Biomasse et carboneutralité

Biomass and Carbon Neutrality

INSTITUT
DE L'ÉNERGIE
TROTTIER

The Transition Accelerator

L'Accélérateur de transition

Energy efficiency and carbon intensity of bioenergy systems

Serge Bédard, CanmetEnergy in Varennes
Fred Ghatala, Advanced Biofuels Canada
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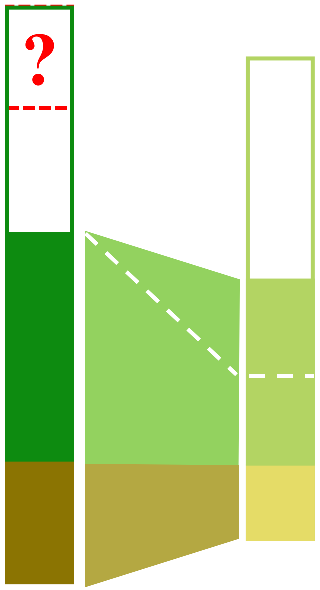
Jack Saddler, University of British Columbia

Simon Langlois-Bertrand, IET, moderator



Panelists

Serge Bédard

CanmetENERGY in Varennes

Fred Ghatala

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CanmetENERGY in Varennes

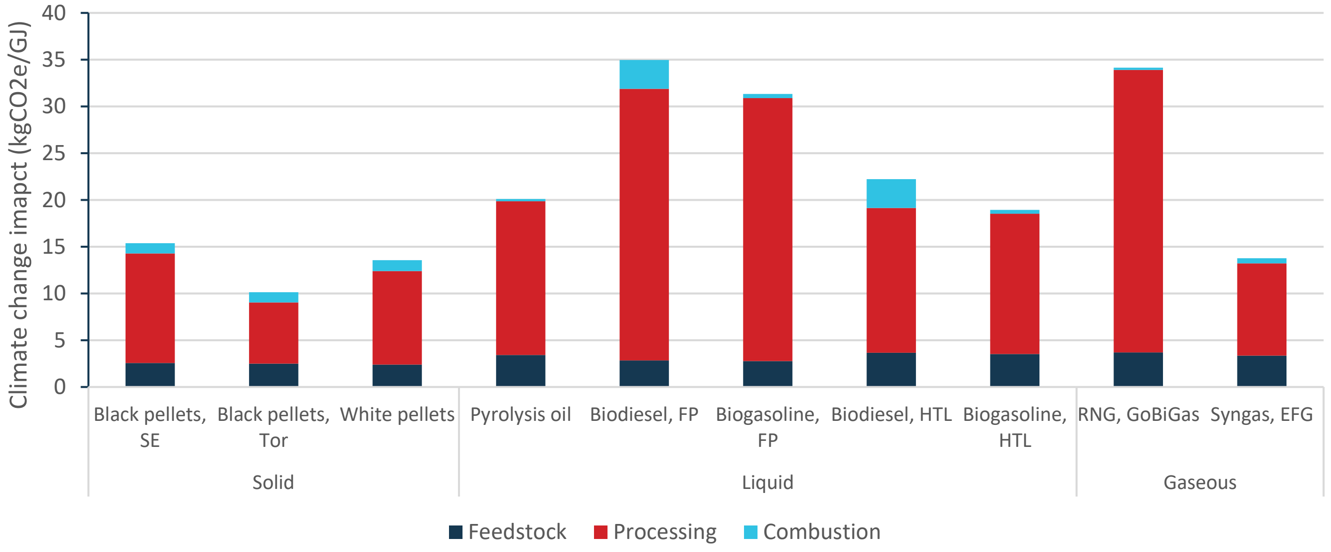
Biomass Conversion Efficiency

	Reference case			Energy Efficiency Measures		
Bioenergy product	**Drying**	**Process**	**Energy yield****	**Drying (low temperature)**	**Process (high temperature)*****	**Energy yield*****
White pellets	Electricity, natural gas or biomass	Electricity	80-85%	Waste heat	Same as the reference case	90-99%
Black pellets	Pre-heated air with the waste heat (indirect heat recovery)	Part of the torrefaction products	70-80%*	Waste heat	Waste heat at 500°C	85-95%
