

Carbon Fibre Grand Challenge Phase I Webinar

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February 11, 2020



ALBERTA INNOVATES



AGENDA

- Housekeeping
- Alberta Innovates Background
- Bitumen Beyond Combustion
- Asphaltenes & Their Properties
- Grand Challenge Objectives & Program Details
- Application Process
- Evaluation Criteria
- FAQs
- Q&A



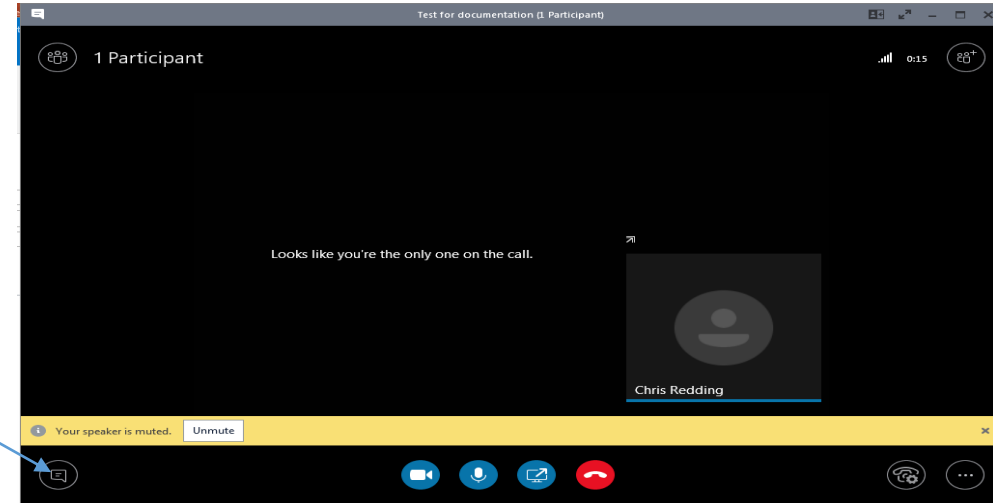
Housekeeping

1. Please mute your Microphones.
2. If you are joining by phone, please enter your Conference ID when prompted and then mute your phone to avoid echo.
3. Questions about connecting to the webinar can be sent by email to:
 - Steve Wlasichuk– Steven.Wlasichuk@albertainnovates.ca
 - Or contact our Helpdesk at: 1-877-225-0099

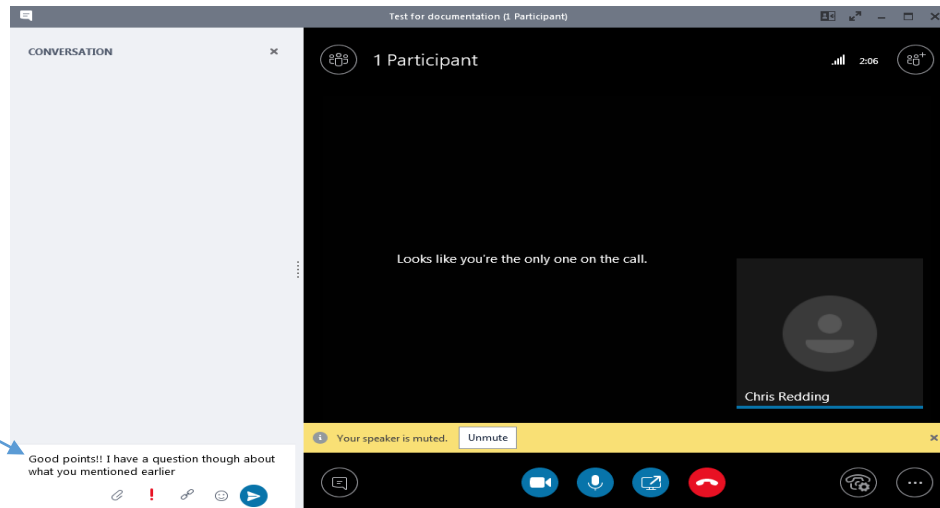
Housekeeping – Submitting Questions (via Skype)

1. Click on the message box located at the bottom corner
2. Type in the message you would like to send
3. Click on the blue and white arrow to send message

