REDUCING GHG EMISSIONS. FUNDING A WAY FORWARD.

Climate Change and Emissions Management Corporation

Presentation to: Alberta Forest Products Association

Steve MacDonald Sept. 23 2016

Discussion Outline

- About CCEMC
- Portfolio Overview
- Forest Sector Potential
- BioCleantech Forum

CCEMC

About CCEMC

- Key component of Alberta Government's action on climate change
- Created in 2009 as part of Alberta's Climate Change Strategy
- Mandate to identify and accelerate innovative solutions that secure Alberta's success in a lower carbon economy.
- Invests in transformative technologies to build a sustainable and diversified economy that:
  - Attracts investment;
  - Expands market access; and
  - Delivers improved environmental outcomes.

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About CCEMC

- Funding comes from Alberta's Large Final Emitters (LFEs) that pay levy for every tonne emitted over the government-mandated reduction limit
- Funds are collected by Government in the Climate Change and Emissions Management Fund (CCEMF) and granted to CCEMC
- CCEMC intent is to align its investments with GoA climate policy
- Enables leveraging of industry money to support innovation and a clear line of sight for where dollars flow

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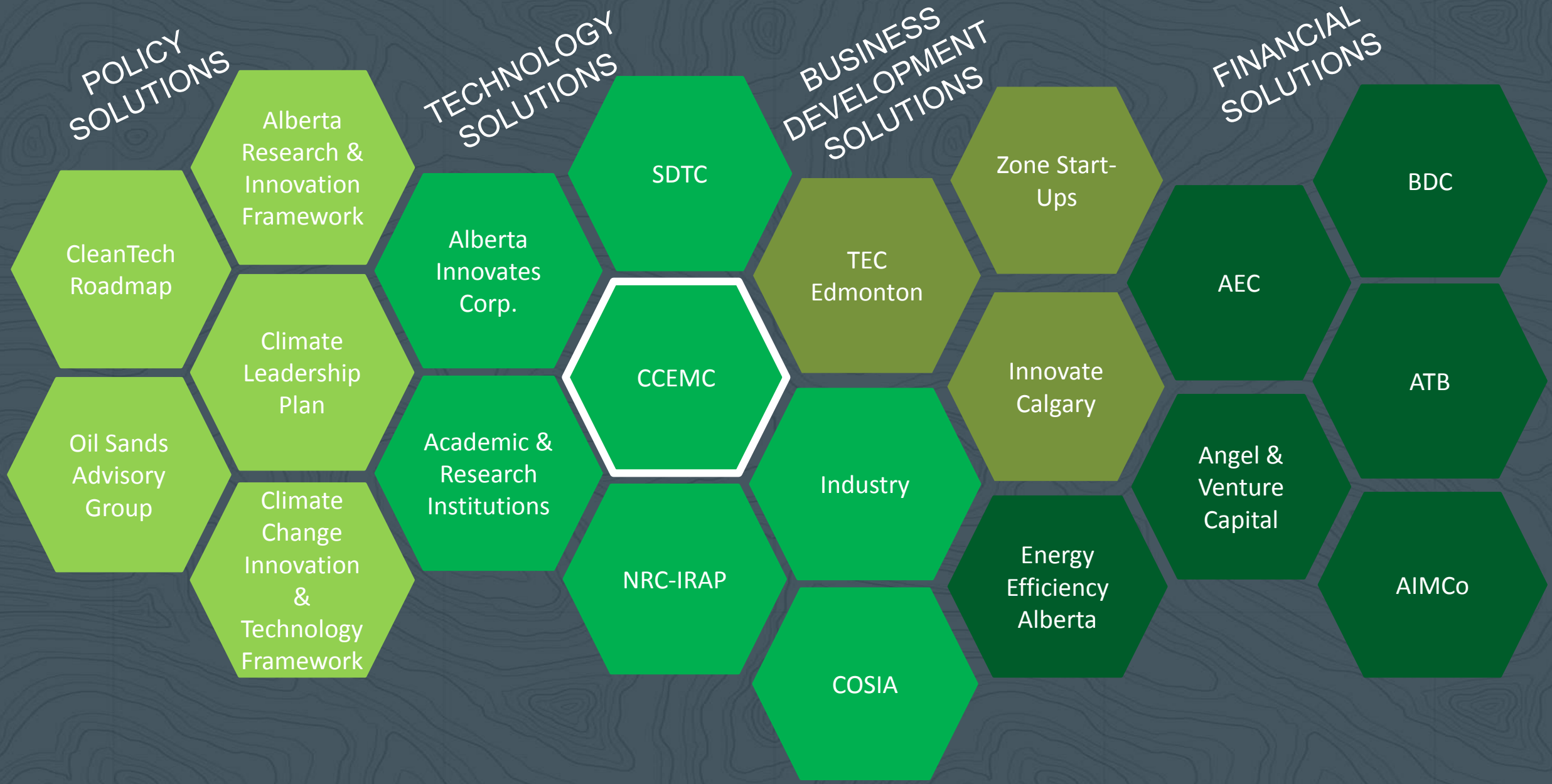
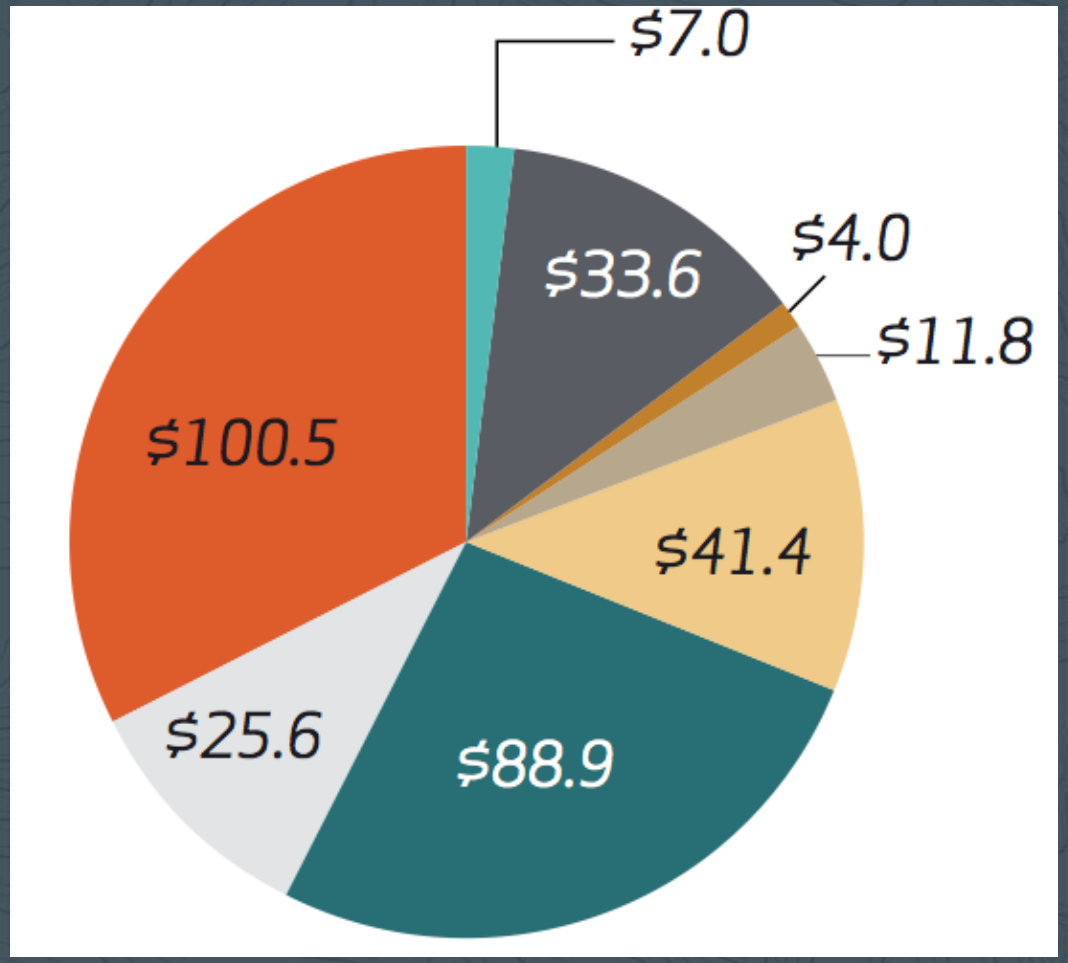
CCEMC and Alberta's Innovation System