Slow pyrolysis (biochar and biooil/synthesis gas)	Pre-heated air with the waste heat (indirect heat recovery)	Part of the pyrolysis products	70-80%	Waste heat	Waste heat at 700°C	80-90%
Gasification (without purification)	Electricity, natural gas or biomass	Part of the gasification products	60-65%	Waste heat	Waste heat at 900°C	70-85%

$$\text{Energy yield} = \frac{Sum\ of\ the\ remaining\ energy\ in\ the\ products}{\text{Sum of the all entering energies to the process exept the waste heat}}$$

*If an external source is used for biomass drying, the energy efficiency of the refernce case will be reduced by around 10%.
**Suppose that a process is well integrated from the heat recovery and volatiles/synthesis gas
***If the heat source at high temperature is not available, which usually the case, the efficiency gain corresponds to the lower limit of the energy yield

Carbon Intensity – LCA Analysis of Bioenergy Pathways

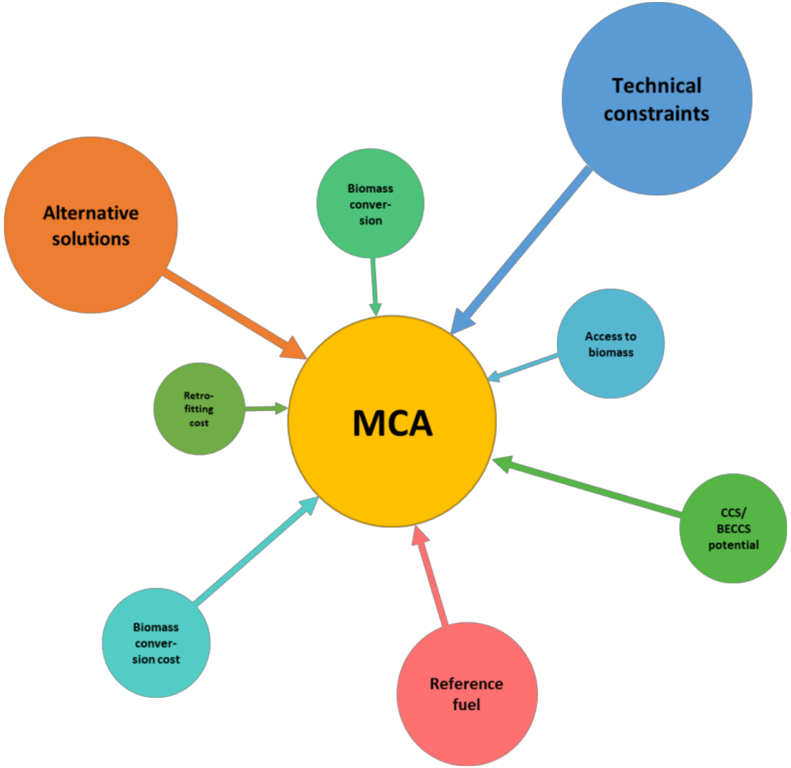


Biofuels that require the less amount of processing, such as pellets and pyrolysis oil, have lower GHG emissions per energy unit. When excluding biogenic CO_2 emissions and removals, processes with further conversion steps but where energy needs can be met using biomass, such as entrained flow gasification, also show a low carbon footprint.

