

Circular Economy: Best Global Sector Practices

Research in Progress

Stephanie Cairns,
Director, Circular Economy
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Research Teams:
Yves Richelle, Henri Thibaudin, Jérôme Larivière

Justine Beaulé, Stephanie Cairns, Catherine Christofferson, Genevieve Donin, Ghita Ikhoyaalo, Marcelin Joanis, Isabel Racine, Emmanuel Rauflet, Natalie Sutt-Wiebe



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Materials for potential Canadian sector roadmaps

- GDP analysis to identify potential priority sectors for Canada
- Document best technical practices for 7 sectors, drawing on global as well as Canadian real-world examples



1. Priority sectors for Canada (1):

Yves Richelle, Henri Thibaudin, Jérôme Larivière

- What criteria might be used to identify Canadian sectors most amenable to shift towards circularity?
- Methodology
 - Screen 1: 12 products/materials most mentioned in 12 international CE strategies
 - Screen 2: Top 6 of these products/material being consumed in Canada, and therefore available as post-consumer reuse/recycling?
 - \$ value of the product acquired in 2016 by industries, households, and public sector

Food	Steel, steel and semi-steel products
Used building materials	Plastic products
Electrical and electronic waste	Residual packaging (wood, paper cardboard)/ AB only - Used oil



Priority sectors for Canada (2):

- Screen 3: Do we have related industries big enough to process these post-consumer resources?
 - Top 6 industries with ability to process the core products/materials (by GDP).

Nat'l: Construction	Building materials
Nat'l: Food manufacturing	Food
Reg'l: Mining and Quarrying (palladium, copper)	Electrical and electronic waste
Reg'l: Primary metal manufacturing and fabricated metal product manufacturing	Steel & related products
Reg'l: Petroleum and coal product manufacturing	Used oil
Reg'l: Plastics and rubber products manufacturing	Plastic products

2. Profiles of best technical practices in 7 sectors

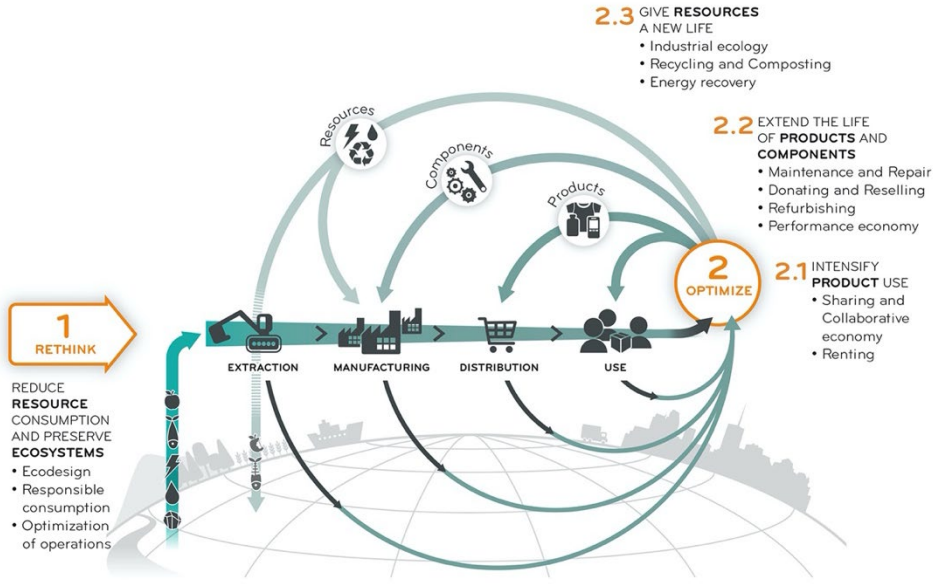
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Agri-food	Automotive	Construction
Electronics	Forestry/bioeconomy	Minerals and Metals
Plastics		



Framework for categorizing best technical practices

Circular economy



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1 Rethink

To Reduce Resource Consumption

Ecodesign

Responsible Consumption

Optimization of Operations or Lean Manufacturing

2. Optimize

To Intensify Product Use

Sharing and Collaborative Economy

Renting

To Extend the Life of Products and Components

Maintenance and Repair

Donating and Reselling

Refurbishment

Performance Economy¹ ("Product as a Service")

To Give Resources as New Life

Industrial Ecology/ Symbiosis

Recycling and Composting

Energy Recover



Example: Plastics Practices

Table X. Summary of circular economy practices found in the plastics sector

CE Strategies		Practices
1. Reduced resource consumption	a) Ecodesign	Carbon Capture-Sourced Plastics
		Biomimicry
		Bio-Benign Plastics
		Life Cycle Design
		Use of Recycled Materials
		Design for Recycling
2. Intensified product use	b) Lean manufacturing/ production efficiency c) Responsible consumption	Life Cycle Evaluation
		Closed Loop Manufacturing
		Energy Efficient Production
		Content Labelling
		Reduced Single-Use Plastics
		Reduced Packaging
3. Extending life of products and components	a) Sharing and collaborating economy b) Product as service a) Design for maintenance, durability, repair, refurbishment b) Donating and reselling c) Refurbishing d) Performance contracts	Innovation Hubs
		Reusable Packaging Services
		Durable Goods Recycling
		Self-Healing Plastics
		Materials Matchmaking Platforms
		Plastics Repair
4. Giving resources new life	a) Industrial ecology b) Recycling and composting c) Energy recovery	Extended Producer Responsibility
		Reduced Supply Chain Leakage
		Vertical Integration
		Distributed Recycling Models
		Alternative Recycling Technologies
		Recycling Technologies for Hard-to-Recycle Plastics
		Biodegradable or Compostable Packaging
		Biodegradable and Compostable Plastic Goods
		Tolling and Grinding Services
		Developing Markets for Recycled Materials
		Energy Recovery and Fuel Production from Plastic Waste



