Woodchip Heating Fuel Quality Standard for the US

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BERC
Biomass Energy
Resource Center

Biomass Energy Resource Center (BERC)

Advancing Modern Wood Heating & CHP in North America

Technical Consulting

- Project feasibility studies
- Fuel supply assessments and procurement
- Third-party expert review
- Develop and review of standards
- Market Assessments

Program Design & Implementation

- Expansion potential assessments
- Program management
- Training, and advisory support services

Advocacy

- Showcasing “best practices” and case studies of successful projects
- Tracking market growth and impacts

BERC is a program of the Vermont Energy Investment Corporation
A mission-driven non-for-profit whose mission is to reduce the economic and environmental impacts of energy production and consumption

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Project Partners

Context

- Medium to large-scale commercial woodchip heating/CHP represents significant growth opportunity in various regions of the US

- For woodchip heating/CHP to become mainstream energy choice, it must be clean and efficient, with high reliability and consistent, predictable performance

Why is a standard needed?

- **No widely adopted, fully recognized woodchip fuel standard in market today**

- **Every other major heating fuel, except wood chips**, subject to unambiguous fuel standards certified by recognized agency
  - Heating oil
  - Propane
  - Natural gas
  - Pellets (PFI, ENPlus, ISO)

- **Failure to act could lead to regulators** (e.g. EPA) taking matters into their own hands

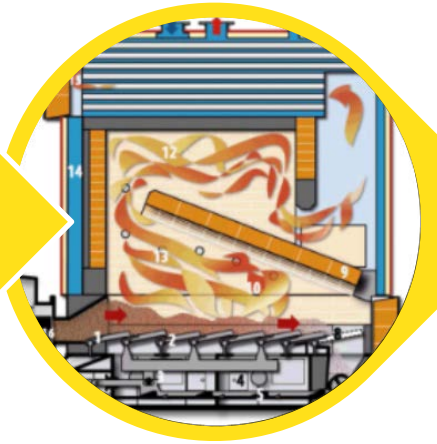
No Standard Terminology for Woodchips as Heating Fuel!

- “Hog fuel”
- “Dirty chips”
- “Clean chips”
- “Grindings”
- “Whole tree chips”
- “Paper chips”
- “Screened chips”
- “Bole chips”
- “Microchips”
- “Semi-dry chips”
- “Precision dry chips”
- “Refined dry chips”

Elements of Success

Know-how to produce given grades of fuel

Fuel that consistently meets the specs.



State of the art combustion technology engineered to burn specific fuel

Optimal system performance (low emissions, high efficiency, & minimal O&M)

Market and Regulatory Confidence and Trust

Benefits of Fuel Quality Standards

1. Appropriate fuel for the combustion equipment
2. The consumer knows what they are getting
3. The producer knows what woodchip grade their local market demands, and how to produce, store and distribute that specific woodchip grade
4. Trouble-shooting of operational failures of the combustion system is simplified
5. There is an increased confidence in the equipment and its performance, the fuel and its performance, which ultimately builds the market for woodchip fuel

Stakeholder Categories

- USDA Forest Service
- Boiler manufacturers
- Chipping and grinding equipment manufacturers
- Forestry officials (state and local)
- Consultants
- University
- NGOs
- Air quality regulators
- Boiler safety experts
- Mechanical/ agricultural engineers

Parameter	ISO 17225-4	EN 14961	ONORM M7 133
Origin	A1/A2/B1/B2	1.1/1.2/1.3/1.4	
Particle Size (mm)	P16S/P31S/P45S	P16A/P16B/P45A/P45B/P63/P100	G30/G50/G100/G120/G150
Moisture Content	M10/M25/M35 (for B1)	M10/M15/M20/M25/M30/M40/M45/M55/M55+	W20/W30/W35/W40/W50
Ash Content	A1.0 (for A1)/A1.5 (for A2)/A3.0 (for B)	A0.5/A0.7/A1.0/A1.5/A2.0/A3.0/A5.0/A7.0/A10.0/A10.0+	A1/A2
Bulk density	BD150/BD200/BD250/BD300 (for A2)	BD150/BD200/BD250/BD300/BD350/BD400/BD450/BD450+ (if traded by volume)	S160/S200/S250
Nitrogen	N1.0 (for grade B)	N0.3/N0.5/N1.0/N2.0/N3.0/N3.0+ (for 1.2.2, 1.3.2)	
Chlorine	Cl0.05 (for grade B only)	Cl0.02/Cl0.03/Cl0.07/Cl0.10/Cl0.10+ (for 1.2.2, 1.3.2)	
Sulfur	S0.1 (for grade B only)		
Arsenic	<=1 (for grade B only)		
Cadmim	<=23.0 (for grade B only)		
Chromium	<=10 (for grade B only)		
Copper	<=10 (for grade B only)		
Lead	<=10 (for grade B only)		
Mercury	<=0.1 (for grade B only)		
Nickel	<=10 (for grade B only)		
Zinc	<=100 (for grade B only)		
Net energy content	MJ/kg or kWh/ m^3 l	(LHV)) as MJ/kg or kWh/m^3 l	