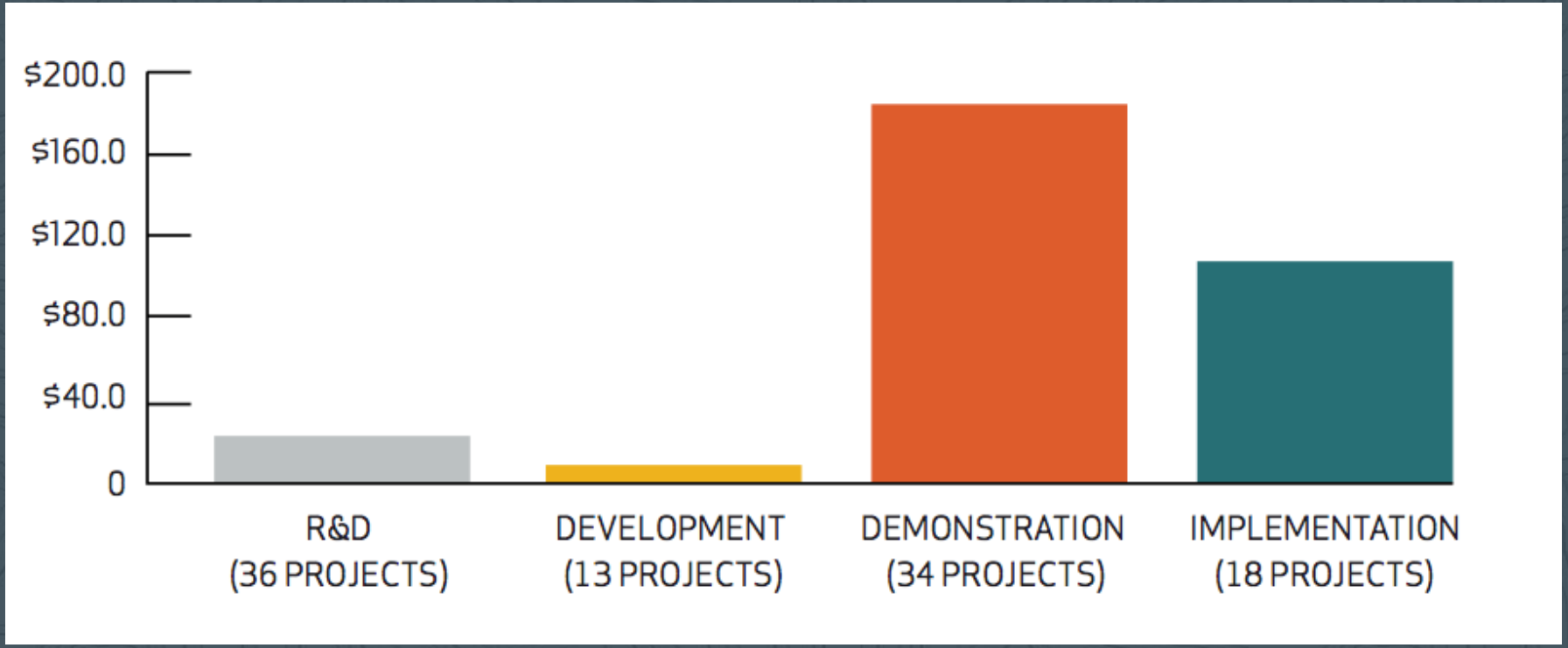


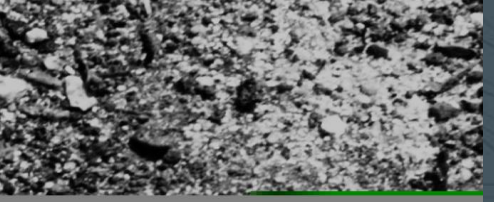
CCEMC Investment Portfolio ($ millions)



- RENEWABLE ENERGY (15 PROJECTS)
- CLEANER ENERGY PRODUCTION (12 PROJECTS)
- CCS (10 PROJECTS)
- ENERGY EFFICIENCY (12 PROJECTS)
- BIOLOGICAL GHG MANAGEMENT (8 PROJECTS)
- CARBON USE (24 PROJECTS)
- ADAPTATION (3 PROJECTS)
- BIOLOGICAL PROGRAM (17 PROJECTS)

CCEMC Investment by Innovation Stage ($ millions)





Measuring Value

- Since 2009 CCEMC has invested in > 100 projects
    - Committed > $310 M
    - > $2.2 billion in total project value
    - Leverage >6:1
    - Emissions reduction est. >7 MT/2020
        - Market potential >4 MT/2020
- 24 Grand Challenge projects (1 MT)
- Adapting to climate change – $7M, 3 projects
- Bio program – $8.4M, 17 projects (1MT)

Measuring Value (Cont.)

2015 Conference Board of Canada report*

- CCEMC portfolio from 2011-16
- Total economic impact - $2.4 B
- 15,017 person years of employment

Impact in Alberta

- GDP impact approx. $2B
- 11,000 person years employment

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CCEMC's Commitment

CCEMC's 2016-2019 Business Plan commits to:

- Invest in both open and directed innovation opportunities that reduce greenhouse emissions.
- Invest in innovation that aligns with the Climate Leadership Plan and addresses an identified market need.
- Invest in technologies with near-term impact (eg. Industrial energy efficiency)
- Invest in breakthrough technologies with large longer-term impacts

Forest Sector Potential

