being introduced by local governments, albeit in an uncoordinated way. Tax policies largely favor the extraction of primary materials over incentivizing the use of secondary ones. Industry representatives interviewed in 2018 highlighted the need to get prices right. Specifically, they mentioned ideas including consumption taxes on aggregates, full-cost pricing for water, higher carbon prices, waste fees, levies on virgin materials, or subsidizing secondary (circular) materials.

Finally, Canada's current green procurement strategy, now mainly focussed on climate mitigation and zero plastic waste objectives, offers a platform to pull the market for broader circularity objectives. Procurement was a key strategy identified by industry representatives. They called for greater weight to be given to sustainability criteria in procurement decisions, and for engineering, procurement, and sustainability teams within government to work together to use the power of procurement to help commercialize and advance more circular materials, products, and services.

5.3. GROW Policies – Converting Ideas into Marketable Solutions

5.3.1. Lessons from the Clean Innovation Journey

The road is long between the development of ideas and the conversion of these ideas into marketable goods and services. While some ideas stumble in the early stages of innovation – referred to as the 'valley of death' – for good reasons, such as technical dead ends, many do not reach commercialization due to prevailing market barriers such as capital intensity, long timelines for investment return, and the absence of a price reward. GROW policies seek to fill this gap by helping firms secure the capital and business support required to turn their ideas into market ready solutions.

In Canada, it can be difficult for firms developing clean innovations to secure debt or equity financing. Factors including unproven business models, limited assets to pose as collateral, hereterogeneity (cutting across sectors), high capital costs, and policy uncertainty, make accessibile and affordable financing hard for companies to come by. Further, Canada's large lenders (e.g. banks) and investors (e.g. pension funds) are still hesitant about investing in clean technology given a perceived lack of market maturity and consistent profitability.[83] This situation is exacerbated when such technology is not recognized as an asset class by lenders. As a result, most companies in the early stages of the innovation pipeline seek equity funding, particularly from venture capitalists. As firms developing cleantech solutions get closer to market entry, they tend to shift from equity to debt.[84]

More than half of equity financing comes from venture capital, when it comes to firms that are developing technologies that reduce or eliminate negative environmental impacts and address social need. This may include government-backed venture capital.[85] However, in Canada, the venture capital industry is not as developed as in the US or other peer countries, and very few venture capital funds are large enough to finance a company through multiple commercialization stages. Since 2010, only five environmental technology companies in Canada have raised over US$50 million in venture capital, against 183 companies in the U.S.[86] Canada also lags behind the U.S. in venture debt, however, 88% of this debt raised in Canada is concentrated in biofuels and biochemicals, which are an important element of the circular economy.[87]

These financing challenges are acutely affecting Canadian companies capacity to scale. While more clean technology firms are getting close to the growth stage,[88] this is not resulting in growing commercial successes,[89] indicating that many firms are stalled rather than growing. Further, Canadian firms reaching this stage are older (by 1-2 years) than the average for other countries, implying that even those that achieve commercial success are not doing so in a timely manner.[90]

As a result of this scarce funding for scale-up and commercialization, many Canadian cleantech firms have been seeking funding elsewhere (usually the U.S. but increasingly now in China), leading to control of these companies moving out of Canada. Others have sold to foreign buyers before reaping the full returns for their R&D investments. While Canada incubates promising new technologies, supported in part by public funds, these either cannot secure financing to achieve commercial success or end up doing so elsewhere, thereby generating jobs and wealth in other countries.

5.3.2. GROW Policies for a Circular Economy

GROW public policies aim to help innovators and entrepreneurs secure the financial, technical, and business support required to turn their ideas into demonstratable products and services, and then scale up their solutions to meet market demand. They typically take the form of public investments paired with complementary policies. These are aimed at de-risking innovation and crowding in private capital which is critical for a healthy innovation system over the long term. Non-financial support includes technical support, business development support, and assistance in overcoming inhibiting regulations and helping to secure export markets.

Firms developing circular innovations can struggle with accessing capital, and in some cases with profitability, due to their novel business models and often small scale set-ups. The concept of product as a service, for example, has a different risk profile than the established model of product ownership. For this reason, public investment or assistance in obtaining financing is a key government lever to enable the transition to a circular economy. Recommended financial policy interventions in this area take various forms such as grants or loans, tax credits for capital investments, risk-pooling fund models for waste service providers, soft loans, and green bonds. Non-financial business support is also recommended, such as technical support, advisory, training, demonstration of best practices, and development of new business models for circular solutions.

Leading international examples of such GROW policies include financial support instruments, non-financial support, and blended models. The European Commission has many funding

programs for the circular economy including the European structural and investment funds, projects under Horizon 2020, the EU program for Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME), the LIFE program, the Connecting Europe Facility, and the European Fund for Strategic Investments. They also have a Circular Economy Finance Support Platform which draws on both public and private resources. A pioneering example of non-financial government support is the Green Deals initiative of the Netherlands. An example of a blended model is Denmark's Fund for Green Business, which provides grants, advice, support for partnerships and pilot projects, and an acceleration program for new green business models.

Spotlight: The Netherlands' Green Deals

Under the highly collaborative Netherlands Green Deals program, the government works with the community, interest groups, and companies to identify non-financial hurdles to their circular solutions and helps them overcome these by lifting regulatory and legislative barriers, standards, authorizations, and permits.

The Canadian government has addressed the need to grow Canada's venture capital capacity through measures such as the creation of a Venture Capital Action Plan (VCAP) in 2013 and the Venture Capital Catalyst Initiative (VCCI) announced in 2017. Budget 2017 also extended support to Canada's clean technology sector with $1.4 billion in new funding through the Business Development Bank of Canada (BDC) and Export Development Canada (EDC). It also allocated $200 million to specifically support clean technology research, and the development, demonstration, and adoption of clean technology in Canada's natural resources sector. Other programs support early-stage technology development and demonstration, the best known being Sustainable Development Technology Canada (SDTC), which provides project financing for development and pre-commercial demonstration, along with coaching to help companies bring their innovation to market. To date, SDTC has supported more than 300 projects with close to $1 billion and leveraged an additional $ 2.45 billion in funding.[91]

When it comes to non-financial support mechanisms, Canada does not currently have any policies in place to offer business, technical or regulatory support specific to innovation for a circular economy. However, the Clean Growth Hub, launched in 2018, offers a whole-of-government focal point for clean technology, including advice and connections regarding regulatory, standards, government procurement, and skills and training matters. It also has a mandate of connecting companies to international markets.