Standard Development Process and Timeline

October 2016
- Development of www.woodchipstandard.org
- Outreach to stakeholders and formation of steering committee
- Kick-off steering committee

December 2016
- Technical review of ISO, EN, ONORM and other woodchip fuel quality standards
- ID of three options for US standard (create new, adopt ISO, or modify ISO)

May 2017
- ASABE Announces first draft of the standard for public comment

July 2017
- Draft is approved with substantial comments and need for revisions

November 2017
- Second draft is approved

Standard Under Development

- Modifying ISO 17225 – 4 standard
- Will become the US standard under the American National Standards Institute (ANSI)
- ASABE X17225-4 Solid biofuels – Fuel specifications and classes – Part 4: Graded wood chips

Qualitative Parameters

- Source of wood fuel
- Particle Size
- Moisture content
- Ash content
- Bulk density
- Elemental composition

Wood Fuel Sources

- Forests, plantations, and other virgin wood including the following:
  - Whole trees without roots
  - Stemwood
  - Logging residues (tops and limbs)

- By-products and residues from wood processing industry, including the following:
  - Chemically untreated wood residues

Deviation to ISO standard = Source does not automatically dictate the overall grade of chips.

Particle Size

Main fraction a (minimum 60 w-%),		Fines fraction	Coarse fraction	Max. length of particles b, mm	Max. cross sectional area of the coarse fraction
P9.5S	1/8 in < P ≤ 3/8 in	≤ 15 %	≤ 6 % >3/4 in	≤1-1/4 in	≤ 0.2 in2
P16S	1/8 in < P ≤ 5/8 in	≤ 15 %	≤ 6 % >1-1/4 in	≤ 1-3/4 in	≤ 0.3 in2
P25S	1/8 in < P ≤ 1.0 in	≤ 15 %	≤ 6 % > 1-1/4 in	≤ 1-3/4 in	≤ 0.3 in2
P38S	1/8 in < P ≤ 1.5 in	≤ 10 %	≤ 6 % > 1-3/4 in	≤ 6.0 in	≤ 0.6 in2
P50S	1/8 in < P ≤ 2.0 in	≤ 10 %	≤ 10 % > 2-1/2 in	≤ 8.0 in	≤ 1.0 in2

Deviation from ISO standard = minor adjustments to ranges and use of US imperial units.

Particle size designation does not impact overall chip grade.

Moisture Content

A1	A2	B1	B2
M13 ≤ 13 M25 ≤ 25 M30 ≤ 30 M35 ≤ 35 M35 + M50 ≤ 50		M13 ≤ 13 M25 ≤ 25 M30 ≤ 30 M35 ≤ 35 M35 +	

Deviation from ISO standard = minor adjustments to ranges
+ increased allowance for MC in A1 and A2 grades

Ash Content

A1	A2	B1	B2
≤ 1.0%	≤ 1.5%	≤ 3.0%	

No deviation from ISO standard

Bulk Density

Moisture content on wet basis		8% to 18%	18% to 25%	25% to 35%	35% to 45%
Bulk density for conifer species	Pounds per cubic yard (loose volume)	461 to 519	519 to 576	576 to 648	648 to 778
	Property class	BD150	BD150	BD200	BD200
Bulk density for deciduous species	Pounds per cubic yard (loose volume)	648 to 720	720 to 807	807 to 922	922 to 1095
	Property class	BD200	BD250	BD250	BD300