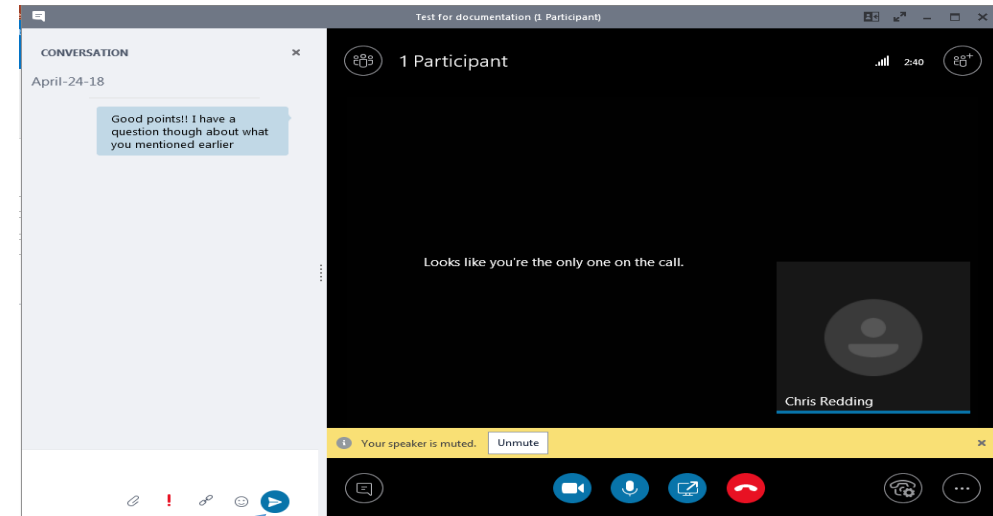
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Alberta Innovates At A Glance

- Largest provincial R&I agency in Canada (\$180M/year)
- Innovation strategy and programs
- Provide technical expertise, entrepreneurial advice
- Provide funding to advance innovation

Business Lines

- Clean Resources
- Health Innovation
- Investments + Emerging Tech

Subsidiaries

C-FER
Technologies
A SUBSIDIARY OF ALBERTA INNOVATES



InnoTech
ALBERTA
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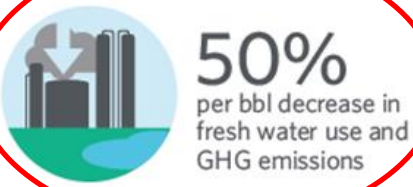
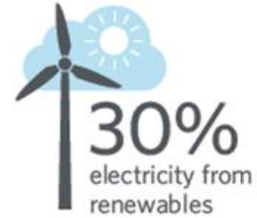
Storied History of Supporting Innovation

- Oilsands (BPU, BBC)
- Materials (MARIOS)
- Wood Products (OSB)
- Artificial Intelligence / Machine Learning (Amii)
- Agriculture (CAAIN)