Example: Minerals and Metals Practices

Table X. Summary of circular economy practices found in the Minerals and Metals sector

CE Strategies		Practices
1. Reduced resource consumption	a) Ecodesign	Electric-Powered Extraction Equipment Eco-friendly Chemical Inputs Technological Innovations Environmental Offsets Energy Efficiency
	b) Lean manufacturing/ production efficiency	Efficient Extraction Water Conservation
	c) Responsible consumption	Sustainable Certifications
2. Intensified product use	a) Sharing and collaborating economy	Extraction Equipment Rental
	b) Product as service	-
3. Extending life of products and components	a) Design for maintenance, durability, repair, refurbishment	Extraction Equipment Designed for Reuse, Repair and Recycling
	b) Donating and reselling	-
	c) Refurbishing	Extraction Equipment Refurbishment Repurposing the Mine Site
	d) Performance contracts	-
4. Giving resources new life	a) Industrial ecology	Tailings as a Product Carbon Capture
		Reuse or Recycling of Mining Waste
	b) Recycling and composting	Minerals Recovery
c) Energy recovery	Solar Panels on Site Planting Bio-crops on Site	



Example: Minerals and Metals Company examples of specific practices

Strategies		Practices	Specific examples
1. Reduced resource consumption	a) Ecodesign	Electric-Powered Extraction Equipment	GHH Fahrzeuge ¹ (global); ETF Equipment ² (global)
		Eco-friendly Chemical Inputs	Mineworx ³ CDN
		Technological Innovations	Rio Tinto ⁴ (global); Rio Tinto Tinto ⁵ (global); Elysis ⁶ CDN
		Environmental Offsets	Rio Tinto ⁷ (global); BHP ⁸ (global); B2Gold ⁹ CDN
		Energy Efficiency	ArcelorMittal ¹⁰ (global); ZeroBrine ¹¹ (global); B2Gold Corp. ¹² CDN
	b) Lean manufacturing/production efficiency	Efficient Extraction	Mineworx Technologies Ltd ¹³ CDN; Tomra Systems ¹⁴ (global)
		Water Conservation	Mineworx Technologies Ltd ¹⁵ CDN; Newmont Goldcorp ¹⁶ CDN; ZeroBrine ¹⁷ (global)
	c) Responsible consumption	Sustainable Certifications	ArcelorMittal ¹⁸ (global); Rio Tinto ¹⁹ (global)



Example: Minerals and Metals Practice Detailed Examples

Ecodesign

- Electric Extraction Equipment
 - [GHH Fahrzeuge](#)⁵⁰ is offering electric Load, Haul and Dump (LHD) machines with capacities ranging from 10 to 21 tons. In connection with an intelligent monitoring system, efficiencies are increased, and power consumption is reduced significantly.
 - [ETF Equipment](#)⁵¹ has designed a Battery-Operated Modular Mining Equipment which is fully powered by a heavy-duty rechargeable lithium-Ion D5 battery arrangement. The D5 battery system creates no emissions, lower noise levels, and requires less maintenance than a conventional diesel-powered vehicle.
- Eco-friendly Chemical Inputs
 - [Mineworx Technologies Ltd](#)⁵²CDN (in joint partnership [EnviroLeach](#)⁵³) is reducing its operational footprint and energy consumption through the use of the HM X-leach, an innovative new eco-friendly technology which offer cyanide free precious metals extraction.
- Technological Innovation
 - [Rio Tinto](#)⁵⁴ has achieved gains in mining automation through the Mine of the Future program. The program was founded to help the company find innovative ways of extracting minerals while reducing environmental impacts and improving worker safety.
 - [Rio Tinto](#)⁵⁵ has modernized it's 60-year-old Kitimat aluminum smelter in British Columbia using the latest evolution of their APTM technology. The result was an environmentally superior, safer, and more productive facility. The project also reduced the smelter's overall emissions by nearly 50 percent.
 - [Elysis](#)⁵⁶CDN is delivering a new technology⁵⁶ which eliminates all greenhouse gas (GHG) emissions from the aluminum smelting process and is the first technology ever that emits pure oxygen as a by-product.



Example: Minerals and Metals Practice Ecodesign Ideal

The Ideal

- Extraction is designed with a holistic approach, considering the environmental impacts of the mine site at every stage of the process, from the planning phase to the remediation phase.
- Extraction is designed to have a minimal impact on the surrounding environment through low-carbon considerations, fewer harmful chemical inputs, minimizing waste and providing environmental offsets to reduce the impact of mining on local biodiversity



Additional information for each sector

- High level economic and environmental profile (Canadian if available)
- Deeper snapshots of specific company examples
- List of leading global sector specific public policies supporting circularity
- Annotated bibliography: 5-10 key resources on circular economy and the specific sector



Next Steps

- Planned release June 2020
- Intended use is twofold:
 - As technical resource for potential future sector roadmapping exercises
 - As a resource for communications—we have now identified 200+ specific real world circular economy practices in 7 sectors, and systematically categorized and organized these for future reference and use

