Building Canada's BioEconomy Cluster: Value Chain Gaps and their Solutions

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POLYTECHNIQUE MONTRÉAL
LE GÉNIE EN PREMIÈRE CLASSE

OUR OBJECTIVES

To introduce the concept of "value chain gaps" and their "attributes"…

To summarize the most critical value chain gaps/attributes for Canada's bioeconomy, identified in cross-Canada workshops…

Context: Cross-Canada Workshops



- 6 workshops were held, whose goal was to **identify value chain gaps** which if addressed, would increase **the potential for success** of bioeconomy strategies at the value chain level.
- BioEconomy stakeholders were involved such as **value chain operators** including **Anchor Firms** and **Ultimate Market Pull Firms**, leading **technology developers**, **cluster service providers**, and **government**.
- In total, the workshops attracted **142 BioEconomy Stakeholders**, and **22 potential BioEconomy value chains** were identified.

AGENDA – DAY 1

10:00	**Welcome and Roundtable Introductions** Paul Stuart (Polytechnique Montreal) – *30 minutes*
10:30	**Regional Strengths and Provincial Programs in Support of the BioEconomy** André Denis (MFFP) – *20 minutes*
10:50	**Federal Programs in Support of Canada's BioEconomy** Virginie Chambost (EnVertis) – *20 minutes*
11:10	**BioDesign SuperCluster** John Schmidt (FPInnovations)– *20 minutes*
11:30	*Health Break - 15 minutes*
11:45	**BioEconomy Questions that Keep Me Up at Night** Maria Wellisch (Agriculture and Agri-Food Canada) – *15 minutes + 15 minutes discussion*
12:15	**BioEconomy Questions that Keep Me Up at Night** Mena Salib (Air Canada) – *15 minutes + 15 minutes discussion*
12:45	*Lunch – 45 minutes*
13:30	**BioEconomy Clusters and Value Chains** Paul Stuart (Polytechnique Montreal) – *20 minutes + 10 minutes discussion*
14:00	**Break-Out Sessions:** **Potential BioEconomy Value Chains and Clusters** • Break-Out Sessions - Methodology • Break-Out Sessions – Identifying bioeconomy Value Chains and Clusters • Feed-Back Presentations and Discussion
17:00	**Short Survey**
17:30	**Workshop Adjourned – Dinner Logistics**

AGENDA – DAY 2

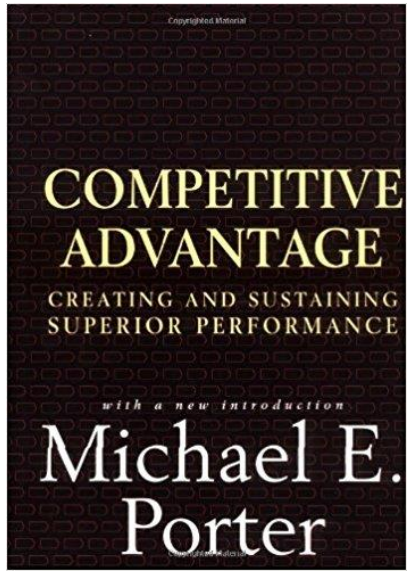
8:00	**Welcome** John Schmidt (FPInnovations) – *15 minutes*
8:15	**University Networks in Support of Potential BioEconomy Clusters** BiRNet – Warren Mabee (Queen's University) –*10 minutes + 10 minutes discussion*
	University Networks in Support of Potential BioEconomy Clusters EAFIT - Paul Stuart (Polytechnique Montreal) – *10 minutes +10 minutes discussion*
9:00	*Health Break - 15 minutes*
9:15	**Facilitated Discussion: BioEconomy Clusters, Value Chains and Value Chain Gaps** Paul Stuart (Polytechnique Montreal)
10:00	**Break-Out Sessions:** **Potential BioEconomy Value Chains and Clusters** • Break-Out Sessions - Methodology • Break-Out Sessions – Addressing BioEconomy Value Chain Strengths and Gaps • Feed-Back Presentations and Discussion
12:30	**Path Forward and Short Survey**
13:00	*Lunch – 45 minutes*
13:45	**Workshop Adjourned**

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2-Minute Primer on Value Chains and Clusters



Michael E. Porter
"Competitive Advantage"
1985
The Free Press. New York.