5.3.3 Observations – GROW Policies for Innovation for a Circular Economy in Canada

There are currently no federal financial or non-financial support programs in Canada targeted specifically to converting ideas into marketable solutions for the circular economy. However, numerous funds, initiatives, and programs have been put in place for the clean technology sector. While technology is only one of the innovation types required for a circular economy (*see Table 1*), these programs could be reviewed to assess if adaptations could position them to support the commercialization of circular economy innovations.

The industry representatives interviewed in 2018 underscored the need for public investments into the circular economy, and the role of government intervention in de-risking the commercialization stages of innovation and supporting the growth of businesses in this area. In particular, they sought capital for the development and application of new technologies, platforms for products as services technologies, and sharing economy business models.[92]

5.4. STRENGTHEN Policies– Building an Effective and Resilient Supporting Ecosystem

5.4.1 Lessons from the Clean Innovation Journey

Polices explored under the PUSH, PULL, and GROW sections target specific market failures and barriers at specific points in the innovation process. However, there are also barriers that are more distributed throughout the innovation process that remain unaddressed by these. STRENGTHEN policies fill in these gaps and reinforce the effectiveness of the policies that stimulate ideas, convert them into marketable solutions, and create the market demands for them. As a result, they make the innovation ecosystem more effective and resilient.

Six broad public policy tools fall under this category:

1. Creating visions and strategies
2. Establishing policy congruency and coherence
3. Strengthening public institutions
4. Building partnerships
5. Investing in skills, training and workforce development
6. Monitoring and accountability.

Stemming from its vision and commitment to become a global leader of clean growth Canada has begun putting in place a healthy ecosystem to support its clean growth agenda. Much of this vision was articulated in the Pan-Canadian Framework on Clean Growth and Climate Change which outlines a plan to meet emissions reduction targets, grow the economy, and build resilience to a changing climate.[93]

Importantly, Canada has assigned clean innovation mandates to a number of public institutions that support innovation across jurisdictions, sectors, and innovation stages. The federal-provincial Working Group on Clean Technology, Innovation and Jobs has identified several ministries, agencies, and institutions that oversee more than 180 programs and regulations supporting clean technology. [94]

In part due to the growing programs and opportunities in the cleantech space, the sector has witnessed employment growth in recent years. The sector currently accounts for over 55,000 jobs, which are skewed in favor of high-skilled and high-wage jobs [95] While data on current and future skills required to grow this sector are currently missing, the federal Innovation and Skills Plan introduced in 2017 has introduced a number of programs with an aim to increase cleantech's contribution to Canada's GDP.

Recognizing the overall gap in data collection, the government also established the Clean Technology Data Strategy (CTDS) in 2017. This strategy supports the collection of data and regular reporting on clean technology activities in order to strengthen the evidence-base for decisions and improve understanding of the emerging clean technology landscape.

5.4.2 STRENGTHEN Policies for a Circular Economy

Vision and Strategies

To successfully drive the circular economy, there needs to be a bold, inclusive, and shared guiding vision. This bold vision needs to be supported by concrete strategies built on both existing experience and expertise as well as new research and ideas.

Such strategies should not only articulate high-level objectives, priorities, and actions but also describe the potential pathways (or roadmaps) for different sectors and regions. It is important that they are developed collaboratively between all levels of government, industry, civil society, academia, and Indigenous Peoples.

STRENGTHEN policies make the innovation ecosystem more effective and resilient.

Several countries at the helm of a circular economy transition have strong visions and comprehensive strategies to their credit. For instance, Finland's policy is shaped by a guiding strategic document launched in 2016 and updated in 2019, entitled 'Finnish Roadmap to a Circular Economy'. This document set the goal 'to become a circular economy leader by 2025' and was prepared with contributions from over 1,000 stakeholders. [96] Other countries have sectoral strategies – for example, Scotland's 2010 Zero Waste Plan and the Netherlands' 2012 Framework on the Biobased Economy.

Box 5

What is a Circular Economy Roadmap?[97]

"A circular economy roadmap is a tool for change…. It is a document that includes a vision as well as goals and tangible actions that will accelerate a country's transition towards a circular economy.

Shifting to a circular economy requires a long-term effort that spans multiple terms of office. A roadmap helps to build the necessary timetable for uninterrupted progress.

A circular economy roadmap compiles the key stakeholders' views on the essential developments and actions required for the transition as well as clarifies their own role in the transition. It is a proven tool for engaging key stakeholders and creating shared understanding about the changes needed on the path towards a future that fits within the planetary boundaries and avoids shortfalls in well-being.

At its best, a circular economy roadmap is a combination of strategy and action plan."

To date, Canada does not have a holistic federal vision or framework in place to promote the circular economy. It has tackled several specific topics that could feed into a larger circular economy strategy. These include:

- The Canada-wide Strategy on Zero Plastic Waste, through which Canada is moving towards a circular economy for plastics
- The Canadian Minerals and Metals Plan, which envisions a circular economy where mine wastes are transformed into useful products
- The Forest Bioeconomy Framework for Canada, which seeks to establish Canada as a global leader in the use of forest biomass for advanced bio-products and solutions
- The Greening Government Strategy, which seeks to establish Canada as a global leader in government operations that are low-carbon, resilient, and green

Policy Coherence

A common vision is also a foundation for greater policy coherence. The policy suite required to foster circular innovation encompasses national, sub-national, and local goverments, and cuts across policies on innovation, environment, finance, and trade, intellectual property, science and technology, as well as those for education and land training. Alignment and consistency between programs and regulations, both across levels of government and across departments within these governments, can only be achieved with a shared vision. There is also need to recognize how policies specific to a circular economy interact with the wider policy, regulatory and political context in which they occur, and how to combine them to compensate for the unintended consequences of any single one.

The 2019 Canada-wide Strategy on Zero Plastic Waste represents an effort to achieve such a coherence. It is intended to be implemented collaboratively and within the jurisdictional authority of each order of government. It recognizes the shared responsibility between jurisdictions for preventing plastic waste and provides flexibility for jurisdictions to implement actions that meet their unique circumstances. It also recognizes the roles of industry, communities, and consumers, and supports the innovation that is required to reduce plastic waste.

Public institutions can play an important role in driving a government's policy agenda throughout the innovation process; however, to play this role effectively, they must be nimble, risk-tolerant, smart, and adaptable.

