

Ontario's Opportunities


In Forest Bio-Refining



*Prepared by the Centre
for Research & Innovation
in the Bio-Economy*

Road to

2030

A misty forest of tall evergreen trees under a cloudy sky. The trees are dense and layered, with some in the foreground and others fading into the mist in the background. The sky is overcast with soft, grey clouds.

**“Ontario can be a
global leader in the
production and
innovation of advanced
wood-based materials
and building solutions.”**

*This roadmap outlines how Ontario
can get there, by 2030.*

Roadmap Overview

1.

Why Ontario? Current state including industries, infrastructure and forest composition

2.

Why forest-based? Benefits of using forest-based feedstock and why it makes sense in Ontario

3.

Ontario's Opportunities. Summary of new and novel identified opportunities and method of identification.*

4.

Realizing the Opportunities. A deeper dive on each opportunity, related products and markets, case studies and examples, and barriers and actions.

5.

Regional Opportunities. Focusing in on the province's regions and what their unique opportunities are.

*Additional roadmaps focusing on traditional forest products & engineered wood have been produced by various government and other agencies. To bridge gaps and prevent the duplication of work, this report focuses on opportunities relating to biorefineries and next-generation forest-based materials.

Executive Summary

With well-established industries, a wealth of human and natural resources, and fulsome government policy, **Ontario, Canada's economic engine, is poised to be a leader of innovation.** Jurisdictions across the world are facing the impacts of climate change and other global events; **there is significant need to develop made-in-Ontario solutions.** Wood in Ontario is sustainably harvested and plentiful. **Wood can be used to make a wide range of products** including value-added chemicals, **replacing fossil fuels across sectors.** Over the last three years, work has been conducted to identify which materials, pathways and products leverage Ontario's existing assets and strengths. **This report was developed to answer the question: what are Ontario's opportunities within the forest bio-economy?**

- Considering Ontario's existing industrial assets, markets and feedstocks, **the province could largely benefit from the development of integrated bio-refineries and bio-product mills.**
- **These bio-refineries would leverage existing forest industry, extracting and producing new value added products that could be used by the province's manufacturing industry (e.g. automotive and construction).**
- Developing a new greenfield bio-refinery will required significantly higher capital investments. It is recommended that all potential new entrants consider co-locating with existing industry to lower capital investment requirements.
- The technologies needed to make advanced forest-based products are commercial-ready, for example:
 - Lignin from kraft pulp mills can be extracted and made into a variety of products (e.g. chemicals, resins and asphalt)
 - Biochar and advanced biocarbon can be made from sawmill residues and low grade wood to be used in automotive parts and support decarbonization of industry
 - Renewable fuels such as ethanol, heating oil and renewable heavy fuel oil can be produced from low grade sawmill residues and forest biomass
- There are challenges in bringing these technologies to market, but, with the right support, Ontario can become a leader in this space. Here's what's needed:
 - Novel and enabling policies (e.g. green procurement mandates)
 - Investment in Ontario-made supply of modified forest-based feedstock (i.e. lignin, biochar, fuels)
 - Attraction of industrial partnerships and investments in bio-refineries

Executive Summary (Cont')

Acting on this opportunity could result in the following:

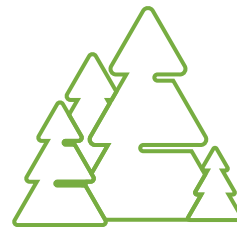
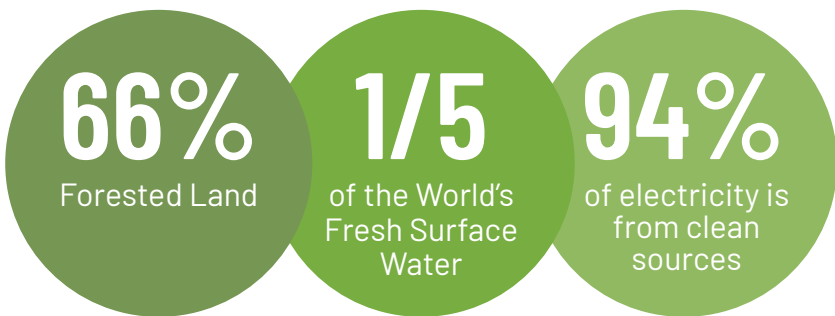
- Attraction of significant capital investment in northern Ontario supporting modernization of existing forest products facilities
- Enabling Ontario's forest sector in creation of additional value and markets
- Support for other Ontario industries; widening the supply of low-carbon bio-products
- Developing supply chains within Ontario; re-shoring production in advanced materials, chemicals, automotive and building material sectors
- Mobilizing research from Canadian Universities and Research Institutions
- Low-carbon products throughout the built environment; contributing to the health of Ontario's environment and society
- Improved climate resilience; sequestered carbon in long-lived wood products, mitigation of forest fires through continued sustainable management of Ontario's forests
- Reducing the dependence of Ontario manufacturing and heavy industry on increasingly volatile world oil prices will help protect jobs and GDP across the province

“Ontario is Canada’s economic engine

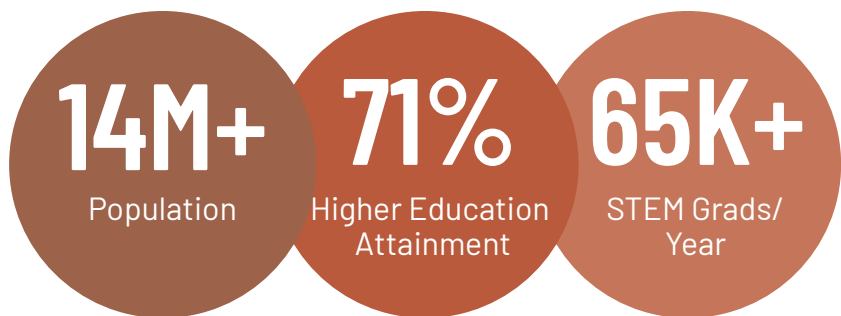
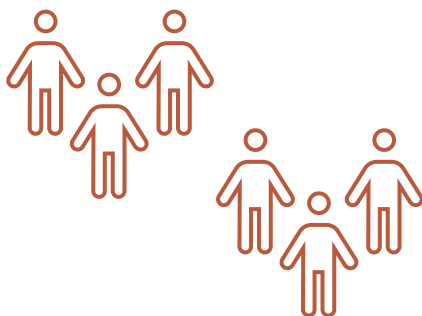
where new innovations, platforms and technologies meet the muscle of the industrial economy.”

Source: investontario.ca, ontario.ca.

Ontario is home to A wealth of natural resources.



Significant human resources.

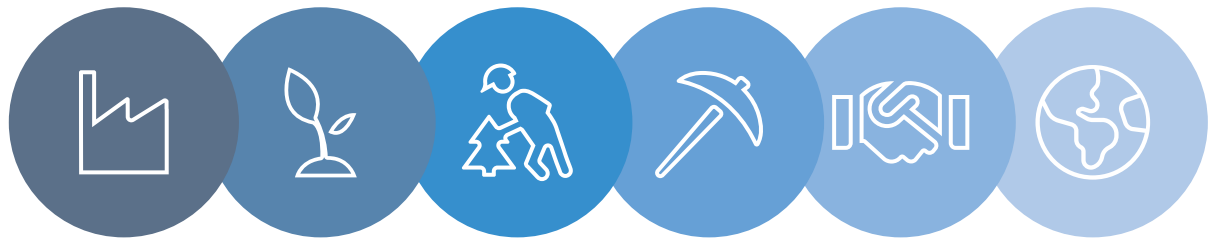


A robust innovation ecosystem.

- World-class pilot & research facilities
- Leading research & development in clean tech and forest bio-economy



Well-established industries.



Manufacturing

Agriculture

Forestry

Mining

Service

Access to US
+ Global Markets

Fulsome government policy.