- The idea of the value chain considers a manufacturing organisation as a system made up of **subsystems**…
- Each with **inputs, transformation processes and outputs**, involving the acquisition and consumption of resources…
- How the value chain activities are carried out determines its **cost and affects profits**…

BioEconomy Value Chain Context

- To achieve and sustain a competitive advantage in the BioEconomy, **typically enabled by information technologies**, companies must understand each component of their future value chain…
- Companies who will succeed in the bioeconomy will likely take risk in becoming "**The Walmarts of the BioEconomy**"…
- This risk can be greatly mitigated by considering **value chain** and **cluster** approaches…



Canada's Cluster: Sarnia



Bio-Jet fuel

PLA
Butanediol
Carbon Fibre
PET

Fossil-based Feedstock

Fuels & Energy

Primary Chemicals

Polymers & Chemicals

Finished Products

Advanced Manufacturing

Consumer

Ethanol
Butanol
Biodiesel

Bio-based Feedstock

Succinic acid
iso-Butanol
Levulinic acid
Lignin

Cellulosic sugars
Oils

Lignin
NCC
Natural fibres

Pre-Processed Biomass

Low Value Added → High Value Added

Clusters



- Clusters increase productivity and operational efficiency
- Clusters stimulate and enable innovation
- Clusters facilitate commercialization and new business formation
- Etc….

