NATURAL RESOURCES CANADA - INVENTIVE BY NATURE

Canada's Bioeconomy

BDC 2016 Fall Symposium
Economic Renewable Processes

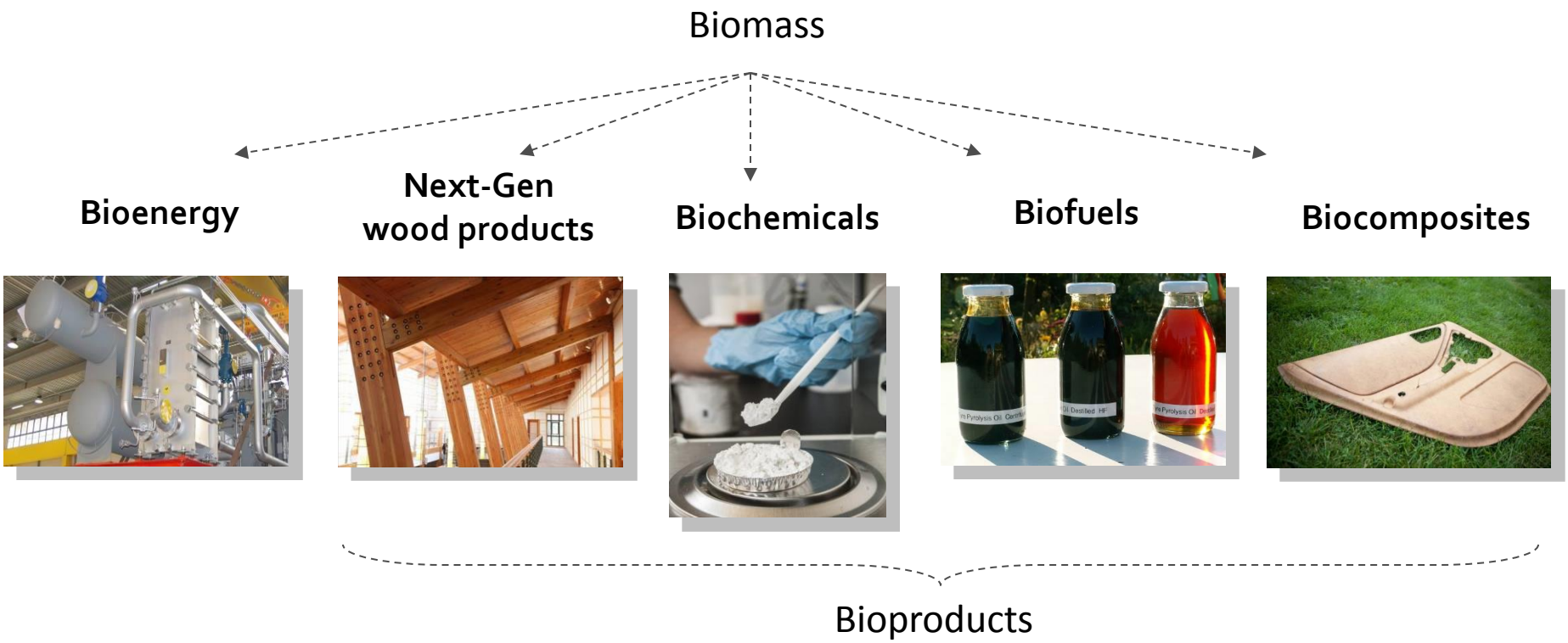
Outline

- Canadian context for the bioeconomy
- Current state of bioeconomy deployment in Canada
- Canada's bioeconomy future

What is the Canadian context for the bioeconomy?

How we see the bioeconomy?