ALBERTA RESEARCH AND INNOVATION FRAMEWORK (ARIF) | 2030 TARGETS

ENERGY AND GHG MITIGATION



BIOINDUSTRIAL



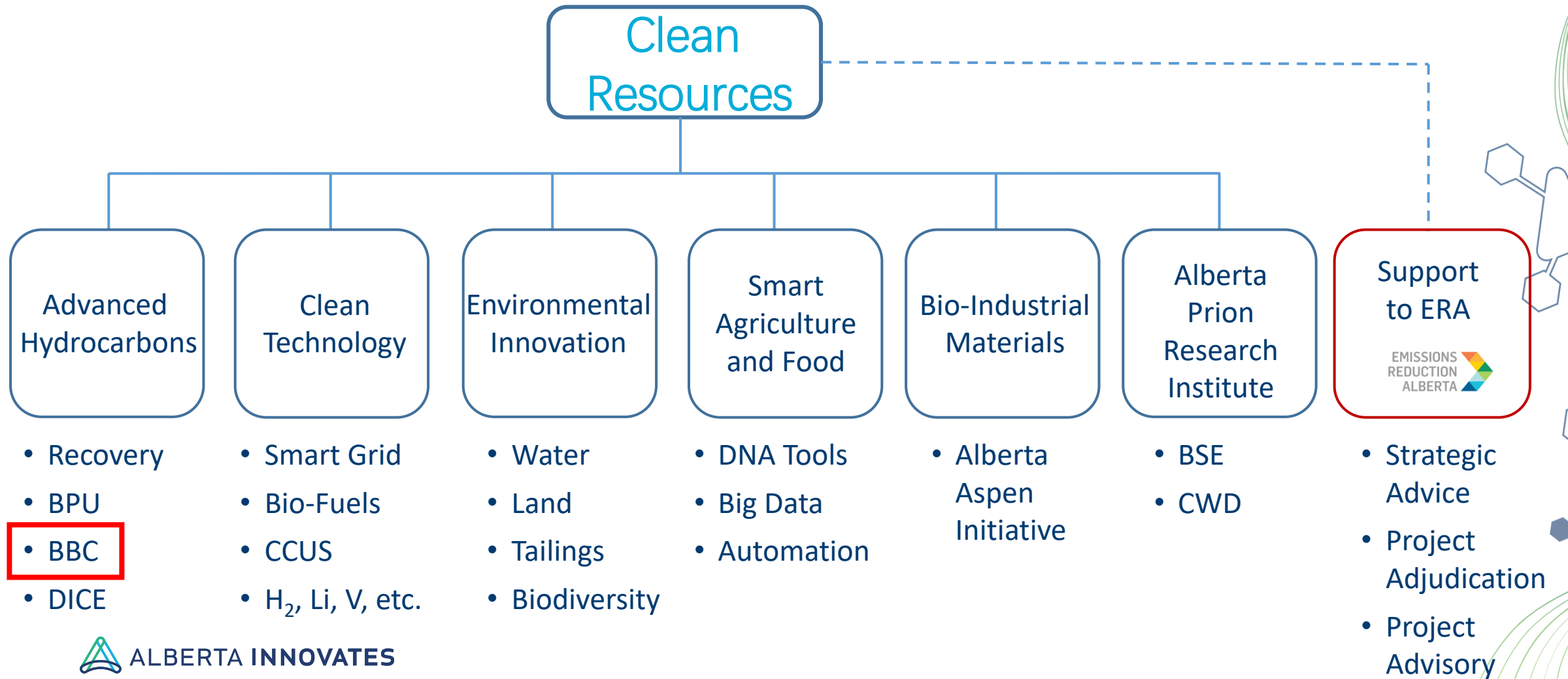
ENVIRONMENT AND CLIMATE ADAPTATION



EMERGING TECHNOLOGIES



Clean Resources Program Areas



Diversity, Equity, Inclusivity

- We believe the Alberta Research and Innovation (R&I) ecosystem is stronger and more sustainable when it is broadly representative of the overall diversity of our community.
- We strive to ensure that all interested and qualified parties have an equitable opportunity to participate and contribute to the ecosystem and that our processes are inclusive.
- Historically, there have been a number of groups/populations that have been under-represented in the R&I landscape including:
 - Women entrepreneurs/researchers
 - Indigenous entrepreneurs/researchers
 - Remote/small community entrepreneurs/researchers
 - New immigrant entrepreneurs/researchers
- We encourage ALL entrepreneurs/researchers to apply!
- If you are a first time AI applicant, don't hesitate to reach out to the program contacts for navigation information.

BACKGROUND

Alberta Oilsands Bitumen

- Reserves: 180 Billion bbl
- Production: 3 Million bpd



Combustion Products (~90%)

Non-combustion Products (~10%)

- Non-combustion products are produced by refineries (e.g. lubricants, etc.)

Bitumen Beyond Combustion (BBC)

What is BBC?

- BBC involves the conversion of bitumen to non-combustion materials instead of using bitumen as a source for transportation fuels
- Asphaltene, the heaviest component in bitumen, holds the best promise for BBC
- 15 - 20% of the barrel is asphaltenes
- Carbon fiber is identified as a top BBC product

Bitumen and
Asphaltene

Process
Technologies

Carbon fibre (CF)