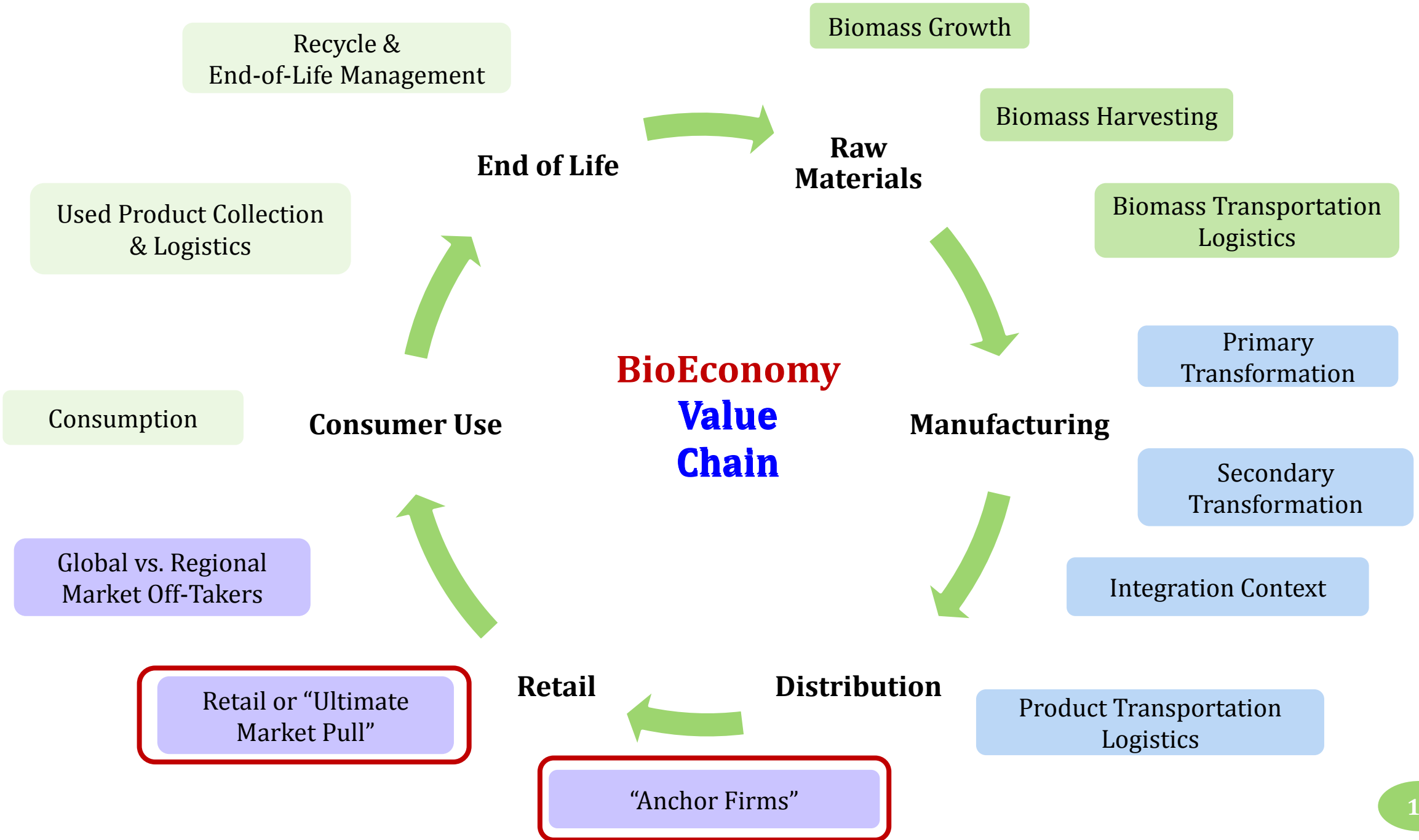
Some Attributes of Successful Clusters

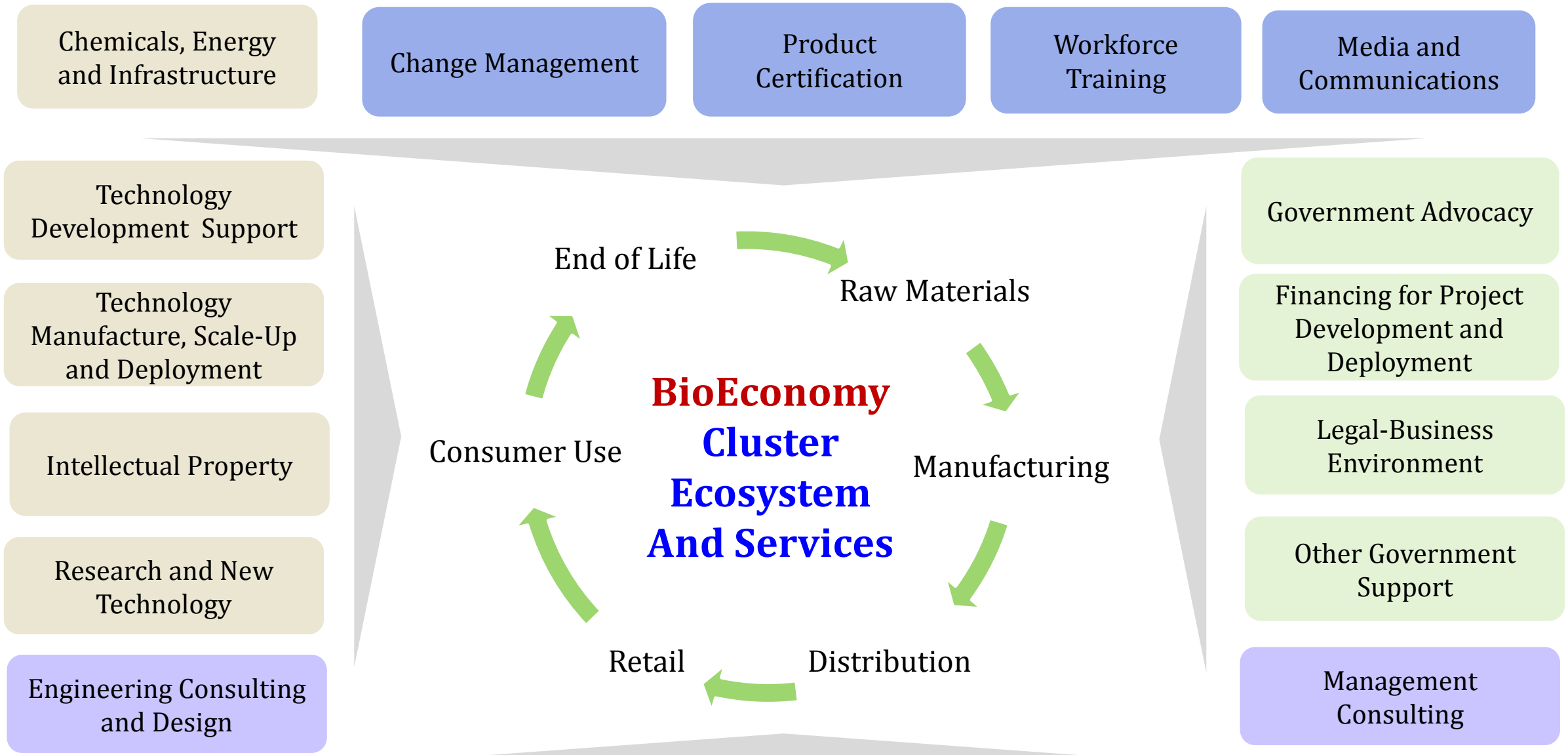
"European Cluster Observatory"

