DOCUMENTATION TO SUPPORT

BIOMASS – WOOD CHIP PROPOSALS

T.S. Laurent Forest Preservation LLC

Proposal dated: January 2020

PROPOSED SUPPLY & SOURCING FOR
PROCUREMENT OF BIOMASS WOODCHIPS or HOG FUEL

We can be reached at:
56 Stephenson Lane – Belfast, ME 04915
http://www.arthurhouse.com/ and art@arthurhouse.com
+1-207-930-5168

Introduction:

This document provides overview and details on how combined heat and power "CHP" operators can take advantage of multiple significant benefits related to the consumption of Phytosanitized biomass wood chips from Maine, USA. Heat treated sanitation of exportable wood chips is the internationally recognized alternative to banned chemical-based fumigation.

Wood chips are heated, with steam (non-fossil fuel) to a minimum 56° Celsius for a period of 30 minutes to achieve the mandated requirements of the EU. The steam used for heating is an off-gas or byproduct, generated by an existing 30-year operating electric power plant. The fuel used by the plant is RDF and the steam is captured and redirected to the wood chip heating system. Electric required for the operation is also generated inside the plant, which eliminates transmission costs.

The Phytosanitation System foot print is inside an existing plant facility where significant space was created during the RDF plant retrofitting which is complete. This facility provided for significantly reduced CAPEX, low cost electricity, low cost steam and existing infrastructure. The strategic dynamic of this facility is that the more RDF it burns, the more steam it generates, and the more wood chips it can process. This option alone provides for a streamlined vessel operation where dedicated vessels can arrange for consistent, long-term backhauls to and from the same ports of call. Wood chips one way and RDF backhaul.

Inland transportation is by rail and truck, with rail slated to be about 70% of the movement of product. Approximately 2 million US tons of fiber and hog fuel can be obtained within a 50 mile radius of the plant so there is a local trucking process that would account for about 30% of fiber procurement. As an indication of fiber supply, we have relationships with the largest landowners in the region, including J. D. Irving of Canada and Maine. Once such fiber supplier alone can provide in excess of 800,000 US ton of bankable fiber annually – predominantly by rail. Additional fiber sources are from larger landowners and forest operations.

We are the only fiber provider for export that has site control over a large lot of land, situated at the Port of Searsport, adjacent to and within 1,800 feet of the Sprague loading dock and facility. Our 17 acre site has been dedicated solely for the purpose of operating a wood yard for procurement, aggregation, processing, storing of product for delivery to the heat treatment plant and then alongside vessels for loading.

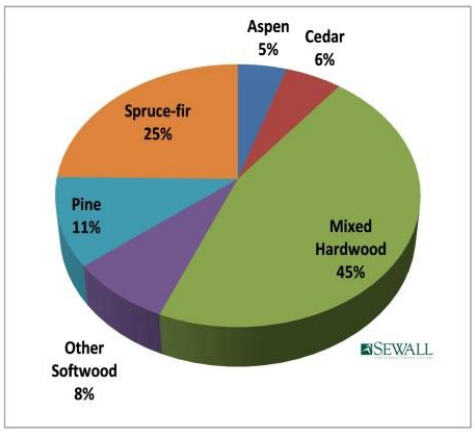
In this document we provide an overview of: 1.) Extraordinary sustainable supply of certificated raw fiber; 2.) Particularly low carbon footprint cost of inland transportation; 3.) Meticulous product procurement, classification and specification management including monitoring and inspection; 4.) Phytosanitation (heat treatment) process and procedure; 5.) Material handling processing to eliminate rehydration of fiber, maximized densification beneficial for ocean freight costs; 6.) Aggregating of raw material, its handling, storage, and a JIT delivery process to the HT infeed; 7.) Negated need for a storage facility at the end-user's facility; 8.) Benefit of establishing strategic alliances to execute long-term sustainable supply contracts at preferential pricing.

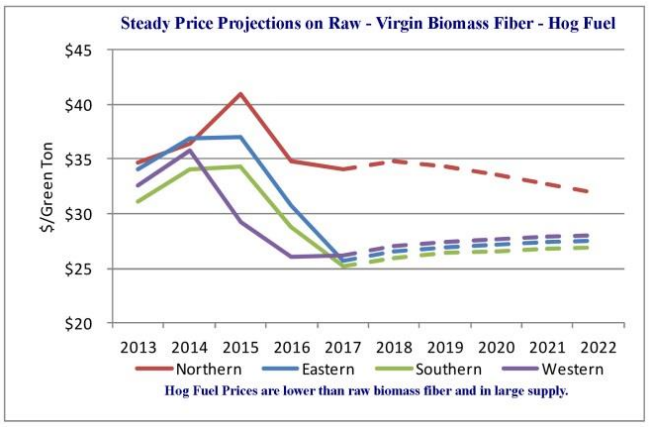
Subsequent discussion can lead to significant cost advantages thru direct privy relationships with landowner/fiber sources, vessel owners and operators, and the establishment of strategic alliances as foundational tenets of a long-term relationship.