- Forest Sector Strategy
- Biomass Action Plan
- Electric Vehicle Initiatives
- Critical Minerals Strategy
- Housing Strategy
- Build Ontario

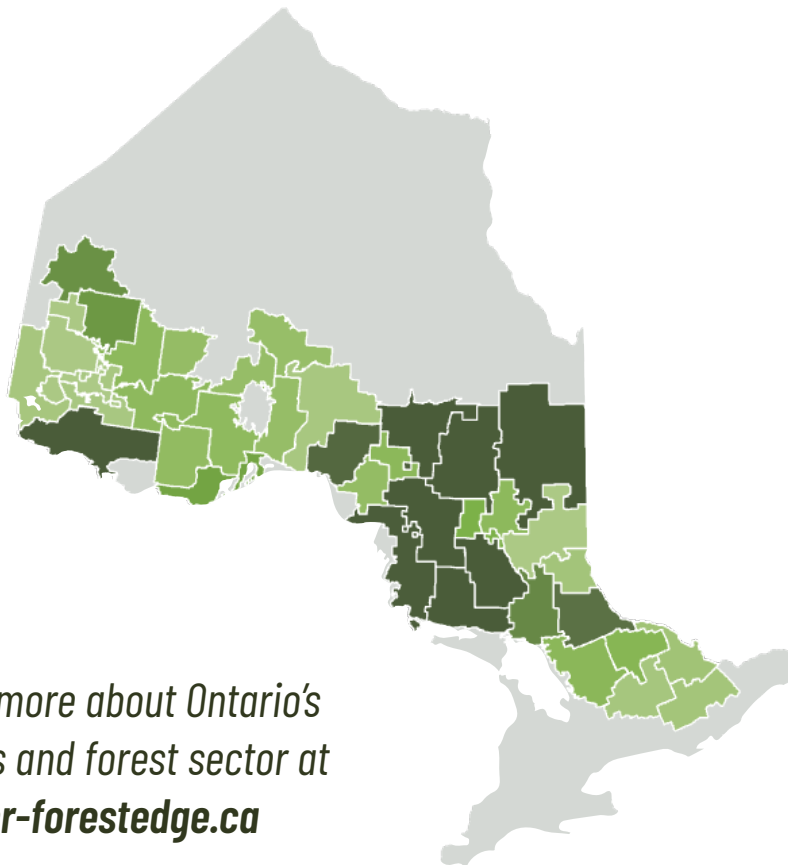


Why Forest-Based?

- Bio-based energy, chemicals and materials help industry meet environmental goals
- Bio-based often replaces fossil-based = GHG reduction
- Some bio-based products outperform their fossil counterparts
- Biodegradability, thermoresistant properties, antimicrobial properties
- Because of Ontario's wealth of sustainably managed forests, bio-based products made from forest feedstock would also provide opportunities to develop made-in-Ontario solutions

Ontario's forests and Forest Sector

Ontario has significant forest resources.



Learn more about Ontario's forests and forest sector at nextfor-forestedge.ca

70.4M

hectares of Ontario's land is forested land.

56.2M

hectares are public land.

7.2M

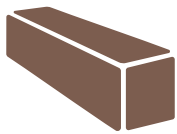
hectares are conserved forest.

7.0M

Hectares are privately, federally or First Nation owned forest.

Ontario has a well-established Forest Sector.

Ontario has robust primary industry built around 4 key products:



Lumber



Pulp



Plywood



Engineered Wood

Ontario is a world leader in sustainable forest management.

10% of the world's forests are third-party certified

75% of Ontario's Crown forests are third-party certified



Ontario is rich in forest-based economic opportunity.

\$18B Revenue (2020)

\$7.5B Exports (2021)

49k+ Employed in the Forest Sector (2021)

Ontario's strengths in the forest bio-economy space

We have investments in the forest bio-economy.



Research support and expertise. (FPIInnovations, Lakehead University, University of Toronto, Western University, University of Guelph)



A robust network of stakeholders along the supply chain (Nextfor)



Innovation support (CRIBE, Bioindustrial Innovation Canada, regional economic development agencies)



Pilot facilities (Lignoforce, TMP Bio, Fraunhofer Innovation Platform for Composites Research, Western University Institute for Chemicals and Fuels from Alternative Resources, Lakehead University Biorefining Research Institute, University of Toronto BioZone)

We have commercial successes to showcase and learn from.



Element 5

Mass timber production
Toronto, ON and St. Thomas, ON



Woodbridge Foam Corporation

Carbon net zero car seat foam
Woodbridge, ON



Ensyn

Biocrude for fuel
Renfrew, ON



Haliburton Forest Biochar

Enhanced Biochar Production
Haliburton, ON

Use our interactive tool to discover more about the current state of Ontario's forest bio-economy:
<https://cribe.ca/our-bioeconomy-today/>



There is room to grow.

“Ontario’s forest industry **generated \$18 billion (CAD) in total revenues** in 2018 – and there is room for growth.”

The province's forests can support a **sustainable harvest of 27 million cubic metres annually**, not all of which is currently being used.



13M m³ harvested in 2021

14M m³ of allocated sustainable harvest unutilized

Additional modeling work conducted by CRIBE shows that there are approximately 7M m³ of opportunity wood* within approved forest management plans.

*Available opportunity wood is fibre that’s available for new economic development, taking into consideration access, existing users and consumers, distance, and cost to harvest. View modeled available opportunity wood on the [ForestEDGE](#).

What’s the bottleneck?

Growth is limited by the need to find outlets for:

Primary industry co-products and residuals (bark, sludge, slash etc.)



Low grade wood

The solution?

Continuing to support primary forest industry through **extracting whole-tree value** and **mobilizing innovation in new technologies**.

What is the forest bio-economy?

From the forest to consumer products,

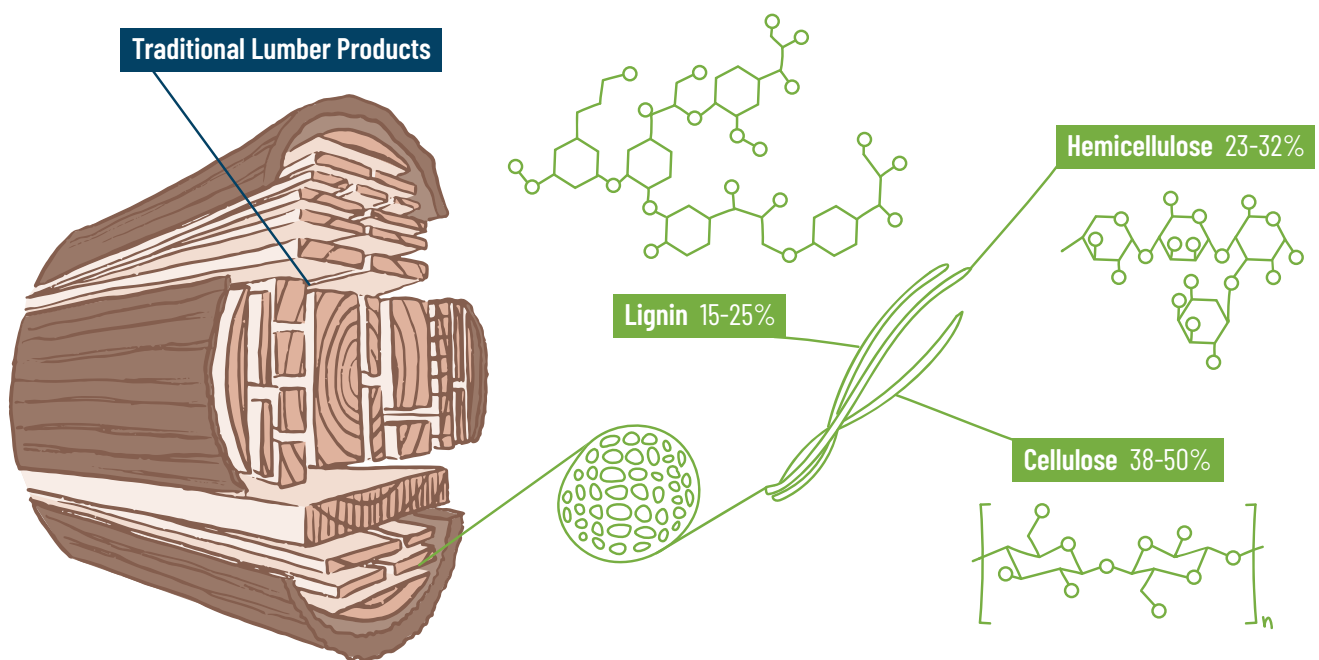
the forest bio-economy encompasses all innovative, low-carbon materials derived from sustainably sourced forest biomass, and the supply chains that serve to produce those materials.



