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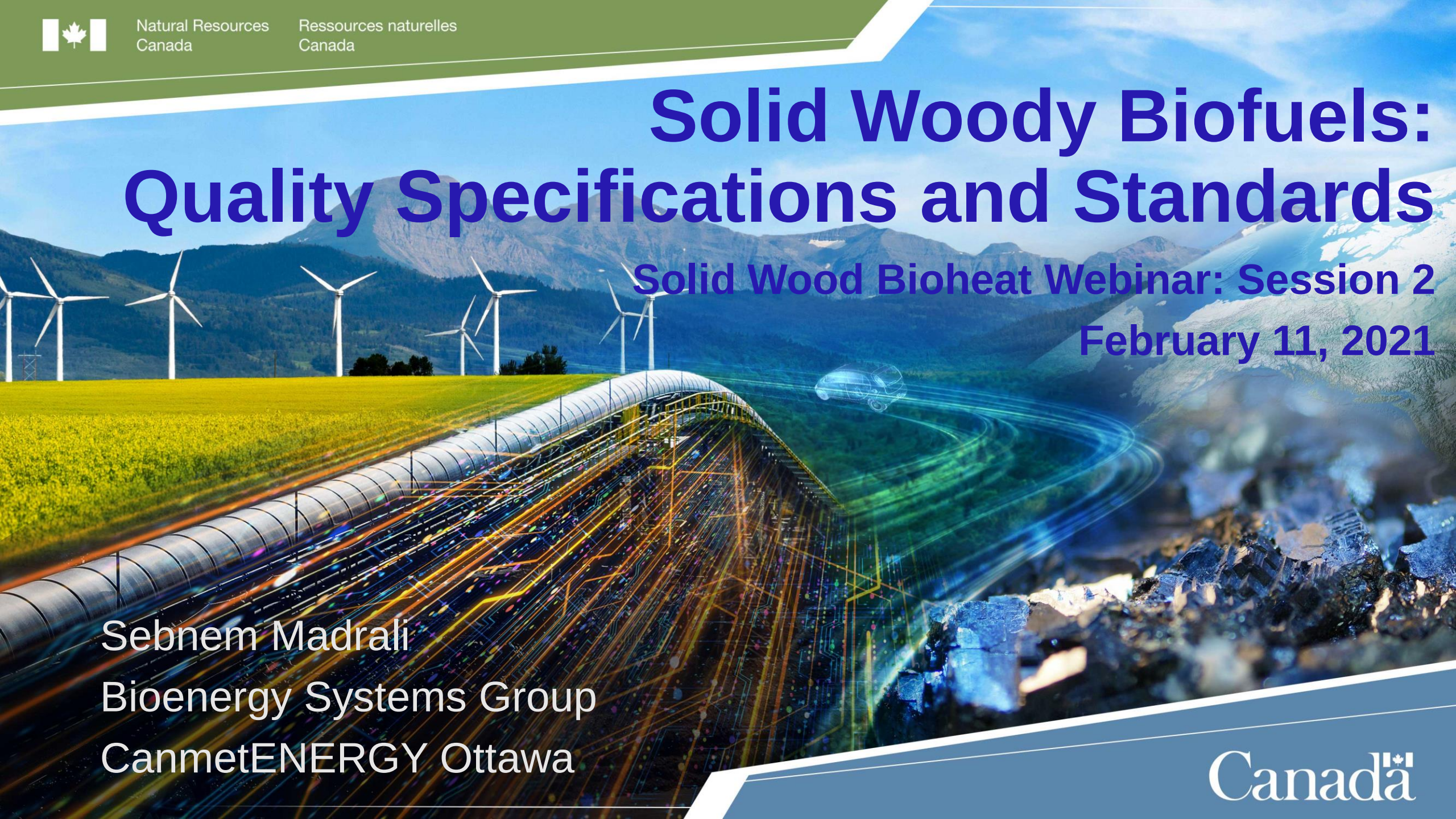
Solid Woody Biofuels: Quality Specifications and Standards

Solid Wood Bioheat Webinar: Session 2

February 11, 2021



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- Increased utilization of biomass allows Canadian industries to lower their carbon footprint while using secure, local, sustainable resources. Communities derive economic and employment benefits from increased use of local resources.
- CanmetENERGY-Ottawa (CE-O) advances national interests through innovation on conversion of biomass for heat, power and production of solid, liquid, and gaseous fuels.