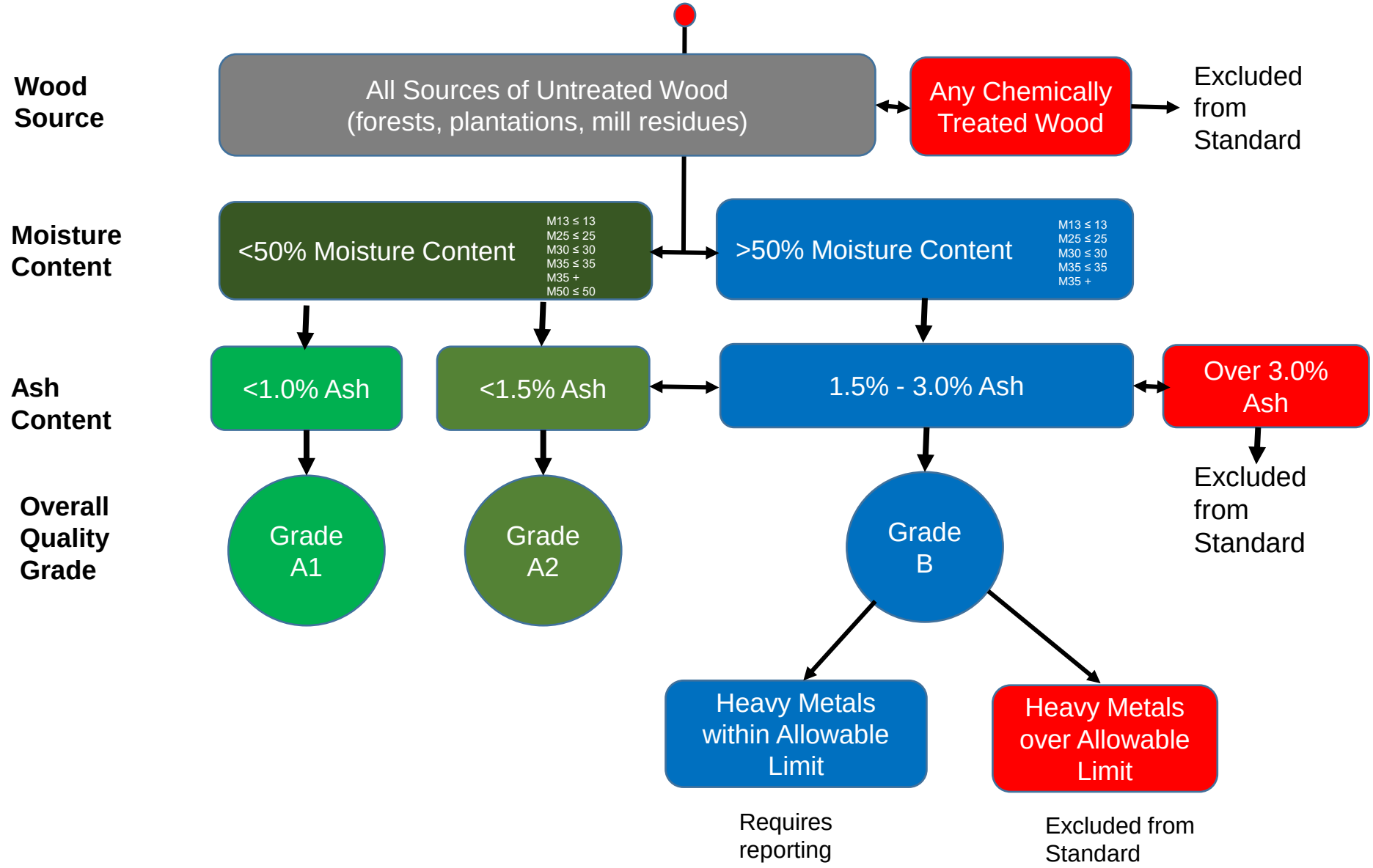
No deviation from ISO standard. Informative only.

Elemental Composition

	Measure	Threshold
Nitrogen	% dry	≤ 1.0
Sulfur	% dry	≤ 0.1
Chlorine	% dry	≤ 0.05
Arsenic	mg/kg dry	≤ 1
Cadmium	mg/kg dry	≤ 2.0
Chromium	mg/kg dry	≤ 10
Copper	mg/kg dry	≤ 10
Lead	mg/kg dry	≤ 10
Mercury	mg/kg dry	≤ 0.1
Nickel	mg/kg dry	≤ 10
Zinc	mg/kg dry	≤ 100

No variation from ISO standard.

Woodchip Heating Fuel Quality Classification Diagram



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Next Steps

- General input – public comment period open until December 5th 2017.
- Developing a “user guide” document
- Technical standard will be available for download at www.ASABE.org
- User guide and further information will be available at: www.woodchipstandard.org

  www.biomasscenter.org

  www.biomassthermal.org

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Contact Information

Extra Slides

Special Topics & Issues

- Singular gradation standard incorporating multiple quality parameters?
- Recommended matching grades of fuels with boiler sizes and combustion technology?
- Recommended matching of grades of fuels with source material, equipment & handling best practices?
- Matching of the resulting US woodchip standard to the international standards?
- US Imperial system of measure versus International metric system?