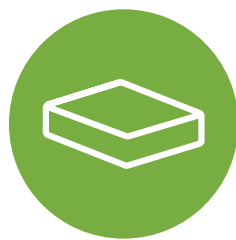
When we say “Extracting Whole-Tree Value”

it means “finding innovative, value-added uses for the co-products and residuals of the primary industry”.

Extracting Whole-Tree Value enables the creation of **low-carbon, made-in-Ontario, forest-based solutions.**



Building Supplies



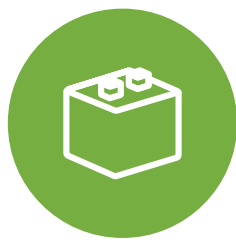
Construction Materials



Furniture



Auto Parts



Batteries



Packaging



Advanced Chemicals

We know there are many opportunities.

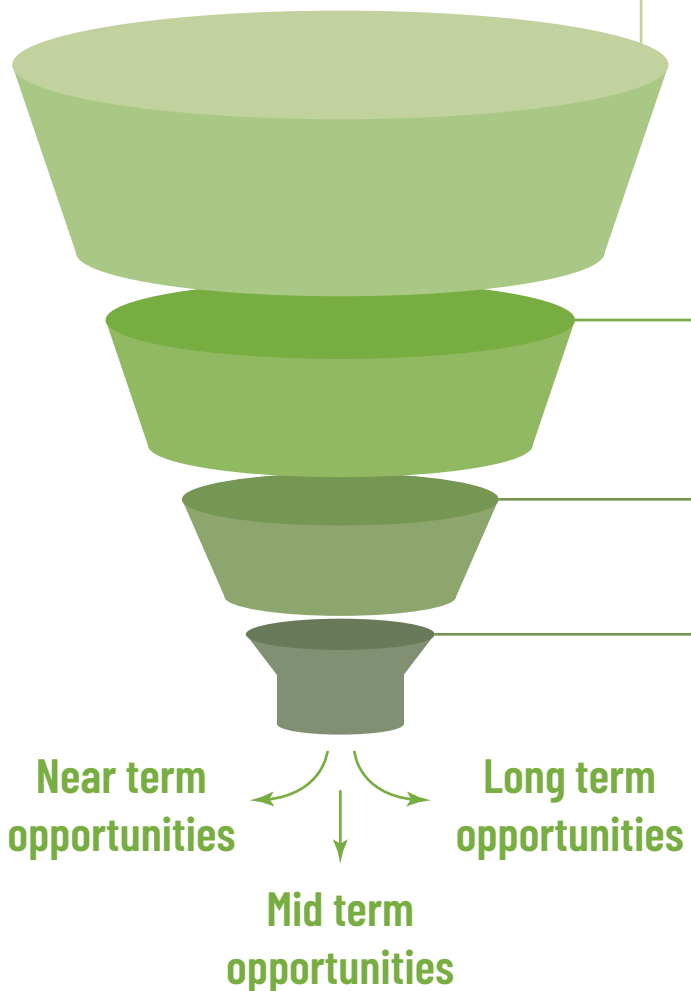
The forest bio-economy is expansive and extracting whole-tree value can be accomplished in many ways, with many end-use applications.

Traditional Forest Products	Biomaterials	Biochemicals	Bioenergy
<p>Solid Wood Products</p> <ul style="list-style-type: none"> ◦ Dimension Lumber ◦ Appearance Lumber ◦ Machine Stress Rated Lumber <p>Engineered Wood</p> <ul style="list-style-type: none"> ◦ Particle Board ◦ Plywood ◦ Fiberboard <p>Pulp Products/ Co-Products</p> <ul style="list-style-type: none"> ◦ Market Pulp ◦ Fluff Pulp ◦ Tall Oil ◦ Turpentine <p>Paper Products</p> <ul style="list-style-type: none"> ◦ Cardboard/ Paperboard ◦ Coated Paper ◦ Newsprint ◦ Printing Paper ◦ Tissue Paper <p>Traditional Bioenergy</p> <ul style="list-style-type: none"> ◦ Forestry Residues ◦ Mill Residues ◦ Wood Pellets/Chips ◦ Firewood 	<p>Biocomposites</p> <ul style="list-style-type: none"> ◦ Engineered Wood Products ◦ Mass Timber ◦ Composite Lumber ◦ Wood-Cement Composites ◦ Wood-Plastic Composites <p>Specialty/Advanced Fibres</p> <ul style="list-style-type: none"> ◦ Wood PLA Filaments ◦ Carbon Fibre ◦ Nano Cellulose ◦ MCC 	<p>Pulping Coproducts</p> <ul style="list-style-type: none"> ◦ Tall Oil ◦ Turpentine <p>Lignin Products</p> <ul style="list-style-type: none"> ◦ Hydrolysis Lignin ◦ Kraft Lignin ◦ Lignosulfonate ◦ Organosolv Lignin <p>Biochar Products</p> <ul style="list-style-type: none"> ◦ Biochar ◦ Activated Carbon <p>Extractive Products</p> <ul style="list-style-type: none"> ◦ Cellulose Gum ◦ Cellulose Ethers ◦ Cellulose Sugars ◦ Epoxy Resin ◦ Chloromethylfurfural ◦ Nitrocellulose ◦ Bio-phenol Formaldehyde Resin ◦ Vanillin 	<p>Second-Generation Biofuels</p> <ul style="list-style-type: none"> ◦ Biogas ◦ Biocrude ◦ Biodiesel ◦ Biohydrogen ◦ Ethanol ◦ Methanol ◦ Butanol ◦ Syngas ◦ Renewable Natural Gas ◦ Sustainable Aviation Fuel

The objective is to identify which materials, pathways and products leverage Ontario's existing assets and strengths. In other words, **what are Ontario's opportunities within the forest bio-economy?**



How did we evaluate potential opportunities?



Technical and commercial readiness

Have there been any successful trials for technologies? Which technologies are closest to market? Benchmarking from other jurisdictions.

Feedstock availability

What feedstock does the technology/product require? Does Ontario have a surplus of this feedstock? Would utilizing this feedstock help primary forest industry in Ontario? (Overcoming the bottleneck)