Natural Resources, 2017

Fuel Quality MATTERS….

- Biomass materials are important source of renewable energy in Canada, however, not all the biomass is created equal.
- Smaller bioenergy systems, require tighter fuel specifications while industrial plants can utilize large variances in fuel quality and consistency.
- Controlling fuel quality are critical to project viability, safe and reliable operation and to the project bottom line.

Biomass vs Solid Biofuels

- Broad variety of biomass materials can be used for solid biofuels: forestry to agricultural to MSW
- Common sources of woody biomass -
  - forest residues: branches, tops of trees and other stem wood from harvested trees and unmerchantable trees
  - wood processing residues: bark, sawdust, shavings and off-cuts from processed wood such as panel board, construction timber and furniture
- Wood residue (Hog fuel / bark) / firewood / wood chips / wood briquettes/ wood pellets

Large Variance in Solid Biomass Fuel Characteristics

Biomass collection & processing

- harvesting practices, equipment, forest type, climate, soil type
- processing (such as comminution, drying), storage, handling & transportation

- **moisture content**
- **bulk density**
- **heating value**
- **size**
- **ash content**
- **fuel nitrogen**
- **chlorine content**

Boiler Operation

design, operation, and performance of
- storage & handling,
- feeding,
- combustion systems

Impact of Processing on Fuel Quality: Drying & Screening

courtesy of ACFOR

courtesy of Bothermic

Moisture Content

- CRUCIAL Property as it has direct effect on the fuel value
  - energy content -> boiler efficiency
  - on weight -> cost of heat production

- Large Variance
  - Freshly harvested (green) wood typically contains about 55-60% water
  - Seasonal variance
  - Due to growth site, tree species, age of tree, local climate

Impact of Moisture Content on Heat Production

Drier Wood Chips

12.5 GJ/t @ MC 30% (wet basis)

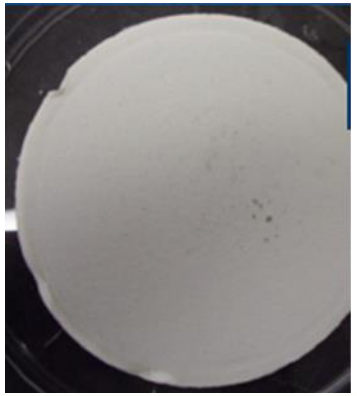
375 GJ

Green Wood Chips

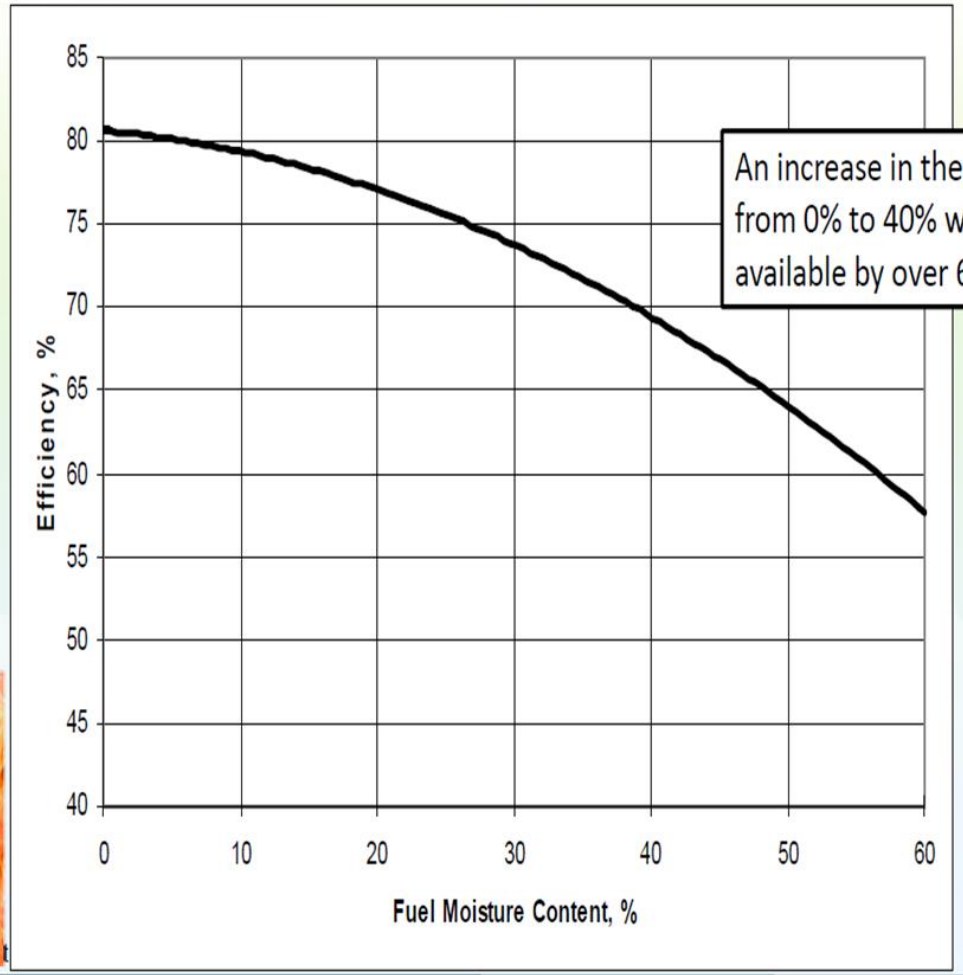
8 GJ/t @ MC 55% (wet basis)