- The **bioeconomy** is economic activity based on the production of next-generation products and energy from biomass



Synergies between the bioeconomy and the government agenda

1. Protecting the environment and growing the economy
2. Reducing carbon pollution
3. Making strategic investments in clean technology, providing more support for companies seeking to export those technologies, and leading by example in their use

MAKING REAL CHANGE HAPPEN

Speech from the Throne to Open the First Session of the Forty-second Parliament of Canada

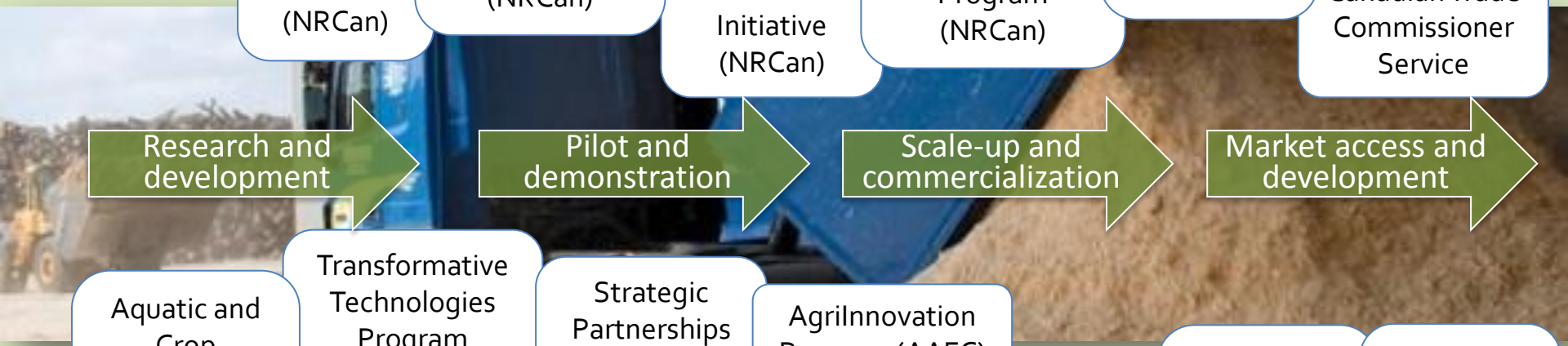
December 4, 2015

"Protecting the environment and growing the economy are not incompatible goals; in fact, our future success demands that we do both."

"Working together, the Government will continue to provide leadership as Canada works toward putting a price on carbon and reducing carbon pollution."

"To encourage economic growth, the Government will make strategic investments in clean technology, provide more support for companies seeking to export those technologies, and lead by example in their use."

Scope of Canadian Federal Government bioeconomy related activities



Research and development

Pilot and demonstration

Scale-up and commercialization

Market access and development

NSERC Strategic Partnerships Grants

Canadian Biomass Innovation Network (NRCan)

Program of Energy Research and Development (NRCan)

Sustainable Development Technology Canada

ecoENERGY Innovation Initiative (NRCan)

Investments in Forest Industry Transformation Program (NRCan)

Industrial Bioproducts Value Chain Roundtable (AAFC)

Expanding Market Opportunities Program (NRCan)

Canadian Trade Commissioner Service

Aquatic and Crop Resource Development Research (NRC)

Transformative Technologies Program (NRCan)

Algal Carbon Conversion Program (NRC)

Strategic Partnerships Initiative (AANDC)

Industrial Biomaterials (NRC)

Bio-based Specialty Chemicals (NRC)

AgriInnovation Program (AAFC)

Industrial Research Assistance Program (NRC)

Renewable Fuels Regulation (EC)

Canada-US Regulatory Cooperation Council (AAFC)

Exploring Renewable Fuels/ Lubricants (DND)