CCEMC recognizes the role of biogenic carbon in moving to a lower carbon economy.

1. Forest carbon sequestration in trees and soils
2. Switching forest-derived carbon for fossil fuel resources used in industrial process heat, bio-power generation and co-firing, bio-heat and district energy, biofuels and materials and renewable natural gas

The forest sector provides biomass feedstocks, carbon conversion expertise, and logistics and supply chain management.

Carbon Sequestration Potential

Biological carbon sequestration relies on sustainable production of forests (as well as crop production and natural, unmanaged landscapes).

Carbon sequestration can be enhanced by soil management, use of biochar, silviculture techniques that enhance growth of both root and trunk.

CCEMC has supported work to better understand adaptation needs and strategies as a changing climate will impact sequestration potential throughout the province.

Biogenic Carbon Potential

Use of biogenic carbon for energy, fuels and materials

- reduces net carbon emissions
- supports the forest industry

Forest resources must continue to be harvested sustainably.

Currently, about 2.7 M m3 of Alberta's Annual Allowable Cut (AAC), along with the residues associated with that volume remain unused and could provide heat and power for *in situ* oil sands operations or electrical power generation. (See 2016 Biomass Innovation paper on CCEMC.ca)

Reductions Across Multiple Timescales

Investment across multiple timescales (both near and long term) is required to be successful in addressing the climate change challenge.