* From Internal Report: Life Cycle Assessment of Wood Biofuel Pathways , Marieke Head, Bruno Gagnon, NRCan, 2020

Multi-Criteria Analysis – Bioenergy

- Conversion efficiency and carbon intensity of production pathways are important, but insufficient indicators for reaching a net zero target
- Pathways requiring less transformation steps generally provide a higher conversion efficiency
- Pathways allowing carbon sequestration are needed to reach net zero at the least cost
- Otherwise, more electrification, CCS and DAC are required
- Potential industrial needs far exceed resource availability in some provinces



Panelist

Fred Ghatala

Advanced Biofuels Canada

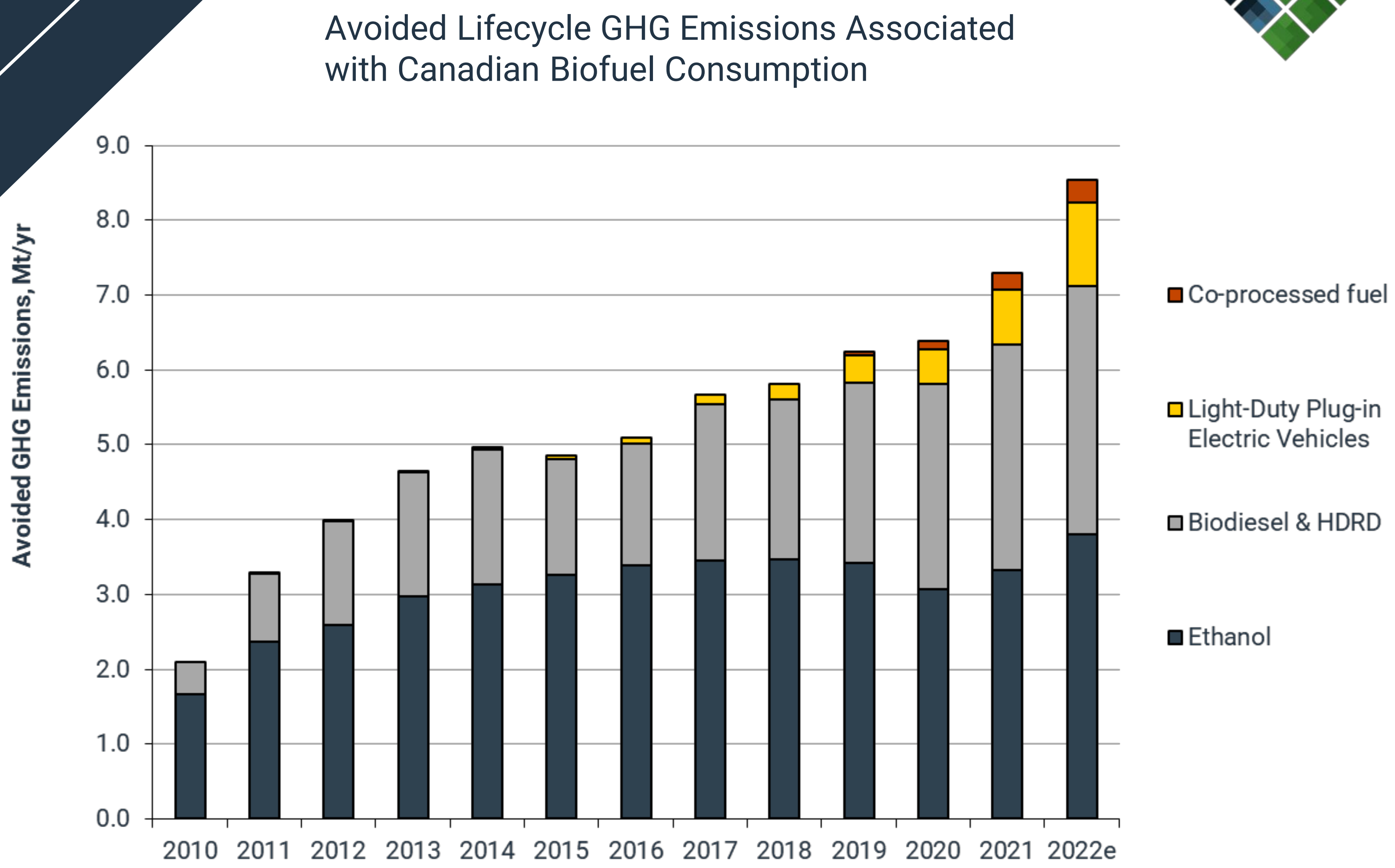
Advanced Biofuels Canada
Biocarburants avancés Canada