Ontario's Markets

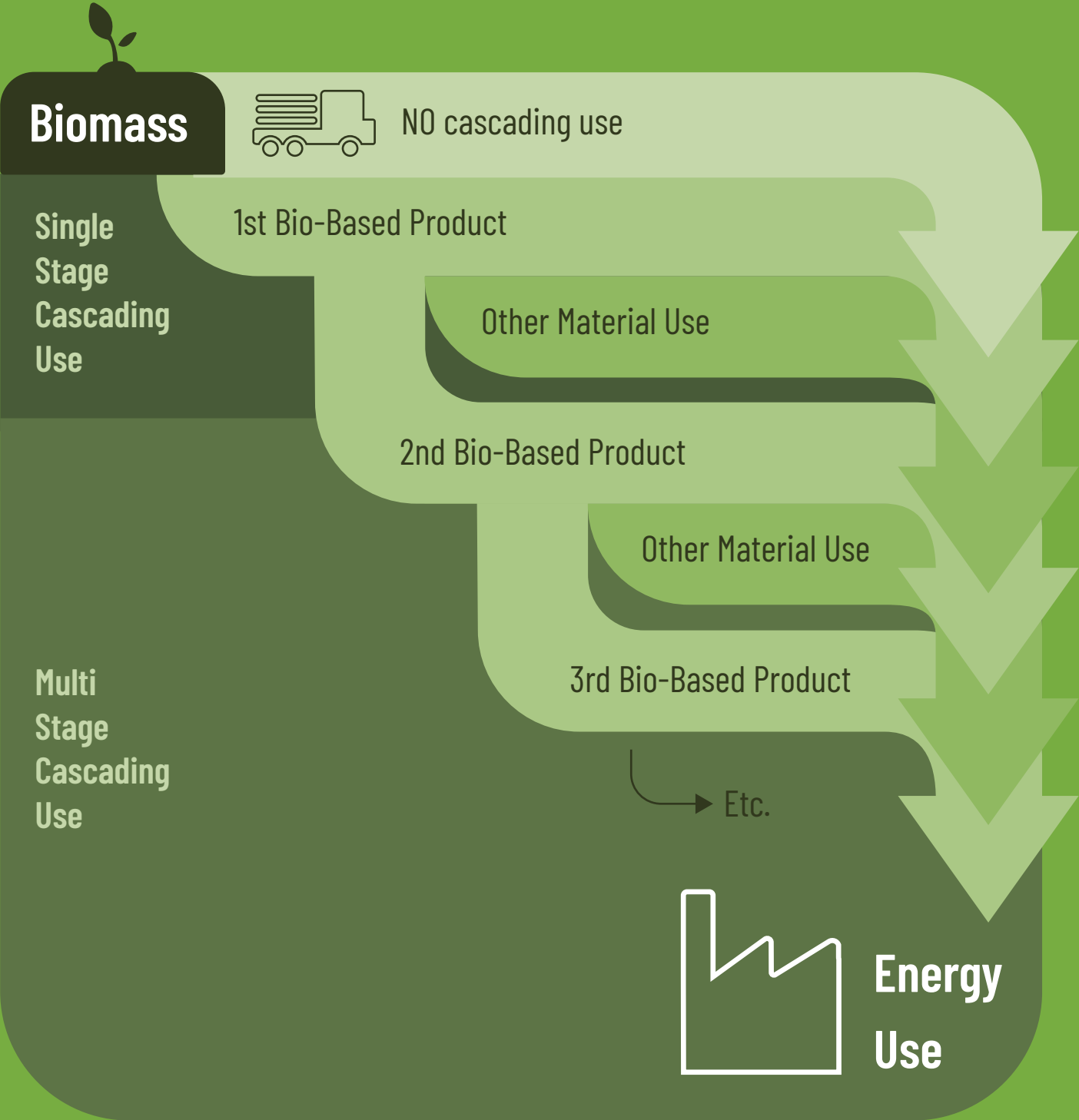
Does the technology or product compliment Ontario's manufacturing and other industries? Does Ontario have existing infrastructure and expertise to realize this opportunity? Can Ontario feasibly export the product or technology?

Industry Feedback and Market Signals

Leveraging the experience of the Nextfor network, we asked: What do stakeholders along the value chain think the most feasible technologies/products are? Are there any emerging trends or government policy that would support specific products and markets?

Ontario's Opportunities

In order to be economically feasible, the bio-based opportunity, or opportunities, should leverage existing industrial assets and should implement the cascading model wherever possible.



The background of the page is a photograph of a forest. In the foreground, several large logs are stacked horizontally, showing their natural wood grain and bark. The logs are arranged in a way that they recede into the distance. In the background, there are many thin, vertical tree trunks, some of which are slightly out of focus, creating a sense of depth. The lighting is natural, suggesting a forest setting.

Introducing Biorefineries

“Biorefining can be broadly defined as the sustainable processing of biomass into a portfolio of marketable bio-based products, which could include co-production of food and feed, materials and chemicals and bioenergy (power, heat/cold, fuels).”

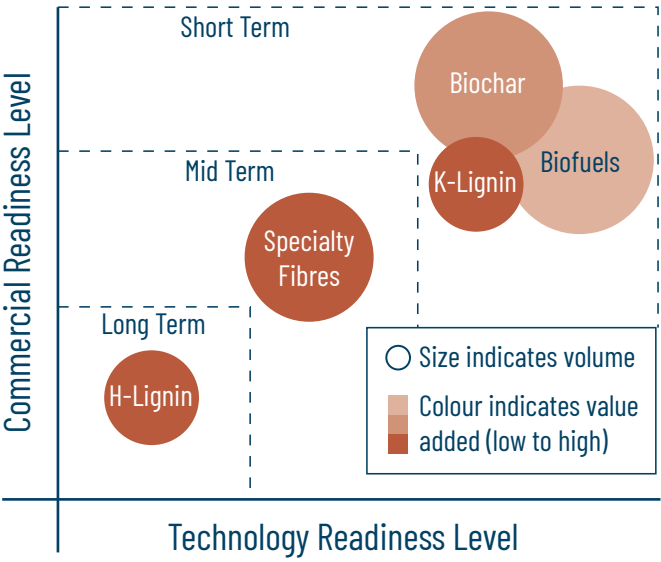
Source: [EU Biorefinery Outlook to 2030](#)

Ontario's Opportunities

Considering Ontario's existing industrial assets, markets, and feedstock, with considerations for the cascading use model built around the primary forest industry, we identified the following opportunities for Ontario: Specialty fibres, Kraft lignin, Hydrolysis lignin, Biochar and Biofuels.

Sources: *EU Biorefinery Outlook to 2030*

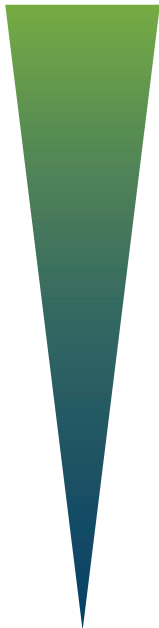
Feedstock(s)	Processing	Intermediate Products	Final Products
Wood/forestry, forestry residues	Mechanical processing, chemical pulping, combustion, (separation, extraction, gasification)	Pulp, spent (black) liquor	Materials (pulp & paper, specialty fibres), chemicals (turpentine, tall oil, acetic acid, furfural, ethanol, methanol, vanillin, Kraft lignin (K-lignin)), power and heat
Wood/forestry, forestry residues	Pre-treatment, hydrolysis, fermentation, combustion, (thermo-/chemical conversions)	C5 & C6 sugars, Hydrolysis Lignin (H-lignin)	Chemicals, lignin products (materials, aromatics, pyrolytic liquid, syngas), ethanol (building block or biofuel), power and heat
Lignocellulosic from Wood/forestry, forestry residues	Pyrolysis, separation, combustion, (gasification, cracking, extraction)	Pyrolytic liquid (biofuels), biochar	Pyrolysis oil (for materials, chemicals, food flavourings, syngas, biofuels), biochar, power and heat
Wood/forestry, forestry residues	Hydrothermal liquefaction, upgrading	Bio-crude	Chemicals and biofuels



Globally, all new biobased products and technologies face the same high level challenges and barriers in reaching the market; these include cost, scale-up and sustainability challenges that need to be overcome to be successful.

Barriers and actions common to all identified opportunities

Highest
CAPEX



Lowest
CAPEX

- New greenfield biorefinery
- New biorefinery on a brownfield state (lower capex from shared services such as steam, water, power, storage, logistics etc...)
- Re-purposing/conversion of a plant on existing brownfield site (highly project dependent as only some equipment can be reused)
- Expansion of a biorefinery on a brownfield site (e.g. valorising a side stream) - capacity increase often limited
- Debottlenecking (improving processes, revamping or new equipment) to increase the capacity of existing biorefineries - capacity increase is limited however
- Co-processing / re-focus of existing plants from fuels to chemicals (drop-in such as methanol)