Örjan Sölvell, Stockholm School of Economics



- Spawns innovation to improve **competitiveness** on a **global basis**
- Facilitates **access to funding** throughout research, development and deployment
- Assists with value chain operating **flexibility**, supply chain **efficiency** and **effectiveness** globally
- Communications to **promote the growth of firms** and attract entry of new ones
- Intensity of cluster is increased and **refined over time**, and gives rise to further growth


Recycle &
End-of-Life Management
Biomass Growth
Biomass Harvesting
End of Life
Raw
Materials
Biomass Transportation
Logistics
Used Product Collection
& Logistics
Primary
Transformation
BioEconomy
Value
Chain
Consumption
Consumer Use
Manufacturing
Secondary
Transformation
Integration Context
Global vs. Regional
Market Off-Takers
Retail or "Ultimate
Market Pull"
Retail
Distribution
Product Transportation
Logistics
"Anchor Firms"


Chemicals, Energy and Infrastructure
Change Management
Product Certification
Workforce Training
Media and Communications
Technology Development Support
Technology Manufacture, Scale-Up and Deployment
Intellectual Property
Research and New Technology
Engineering Consulting and Design
End of Life
Raw Materials
Manufacturing
Distribution
Retail
Consumer Use
BioEconomy Cluster Ecosystem And Services
Government Advocacy
Financing for Project Development and Deployment
Legal-Business Environment
Other Government Support
Management Consulting
Technology and Business Analytics
Enterprise Resource Planning
Transportation Logistics Optimization
Partnership Support

Metsä Fibre Bioproduct Mill in Äänekoski (Finland)

- 1.3 million Adt/a softwood pulp mill
- €1.2 billion capital investment
- 2,500 jobs throughout the value chain, including 1,500 new jobs



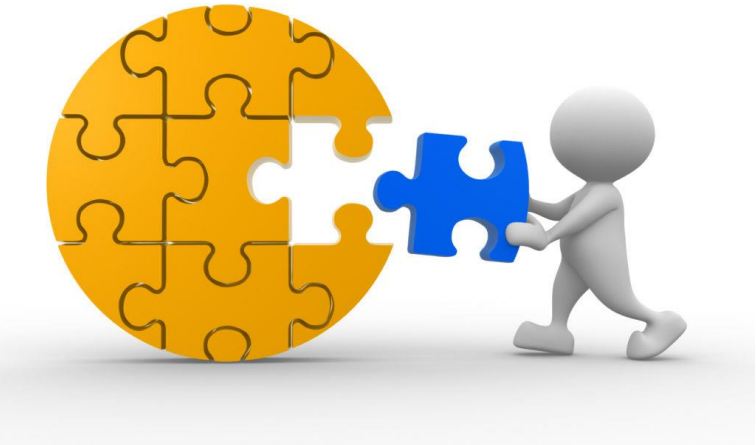
- In addition to softwood pulp, bioproducts such as tall oil, turpentine, bioelectricity and wood fuel are produced
- Potential bioproducts created from production side streams include textile fibres and lignin products
- Partners: largely small and medium-sized enterprises