Canada's Clean Fuels Sector

Clean Fuel Projects	Qty	Capacity	CAPEX (billion CAD)
Oilseed Crushing	4	4.3 Mt seed	2.0
Feedstock (excl. crushing)	3	87 MLY	0.6
Clean Fuel Production	**19**	**4,726 MLY**	**11.7**

Clean Fuel Production Projects	Economic Activity (billion CAD) Full Buildout	Jobs Full Buildout
Construction	0.2	1,900
Direct	2.3	5,900
Indirect	2.7	17,100
Distribution and Use	1.8	10,900
Total	**7.0**	**35,600**

Avoided GHG Emissions

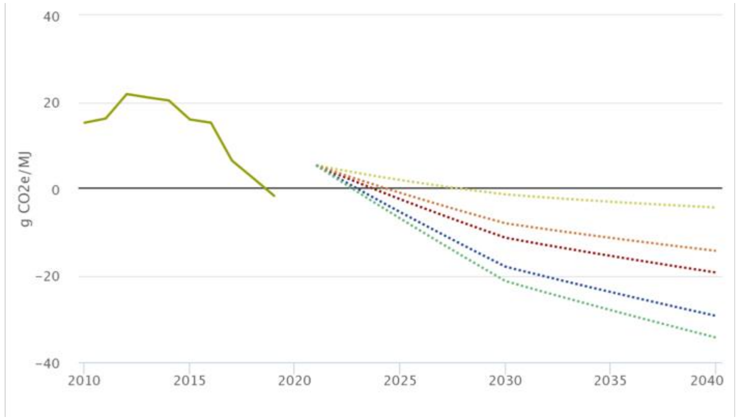


Navius Inc. “Biofuels in Canada 2023”