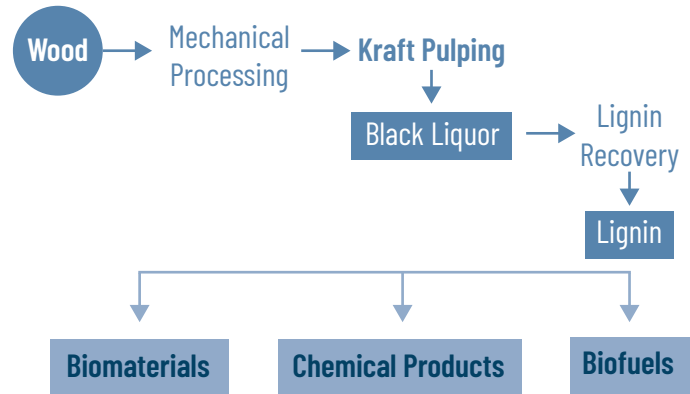
Area	Barriers	Actions
Economic	Little willingness to pay for bio-content	<ul style="list-style-type: none"> ◦ Continue to implement provincial and federal policies and incentive programs to offset costs or make more cost competitive
	Bio-product production costs are expected to be higher than fossil equivalents	<ul style="list-style-type: none"> ◦ R&D on all pathways along TRLs to ensure process efficiency, optimisation and integration into supply chain ◦ Decrease CAPEX and OPEX of biorefineries by developing on existing industrial sites ◦ Develop regional bioeconomy strategies that leverage existing industry, infrastructure and transportation methods to reduce cost. ◦ Work with regional forestry industry to identify lowest cost feedstock.
	Limited integration of processing steps and other industries	<ul style="list-style-type: none"> ◦ Stakeholders along value chain working together to identify integration issues at early product development stages and tailor to fit existing production lines
Scale-up	Validation of new technologies is expensive	<ul style="list-style-type: none"> ◦ Public-private partnership projects to co-fund pilot/demonstration plants ◦ Provide opportunities/support for shared facilities to reduce costs of scale up steps
	Academic research teams having limited industry know-how	<ul style="list-style-type: none"> ◦ Continue funding collaboration between research, engineering and industry ◦ Continue to connect stakeholders through Nextfor
	Challenge in financing commercial scale projects	<ul style="list-style-type: none"> ◦ Projects of this scale require ~10 year time frame and significant investment requirements, need to fund longer term projects with higher funding support
Sustainability	Lack of standardized data on the sustainability benefits of bioproducts	<ul style="list-style-type: none"> ◦ Standardized carbon intensity frameworks ◦ Develop a common language for sustainability testing and communication ◦ Organize information campaigns to raise awareness and clarify misconceptions
	Risk of use of fossil based energies limits the GHG reduction potential for many biorefineries	<ul style="list-style-type: none"> ◦ Support green energy development ◦ Support efforts to decarbonize heavy industry which will provide insight for technology readiness and integration

Kraft Lignin (K-Lignin)

Short Term Opportunity











Small volume, high value

- The production of K-lignin is dependent upon kraft pulp mills. K-lignin is extracted from a by-product of the pulp making process (black liquor).
- K-lignin may need to be dried, modified and/or valorized before it can be used in value-added applications.



Potential products and markets:

- K-lignin can be used in a **wide variety of applications**
- Commercial trials are being conducted in Ontario for value-added applications (see [CRIBE funded projects](#))

				
Adhesives	Polyols	Thermoplastics	Resins	Composite Materials
				
Asphalt	Dispersant & Binders	Surfactants	Carbon Fibre	Fine Chemicals

- ### Examples
- [Lignoforce pilot plant & research facility in Thunder Bay, ON](#)
 - [Lignoboost pilot plant & research facility \(Lignocity\) in Bäckhammar, Sweden](#)
 - [Lignoforce commercial technology \(Noram\)](#)
 - [Lignoboost commercial technology \(Valmet\)](#)
 - [LignaRec](#)

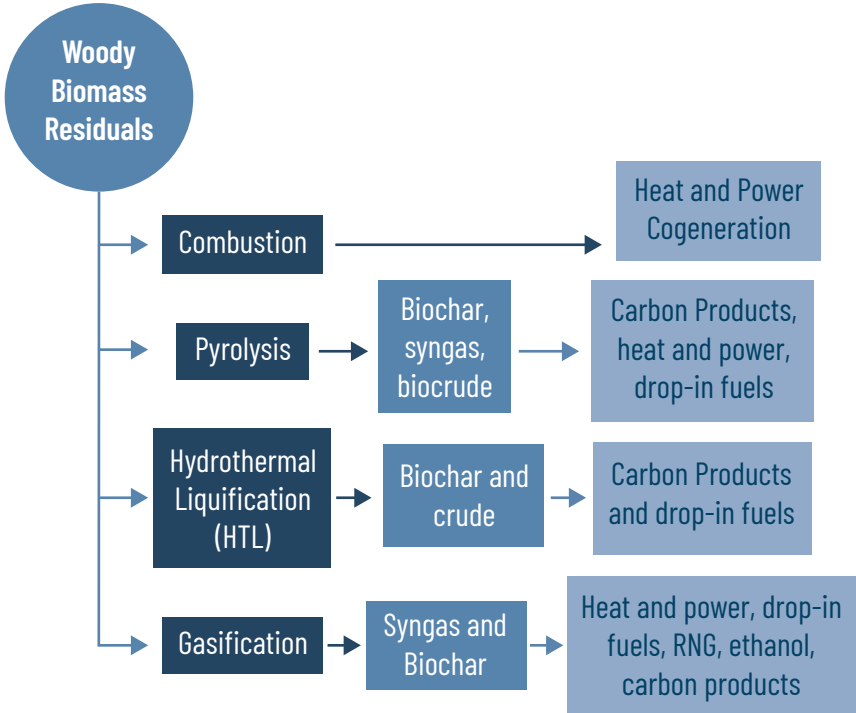
To capitalize on the K-lignin opportunity in Ontario, we need to address the following barriers (in addition to those barriers which are common to all of the identified opportunities):

- Technologies for extracting k-lignin have been demonstrated at the commercial level
- Supply in Ontario is limited, with a need to establish a commercial supply integrated with existing pulp mills
- There are technical challenges associated with many of the high-value, low-volume applications - need to continue to prove success through low-value, high-volume applications (e.g. asphalt)
- High-value applications may require costly and time intensive modifications
- A supply of pre-modified/valorized k-lignin will be required to advance high-value applications


Biofuels

Short Term Opportunity


- The use of solid woody cellulosic material as CHP is already established in Ontario and will not be covered in this report.
- There are multiple pathways to convert woody cellulosic material to advanced biofuels (liquid or gaseous). We've presented a simplified pathway, please refer to EU Biorefinery Outlook to 2030 as an example of detailed pathways.




Potential products and markets:




Syngas to RNG or Hydrogran




Drop-in renewable diesel



Bio Crude



Bio Ethanol



Sustainable Aviation Fuel

Examples

- [Arbios Biotech](#)
- [Ensyn](#)
- [Steeper](#)
- [logen](#)
- [CHAR technologies](#)

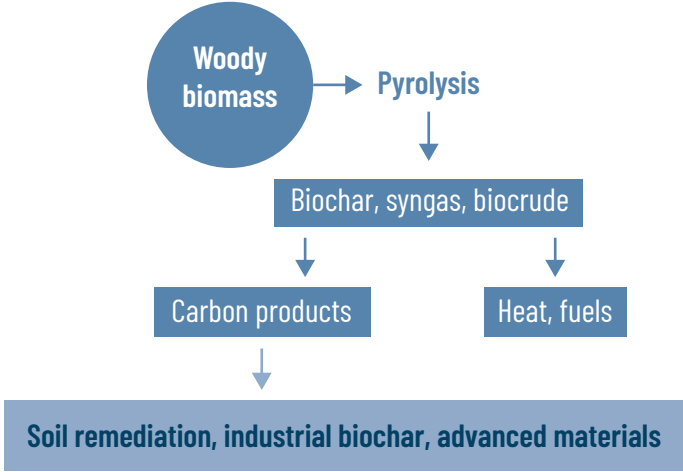
To capitalize on the Biofuels opportunity in Ontario, we need to address the following barriers (in addition to those barriers which are common to all the identified opportunities):

- Industry partnership is vital
- Location of facility impacts environmental and economic feasibility – should be located close to end-use facility or drop-in location
- Policy and incentives for clean energy significantly impact the feasibility of this pathway
- Need to find value-added use for side streams produced

Biochar

Short Term Opportunity

- Biochar is produced through pyrolysis and can be treated and modified to fit specifications of end users, for substitution in fossil-based products.
- Biochar can be used in a wide range of products; soil remediation, industrial decarbonization, advanced applications.