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Value Chain "Gaps"



- To establish a successful biorefinery VC, it must be innovative, efficient and **competitive** while implicating the **sustainable** use of renewable resources.
- BioEconomy cluster services in the VC ecosystem are essential to achieve this – to identify, quantify and provide solutions for **value chain "gaps"**, or critical issues that must be addressed so that the VC is competitive and sustainable.
- A cluster approach is especially valuable to **BioEconomy VCs**, which typically require the transformation of stakeholder relationships, and/or establishing **non-traditional stakeholder relationships between industry sectors**.

Value Chain Gaps - Terminology

- **5 value chain gaps** were defined
- **30 value chain gap attributes** (or characteristics) were identified, across the value chain gaps
- **Solutions** for each of the value chain gap attributes were identified
- Value chain gaps and attributes were **assessed** by workshop participants



5 Value Chain Gaps

1.	**Market-Production Imbalance**	The inquality between the rate of production of bioproducts from the VC, and market demand. Whether for added value or commodity centric VCs, market-production imbalance results in business model weaknesses.

5 Value Chain Gaps

4.	Robust Business Model from Market Diversity	More off-takers for the product portfolio implies a more robust business model, in contrast with the case of a small number of large off-takers having undue negotiating position in partnership agreements.

Value Chain Gap Attributes and Solutions

	Proven Second Transformation Technologies: VC Gap Attribute	Potential Solution(s) (AV: added value centric VCs; C: commodity centric VCs)
1.	Experience curve heuristics show that production costs are reduced by at least half between the 1st and the nth commercial implementations of a new technology	Focus on distribution channels and supply chain efficiencies while rolling out second transformation implementation strategy (AV); Execute a continuous investment strategy to improve second transformation technology effectiveness over time (AV/C)
2.	Second transformation technologies should be developed through JDAs, taking advantage of VC implementation scales	Develop JDAs with second transformation technology developers seeking to accelerate development and mitigate technology risk by integrating into the VC at smaller scales (AV/C)
3.	Added value bioproducts manufactured by second transformation processses can have different performance than the competing conventional product, and there are barriers to testing with potential off-takers and assessing the value proposal	Work with members of the VC, in a manner equivalent to a vertically-integrated company, proving the value proposal, and developing flexible partnership agreements based on this (AV/C)
4.	Distinct properties of and contaminants in primary transformation bioproducts are unique to feedstocks/processes, which can be a barrier to development of second transformation technologies	Work with VC partners to find innovative solutions requiring a minimum of pretreatment ahead of second transformations, creating competitive advantage (AV)
5.	There is a dynamic landscape for new second transformation innovations that convert bioproducts from the first transformation, considering depolymerization of biomass carbohydrates, and repolymerization to added value products	Close collaboration with research institutes and university to develop break-through second transformation technologies (AV); Monitor technology landscape closely, and implications to VC competitive position (AV/C)

Value Chain Gap 4 Attributes



Most Important Value Chain Gap Attributes

- Workshop participants became **familiar** with the Value Chain gaps in 4 steps, and **assessed** them:
  - The value chain gaps were introduced
  - **Workshop participants were requested to identify most important (MI), least important (LI) and least clear (LC) value chain attributes**
  - Workshop participants reviewed the written description of each value chain gap and attributes – first evaluation
  - After reading, the gaps were discussed between participants – refine evaluation
  - Lastly, break-out groups were carried-out to concretize the VC gap attributes by assessing bioeconomy value chains