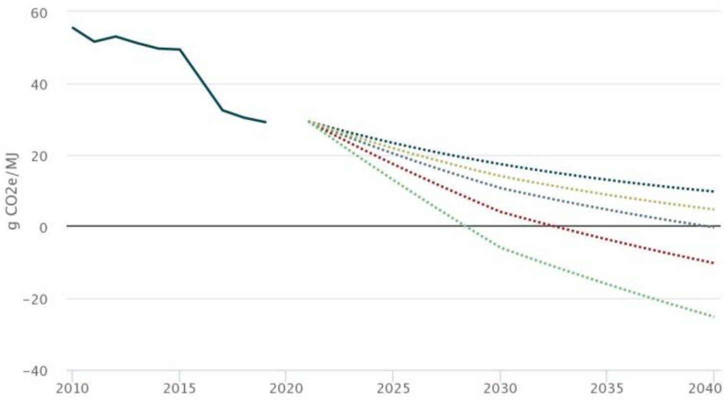
Biofuels: Net-Zero Ready

BC LCFS Carbon intensity reductions

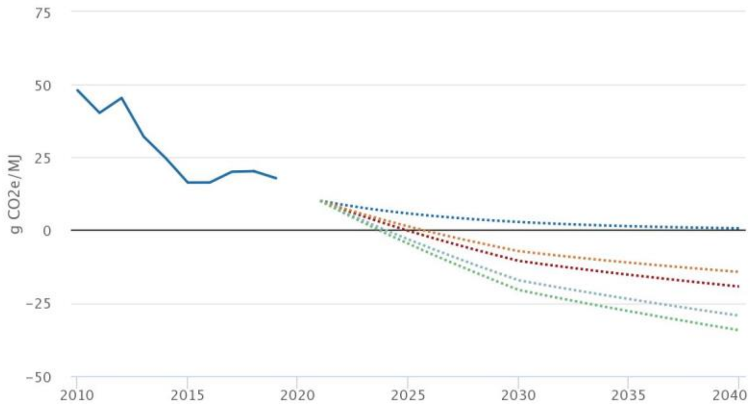
Biodiesel ⬇84%



Ethanol ⬇45%



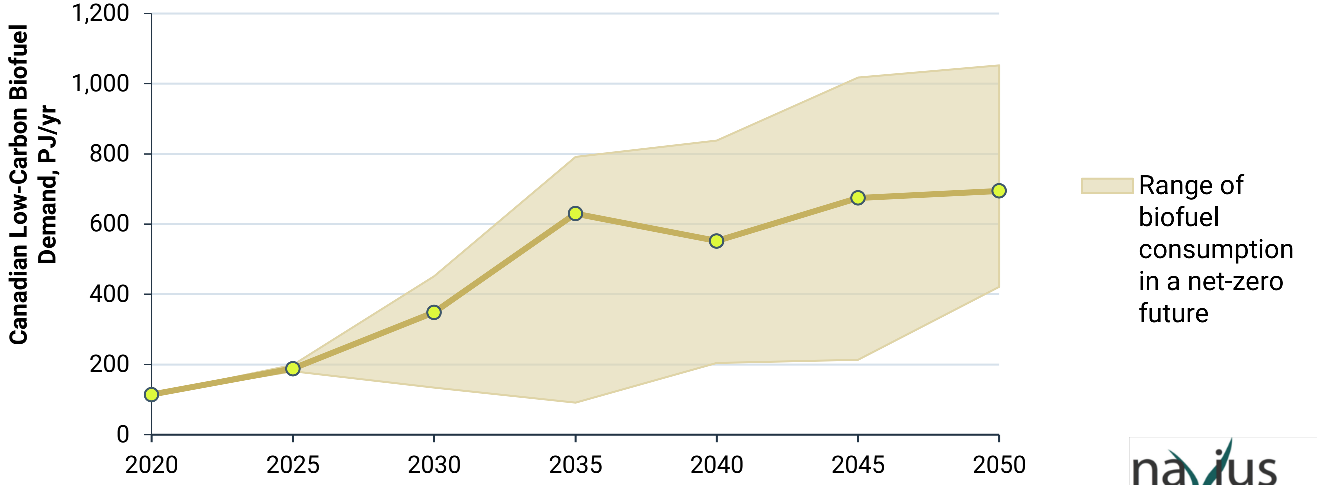
HDRD ⬇58%



Biodiesel is a commercially supplied net-negative biofuel (BC: from 2019 to current compliance year).

Advanced ethanol and HDRD will be net-negative 2025-2030 using available carbon dioxide removal ('CDR') technologies (BECCS, soil sequestration, etc.).

Net zero by 2050 requires transformative change: Four-to-ten-fold increase in demand for energy-dense, low-carbon fuels.