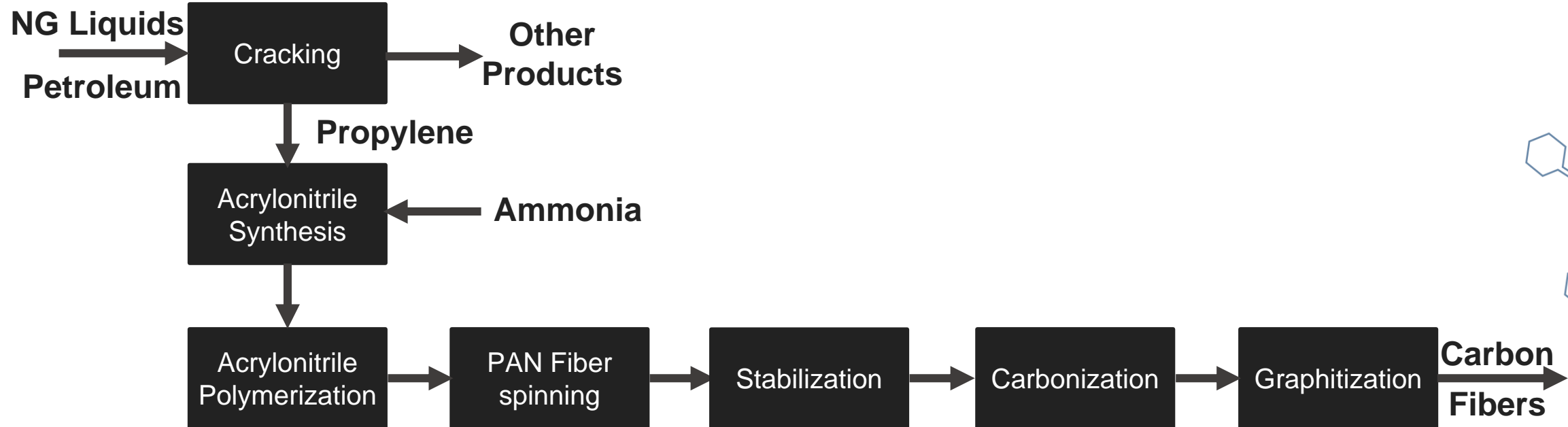
Asphalts

Activated carbon

Vanadium flow battery

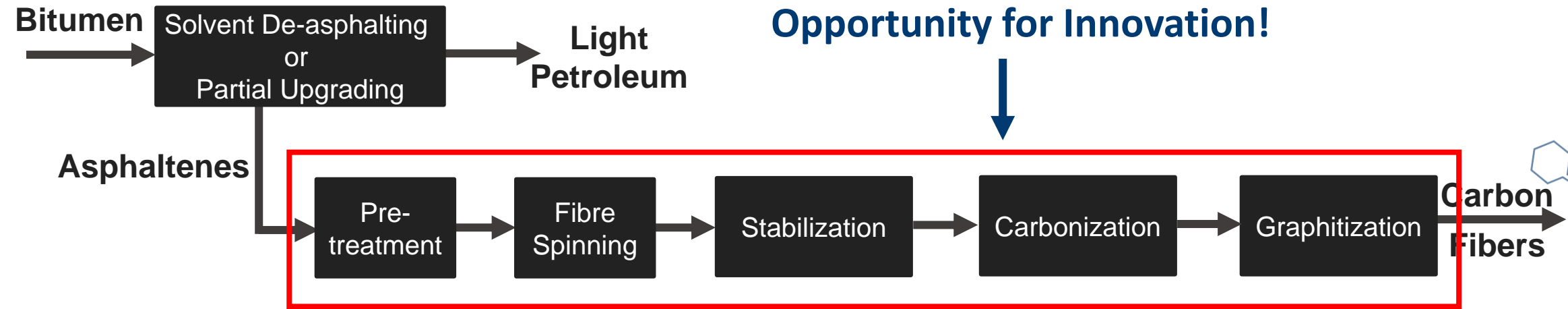
Metal carbides & graphene

Carbon Fibres: Production from PAN



- Commercial process
- Complex and costly
- Capacity (per train): ~2,000 tonnes per year

Carbon Fibres: Example Production from Asphaltenes



Advantages

- Favourable chemistry
- Low cost supply
- Divert hydrocarbons away from combustion

Challenges

- Stabilization
- Pre-treatment necessary?
- Sulfur and metal content
- Scale-up
- Carbon efficiency & GHGs
- Don't know what we don't know

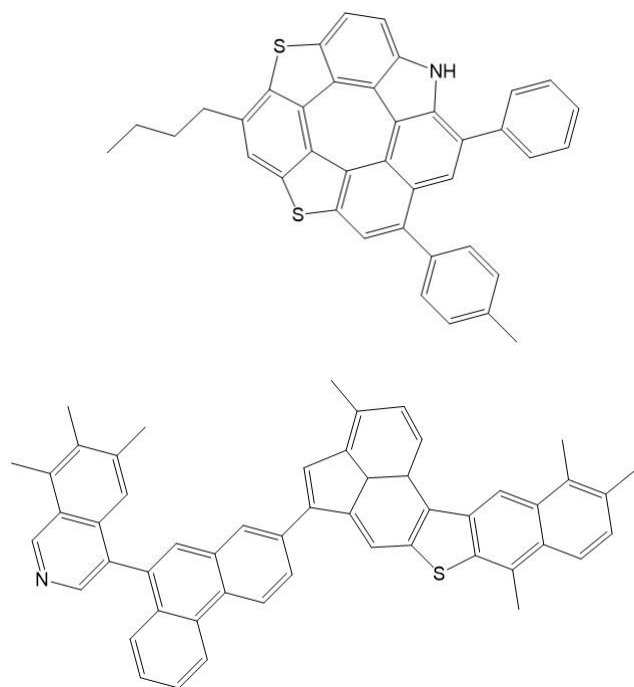
What Are Asphaltenes?