240 GJ

Impact of Moisture Content on Boiler Performance



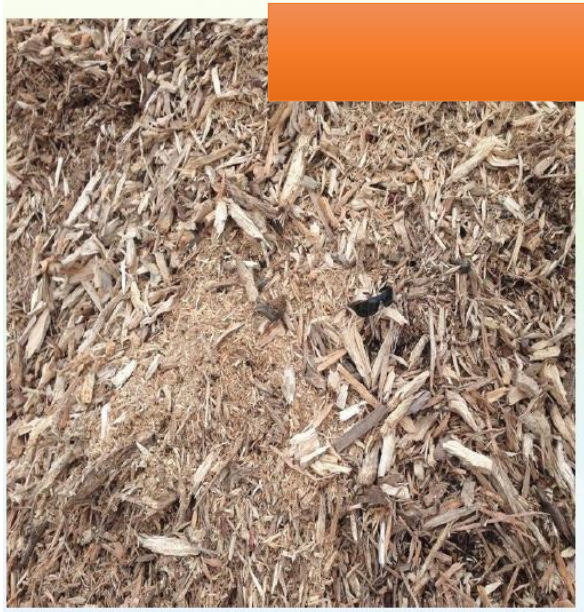
Impact of moisture content on particulate matter



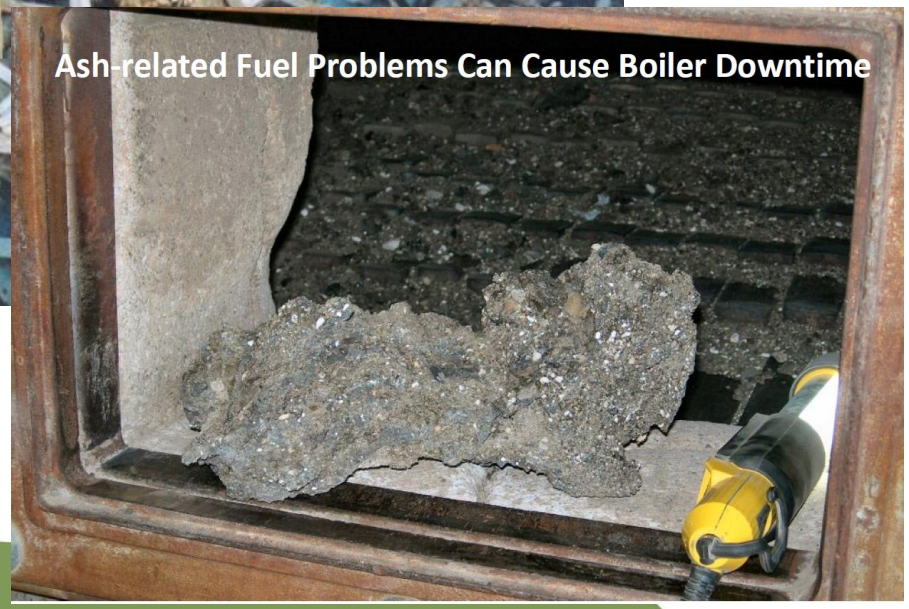
An increase in the moisture content of biomass from 0% to 40% will decrease the energy available by over 65%