Public Institutions

Public institutions can play an important role in driving a government's policy agenda throughout the innovation process; however, to play this role effectively, they must be nimble, risk-tolerant, smart, and adaptable.

Successful circular economy policies and initiatives the world over have been driven by pioneering public institutions. In Finland, for example, SITRA - the Finnish Innovation Fund - is the catalyst of the country's circular economy transition. In Belgium, the Flanders' Materials Programme, a public-private initiative run by OVAM, the public waste and materials agency, combines ambitious long-term vision development, experimental pilot projects, policy-relevant research, and concrete priority actions to accelerate the transition to a circular economy.

While no public institutions presently have a specific circular economy innovation mandate, many have the potential to include circular economy related work streams into their ongoing streams of work and programs around clean innovation. These include the National Research Council, Sustainable Development Technology Canada, Business Development Canada, Innovation Canada, Innovative Solutions Canada, Impact Canada Fund, Strategic Innovation Fund, and the Clean Growth Hub, among others.

Partnerships

The circular economy will require partnerships and a collective effort between governments and public and private researchers, public and private finance, small and large businesses, and consumers among many others. Cross-government and multi-stakeholder collaboration and partnerships are key to push the transition forward. Collaboration platforms can take many forms including industrial symbiosis, public-private agreements, R&D clusters, and voluntary industry initiatives.

Given that the circular economy is still a relatively new area of knowledge, collaboration found in R&D clusters can prove

Spotlight: UK's National Industrial Symbiosis Programme

Launched in 2005, UK's National Industrial Symbiosis Programme has more than 15,000 participating companies and is considered one of the most internationally successful programs.

A Canadian pilot of this programme has been piloted in the Metro Vancouver and Greater Edmonton regions.

effective. A good example is Rethink Resources, an innovation center in Denmark for resource-efficient production and product design. A partnership between universities, technology centers, manufacturing companies, and the Danish Ministry of Environment, it aims to grow the knowledge base on product design, manufacturing processes, closed-loop, life-extension, and new business models. [98] Another circular economy partnership model is the National Industrial Symbiosis Programme (NISP) in the United Kingdom. Associations and institutes, such as the Chinese Circular Economy Association (CCEA) and the Circular Economy Institute in France, [99] are yet another common type of collaboration platform.

Canada has a small number of circular partnership initiatives led by civil society and/or business groups, although these are less mature than many at the international level. Prominent among these are:

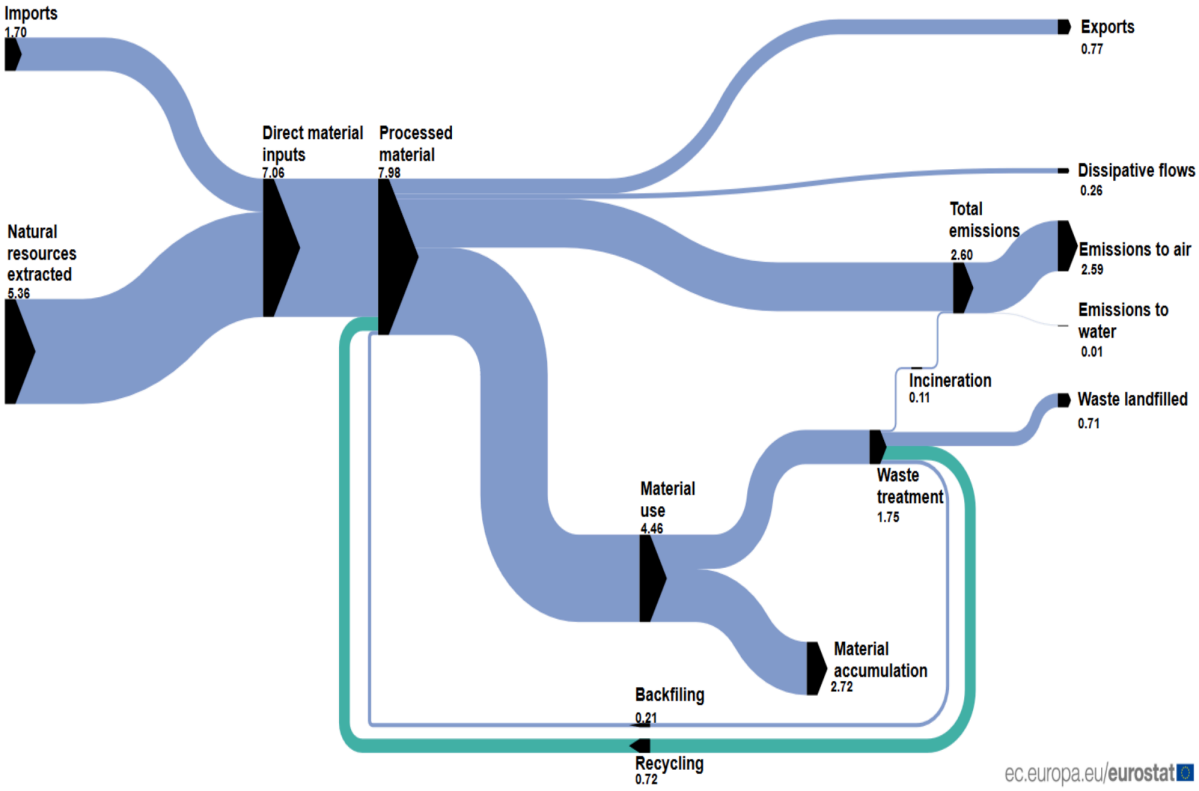
- The Circular Economy Leadership Coalition, an independent not-for-profit alliance with the mission to accelerate sustainable, profitable, zero-waste solutions to ensure Canadian leadership in the circular economy
- The National Zero Waste Council, which brings together governments, businesses and non-government organizations to advance waste prevention in Canada
- Guelph- Wellington's 'Our Food Future' initiative, which aims to create Canada's first technology-driven circular food economy
- National Industrial Symbiosis Program piloted in the Metro Vancouver and Greater Edmonton regions to demonstrate the importance of facilitated industrial symbiosis
- The recent Institut d'environnement, du développement durable et de l'économie circulaire (EDDEC), which convened stakeholders, specialists, researchers and students to shape a circular economy implementation model in the province of Québec

Skills, Training & Workforce Development

While the demand for skills and knowledge in the circular economy will vary across sectors, geographies, and stages of the transition, it is expected to require a general upskilling of the labor force. [100] The circular economy will continue to require many traditional skills, a well as new skills such as those needed for modular design or the analysis of material compositions. Soft skills for collaborating across sectors and service-related skills will be just as important as hard skills for programming, operating, and repairing equipment.[101] The circular economy will also require sharp business skills to support innovation and company growth. In addition, financial institutions will need to develop the skills to provide innovative financial solutions to meet the unique needs of the circular economy. Training for the circular economy will require both academic education pathways as well as practical training, across all fields of knowledge. Labour policy can play a key role in attracting and developing the required talents and skills, and also be critical to support workers in sectors which may see job losses to adapt their skills to growing sectors.