- Nearer-term GHG reductions are typically achieved through large-scale or widespread deployment of commercially available technologies.
  - When supporting deployment of commercially available technologies to achieve near-term GHG reductions (“buying carbon”) it is more challenging to be seen as transparent and equitable.
- Longer-term GHG reductions require focused and sustained investment in breakthrough solutions.
  - Such technologies are substantially more risky but potentially high reward.

Reductions Across Multiple Timescales

In the longer term, investments to support

- District energy systems that use biomass to produce space heat and electricity, estimated to reduce emissions in AB by >4 Mt CO2eq
- Oil sands *in situ* operations to produce process heat from biomass, displacing natural gas for the recovery of bitumen, estimated to reduce emissions by > 11 Mt CO2eq

Such technologies are substantially more risky but potentially high reward.

CCEMC Investments to Date

- Slave Lake Pulp Biomethanation with West Fraser Timber
  - $5M to generate methane rich biogas from pulp sludge to power the pulp mill
  - > 320K tons CO2eq reductions by 2020

CCEMC Investments to Date

- Supporting innovation in energy efficiency with Weyerhauser at Grande Prairie
- $5M invested in a high efficiency evaporator system to enhance steam capture for electricity generation from the recovery boiler – 27 MW green power for the grid
- > 600 K tons CO2eq reductions by 2020

CCEMC Investments to Date

- Foothills Research Institute
  - $3M to examine trees species adaptation strategies to ensure the future health of Alberta forests
  - Goal was to support establishment of vibrant forests under anticipated climate change regimes so that carbon sequestration and forest biomass resources are maintained.

Challenges for securing project investment

- CCEMC has a rigorous review process with criteria that can be difficult to calculate for biological systems

- Match funding from industry can be difficult to obtain, especially at the scale required for new infrastructure
  - Internal rates of return can be slower and lower than needed by forest companies
  - Adoption of new technology incurs business risks

Stranded Grants are a Growing Concern

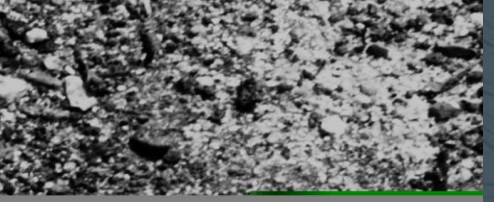
In the current economic environment, promising technologies and projects are struggling to find private funding to match public dollars.

- CCEMC has advanced promising technologies that are now at a scale where large investments are required ($50-$100+ million) to de-risk the technology and demonstrate commercial viability before venture capital funds or traditional financial institutions will invest.
- CCEMC has an opportunity to work with its partners in the system and to explore new investment tools to address these challenges (e.g. continuous intake, repayable grants, green loans, equity).

How can a whole solutions system approach to accelerate innovation?

A whole solutions approach is necessary to tackle the climate challenge.

- Requires not only technology innovation, but also financial, regulatory and business innovation.
- Alberta's innovation ecosystem needs to think like a single enterprise to identify and scale up the most promising solutions across the innovation spectrum (e.g. "Alberta, Inc.")
- Other funders in the global innovation system are bringing significant resources to the table – Alberta needs to do the same if we want a seat



Highlighting Alberta's Capacity in Measuring, Modeling and Verification

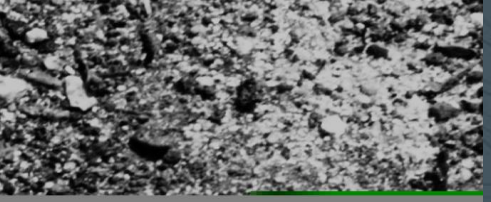
AB's Climate Leadership Report emphasizes the need to:

- Keep produced carbon out of the atmosphere
- Support more rapid scaling up and commercialization
- Enhance global competitiveness

Credible measuring, modeling and verification (MMV) is central to achieving these goals, and represents an existing strength within Alberta.

Offset technologies support domestic emission reductions and a mechanism to engage the world.

CCEMC Supports Emerging BioCleantech Opportunities



Questions?