Particle size

Hog fuels



Ash and Extraneous Materials



- Typical ash contents of wood fuels are low (0.5% and 2%)
- Materials, such as soil, gravel, rock, sand and metal, have no fuel value
- Excessive ash leads to:
  - lower energy content per tonne
  - reduced boiler output
  - higher ash volumes to be disposed of
  - more boiler and fuel feed wear and maintenance.
  - problematic for most in-feed systems

Safety & Health Considerations

Courtesy of Biothermica

Dust Generation (can lead to explosivity)

Off-gassing

Self heating (can lead to instantaneous combustion

Importance of Solid Wood Fuel Quality

- Controlling fuel quality are critical
  - to project viability
  - for safe and reliable operation
  - contributes directly to the bottom line.
- Wide variances in woody biomass fuel quality mean significant thought needs to be put into the feedstock handling system.
- smaller bioenergy systems, have tighter fuel specifications unlike industrial plants which can utilize large variances in size, moisture and ash content.

Standards for Solid Biofuels

Necessary for solid biofuels to become a commodity fuel that users can buy with the expectation of trouble free operation:

- Facilitate free and fair cross-border trade
- Facilitate quality assessment of solid biomass resources
- Facilitate efficient permitting of bioenergy systems (fuel specifications and certified combustion systems)
- Minimize emission of pollutants
- Ensure safe handling and storage of solid biofuels

Principles of CAN/CSA-ISO 17225 Solid Biofuels

All biomass raw materials

- Woody / Herbaceous / Fruit / Blends

Major traded forms

- Chips / Pellets/ Briquettes / Bales / Firewood / Bark

Hierarchical and flexible classification

- Origins and sources
- Traded forms
- Properties

Establishes Grading System

- Grades A and B: Residential / Commercial / Institutional
- Grade I: Industrial

Firewood

Wood Chips

Briquettes

Wood Pellets

Classification of Origin and Sources of Woody Biomass

Forest, Plantation and other Virgin Wood (1.1)

- 1.1.1 Whole trees without roots
- 1.1.3 Stemwood
- 1.1.4 Logging residue
- 1.1.6 Bark
- 1.1.7 Segregated wood from gardens, parks, roadside maintenance

By-products and residues from wood processing industry (1.2)

- 1.2.1 Chemically untreated wood by-products and residues
- 1.2.2 Chemically treated wood by-products, residues, fibres and wood constituents

Used Wood (1.3)

- 1.3.1 Chemically untreated used wood
- 1.3.2 Chemically treated used wood

Blends and Mixtures (1.4)

Specification for Graded Wood Pellets (Final Draft of 17225-2:2021)