The circular economy will require partnerships and a collective effort between governments and public and private researchers, public and private finance, small and large businesses, and consumers among many others.

While some universities and international organisations working in this area have developed learning material on the circular economy, government offered training programs have yet to be developed and deployed. Labor policies currently in place in Canada have a long-term vision to build a resilient workforce that can support the jobs of the future. The federal Innovation and Skills Plan is an ambitious effort to make Canada a leading center for innovation and create more well-paying jobs. It targets six areas including advanced manufacturing, agri-food, clean technology, digital industries, health/bio-sciences, and clean resources, all relevant to the circular economy. Future Skills is a new federal initiative that responds to the effects of disruptive changes in the workplace. It includes the Future Skills Council which has a mandate to provide advice on emerging skills, workforce trends, and pan-Canadian priorities to policymakers. Additionally, Canada is leveraging its broader innovation initiatives such as the Innovation Superclusters Initiative, the Strategic Innovation Fund, and the Industrial and Technological Benefits Policy to expand skills development in line with industry needs.



Material flows true scale in Gt/year (billion tonnes per year) in 2017, EU27

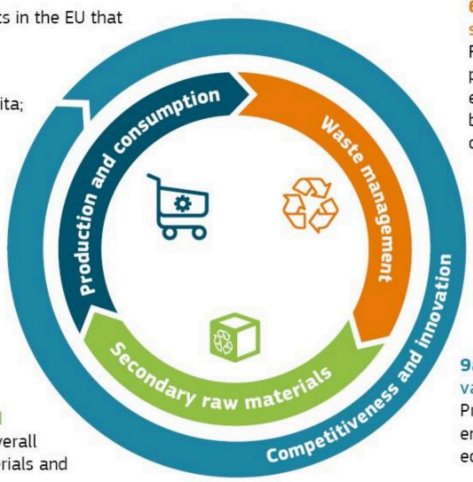
Circular economy monitoring framework

1 EU self-sufficiency for raw materials
The share of a selection of key materials (including critical raw materials) used in the EU that are produced within the EU

2 Green public procurement
The share of major public procurements in the EU that include environmental requirements

3a-c Waste generation
Generation of municipal waste per capita; total waste generation (excluding major mineral waste) per GDP unit and in relation to domestic material consumption

4 Food waste
Amount of food waste generated



5a-b Overall recycling rates
Recycling rate of municipal waste and of all waste except major mineral waste

6a-f Recycling rates for specific waste streams
Recycling rate of overall packaging waste, plastic packaging, wood packaging, waste electrical and electronic equipment, recycled biowaste per capita and recovery rate of construction and demolition waste

7a-b Contribution of recycled materials to raw materials demand
Secondary raw materials' share of overall materials demand - for specific materials and for the whole economy

8 Trade in recyclable raw materials
Imports and exports of selected recyclable raw materials

9a-c Private investments, jobs and gross value added
Private investments, number of persons employed and gross value added in the circular economy sectors

10 Patents
Number of patents related to waste management and recycling

Figure 7: Eurostats Material Flow Analysis and Circualr Economy Monitoring Framework

Source: Eurostat

Monitoring and Accountability

Accountability for the visions and strategies outlined above depends on monitoring, and monitoring depends on data. Accountability is also one foundation for the predictability required to encourage more private capital to co-invest, particularly across the long time-lines inherent in the transition to a circular economy.

There is no universally recognized indicator of circularity to date, and in most cases, existing metrics do not fully cover the circular economy. At a macro-level, tools that monitor material flows are used to capture system-wide effects and study trends in resource use and waste flows. However, while material flows highlight circularity gaps, they suffer from limitations such as an inability to convey information about the products in which the materials are used. Hence additional metrics at the level of product flows and stocks are also crucial. [102]

In order to measure progress towards a circular economy, data is needed for all stages of the life-cycle of resources, products, and services. With the circular economy encompassing all sectors, products and services, there could be endless possibilities on indicators to measure these. The growing need for data pertaining to the circular economy could potentially be met by the recent explosion in big data sources driven by digital technologies such as the internet of things, blockchain, artificial intelligence and interactive platforms.

The EU is at the forefront of collecting data on the circular economy transition. The Eurostat uses data on material use, waste, and recycling to produce material flow analyses and Sankey diagrams that visually depict the state of circularity in Europe's economy. It also collects data for the EU monitoring framework for a circular economy, which has a set of ten indicators grouped into four stages and aspects of the circular economy: production and consumption, waste management, secondary raw materials, and competitiveness and innovation.

While Canada does not have a monitoring framework or maintain a comprehensive database on the circular economy, data for some useful indicators on the subject are collected and tracked by various government frameworks, civil-society organizations, universities, and industries. Key federal sources of data available include Statistic Canada's environmental surveys and environmental accounts; Statistic Canada's programs on agriculture, energy, manufacturing, innovation, etc; and the inventories and databases maintained by Environment and Climate Change Canada, Natural Resources Canada, Fisheries and Oceans Canada, and Agriculture and Agri-food Canada. Building on these is key to gauge the status and way forward to accelerate the transition. Initial steps are underway in the form of a new Physical Flow Account for Plastics and the addition of scrap metal dealers, waste plastic brokers, and EPR programs to the Waste Management Industry Survey.

5.4.3. Observations – STRENGTHEN Policies for Innovation for a Circular Economy in Canada

Most of the ecosystem of STRENGTHEN policies for a circular economy has yet to be built in Canada, not surprisingly given that Canada has barely begun to consider broader and more integrated public policies for a circular economy.

The starting point for this is to begin to elaborate a vision. Absent this, policy development will be at best slow, at worse disjointed. The need for a common vision was highlighted in the 2018 interviews with industry representatives, who cited "a common nation-wide agenda" as one of their top three suggestions for accelerating and supporting circular economy activity in Canada.