Source: BC Energy Mines and Low Carbon Innovation, Navius Research, ABFC

Panelist

Ka Wing Ng

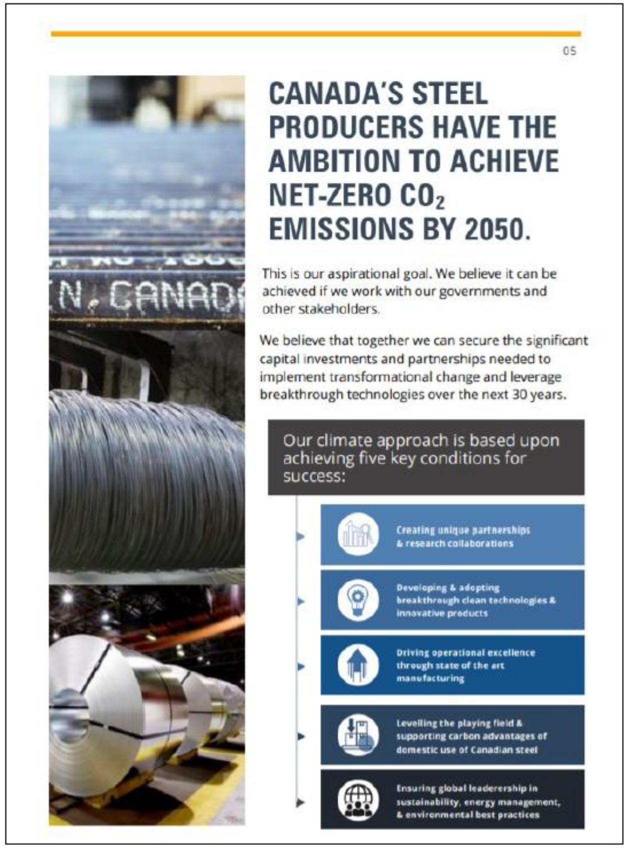
CanmetENERGY in Ottawa

Canadian Steel Sector Climate Action

- CE-O in partnership with Canadian Steel Producers Association (CSPA) and Canadian Carbonization Research Association (CCRA) developed 5 pillars for decarbonization R&D
- Utilization of biocarbon plays an important role in achieving net-zero emissions by 2050

Net Zero Emissions Steel R&D

- **Supply of Alternate Reductants and Alternate Fuels** → To develop supply chain of renewable reductants and fuels to support steel and other heavy industries
- **Utilization of Alternate Reductants (H2, Biocarbon, Electron)** → To develop technologies for enabling utilization of renewable reductants in ironmaking and steelmaking
- **Utilization Alternate Heating (Renewable Fuels and Non-Emitting Electricity)** → To develop technologies for enabling renewable fuels and non-emitting electricity utilization to meet heat demand in steel production
- **CO2 Capture, Utilization, Transportation and Storage** → To apply CO2 capture in steel production processes and development of technology for utilization, transportation and storage of captured CO2
- **System Integration and Optimization** → To integrate decarbonisation technologies with steel production processes and development of modeling tool to assist business case assessment



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CANADA'S STEEL PRODUCERS HAVE THE AMBITION TO ACHIEVE NET-ZERO CO_2 EMISSIONS BY 2050.

This is our aspirational goal. We believe it can be achieved if we work with our governments and other stakeholders.

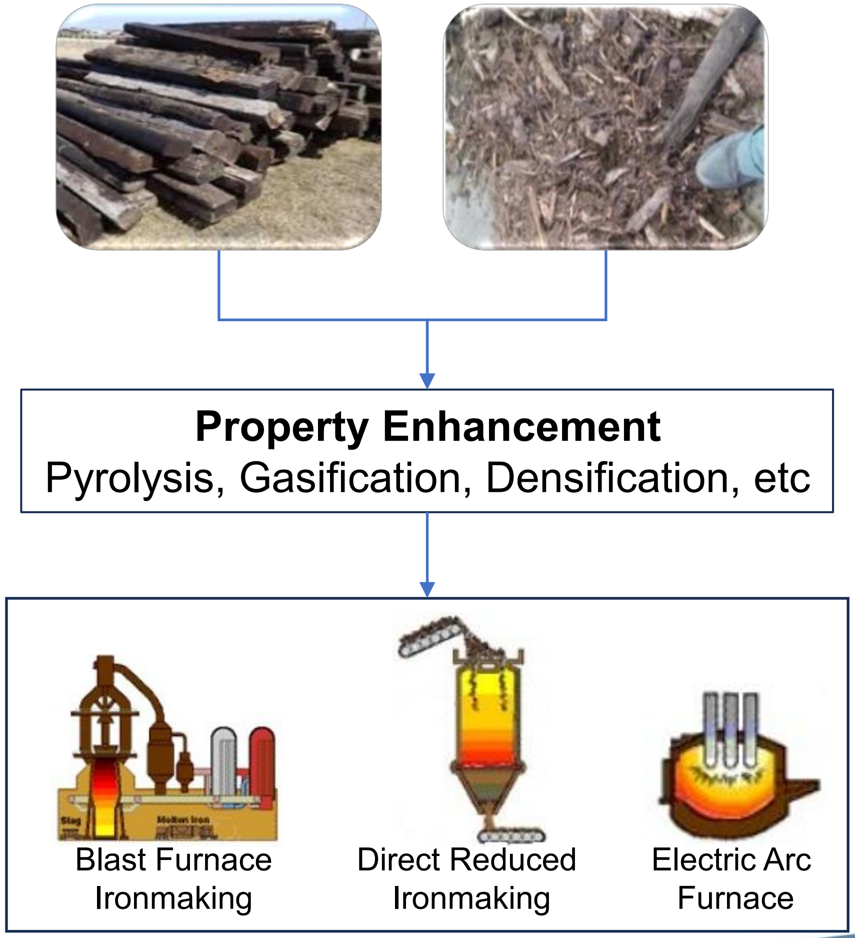
We believe that together we can secure the significant capital investments and partnerships needed to implement transformational change and leverage breakthrough technologies over the next 30 years.