- Solubility fraction of petroleum (including bitumen): insoluble in n-alkanes; soluble in toluene
- Polydisperse complex mixture
 - MW from ~400 to 1,000 Da
 - Wide range of molecular types
 - 78-80 wt % carbon; range of H, S, O, N per molecule
- Glassy solid at room temperature
- Thermoplastic; softening at 120 – 230°C depending on composition and treatment
- NOT petroleum pitch

What Are Asphaltenes?

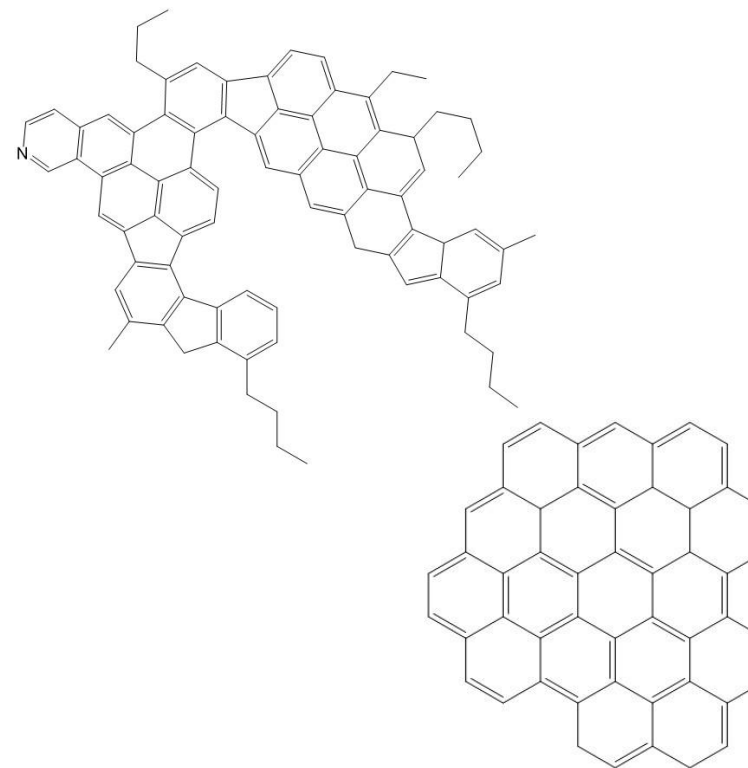
80-90 wt% bridged structures

Strong aggregation



10-20 wt% island structures

Weak aggregation



Carbon Fibres: Production

	Carbon Fiber Production	
	From PAN & Pitch (Current)	From Asphaltenes (Target)
Cost, US\$/kg	18 – 35	< 9
Global production, tpy ^a	100,000	400,000 ^b
Train capacity, tpy ^a	~2,000	>2,000?

^a tonnes per year

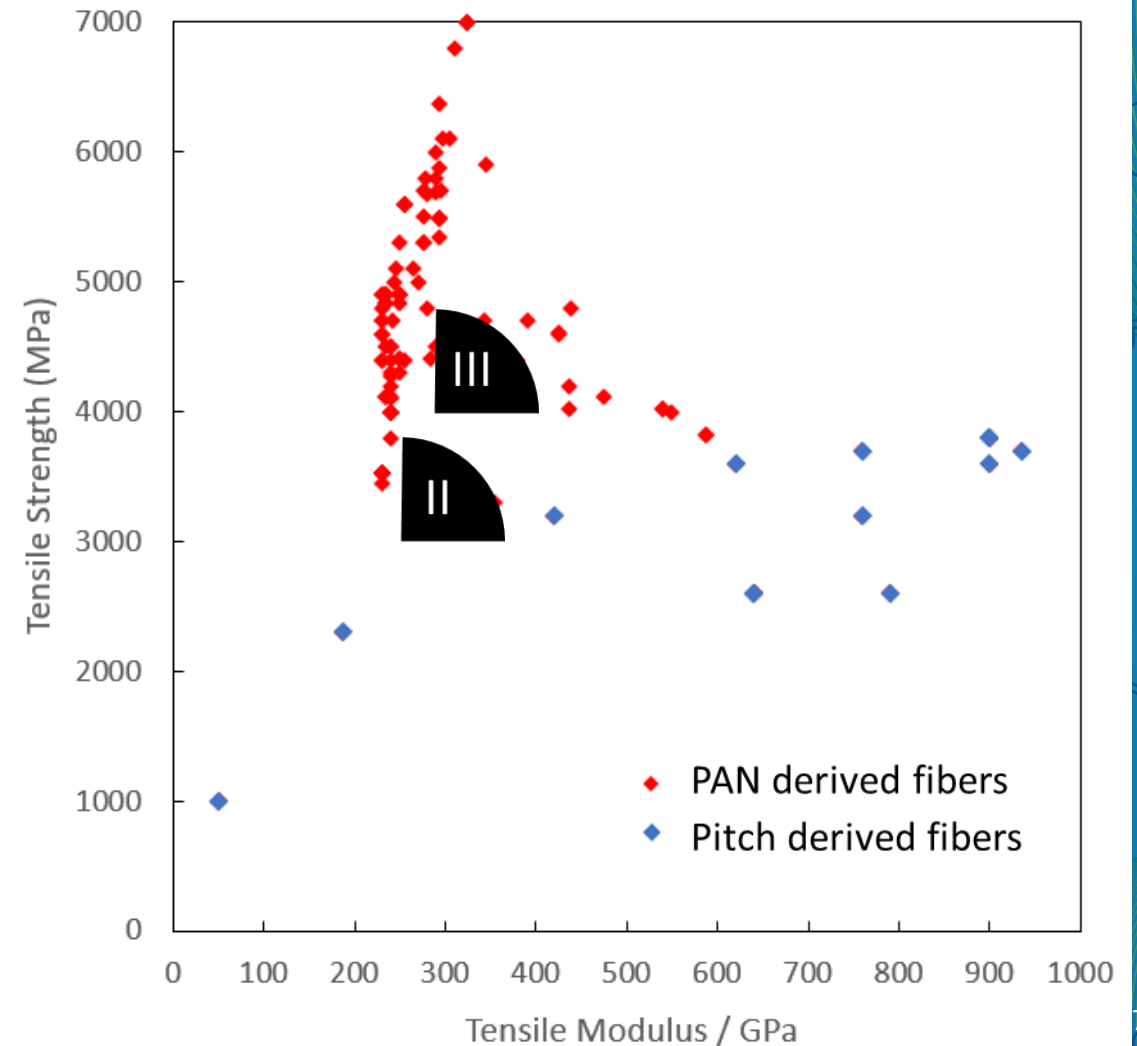
^b requiring app. 100,000
barrels per day of bitumen