Potential products and markets:

- Soil remediation (leaf icon)
- Activated carbon (pile of carbon icon)
- Carbon black (pile of carbon icon)
- Biocoal (pile of carbon icon)
- Energy Storage (flame icon)
- Graphite (pile of carbon icon)

- ### Examples
- [Char Technologies](#)
 - [Haliburton Biochar](#)

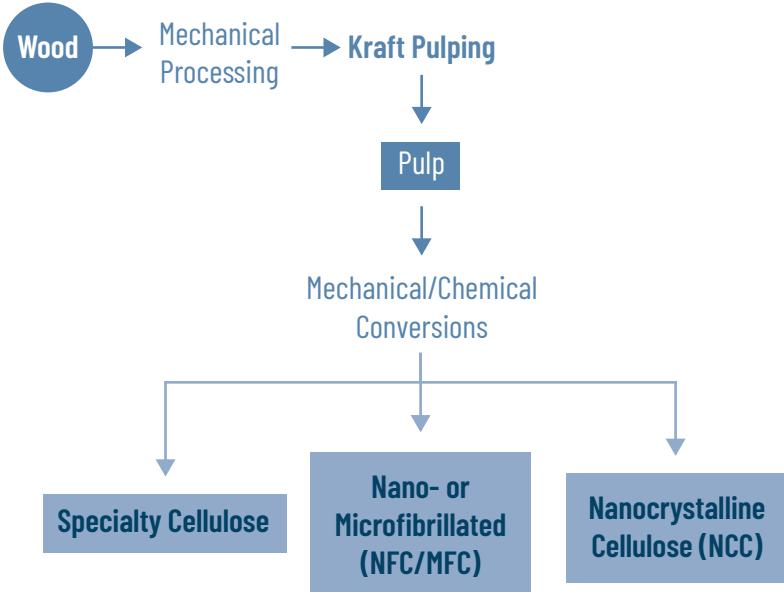
To capitalize on the biochar opportunity in Ontario, we need to address the following barriers (in addition to those barriers which are common to all of the identified opportunities):

- Industry partnership is vital
- Location of facility impacts environmental and economic feasibility – should be located close to end-use facility or drop-in location, transportation can be costly
- To be cost-effective, biochar facilities should find outlets for secondary products (syngas)
- Carbon accounting for end-product is essential for commercial deployment

Specialty Fibres

Mid Term Opportunity

- Wood-based specialty fibres can be classified as nano- or microfibrillated cellulose (NFC/MFC), or nanocrystalline cellulose (NCC).
- These specialty fibres can be extracted from wood either mechanically or chemically.
- These specialty fibres may have properties that allow use in advanced applications.



Potential products and markets:

 Concrete & Building Materials	 Textiles	 3D Printing	 Cosmetics
	 Auto Parts	 Mining Tailing Modification	

Examples

- [Celluforce](#)
- [Performance Biofilaments](#)

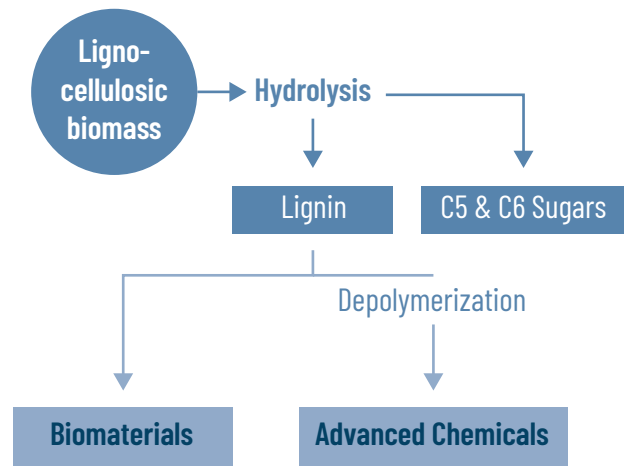
To capitalize on the Specialty Fibres opportunity in Ontario, we need to address the following barriers (in addition to those barriers which are common to all of the identified opportunities):

- The product must be fine tuned for end use that leverages Ontario’s strong manufacturing industries
- Commercial facility should be co-located at an existing pulp and paper facility
- Product development must include high-volume applications (e.g. mining tailing modification) in conjunction with high-performance applications (e.g. cosmetics)

Hydrolysis Lignin (H-Lignin)

Long term opportunity

- Wood and forestry biomass are reduced to their constituent parts, namely C5 and C6 sugars, and a lignin product through hydrolysis.
- The viability of a hydrolysis lignin process is dependent on finding economically viable markets for the lignin and sugars.
- Hydrolysis lignin plants can be stand-alone or integrated with existing forest product facilities.



Potential products and markets:

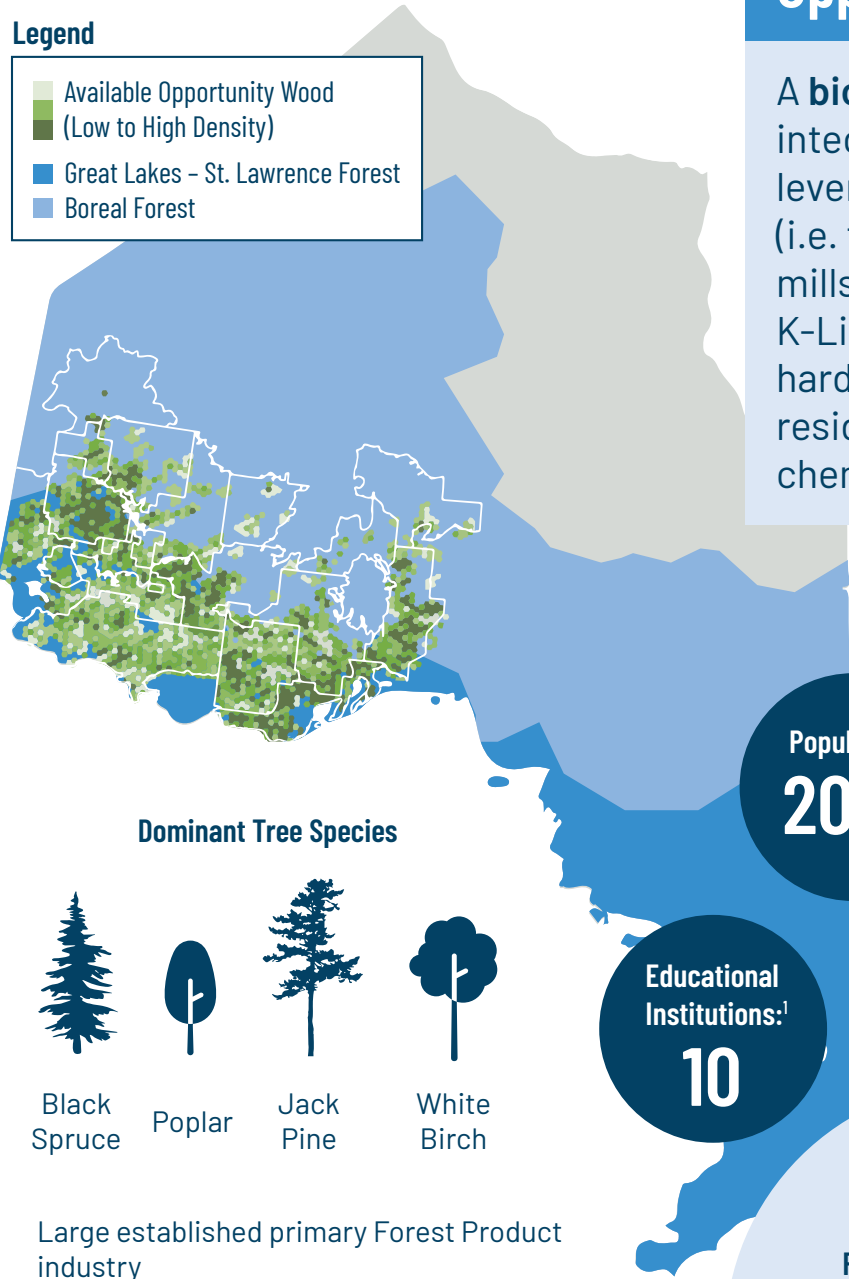
 Adhesives	 Polyols	 Thermoplastics	 Resins	 Composite Materials
 Asphalt	 Dispersant & Binders	 Surfactants	 Carbon Fibre	 Fine Chemicals

- Examples**
- [TMP Bio Pilot Plant in Thunder Bay, ON](#)
 - [Fibenol](#)
 - [UPM Leuna](#)

To capitalize on the H-lignin opportunity in Ontario, we need to address the following barriers (in addition to those barriers which are common to all of the identified opportunities):

- H-lignin can be produced using low-grade hardwoods while utilizing existing paper mill assets
- Need to find cost effective applications for the C5, C6 sugars
- Developing and strengthening value chains for end-use applications is vital in advancing commercial production

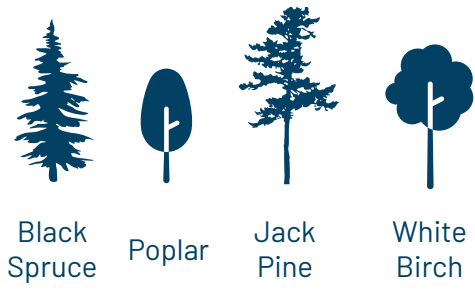
Northwestern Ontario



Opportunity:

A **biorefinery** that is integrated with, and leverages, **primary industry** (i.e. the existing kraft pulp mills) to **extract materials** (i.e. K-Lignin), or to **utilize low grade** hardwoods and biomass residuals to manufacture chemical or fuels.