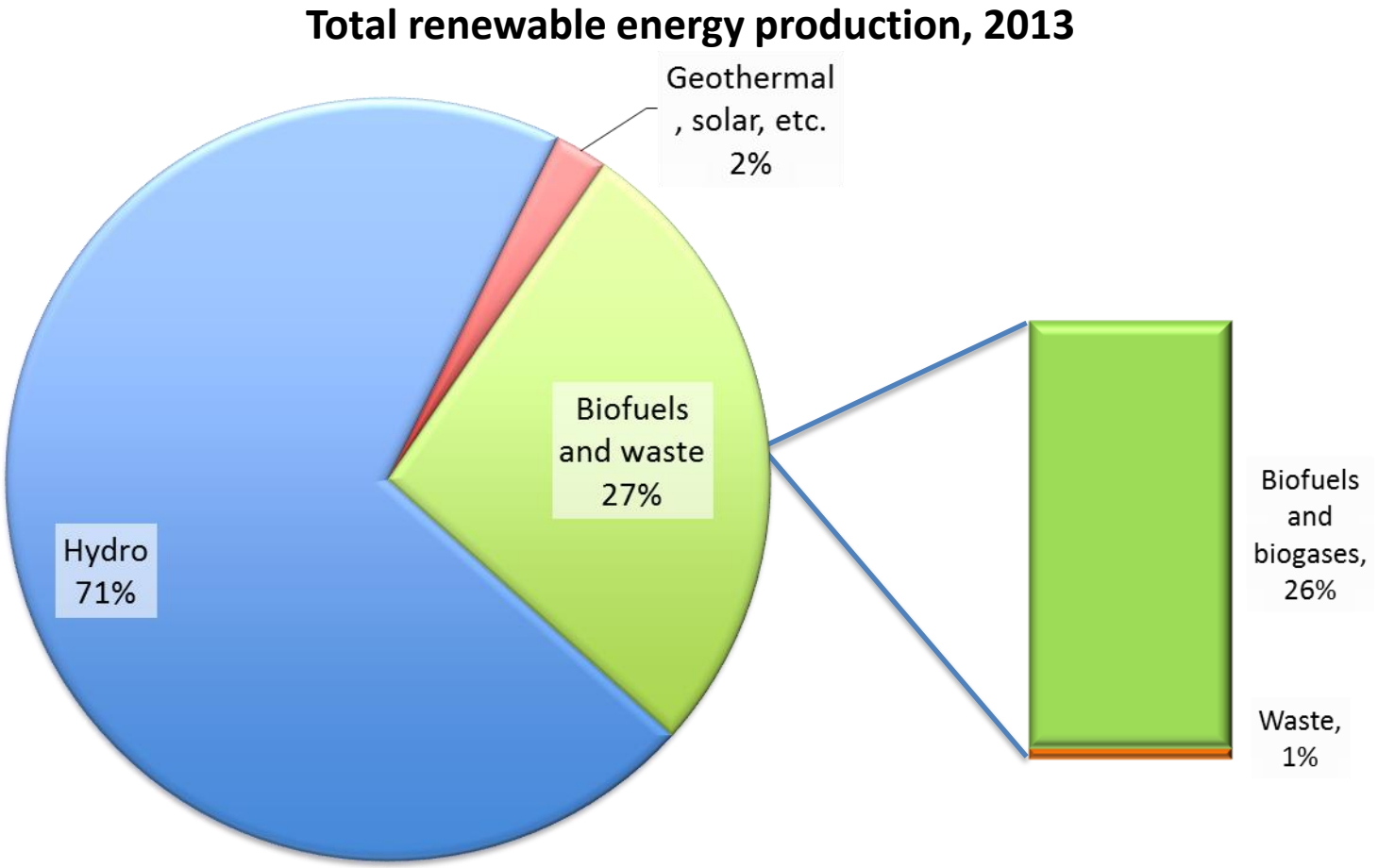
Procurement Program (PWGSC)

What is Canada's current capacity to implement the bioeconomy?

Canadian bioenergy sector has been demonstrating strong growth

- 150 community heat projects in 2014 using only biomass (from 5 projects in 2000)
- 39 pulp and paper mills operated cogeneration facilities in 2014
- 29 independent heat and power producers in 2014
- 77 Operating biogas installations in 2013 (from 43 operations in 2012)
- Wood pellet production has grown from 356,000 tonnes in 2000 to 2.6 M tonnes in 2014
- Renewable fuel consumption doubled from 2010-2014

Bioenergy is the 2nd largest source of renewable energy in Canada



Emerging production of bio-chemicals and materials

- Lignin
  - glues for plywood and wood panels, resins, thermoplastics and insulating foams.
- Hemicellulose
  - C5 raw sugars feedstock to produce biofuels and other chemicals
- Methanol
  - platform chemical
- Ethanol
  - biofuel
- Advanced Cellulosic BioMaterials
  - Biocomposites and Fibre Mats
  - Cellulose Nanocrystals (CNC)
  - Cellulose Filaments (CF)