Current Target Characteristics

Characteristic	Grand Challenge Target
Geometry	
Diameter	7 μm
Length	Continuous or 6 mm
Tensile strength	$>3,000^a$ - $>4,000^b$ MPa
Modulus	$>250^a$ - $>300^b$ GPa

^a Phase II

^b Phase III



Key Knowledge Gaps: Carbon Fibre Production from Alberta Oilsands Asphaltenes

- **Mesophase Requirement** – mesophase is important in CF production from pitch, but is it required when Alberta Oilsands Asphaltenes are the feedstock?
- **Impact of Sulphur and Metals** – Alberta oilsands asphaltenes have substantial concentrations of sulphur and metals. Their impact on CF production and CF properties is unknown.
- **Scientific Fundamentals** - The chemistry and physics (e.g., rheology, heat, and mass transfer) of CF production from PAN and pitch are fairly well understood, but similar knowledge is missing for feedstocks derived from Alberta oilsands, especially asphaltenes.

Key Knowledge Gaps: Carbon Fibre Production from Alberta Oilsands Asphaltenes

- **Short Carbon Fibres** - process technology for producing short CF (not based on chopping continuous fibres) is missing.
- **Large-Scale Production** - technologies for producing CF at >2,000 tonnes per year per train are missing. Conceptualization and demonstration are needed.
- **Economics, Energy Requirements and Greenhouse Gas Emissions** - The economics, energy requirements, and GHG emissions of CF production processes based on Alberta oil sands asphaltenes need quantification.

GRAND CHALLENGE PROGRAM DETAILS

Objectives

- Greatly accelerate the development of technologies that can convert Alberta oil sands asphaltenes ('AOA') into carbon fibre
- Create line of sight to production capacities and costs that would enable rapid uptake of carbon fibre into major existing and new markets
- Advance technologies that will benefit Alberta industry and the province of Alberta

Grand Challenge Timeline

Date	Planned Activity
January 2020	Launch of Grand Challenge
January – April 2020	Phase I application process
June – December 2020	Phase I Projects execution
February – April 2021	Phase II application process
June 2021 – December 2022	Phase II Projects execution
January – February 2023	Phase III registration
March 2023 – December 2024	Phase III execution

Phase I – Conceptualization / Proof of Concept

- **Goal:** advance concepts and ideas for manufacturing carbon fibre from AOA while addressing knowledge gaps.
- **Applicant Objective:** conceptualize and potentially test pathways for manufacturing CF from AOA, with a line of sight to development of the manufacturing pathway in Phase II
- **Minimum Outcome:**
 - a concept for a plausible AOA to CF manufacturing process, including expected inputs and outputs that addresses some or all of the knowledge gaps stated in Appendix A.
 - a plan, based on scientific fundamentals or experimental evidence, of how to investigate in Phase II the impact of sulfur and metals in AOA feedstocks on the carbon fibre manufacturing process and end product CF