Arthur House

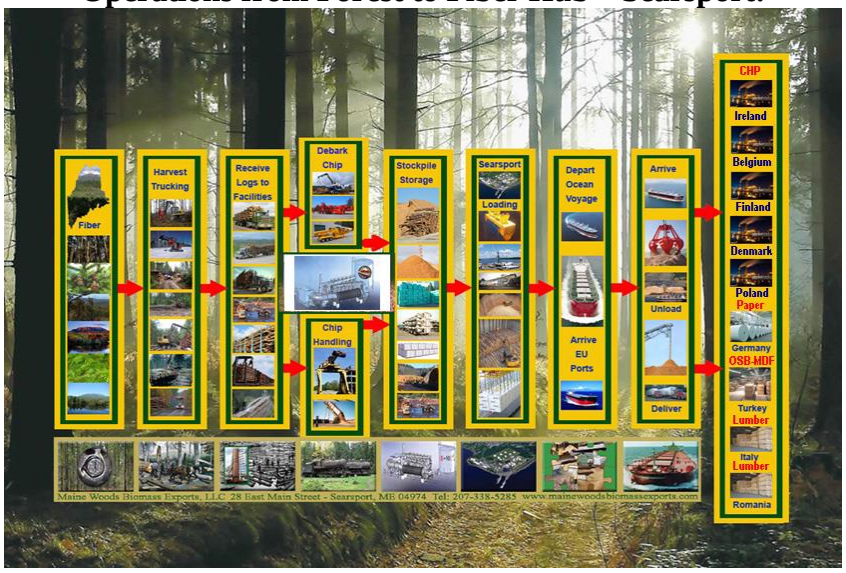
Forest Sustainability:

Maine's forest is comprised of four owner classifications with an aggregate 16.8 million acres of timber land. Privately owned forests account for 94% of all timber or roughly 15.7 million acres. Of those 15.7 million acres, 12.4 million acres are situated in Northern and Eastern Maine – more specifically closest to the primary rail system terminating at the deep water port of Searsport. Supply of raw fiber and hog fuel for biomass is estimated to be 2.5 to 3 million US tons annually in the Northern and Eastern regions.