Alberta-Pacific Forest Industries Inc. , Methanol purification project, Boyle, Alberta

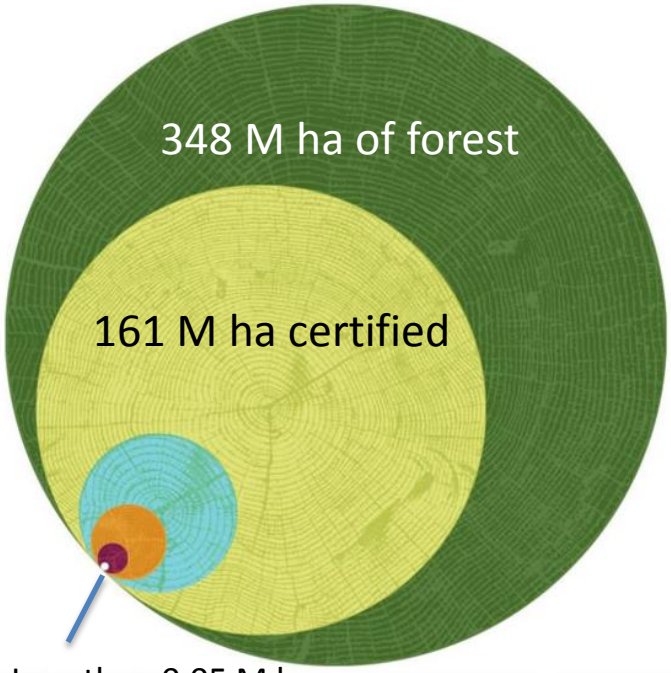
Tekle Technical Services, Drayton Valley, AB
Truck cabin made of wood residues

Car door panels made from fibre mats

Canada's Bioeconomy Future

Sustainability of supply

- Canada is home to 46% of the world's certified forests with the "most advanced regime of forest management and conservation in the world"
- Large amount of residues and wastes available for bioenergy without additional green tree harvesting
  - Harvest residues and unused wood 20 M t/yr
  - Salvage from natural disturbance 51 M t/yr
- Controlled removal of excessive crop residues can reduce tillage and improve soil quality
  - Crop residues 20 M t/yr (IEA)
- Biodigestion of manure and food wastes is a proven manure management strategy and generates clean electricity
  - Recoverable manure 58 M t/yr (IEA)



Source: State of Canada's Forests Report, 2015

Eco-credentials and GHG emissions reductions

Plants and trees absorb and lock-in CO2 from the atmosphere as they grow

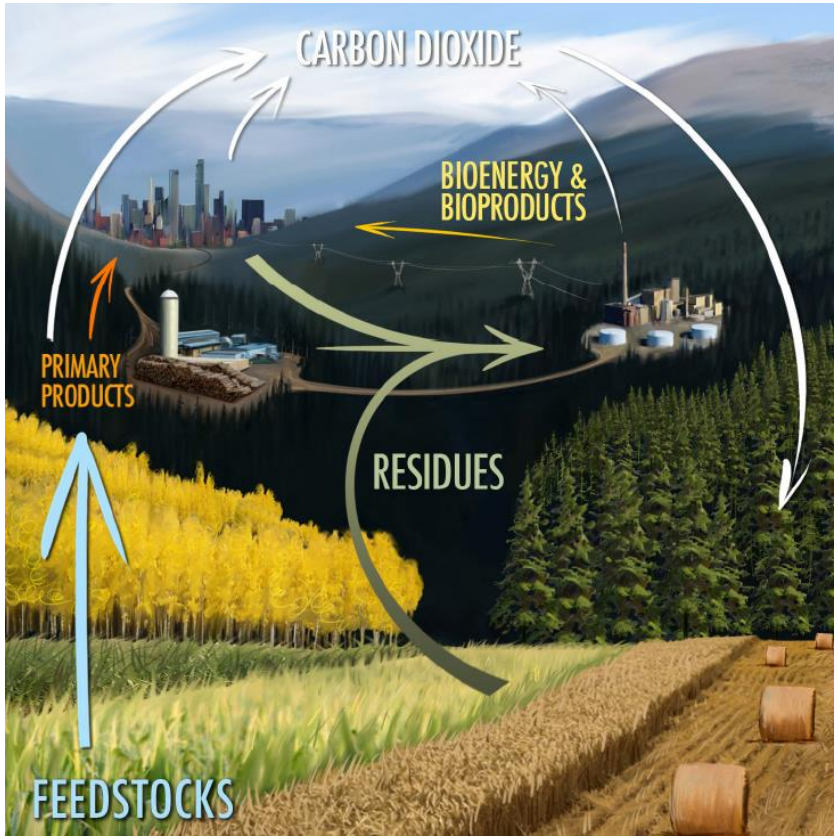
Long-lived products (eg furniture) store carbon