Dominant Tree Species



- Large established primary Forest Product industry
 - Mainly consuming SPF (Spruce-Pine-Fir)
- Lower utilization of hardwood in region
- Hardwoods can be low quality, and exist in mixed stands with SPF
- Forestry and mill residual utilization would require integration with existing regional industry

Population:¹
209k

Opportunity Wood:²
1.9M
m³/year

Educational Institutions:¹
10

Indigenous communities:¹
142

18

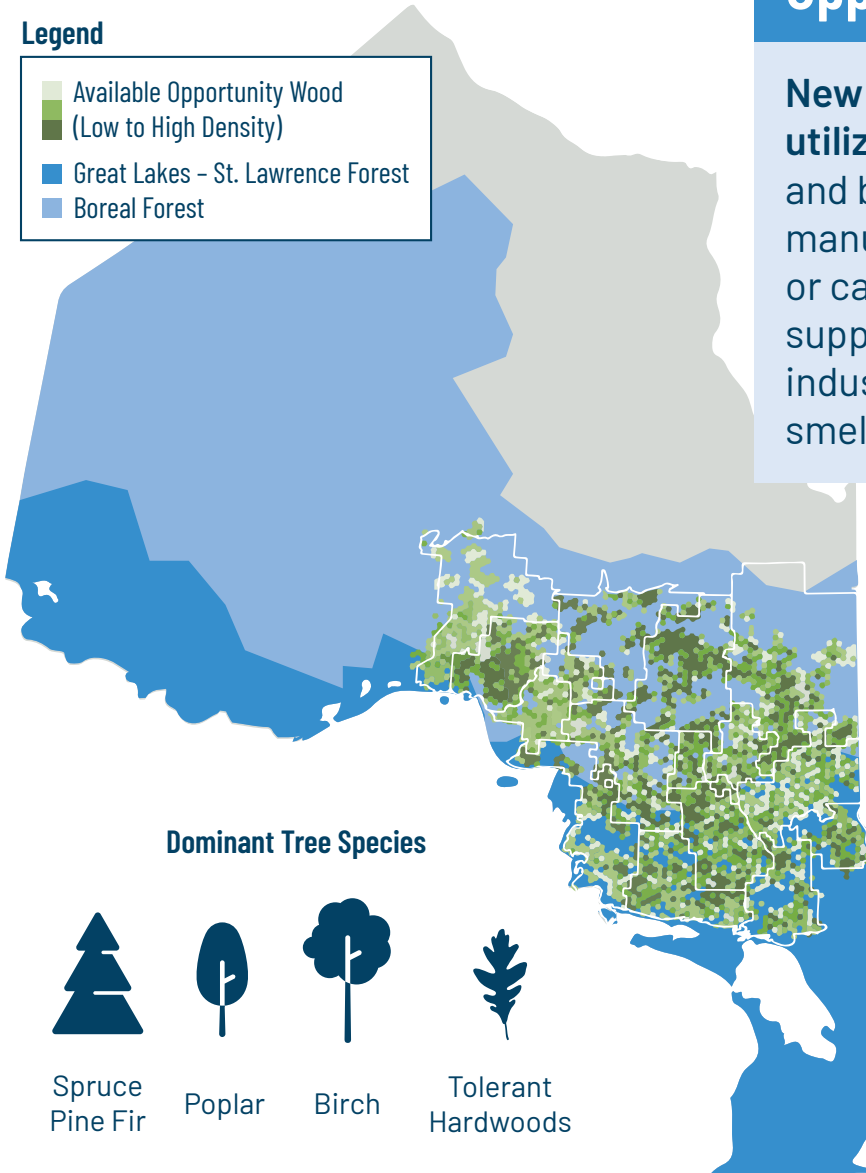
Forest Product Facilities

- Pulp and paper mills
- Pellet mills
- Sawmills of varying size
- Oriented strand board (OSB)
- Laminated strand lumber (LSL)

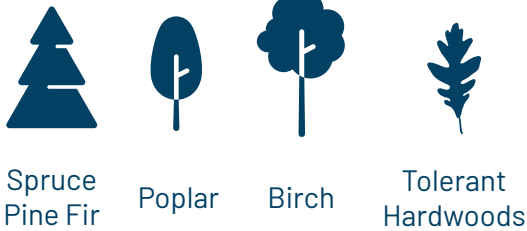
¹Approx. data from Community Analyst by Esri (2022); ²CRIBE modelling case study.

Northeastern Ontario

Legend



Dominant Tree Species



Opportunity:

New entrants that would utilize **low grade** hardwoods and biomass residuals to manufacture chemicals, fuels or carbon products that could support the regional heavy industry (i.e. steel, lime, smelters).



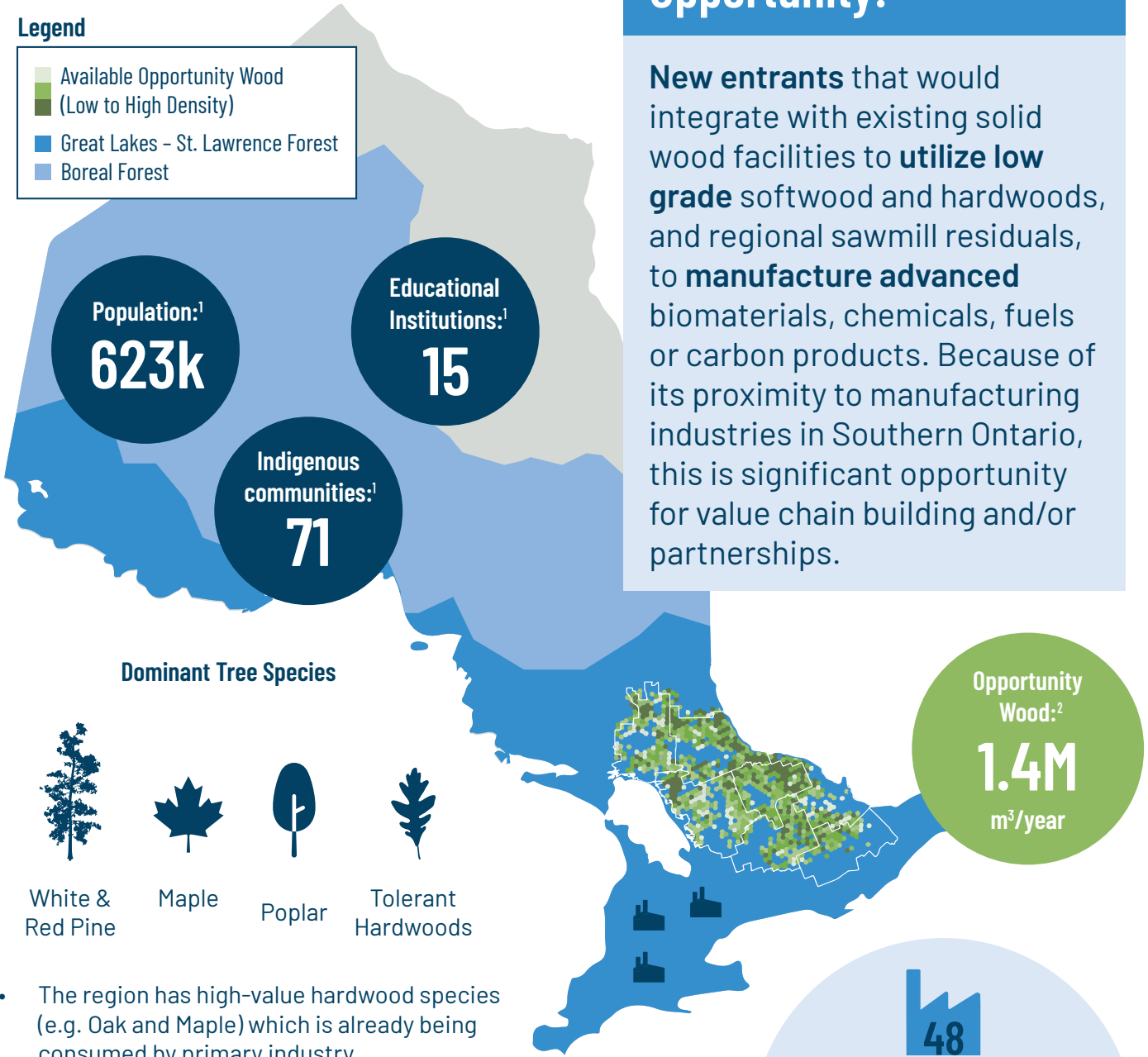
- Significant volumes of hardwood in the region (poplar, birch and tolerant hardwood)
- Varied levels of utilization and species composition across the region
 - Northern portion of the region contains Boreal species
 - Southern portion of the region contains Great Lakes - St. Lawrence species
- Utilization of material in this region will be highly dependent on local industry