Woodchip Fuel Production

Logging Operations

Whole-tree Chips

Sawmills

Paper-grade Chips

Wood Recycling

Urban Wood

Chip Yards

Bole Chips

Pros and Cons of Different Approaches

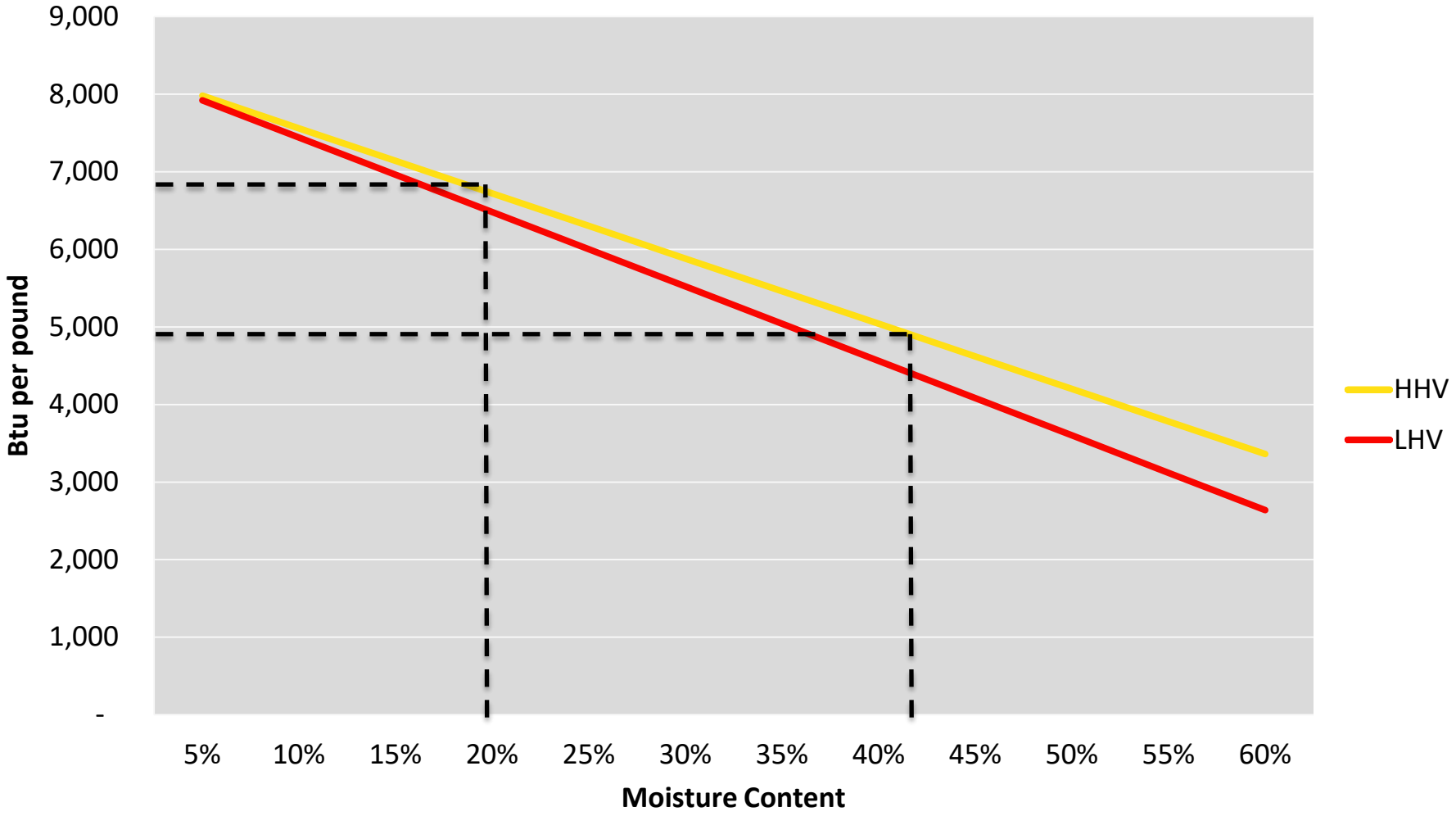
	Using an Existing Standard	Modifying an Existing Standard	Creating a New Standard
Facilitated Trade with other Countries (primarily Canada)	Yes, if ISO standard	Yes, if closely resembles ISO standard	No
Allows for Relatively Easy Adjustments of Standard, Prior to or Post Implementation of Standard	No, would require engagement in the ISO process and engagement of ISO stakeholders	Yes, through ASABE	Yes, through ASABE
Present Absolute Values, Independently Verifiable by Labs and/or Producers	Yes, using existing, standardized measurement protocol	Detailed measurement protocol may need to be determined and published for each criteria modified	Detailed measurement and verification protocol will need to be determined and published for each criteria (equipment to use for measurement, procedures, level of precision, etc.)
Require Producers to Purchase Additional Equipment to Grade their Product	Yes, sieves	Yes, sieves	Likely, sieves. Possibly others
Require Producers to do additional Work to Grade their Product	Yes: sieve, oven dry	Yes: sieve, oven dry	Likely: sieve, oven dry. Possibly others.
Supply Chain and Quality Assurance Protocol Established	Yes	Yes, may need to be modified	Will need to be defined
Legal Obligation to Meet the Standards	Not until the market matures enough	Not until the market matures enough	Not until the market matures enough
Facilitates Woodchip Boiler Manufacturers' Specification of the Proper Fuel	Yes, if ISO, for all European or Canadian	Yes, if closely resembles ISO standard, for all European or Canadian	No, manufacturers will have to understand the new standard for the US market and provide specifications tailored to the US market in addition to the EU and Canadian market
Vulnerability to Void Manufacturer Warranty or Legal Action if Chips do not Meet Grade Advertised	Potentially	Potentially	Potentially
Requirements to Have the Fuel Tested on a Set Schedule or by a Third Party	No	Can be required	Can be required
Offers a Simple, Easy to Understand Standard that Greatly Simplifies the Evaluation and Purchase of a Highly Variable Wood Fuel	Limited	Limited	Potentially
Offers a Detailed, Comprehensive Standard that Classifies Woodchips into a Matrix Covering a Range of Characteristics	Yes	Yes	Potentially