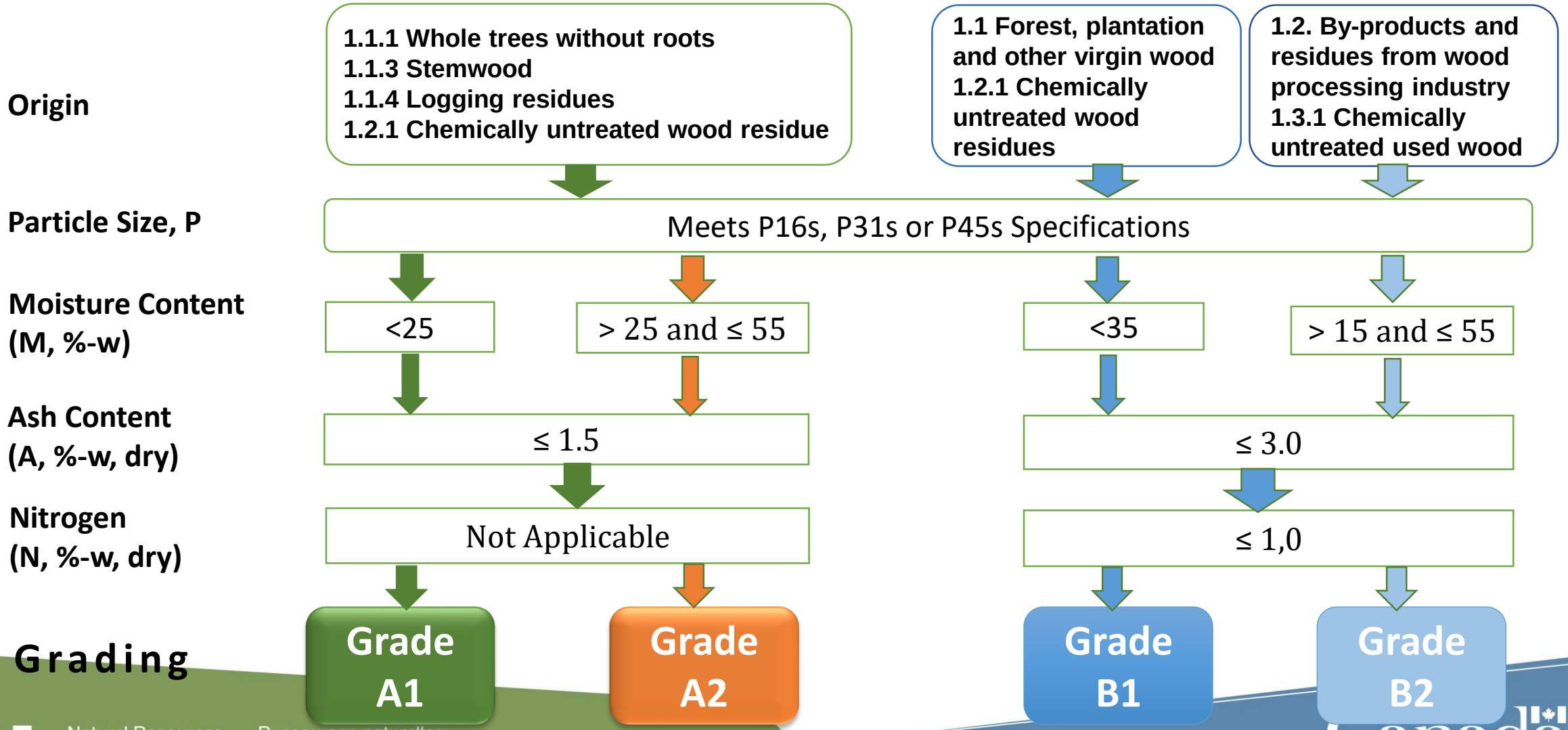
Key Normative Properties Only - Commercial and Residential Applications

		Grade A1	Grade A2	Grade B
Origin & Sources		1.1.3 Stemwood 1.2.1 Chemically untreated wood by-products and residues	1.1.1 Whole trees without roots 1.1.3 Stemwood 1.1.4 Logging residue 1.2.1 Chemically untreated wood by-products and residues	1.3.1 Chemically untreated used wood 1.3.2 Chemically treated used wood
Moisture, M	% in mass, wb, ar	**M10 ≤ 10**		
Ash, A	% in mass, dry	**A0.7 ≤ 0.7**	**A1.2 ≤ 1.2**	**A2.0 ≤ 2.0**
Mechanical durability, DU	% in mass, ar	**DU98.0 ≥ 98.0 for D06** **DU97.5 ≥ 97.5 for D08**	**DU97.5 ≥ 97.5**	**DU96.5 ≥ 96.5**
Fines, F	% in mass, ar	**F1.0 ≤ 1.0**		
Net calorific value, Q	MJ/kg, ar	**Q ≥ 16.5**		
Bulk density, BD	kg/m^3 , ar	**600 ≤ BD ≤ 750**		

ar: as received; wb: wet basis

Specification for Graded Wood Chips (Final Draft of 17225-4:2021)