¹Approx. data from Community Analyst by Esri (2022); ²CRIBE modelling case study.

Southeastern Ontario

Legend

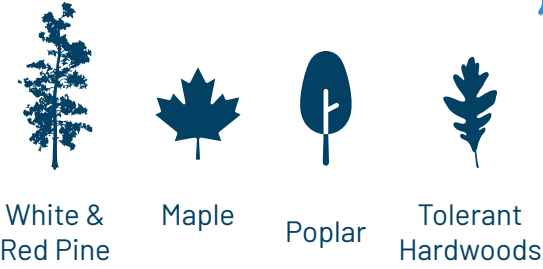
- Available Opportunity Wood (Low to High Density)
- Great Lakes - St. Lawrence Forest
- Boreal Forest



Opportunity:

New entrants that would integrate with existing solid wood facilities to **utilize low grade** softwood and hardwoods, and regional sawmill residuals, to **manufacture advanced** biomaterials, chemicals, fuels or carbon products. Because of its proximity to manufacturing industries in Southern Ontario, this is significant opportunity for value chain building and/or partnerships.

Dominant Tree Species



- The region has high-value hardwood species (e.g. Oak and Maple) which is already being consumed by primary industry
- Significant volumes of white and red pine are being utilized
- Proximity to market allows for variation in facility size; shorter haul distances could enable smaller facilities
- Abundant residuals generated from sawmills; there is a robust existing market for residuals
- Production of primary forest products and residuals could be increased with further outlets for residuals and low value fibre

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Forest Product Facilities

- One pulp & paper mill
- Engineered wood facilities
- Sawmills of varying size

¹Approx. data from Community Analyst by Esri (2022); ²CRIBE modelling case study.

Conclusion

Ontario is Canada's economic engine.

Ontario has well-established industries, including manufacturing, agriculture, forestry, and mining. To support those industries, a wealth of natural resources can be found in the province. With significant human resources, fulsome government policy, and a robust innovation ecosystem, Ontario is poised to be a leader of innovation.

The world is changing, quickly.

Jurisdictions across the world are facing the impacts of climate change and other global events; there is significant need to develop made-in-Ontario solutions, building stronger supply chains and increasing economic and environmental resiliency. Moreover, consumers around the world are increasingly looking for low-carbon and sustainable products.

Ontario's forests are key.

Wood in Ontario is sustainably harvested and plentiful; the province's forests can support a sustainable harvest of 27 million cubic metres annually, only roughly 50% of which is currently being utilized. We know that we can make low-carbon, forest-based alternatives to many fossil fuel-based products.

Opportunities exist; Ontario can lead in this space.

Over the last three years, CRIBE has conducted work to identify which materials, pathways and products leverage Ontario's existing assets and strengths. We developed this report to answer the question: what are Ontario's opportunities within the forest bio-economy?

Here's what we found:

- Considering Ontario's existing industrial assets, markets and feedstocks, **the province could largely benefit from the development of integrated bio-refineries and bio-product mills.**
- **These bio-refineries would leverage existing forest industry, extracting and producing new value added products that could be used by the province's manufacturing industry (i.e. automotive and construction).**
- The technologies needed to make advanced forest-based products are commercial-ready, for example:
 - Lignin from kraft pulp mills can be extracted and made into a variety of products including chemicals, resins and asphalt;
 - Biochar and advanced biocarbon can be made from sawmill residues and low grade wood to be used in automotive parts and support decarbonization of industry;
 - Renewable fuels such as ethanol, heating oil and renewable heavy fuel oil can be produced from low grade sawmill residues and forest biomass;

- There are challenges in bringing these technologies to market, but, with the right support, Ontario can become a leader in this space. Here's what's needed:
 - Enabling policies for bio-based products, carbon sequestration, carbon accounting
 - Investment in Ontario-made supply of modified forest-based feedstock (i.e. lignin, biochar, fuels); attract industrial partnerships and investments in bio-refineries
 - Novel policies such as green procurement mandates through Ontario government purchasing
- Acting on this opportunity could result in the following:
 - Attraction of significant capital investment in northern Ontario supporting modernization of existing forest products facilities;
 - Enabling Ontario's forest sector in creation of additional value and markets for their products;
 - Support for other Ontario industries in moving towards a Net Zero future by widening the supply of low-carbon bio-products
 - Developing supply chains within Ontario; re-shoring production in advanced materials, chemicals, automotive and building material sectors
 - Mobilizing research from Canadian Universities and Research Institutions
 - Low-carbon products throughout the built environment; contributing to the health of Ontario's environment and society
 - Improved climate resilience; sequestered carbon in long-lived wood products, mitigation of forest fires through continued sustainable management of Ontario's forests
 - Reducing the dependence of Ontario manufacturing and heavy industry on increasingly volatile world oil prices will help protect jobs and GDP across the province
- Ontario is geographically large compared to other forest-dependent jurisdictions; it is vital to understand the available forest fibre (potential feedstock), innovation ecosystem and economic opportunities specific to each region within the province.

Regional Opportunities

- Northwestern Ontario has a potential surplus of hardwood that could be utilized for various bio-economic products and has a well-established forest industry that could benefit from value-added applications for their side streams
 - Using this hardwood could free up softwood and provide further economic opportunity for the existing forest industry in the region
 - **The opportunity: A biorefinery that is integrated with, and leverages, primary industry (i.e. the existing kraft pulp mills) to extract materials (i.e. K-Lignin), or to utilize low grade hardwoods and biomass residuals to manufacture chemical or fuels.**
- Northeastern Ontario has a potential surplus of hardwood that could be utilized for various bio-economic products, and has significant heavy industry presence that could be leveraged.
 - Using this hardwood could free up softwood and provide further economic opportunity for the existing forest industry in the region
 - **The opportunity: New entrants that would utilize low grade hardwoods and biomass residuals to manufacture chemicals, fuels or carbon products that could support the regional heavy industry (i.e. steel, lime, smelters).**
- Southeastern Ontario has a potential surplus of softwood that could be utilized for various bio-economic products, and has significant manufacturing industry presence that could be leveraged.
 - Using this softwood could free up hardwood and provide further economic opportunity for the existing forest industry in the region
 - **The opportunity: New entrants that would integrate with existing solid wood facilities to utilize low grade softwood and hardwoods, and regional sawmill residuals, to manufacture advanced biomaterials, chemicals, fuels or carbon products. Because of its proximity to manufacturing industries in Southern Ontario, this is significant opportunity for value chain building and/or partnerships.**

Overall, we believe that Ontario can be a global leader in the production and innovation of advanced wood-based materials and building solutions. There is a wide range of opportunities for new entrants, that would support existing forest industry, produce made-in-Ontario solutions, and contribute to the wealth and health of the province.

For more information, or to inquire about specific opportunities please contact the CRIBE team at info@cribe.ca.