This common vision is also the foundation for improving the alignment of local, provincial, and federal regulations (e.g., EPR regulations, municipal recycling frameworks, and programs) initially developed for waste management, but forming critical building blocks for a circular economy.

Public institutions are key to supporting the implementation of a vision into real change. While Canada does not presently have any institutions with a specific mandate to promote the circular economy, it does have a robust system of institutions supporting broader clean innovation. These provide the obvious platforms for integrating distinctive circular economy needs into their ongoing streams of work.

Canada has a robust system of institutions supporting broader clean innovation. These provide the obvious platforms for integrating distinctive circular economy needs into their ongoing streams of work.

A circular economy in Canada also requires deep collaboration among the many different stakeholders of this new economic model. Already new partnerships are beginning to emerge in Canada with the aim of stimulating a circular economy. However, for far-reaching impact they will have to grow to cover larger geographies, more sectors, and all stages of the supply chain

and innovation pipeline. Such collaboration was one of the top three priorities identified in the 2018 interviews with industry representatives. They referenced a wide range of collaboration models, including sector pledges and codes of practice; business-to-business initiatives along value chains and pan-sector partnerships; formal and informal collaboratives between industry leaders, governments, researchers, and NGOs to tackle specific challenges; and public-private partnerships.

A circular economy in Canada also requires deep collaboration among the many different stakeholders of this new economic model. Already new partnerships are beginning to emerge in Canada with the aim of stimulating a circular economy.

Ultimately, reforming an economy should deliver greater welfare to its people, by creating new opportunities and better standards of living. The circular economy is generally expected to deliver on this. However, there is little understanding of how a circular economy will impact future jobs in Canada or the skills that will be needed. More research is recommended to better understand this potential.

Finally, creating informed and evidence-based circular economy policies and accountability for progress towards a vision requires strong data. Currently, data for some circular economy indicators is available from diverse sources in Canada, but there is no single unified database or accepted monitoring framework. Industry representatives echoed global calls for better data, metrics and research on the circular economy in Canada. In particular, they raised the need to reform accounting standards to better account for life-cycle costs rather than capital costs, and to incorporate the use of natural capital in balance sheets. They also called for improved metrics to measure and assess material efficiency and the circular economy.

6. CONCLUSION

Research into clean innovation has identified four types of government policies as necessary to most effectively unleash private sector ambition and crowd in investments for change. The framework of PUSH, PULL, GROW, and STRENGTHEN policies outlines a full suite of supports across both the invention and diffusion stages of change, and can therefore inform what would constitute a comprehensive public policy agenda to support innovation for a circular economy (*Figure 8*)

Reviewing Canadian policies, programs, research, and collaborative activity relevant for the circular economy against this framework, the strengths, opportunities and gaps for supporting innovation for a circular economy in Canada can be identified. Notably, PUSH, GROW, and STRENGTHEN policies will be needed to complement the EPR, regulatory, pricing, and procurement PULL policies which have to date been the focus of initiatives and recommendations for Canada's emergent circular economy policy agenda.

Two decades have been invested in building a strong Canadian ecosystem for clean innovation, with change at the systems level only beginning to be felt now. These existing supports for clean growth and innovation offer a robust initial platform of policies and programs from which to build out timely and wide-ranging policies and programs to support circular innovation.

At the same time, the circular economy offers a largely missing, but complementary, diamention for Canadian approaches to clean innovation. To date, these have focussed on low-carbon industrial processes, energy sources, and energy efficiency. Circular economy strategies offer the next tranche of greenhouse gas reductions by emphasizing material efficiency, thus reducing the upstream demand for energy, and by increasing the use of secondary materials which are typically less energy-intensive than primary materials. In addressing zero waste as well as net-zero carbon, circular economy strategies also offer a broader strategy for addressing the triple environmental crises of pollution, ecosystem degradation and biodiversity loss, and climate change.

With a shift towards a circular economy underway globally, Canada cannot afford to lag in embracing strategies with such potential to reconcile economic growth with ecological limits, boost competitive advantage and create jobs, improve equity and societal well-being, attract green investment, and diversify the economy. The good news is that Canada begins this journey with two strong advantages: the strong set of pre-existing policies and programs to support clean innovation, and the opportunity to learn from international experience. These advantages must be leveraged to spur innovation that can drive a successful circular economy model in Canada.