Key Normative Properties Only

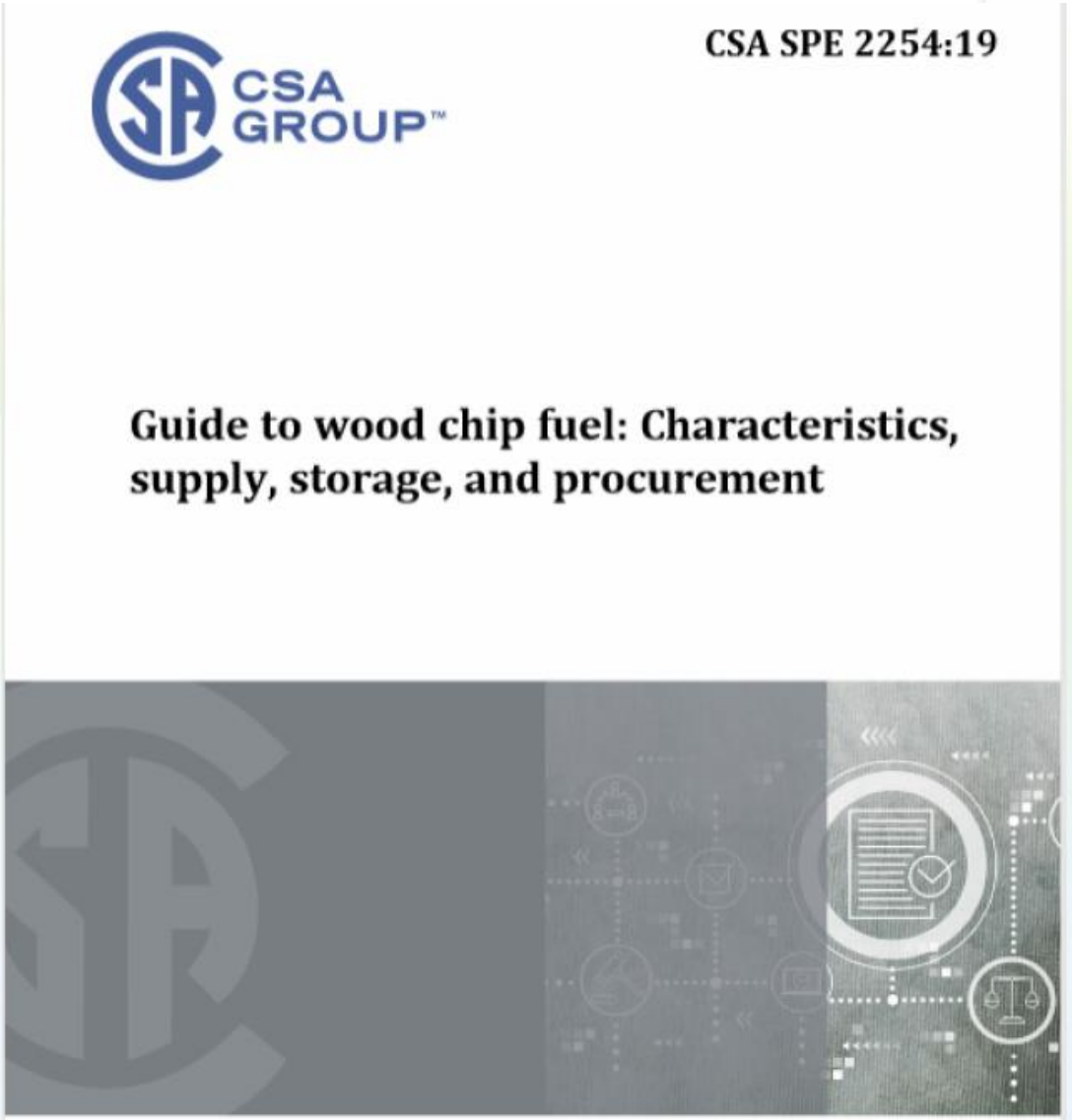


Quality requirements of solid fuels for different applications and technologies

Application	Solid Biofuel	Quality requirements	Technology
Residential (< 150 kW)	Firewood Wood briquettes	Moisture ≤25 %-w for firewood Ash ≤1.0 for Wood briquettes	Stove, fireplace, log furnace, log boiler
	Wood pellets	DU ≥ 97.5w-% Ash ≤ 1 w-%	Pellet stoves, boiler, furnace
Public / Commercial / institutional buildings, small greenhouses (50 kW to <1 MW)	Wood chips	M ≤ 35%-w for combustion technologies M ≤ 15%-w for CHP Homogenous particle size (30 – 45 mm)	Stoker fired boilers Grate combustion Small CHP (gasification + IC engine based) Pellet boilers
	Wood pellets	DU ≥ 97.5 w-% Ash ≤ 1 w-%	
District Heating (< 3 MW)	Wood chips	M ≤ 45%-w for grate combustion Ash < 1%-w Particle Size 10 – 100 mm	Grate combustion CHP (combustion + ORC)