Our climate approach is based upon achieving five key conditions for success:

- Creating unique partnerships & research collaborations
- Developing & adopting breakthrough clean technologies & innovative products
- Driving operational excellence through state of the art manufacturing
- Levelling the playing field & supporting carbon advantages of domestic use of Canadian steel
- Ensuring global leaderership in sustainability, energy management, & environmental best practices

Biogenic Carbon Utilization in Steel Production

- Steel production processes are designed and optimized based on fossil carbon input
- Raw biomass cannot be used directly in existing steel production processes
- Property enhancement is needed to improve suitability
- Requirement on chemical and physical properties depends on targeted area of application
- Current R&D focuses:
  - Further development of raw biomass feedstock processing technologies to enhance products' suitability
  - Steel production processes modification to accommodate biocarbon utilization
  - Development of biocarbon standards for metallurgical applications



Industrial Scale Implementation

- Current production capacity of suitable biocarbon is far less than demand of steel industry
- For example:
  - One industrial scale blast furnace injection trial lasted for 6 hours with partial biocarbon substitution consumed ~200 tonnes of biocarbon
  - Could not conduct a longer duration trial due insufficient biocarbon supply
- Growth in biocarbon production capacity is needed to cope with steel industry demand
- Integration of bioenergy systems with end-users is essential:
  - Competition on limited feedstock and between end-users
  - Logistical challenges
  - Co-products utilization
  - GHG neutrality

Panelist

Jack Saddler

University of British Columbia

The Forest Products Biotechnology/ Bioenergy/Biofuels Group at UBC

- www.bioenergy.ubc.ca
- www.BC-SMART.ca

- www.Task39.ieabioenergy.com

IEA Bioenergy
Technology Collaboration Programme

Forest Management/Biomass schemes; certifying “sustainability”

- Forest Stewardship Council (FSC) https://fsc.org/en
- Sustainable Forestry Initiative (SFI) https://forests.org/
- Programme for the Endorsement of Forest Certification (PEFC) endorses the SFI and the Canadian Standers Association (CSA) systems https://pefc.org/
- Sustainable Biomass Program (SBP) https://sbp-cert.org/
- Others (e.g., roundtable on sustainable palm oil (https://rspo.org/))

Certifying the "sustainability"/ Carbon Intensity (CI) of biofuels: (e.g., terminology, SAF vs. Biojet Fuels)

- Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA): "*a harmonized way to reduce emissions from international aviation, minimizing market distortion, while respecting the special circumstances and respective capabilities of ICAO Member States*".

- GREET: The Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation Model (Various US models, e.g., CA-GREET)

- GHGenius: "*a free to download lifecycle analysis (LCA) model with a primary focus on transportation fuels in Canada*".

- The Government of Canada's (ECCC) Fuel Life Cycle Assessment (LCA) Model: used to calculate the life cycle carbon intensity (CI) of fuels and energy sources used and produced in Canada

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