APPENDIX A: APPLIED STRATEGIES FOR A CIRCULAR ECONOMY

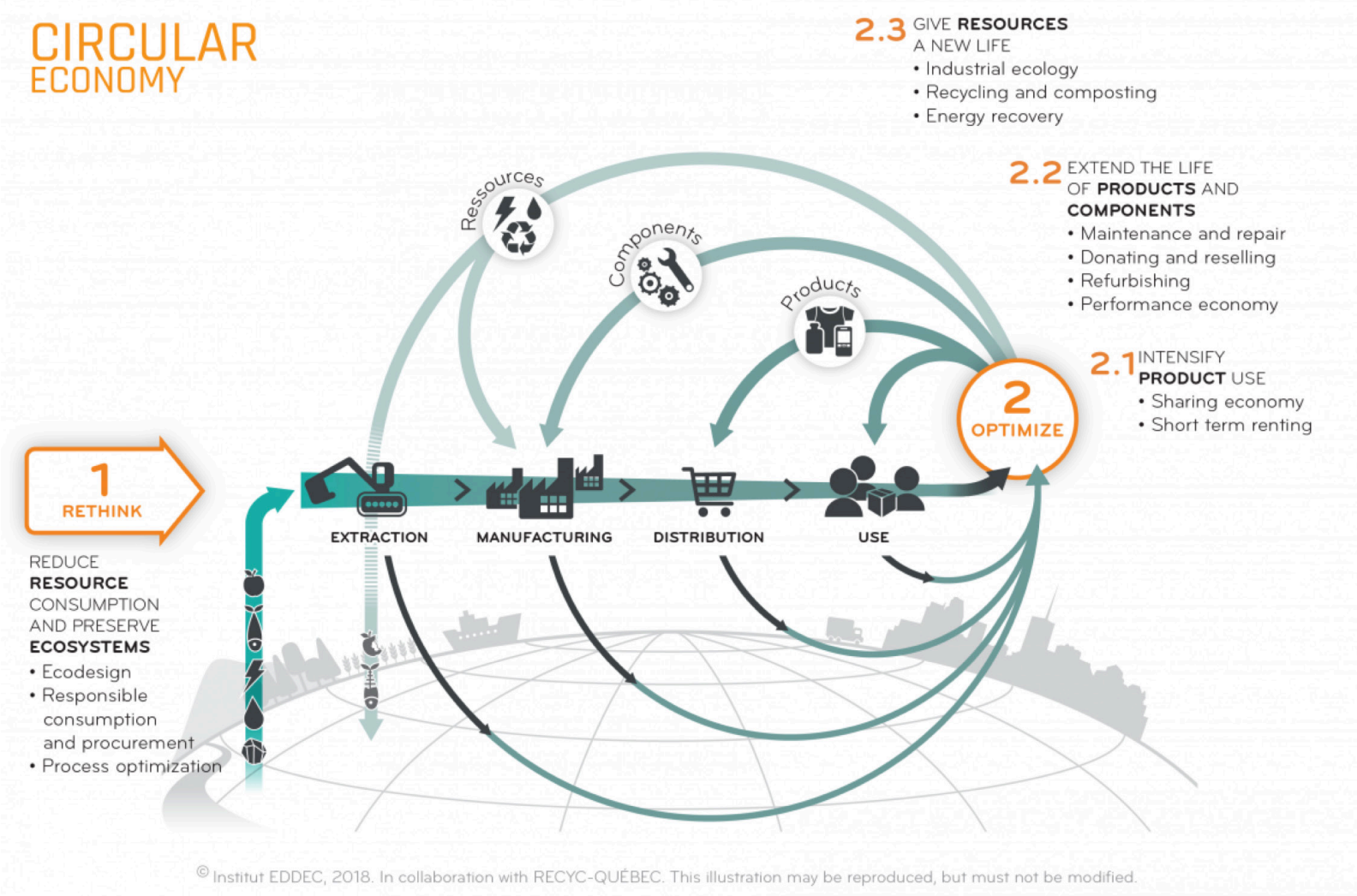


Figure 8: Applied Strategies for a Circular Economy

Source: L'Institut EDDEC

1. RETHINK	
Reduce Resource Consumption and Preserve Ecosystems	
Ecodesign[103]	Ecodesign is a design approach that considers the environmental impact of a product, service, process, or system throughout its entire life-cycle. 80% of impacts can be avoided at the design stage. Ecodesign aims to use minimum resources, produce the least waste and pollution possible, reduce the impacts of distribution, and support easy reuse and recycling. Example: The Ontario Biocar initiative has developed wheat-based bioplastic for use in the automotive industry.[104]
Responsible Consumption and Procurement[105]	Responsible consumption and procurement is when buyers, whether involved in the economy as a private or public entity, or as citizen consumers, make their buying choices taking into account environmental impacts at all stages of the product life cycle. Example: The Germany-based certification Flustix labels products and packaging that are plastic-free or that contain reduced amounts of plastic, helping consumers make an informed purchase.[106]
Process Optimization (Lean Manufacturing) [107]	Process optimization is an operations strategy that aims to continuously and iteratively eliminate waste through improved production processes. It involves making only what is necessary in order to minimize excess inventory, and streamlining production to reduce time spent on production and improve flow processes. Example: SMTC, an Ontario electronics manufacturing service provider has implemented a closed-loop water recycling system, reusing water up to three times in the manufacturing process before using it to flush the facility's toilets.[108]
2. OPTIMIZE	
2.1 Intensify Product Use	
Sharing Economy[109]	The sharing economy is a marketplace, or economic relationship, that consists of giving, swapping, borrowing, trading, renting, and sharing products and services free or for a fee. Example: . The Community Fridge, a food sharing project in Ottawa, provides an online platformwhere households and businesses share surplus food with others, preventing unwanted food from going to waste.[110]
Short-Term Renting[111]	Sort-term renting refers to a process where the consumer has access to a product for a limited time while ownership continues to be maintained by the provider. It is distinguished from leasing as short term rental contracts typically have a duration of one year or under. Example: The Cat Rental Store, offering Caterpillar machinery, has the largest equipment rental fleet in the world and offers flexible options for short- or long-term renting.[112]
2.2 Extend the Life of Products and Components	
Maintenance and Repair	Maintaining and repair prolongs product use, extending the product's useful lifetime. Ease of maintenance and repair, either for the consumer or the producer, repair, are maximized in the design phase of the product, service, process, or system. Example: Fairphone, a social enterprise based in the Netherlands, produces a durable and easily reparable smart phone that features a modular design.[113]
Donating and Reselling	Donating and reselling gives products a new life thereby extending its useful lifetime. Ensuring that used products are attractive to buyers, such as by guaranteeing data privacy for used cell phones, encourages product donation and reselling. Example: The food recovery program One More Bite, launched by the Canadian grocery chain Metro in 2018, has donated 6 million meals to community organizations, a 90% increase in the rate of diverted food from Metro in 2017.[114]

Refurbishing[115]	Refurbishing means collecting discarded products or materials that can be refinished and sanitized to serve their original functions. Refurbishment is often aesthetic in nature and results in a product that, although in good condition, may not be comparable with new or remanufactured products. Example: Samsung sells 'Certified Pre-Owned' refurbished smartphones with a one year warranty attached. [116]
Performance Economy[117] (Product as a Service)	The functional or performance service economy is based on the selling of product services rather than products themselves. In it's purest form the producer continues to own and maintain the product while the customer leases it for use or subscribes to a menu of services. In other models, the customer owns the product but is not responsible for maintenance. Example: Xerox, a printer manufacturer offers the option to rent printers for short periods (3 days to one year) for events, peak periods of workload and short-term projects. [118]
2.3 Give Resources as New Life	
Industrial Ecology/ Symbiosis[119]	Industrial ecology uses one organization's waste as another's input or raw material. Industrial symbiosis does this between businesses located in the same industrial area. Example: ArcelorMittal, a multinational steel and mining company, is partnering with LanzaTech, a company that captures and recycles carbon, to build a plant in Europe that uses waste gases from steelmaking to produce ethanol on a commercial basis.[120]
Material Recovery, Recycling and Composting[121]	Recycling and composting are two distinct processes that recover recyclable materials to reintroduce them into a new product cycle and breakdown organic matter for alternative use respectively. The recycled materials are reused either in a closed-loop system (i.e. reused in similar products) or an open-loop system (i.e. reused in other products). Reused materials can either result in something of a greater value (upcycling) or lesser value (downcycling) than the original. Composting occurs when unwanted organic material is mixed with specific quantities of air and water to aid in the decomposition process. Matter produced from composting can be used for a variety of agricultural purposes, such as growing plants. Example: Pyrowave, a plastic recyling firm recycles post-consumer polystyrene, including contaminated food containers, into high-quality products that can be used as alternatives to virgin-sourced plastics. [122]
Energy Recovery[123]	Energy recovery is a waste treatment process that generates energy in the form of electricity, heat or fuel. Energy recovery is a preferable waste handling process than sending to landfill. However, it should be considered as one of the last options at the end of life, after reuse, refurbishing and recycling. Example: McDonalds France collects used cooking oil from its restaurants and transports it to a processing plant to make biofuel. [124]