Phase I – Conceptualization / Proof of Concept

- No strength or modulus targets for asphaltene fibre or carbon fibre produced in Phase I
- **Funding:** a maximum of \$50,000 in Canadian dollars ('CAD') awarded to successful applicants. A total of \$1,000,000 is available
- **Deadline: April 7, 2020 at 2:00 PM MT (UTC -7:00)**

Phase II – Scaling

- **Goal:** consolidate learnings from Phase I to produce carbon fibre from AOA at lab scale, with line of sight to a demonstration plant that can be commercially scaled.
- **Applicant Objective:** produce CF that meets minimum quality specifications using bitumen derived AOA
- **Minimum Outcome:** Carbon fibre production of > 10 grams per day; tensile strength >3,000 MPa and modulus >250 GPa; potential end uses identified and/or validated. For chopped fibres, the target length is 6 mm with 7 μm diameter.
- **Funding:** \$500,000 CAD awarded to successful applicants. A total of \$5,000,000 is available

Phase III – Demonstration

- **Goal:** achieve pre-commercial demonstration of CF manufacture that enables immediate commercial investment
- **Applicant Objective:** design, development, and demonstration of a pre-commercial CF production process using AOA
- **Minimum Outcomes:** Continuous production of > 10 kg per day; tensile strength >4,000 MPa and modulus >300 GPa; projected commercial cost of CF < US\$9 per kg.
- **Funding:** \$3,000,000 CAD Grand Prizes awarded to 3 winners (total \$9,000,000) as a lump-sum at the end of Phase III

PHASE I APPLICATION

Phase I Application Examples

- Novel approaches to manufacturing continuous carbon fibre that could produce a much greater quantity per train than current technology
- Methods to manufacture short carbon fibre that do not involve chopping continuous fibres
- Methods that utilize existing carbon fibre production technology but are scalable to much larger production capacities
- Methods that blend new (undeveloped) and existing carbon fibre production technologies

Phase I Application

- Applicants MUST propose in their application the basis of the concept or idea for carbon fibre production from Alberta Oilsands Asphaltenes that they will develop during Phase I.
- Applications that do not propose an idea or concept for carbon fibre production from asphaltenes will be not be considered.
- Applicants that indicate that the idea or concept will only be generated during Phase I will be not be considered.
- Ideas or concepts do not have to be fully developed in the application – that is the objective of Phase I

Eligibility

Applicants

- Open to technology developers, industry (including small, medium, and large size enterprises), industry associations, research and development (R&D) organizations, post-secondary institutions, not-for-profit organizations, and government research labs.
- Applicants are not required to be based in Alberta but must demonstrate a clear value proposition for the Province

Eligibility

Applicants

- Must have demonstrated expertise with respect to:
 - Applying scientific and engineering fundamentals relevant to the manufacture of carbon fibre
 - Completing scientific or technical laboratory or other small scale practical work on or relevant to carbon fibre production
 - Utilizing results and conclusions from laboratory and other small-scale work to establish the viability and competitiveness of production technologies, such ability to include experience with preparing process flowsheets (with mass and energy information and basic equipment specifications) for purposes of process evaluation and scale-up;
 - Identifying and addressing critical business issues, including CAPEX and OPEX estimates, market characteristics, and environmental and social acceptance;
 - Addressing scientific, technical, business, and environmental challenges and opportunities.

Eligibility

Project Partners (if any)

- Project Partners must satisfy the following criteria:
 - demonstrate the relationship between the Applicant and the Project Partner(s) does not create a conflict of interest;
 - be in good financial standing with Alberta Innovates and its subsidiaries InnoTech Alberta and C-Fer Technologies;
- Other Funding Agencies are considered eligible partners

Eligibility

Project Eligibility

- To qualify for funding, all Projects must
 - be completed by December 31, 2020; and
 - submit to other criteria that Alberta Innovates may develop from time to time.

Feedstock Samples

- Asphaltenes used in Projects funded by the Grand Challenge must be derived from Alberta oilsands bitumen. **No exceptions will be made.**
- Alberta Innovates can provide samples for those applicants that are unable to source AOA – please indicate on your application form if you require asphaltenes
- If you do not source AOA from Alberta Innovates, you are required to demonstrate the Alberta origin of the asphaltenes and submit a sample to Alberta Innovates for characterization

Application Evaluation Criteria

- The Opportunity
- Proposed Solution
- Project Implementation
- Team

Phase I Application Process

- Online application portal (<http://ai.smartsimple.ca>)
- One-stage application
- Deadline is April 7, 2020 at 2:00 PM MDT (UTC -7:00)

Online Portal Instructions

- Step 1: Register
- Step 2: Select the correct application (Carbon Fibre Grand Challenge)
- Step 3: Fill out the application
- Step 4: Submit

Online Portal Instructions

- Step 1: Register

Organization Information

*** Organization**

?