CSA SPE 2254 : 2019 – Guide to Wood Chip Fuel

- First edition of a homegrown guidance document presenting wood chip fuel as a consistent and reliable renewable low carbon fuel source in Canada.
- Intended audiences include:
  - *producers and suppliers of wood chips* including aggregators, sawmills, loggers, urban tree services, woodland management services, value added wood processors such as furniture and cabinet makers, and flooring manufacturers;
  - *project developers*, including equipment manufacturers, engineering professionals, architects, planning and procurement officers; and
  - *end-users* including facilities managers, maintenance staff and those responsible for the purchase of fuel and operation of biomass systems



https://www.techstreet.com/standards/csa-spe-2254-19?product_id=2045319

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Solid Biofuels Bulletin No. 4

GRADED
WOOD PELLETS

Solid Biofuels Bulletin No. 5

GRADED **WOOD BRIQUETTES**

Solid Biofuels Bulletin No. 6

GRADED
WOOD CHIPS

Solid Biofuels Bulletin No. 7

GRADED
FIREWOOD

ENGLISH bulletins:
http://www.nrcan.gc.ca/energy/renewable-electricity/bioenergy-systems/biofuels/7399

FRENCH bulletins:
http://www.rncan.gc.ca/energie/renouvelable-electricite/systemes-bioenergie/biocombustibles/7400

Concluding Remarks

- Markets for solid biofuels are fast growing and offer significant opportunities as low carbon fuel option in production of renewable energy, space heating, process heat, combined heat and power
- Biomass fuel standards act as a tool creating common terminologies between producers and users.
- Implementation of fuel quality specifications and classification (grading) is critical for the credibility and long term success of bioenergy.

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Key Collaborators / Partners

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ISO

Thank you

For further information please contact

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List of CSA/ISO Solid Biofuel Standards

Standard Number	Title
CSA/ISO 16559	Terminology, definitions and descriptions
CSA/ISO 17225 – 1	Fuel Specifications and Classes Part 1 General Requirements
CSA/ISO 17225 – 2	Fuel Specifications and Classes Part 2 Graded Wood Pellets
CSA/ISO 17225 – 3	Fuel Specifications and Classes Part 3 Graded Wood Briquettes
CSA/ISO 17225 – 4	Fuel Specifications and Classes Part 4 Graded Wood Chips
CSA/ISO 17225 – 5	Fuel Specifications and Classes Part 5 Graded Firewood
CSA/ISO 17225 – 6	Fuel Specifications and Classes Part 6 Graded Non-Woody Pellets
CSA/ISO 17225 – 7	Fuel Specifications and Classes Part 7 Graded Non-Woody Briquettes
ISO TS 17225 – 8	Fuel Specifications and Classes Part 8 Thermally Treated Solid Biofuels
CSA/ISO FDIS 17225 – 9	Fuel Specifications and Classes Part 9 Graded Hog Fuel

TS: Technical Specification
FDIS: Final Draft International Standard

List of Selected CSA/ISO Standards for Physical, Chemical, Mechanical and Safety Test Methods for Solid Biofuels

Standard Number	Title
ISO 14780	Sample preparation
ISO 18135	Sampling
ISO 21945	Simplified sampling method for small scale applications
ISO 17827-1	Determination of particle size distribution for uncompressed fuels — Part 1: Horizontally oscillating screen
ISO 17831-1	Mechanical Durability for Pellets
ISO 17828	Determination of bulk density
ISO 19743	Determination of content of heavy extraneous materials larger than 3,15 mm
ISO 18846	Determination of fines content in quantities of pellets
ISO 18134-1	Determination of moisture content — Oven dry method — Part 1— Reference method
ISO 18134-2	Determination of moisture content — Oven dry method — Part 2 - Simplified method
ISO 18125	Determination of calorific value
ISO 20023:2018	Safe handling and storage of wood pellets in residential and other small-scale applications
ISO 20024	Safe handling and storage of solid biofuel pellets in commercial and industrial applications