APPENDIX B: BARRIERS SPECIFIC TO A CIRCULAR ECONOMY

Barriers to new circular economy ideas—address with PUSH policies

Barrier	Description
Lack of research	In-depth research into the circular economy is required to support it's uptake. This includes research on the state of the circular economy (material flows, recycling rates etc), it's impacts and benefits, circular solutions (new materials, products, and services), business research on new business models, policy research which polices are best suited to accelerate the circular economy. Currently research by government, academics as well as business on the topic is lacking.
Lack of circular design	Given that 80% of a products impact can be avoided at the design stage, product design is a key factor that determines its environmental footprint, durability, reparability, suitability for refurbishment or remanufacturing and recyclability. Today design is focussed more on product attractiveness- e.g. low price and fashionable features-than on end of life considerations. Many industries also practice deliberate programmed obsolescence to drive up sales.
Technology	The circular economy will require the tapping of transformative digital, engineering and biological technologies to enable cleaner and more efficient extraction, production and waste management. Some of the technology required is still underdeveloped or unproven. For technologies that are proven, a poor understanding of potential markets and future returns on investment may keep them from proliferating at scale.

Barriers to converting circular economy ideas into marketable solutions — address with GROW policies

Barrier	Description
Capital intensity	Much of the circular economy infrastructure is yet to be built and will need large upfront costs. Recycling technologies and collection systems for example often require costly plants and equipment as well as having uncertain return on investment and payback times. Recycling also involves additional costs such as materials processing to reach a quality comparable to the original materials.
Difficulty in securing capital	Finding funding to support circular initiatives can be challenging, especially for small-to-medium sized enterprises. Circular economy business models, production methods and products maybe non-traditional and unfamiliar to investors, banks, and funding agencies. Furthermore, some circular economy initiatives are small scale which makes it even harder to attract funding.

Barriers to stimulating market demand for circular economy solution — address with PULL policies

Barrier	Description
Tilted playing field	Pricing failures tilt the playing field towards a linear economy. In most cases market prices do not reflect the environmental and social costs of virgin materials, non-renewable energy and waste disposal. As a result they create perverse incentives for businesses and households.
Insufficient demand for goods	End markets for many circular economy goods and services are still considered unviable, underdeveloped. This could be due to various reasons including the low economic value of some types of waste products or the perception that reused, remanufactured, refurbished, recycled goods are of inferior quality.
Insufficient or unreliable supply of materials and energy	Supply of recycled materials and renewable resource inputs are sometimes inconsistent as they dependent on post-consumer waste streams and uncontrollable factors such as the weather.
Imperfect information	Due to the relatively nascent market for circular economy solutions market players involved may have insufficient information regarding the quality of the circular materials or goods, negatively affecting their decision making.
Supply chain coordination	Diverse and sometimes conflicting interests of actors throughout the product life-cycle and supply chain, make the coordination required for circular economy models challenging. This is made more difficult in the absence of matchmaking services across businesses to facilitate market interaction between upstream and downstream actors.
Unintended consequences of existing regulations	Regulations that were made to support a linear economy, could have unintended consequences for a circular one. For instance waste regulations that treat waste as an environmental hazard could create legal and administrative challenges to using waste as a resource instead.
Implementation and enforcement failures	Monitoring and accountability are key to ensuring policies deployed to create a market demand for circular economy solutions are effective. Lax implementation or enforcement failures can lead to the effects of these polices being diluted or altered.

Barriers to building an effective and resilient circular economy — address with STRENGTHEN policies

Barrier	Description
Myopic planning	As a consequence of quarterly earnings reporting requirements and four year electoral cycles, both businesses and governments tend to focus on the short term and display signs of myopic planning. As a result they may neglect or under invest in circular solutions which have high upfront costs and yield benefits in the longer term. Where they invest in linear economy infrastructure and solutions instead, this could further push back the uptake of the circular economy due to lock-in effects.
Non-collusive collaboration	Many industries limit opportunities for cooperation in non- competitive areas, such as packaging materials and common infrastructure, for fear of violating competition laws or disclosing sources of competitive advantage

Capabilities and skills	The circular economy is likely to require a general upskilling of labour. Without adequate education and training programs in place, these skills could be unavailable in house or in the market at a reasonable cost.
Data and metrics	It is difficult to manage what isn't measured. Unavailable or Insufficient data as well as imperfect measurement frameworks on the circular economy make it challenging to gauge the status quo and track changes over time.
Policy incongruency	Being a system wide change the circular economy requires policies targeting different regimes (innovation, labour, finance, trade etc) stakeholders (producers, consumers etc), sectors (mining, construction, etc), life-cycle stages (extraction, end of life etc) and jurisdictions (federal, provincial etc) . If these are not aligned or work against each other they can undercut circular objectives.
Uncertainty	The transition to a circular economy is a mammoth undertaking. It could take years or even decades before becoming mainstream. Uncertainty about transitions speed and direction can hinder confidence to scale up circular strategies and polices.
Ingrained behaviour and attitudes	Having only known linear production systems and consumption patterns, business executives and consumers seldom look for circular opportunities. In order for the circular economy to flourish, a change in mindset is needed in every segment of society from government to business and consumers. Due to ingrained behaviours and attitudes, it may be difficult for new circular solutions to gain marker foothold without sufficient information and awareness on their advantages.