Woodchip Quality Parameters

	Paper-grade	Screened Bole	Standard Bole	Whole-tree
Typical chip dimensions	1.5” x 1.5” x 0.25”	2”x 2” x 0.25”	2”x 2” x 0.25”	2” x 2” x 0.25”
Typical percent over sized	2%	5%	7%	10%
Typical percent fines	2%	3%	5%	8%
Typical moisture content	40%	42%	43%	44%
Typical ash content	0.5%	1.0%	1.5%	2.0%
Typical energy value (Btu/lb)	4,785	4,785	4,785	4,785

Source: http://www.biomasscenter.org/images/stories/Woodchip_Heating_Fuel_Specs_electronic.pdf

Moisture Content Impact on Energy Value



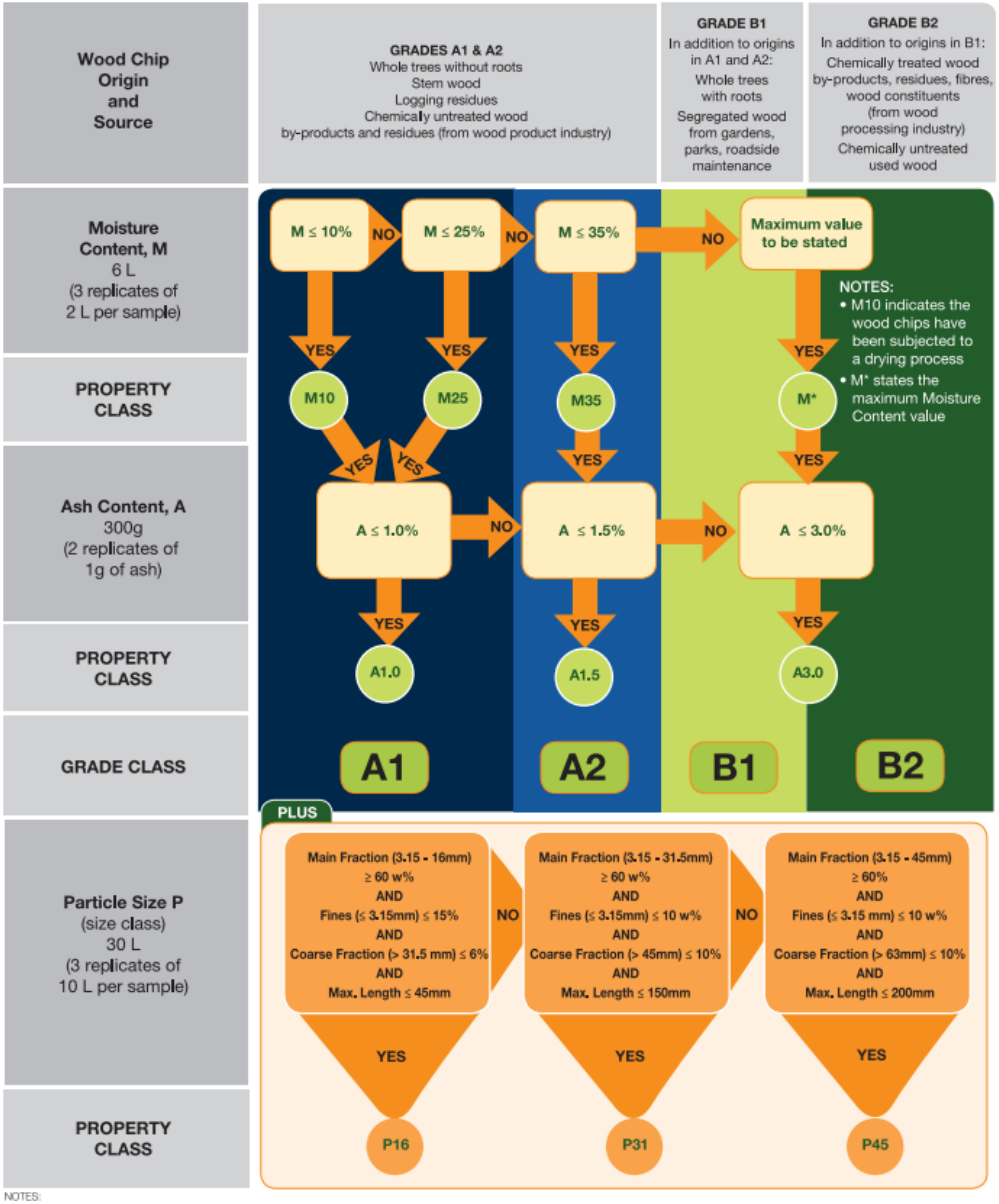
Initiative Boundaries

- Primary focus on woodchips used for heating and CHP, including:
  - Green chips
  - Dry chips
  - Clean wood from residue and harvested wood
  - Bole and tops
- Not covering pellets (or chips as feedstock), briquettes, bio-char, torrified or other thermally treated wood, etc.
- No ag residues, etc.

Committed Stakeholders

Name	Category
AFS	Woodchip system vendor
Better World Energy	Woodchip system vendor
Caluwe	Woodchip system vendor
Bioenergy Project partners LLC	Woodchip system vendor
Tarm Biomass	Woodchip system vendor
Viessmann	Woodchip system vendor
Vermeer	Chipping equipment manufacturer
Forest Concepts LLC	Chipping equipment manufacturer
Alliance for Green Heat	NGO
NY Biomass Energy Alliance	NGO
Wisewood Inc.	NGO
Wisconsin - DES	State government agency
New Hampshire - DES	State government agency
Oregon - DOF	State government agency
Resource Systems Group	Consultants
West Virginia University	University
Biomass Energy Lab	Consultants

Woodchip standards are easy as….



Factors for Success

- Helpful to be consistent with international standards
- But needs to be simple and easy to understand and use
- Address regional variations in grades and sources of chips
- Must be widely distributed and freely available

Existing Standards Reviewed

- EN 3505 & 14961
- ISO 17225-4
- ONORM M7133
- Can/CSA (ISO)
- Regionally adopted specs
- Default boiler vendor specs

Example of European Market

- Early establishment of strict fuel quality standards
- Initial issues resolved
- Gradual yet broad market adoption of this technology and public support for woodchip heating over the last 20 years

Contributing Factors

- Increased regulation
  - Boiler MACT
  - New Source Performance Standards
  - New particulate non-attainment thresholds
- Greater awareness of particulate issues from wood fuels, especially among state regulators
- Fossil heating fuels against which wood competes are getting cleaner (e.g. ULS #2 heating oil, Bioheat blends)
- Public expectation that wood fuels must be as clean as possible (backlash from OWBs)
- Public health officials increasingly taking dim view of wood
- Sophisticated consumers of fuel insisting on verifiable standard