Bioenergy and bioproducts from residual biomass generate lower GHG emissions than fossil fuels and non-renewables on a life-cycle basis

The actual amount of mitigation depends on the baseline and the timing of the carbon uptake

Biomass, when used properly, is carbon beneficial.

Biomass feedstocks and the carbon cycle



BIOMASS INNOVATION: Canada's Leading Cleantech Opportunity for Greenhouse Gas Reduction and Economic Prosperity. 2016

Canada has many competitive advantages

Large supply of sustainably managed biomass resources

Well-integrated wood biomass product supply chain networks

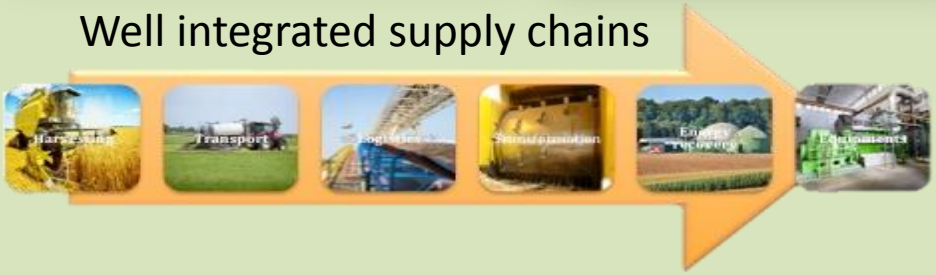
Emerging agri-based clusters and supply chains

Biomass science and technology leadership

Provincial engagement and buy-in

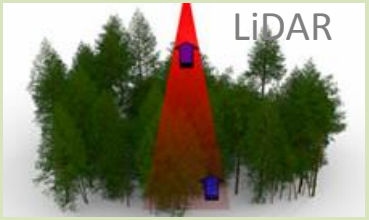
Large sustainable biomass supply

Well integrated supply chains



Biomass technology leadership

Gasification



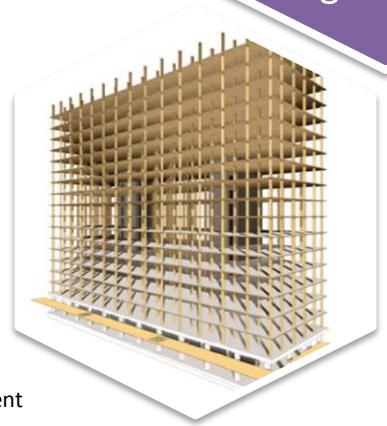
With many more bioproduct opportunities for the long term

Strong partnerships and multilateral interests

E.g. interdepartmental, and public-private working groups

E.g. new products and processes, new ways of doing business

Clean innovation well underway in forest and ag sectors



Synergies with many government initiatives

E.g. climate change mitigation, clean tech, greening federal infrastructure

However, challenges remain

- Lack of economic metrics
- Challenges progressing along the innovation chain
- Complex diverse biomass supply chains
- Changing business models
- Lack of clear regulatory and policy environment, standards
- Complex GHG accounting to measure bioproducts and bioenergy benefits

We can build from our strengths…

- Strong partnerships and multilateral interests
- Large sustainable supply of biomass
- Synergies with many government initiatives

Thank you!

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