APPENDIX C: ELEMENTS OF THE PREVAILING PUBLIC POLICY AGENDA FOR A CIRCULAR ECONOMY

Public Policy	Description
PUSH Polices	
Research and development	Programs in the fields of, for example, material sciences and biosystems
GROW Policies	
Investment	Governments can strengthen markets and align incentives by funding or financing infrastructure, research and development. Options include providing grants or loans, tax credits for capital investments, risk-pooling fund models for waste service providers, soft loans, energy performance contracts and green bonds.
Expert group on financing	To stimulate and circular economy financing
Guidance to industries	Advisory can be for a specific life cycle stage or more comprehensive
Business support -Financial	for example direct subsidies, provision of capital, financial guarantees
Business support- Technical	For example advisory, training and demonstration of best practices to business
PULL Policies	
Extended Producer Responsibility	The producer's responsibility - financial and/or physical - for a product is extended to the post-consumer stage of a product's life-cycle. EPR shifts responsibility upstream in the product life cycle to the producer and away from municipalities. As a policy approach it provides incentives to producers to incorporate environmental considerations in the design of their products. Regulations usually identify designated producers or first importers, the products covered, performance measures, reporting, and targets.
Prohibitions (bans)- Use Bans	To prevent the supply of certain products and packaging that are difficult to collect and/or recycle
Prohibitions (bans)- Disposal Bans	To prevent the disposal of certain products and packaging that can be recycled
Product regulations	Including design, extended warranties and product passports
Waste regulations	Including collection and treatment standards and targets, the definition of waste, extended producer responsibility and take-back systems
Taxes- On extraction	Value Extracted Tax (VET) used to decrease labour (payroll and personal income) taxes while increasing taxation of natural resource use, pollution and consumption (i.e. carbon emissions, water, fossil fuels, electricity).
Taxes- Deductions on repair, refurbishment, reuse, recycling	VAT or exists duty breaks on secondary use materials and goods in the form of a reduced tax rate applied or claiming back from income tax of partial labour costs.
Taxes- On Consumers/Product Use	Taxes on environmentally damaging products to discourage their use.
Taxes- Waste and incineration	Taxes on waste disposal and incineration incentivise alternative treatment methods such as recycling.

Public Policy	Description
Differentiating disposal taxes	According to the environmental harm associated with different types of waste treatment
Fees and Charges- Waste Disposal	Are used to recover the costs of providing goods or services. Unlike taxes, fees and charges are a requited payment, meaning that the person paying gets something in return in proportion to the payment, whereas taxes are unrequited payments. In waste management this may include items such as municipal waste service charges or landfill gate fees.
Fees and Charges- Product fees	To discourage the use of environmentally damaging products
Deposit-refund systems	Place a surcharge on the price of a product likely to pollute the environment. In waste management, this may include measures used to internalise the environmental costs of end-of-life products, such as product levies, advanced recycling fees and extended producer responsibility measures
Subsidy	Can be used in environmental policy to directly or indirectly reduce the use of something that has a proven, negative effect on the environment. In waste management, subsidies may be used to encourage better waste management, waste reduction and investments in improved waste management, and may take the form of direct subsidies or tax exemptions.
Tradable permits	Can be used to allocate emission or resource exploitation rights.
Public procurement	Government have enormous influence as purchasers and can wield that influence to support (or even establish) markets for recovered materials
Codes, standards, ecolables, certification	Governments can use codes and standards to set requirements for performance and facilitate the use of recovered materials (e.g. green building codes, environmental product labelling and standards). They can also leverage third party certifications.
Recycled content performance standards	Set recycled content performance standards either as a minimum percentage of recycled content and packaging or as a tax mechanism that decreases to zero when the desired recycled content threshold is met
Repair, reuse & remanufacturing	•These policies are aimed at supporting business models with extended product life such as reparability. • 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.
STRENGTHEN Policies	
Strategy- Cities as innovation hubs	Knowledge exchanges or strategies for pioneering cities to explore how to approach circular economy implementation within complex and fast-growing urban systems, share challenges and showcase success stories. Cities have proved valuable partners in incubating circular economy experiments and start-ups due to their mandates for waste management and local economic development, their position on the front lines of providing services to swelling urban populations, and the clustering of entrepreneurs and innovators.
Strategy- innovation	Both technical and business
Strategy- National economy-wide and sectoral circular economy road maps	Plans or strategies focused on enabling the circular economy, through tangible actions and pilot projects in areas of strength.
Strategy- Aligning CE in mainstream policies	It is possible to prioritize the circular economy and draw it out of the policy agenda by referencing existing policies to co-create momentum and promote positive impacts.

Public Policy	Description
Strategy-Waste prevention	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. 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.
Strategy- 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.
Creating common definitions, performance standards, measurement and assessment protocols	To create administrative efficiency, reduce transaction costs for participants in the life-cycle and facilitate the scaling up of reverse supply chains to pan-provincial and territorial regional systems that have scale efficiencies.
Support the development of evidence and data	This includes better data at all levels – from materials and products to facilities, sectors and trade flows – as well as pilots to provide proof of concept, and case studies to document lessons learned and the economics of these new strategies.
Development of information systems, indicators and material flow accounts	To effectively monitor the circular economy
Introducing advanced information systems to track industrial and other waste	Taking advantage of digital advancements such as IoT, blockchain etc
Reporting and accountability	Governments can use policies to make specific actors more accountable for reducing and diverting waste. This can be done through Extended Producer Responsibility or other tools (such as requiring IC&I generators to register, report and adhere to standards, or setting licensing requirements for facilities and haulers).
Outreach, education and awareness	Consumer behaviour is one of the key levers for enabling the transition to a circular economy. It is both a strong and a challenging lever. Many businesses typically follow mainstream consumer behaviour and attitudes to identify market potential for new products and services. Similarly, consumer behaviour also determines the space available for policy initiatives stimulating sustainable and more circular behaviour.
Capacity building measure	Including of businesses, enforcement agencies, public, media etc
Partnership and collaboration	Partnerships and collaboration refer to forging mutual agreements among different parties from the private and public sectors. This can include international arrangements between governments on trade regulations or private suppliers and a single ministry within a country. It can include PPPs and coordinated or joint efforts among several government ministries. Collaborative efforts such as these enhance knowledge sharing and eventually the experience needed to create effective circular economy policies.
Encourage Industrial Symbiosis Programs	Industrial symbiosis is a waste to resource model that is designed to optimize underused or undervalued resources by helping companies identify symbiotic partnerships that recognise the value of a company's by-products and assisting it in making connections with companies in other industrial sectors and across traditional value chains.

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