Evaluation

Value Chain Gap Attributes – Most Important

Experience curve heuristics show that production costs are reduced by at least half between the 1st and the nth commercial implementations of a new technology	**Focus on distribution channels and supply chain efficiencies while rolling out second transformation implementation strategy (AV);** **Execute a continuous investment strategy to improve first transformation technology effectiveness over time (AV/C)**
Open innovation is an effective process to identify approaches for the manufacture of added value co-product streams from waste streams across the VC	**Create an open innovation portal and communication program to attract interest by innovators, and design/execute open innovation challenges (AV/C)**



Evaluation

Value Chain Gap Attributes – Most Important

Cost-effective separation and purification may be essential to turn waste streams into added-value co-products	**Work with cluster partners to identify process intensification opportunities that achieve process and product objectives (AV/C)**
Second transformation technologies should be developed through JDAs, taking advantage of VC implementation scales	**Develop JDAs with second transformation technology developers seeking to accelerate development and mitigate technology risk by integrating into the VC at smaller scales (AV/C)**



Evaluation

Value Chain Gap Attributes – Most Important

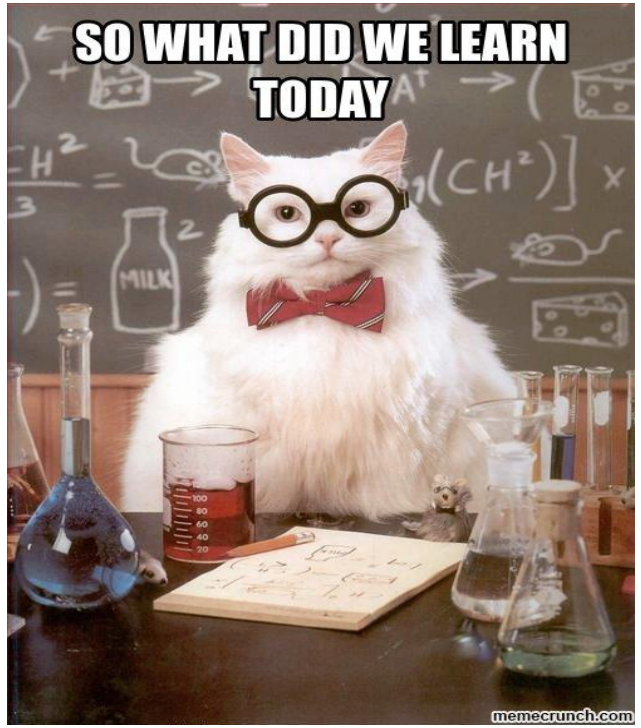
Market demand should be created by Ultimate Market Pull Firms, and/or catalyzed by government procurement policy	Demonstrate the overall competitive advantages that can be accrued by VC partner company off-takers should they purchase bioproducts (AV); Target Ultimate Market Pull Firms for the VC, and support the identification and comprehension of the customer's voice (AV/C); Advocate for government to set policies that stimulate demand for bioproducts, including added value biochemicals and biomaterials, as well as biofuels (AV/C)
Opportunities for industrial symbiosis within the VC should create value from streams that are otherwise waste streams; industrial symbiosis	Match waste streams or upgraded waste streams from one VC partner with the raw material needs of a second VC partner, normally in geographic proximity (AV/C)



Evaluation

Conclusion: Critical Analysis of the Workshop Results

- **142 different stakeholders and experts** from across Canada were assembled in six 2-day workshops to share experiences and discuss the bioeconomy
- **Concepts** of supply chain, value chain, and clusters were systematically introduced
- **Value chain gaps** for bioeconomy implementation and their solutions were identified, and systematically evaluated
- **22 potential emerging bioeconomy value chains** as well as their strengths and weaknesses were identified by the participants in break-out sessions



- The most important value chain gaps were identified by workshop participants; these can be **systematically addressed through cluster-type activities**
- An **effective, distributed bioeconomy cluster** could serve to accelerate advancement of the bioeconomy in Canada for early-market advantage

How might the **distributed bioeconomy cluster** be **designed and financed**?

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Thank you – Merci!



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