*** Address**

?

*** City**

*** Country**

--- Select One ---


▼

*** State / Province**

*** Postal Code**

Online Portal Instructions

- Step 2: Select the correct application (Carbon Fibre Grand Challenge)

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Home

Funding Opportunities

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xR HEAD

Deadline:31/01/2020

Deadline Passed

Carbon Fibre Grand Challenge

Deadline:07/04/2020

Apply Now

CSRI - Stream 1 Community Engagement

Deadline:31/08/2020

Apply Now

My Applications


IN PROGRESS SUBMITTED APPROVED UNSUCCESSFUL / WITHDRAWN / INELIGIBLE

1-2 of 2

Submission Number	Primary Contact	Competition	Created Date	
201910880	Paolo Bomben	Carbon Fibre Grand Challenge	06/02/2020 09:00AM	Open
201811026	Paolo Bomben	Canadian Emissions Reduction Innovation Network (CERIN)	08/03/2019 08:38AM	Open

Online Portal Instructions


- Step 3: Fill out the application


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Paolo Bomben ▾


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 Main

 Notes

Carbon Fibre Grand Challenge (Bomben, Paolo - Application Record Number: 201910880)  

 **APPLICATION FORM:**
Carbon Fibre Grand Challenge

Applicants must complete the Application in its entirety. Each response has a character limit.

The deadline for submission of Applications is April 7, 2020 **at 2:00 PM Mountain Standard Time (UTC -7:00)**. Late submissions will not be accepted. Application decision notifications are anticipated in **early May 2020**. Note that AI at its sole discretion reserves the right to alter or cancel the timelines of the call.

AI is not responsible for the costs incurred by the applicant in the preparation and submission of this Application.

We encourage you to click "Save Draft" often.

To view the application (including a list of the questions), click the "Print/View Application" button below and choose to Print or Export to PDF.

Print/View Application

LEAD APPLICANT

PROJECT

ATTACHMENTS

PROJECT INFORMATION

* Project Title:

Online Portal Instructions

- Step 4: Submit

Print/View Application

LEAD APPLICANT PROJECT **ATTACHMENTS**

ATTACHMENTS

Please download the [Carbon Fibre Grand Challenge Signature Page](#) to read the terms of the application. Please provide signatures of both the Applicant and an Authorized Representative of the Organization.

Upload - Carbon Fibre Grand Challenge Signature Page

Please download and complete the [Work Plan Budget and Metrics Spreadsheet.xls](#). Please use the following steps in order to save and upload the workbook as a .pdf:

In the workbook:

1. Select Save as Adobe PDF
2. On the prompt add "Work Plan", "Budget Forecast", "Performance Metrics", and "Summary" sheets to the "Sheets in PDF column"
4. Select Convert to PDF
5. Save the file

It will now be available as a .pdf for upload to your application

Upload - Carbon Fibre Grand Challenge Workplan, Budget, and Metrics Spreadsheet

BACK

Save Draft **Submit**

Phase I Timelines

Date	Planned Activity
January 15, 2020	Launch of Grand Challenge
February 11, 2020	Webinar
April 7, 2020 at 2:00 PM MST (UTC -7:00)	Close of application submissions
Late April/Early May 2020	Successful Applicants Notified
June/July 2020	Phase I Projects begin
December 31, 2020	Latest completion date for funded projects

Advice for Preparing a Successful Submission

- Read the Program Guide
- Use clear and concise language
- Define what problem you are trying to solve
- Address each question in the application template and read the question guidance carefully
- Don't wait until the last day to submit

FAQ's

- Can projects or funding occur outside the province?
- What are examples of “project partners”?
- What costs are eligible for funding?
- Is there a minimum funding request?



Contact Information

- Dr. Paolo Bomben (CFGF Program Manager), Paolo.Bomben@albertainnovates.ca
- Bryan Helfenbaum, P. Eng. (Chair, BBC Strategic Advisory Committee), Bryan.Helfenbaum@albertainnovates.ca
- Dr. Axel Meisen (Senior Advisor), axel@meisen.ca
- Dr. Murray Gray (Senior Advisor), Murray.Gray@albertainnovates.ca
- Dr. John Zhou (Strategy and Partnership), John.Zhou@albertainnovates.ca

Thank you.