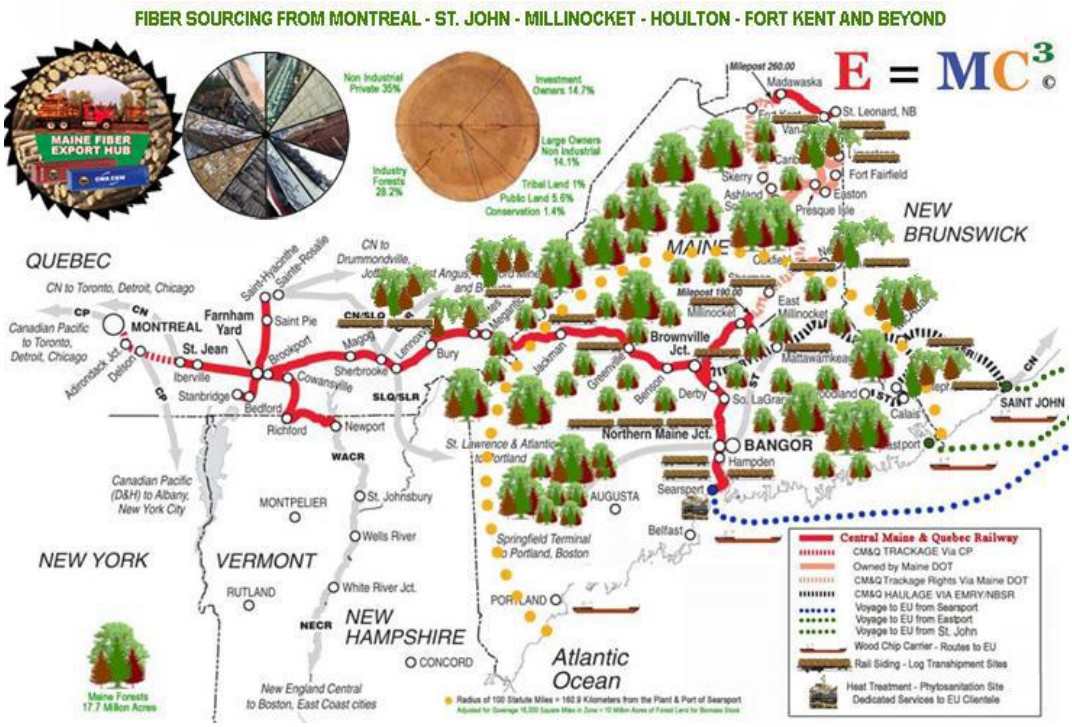




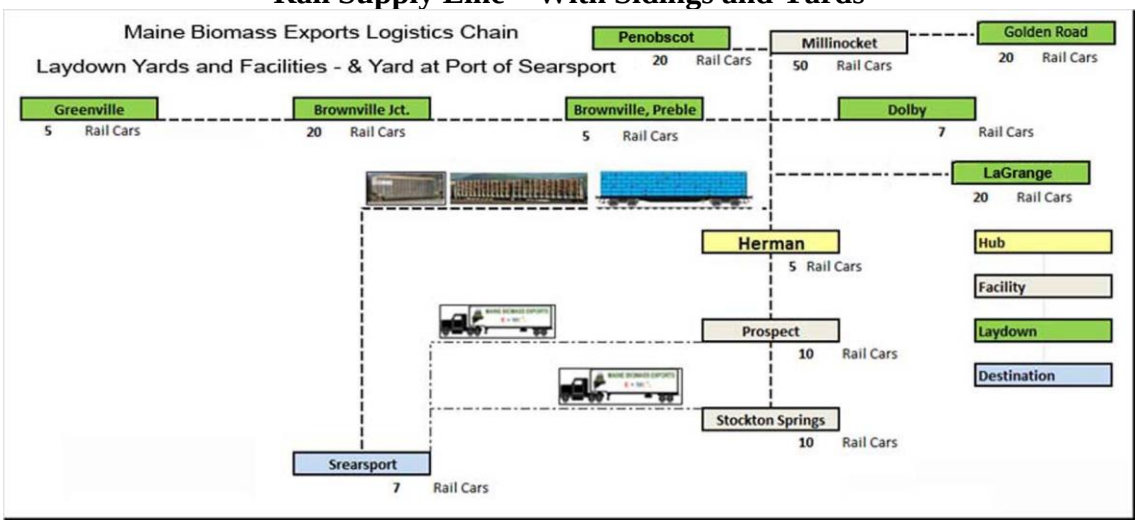
Operations from Forest to Fiber Hub – Searsport:

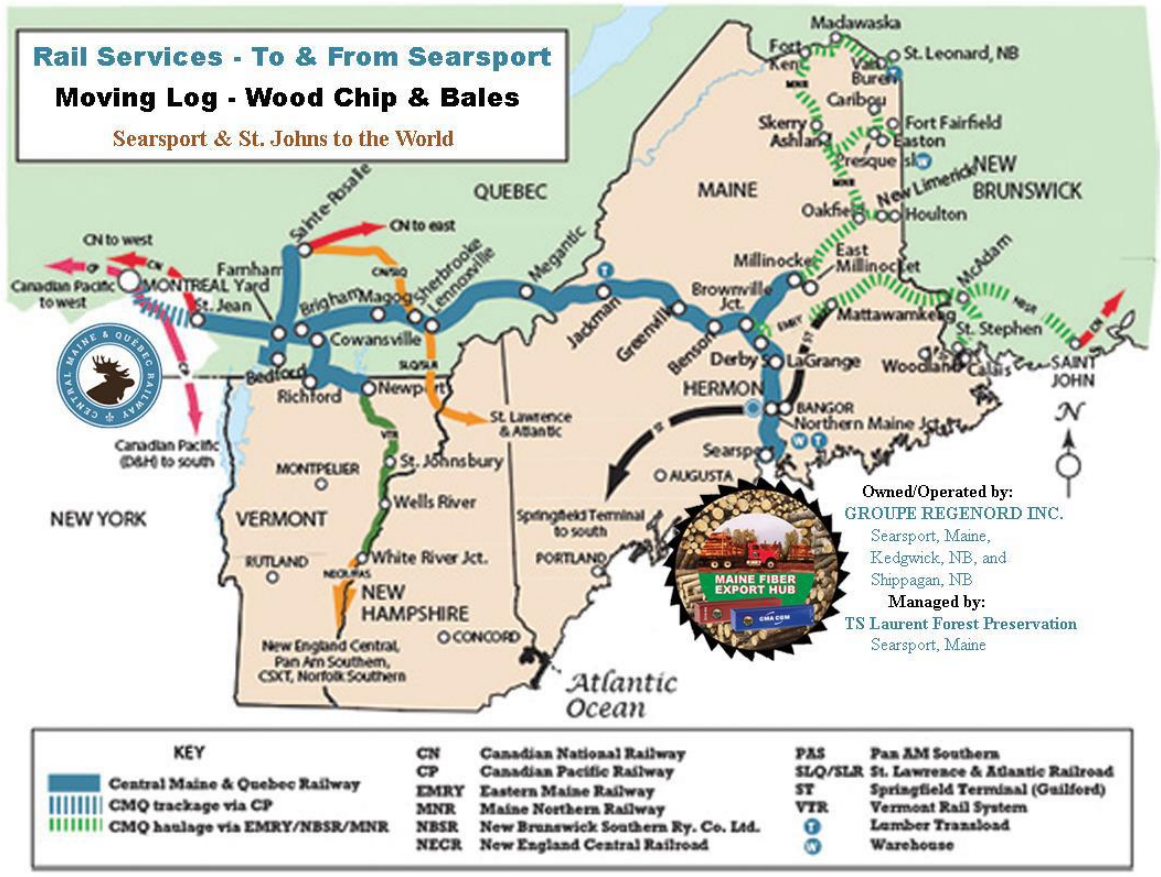


Prospective Rail Supply to Fiber Hub – Searsport:



Rail Supply Line – With Sidings and Yards

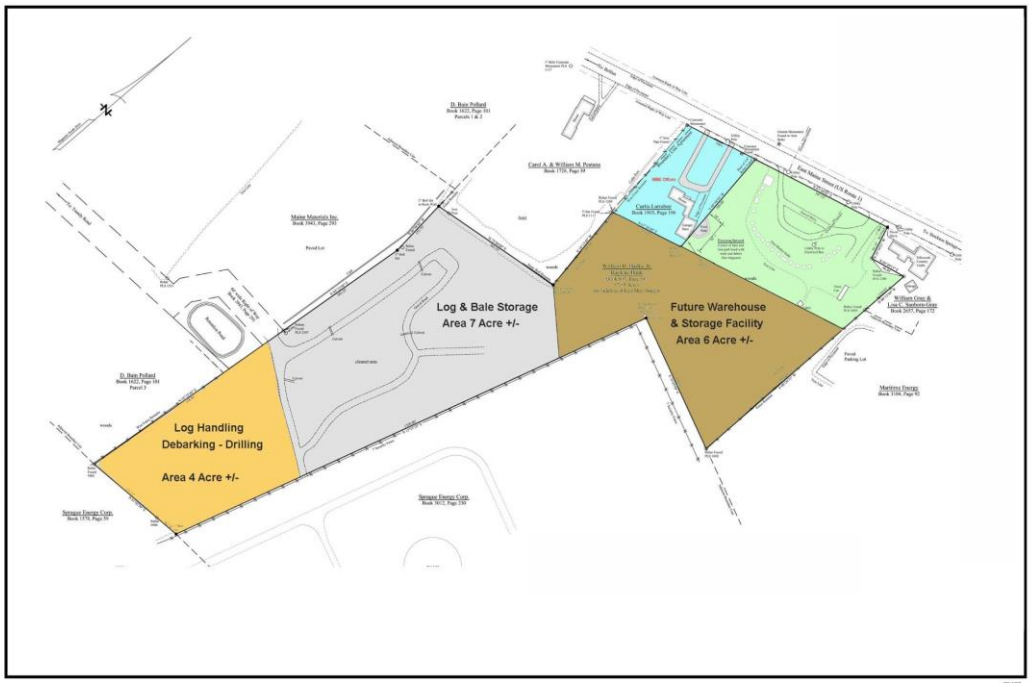




Sanitation: Heat Based – Phytosanitation Mandates by EU

"On June 17, 2014 the European Union published amendments to its principle plant health directive (Council Directive 2000/29/EC) which regulates the import of plants and plant products including forestry products. Member countries of the European Union are to adopt the requirements within their laws, regulations, etc. by 30 September 2014. The Requirements will come into force for imports arriving on or after October 1, 2014. Wood must be: - heat Treated where: Heat treatment is defined as the application of 56°C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including at its core)." We meet and exceed this requirement.

T.S. Laurent - Fiber Hub – Searsport:



T.S. Laurent - Fiber Hub:

WOOD CHIPS - SOFTWOOD (SPRUCE/PINE/FIR – SPF)

Maine wood chips are produced from paper-quality, SPF fiber. Harvested from within a 17.7 million acre wood basket in the state of Maine. Maine fiber is chosen for its extremely high quality and designer suitability in the manufacture of paper and pulp, particleboard, MDF and wood pellets.

PROCESSED – VALUE ADDED

Maine softwood chips are harvested from base-cut trees, debarked, and chipped according to design specifications. They are screened and size-filtered to spec and finish as pristine softwood chips.

TYPICAL WOOD CHIP SPECIFICATIONS

Spruce/Pine/Fir – and Hemlock

Accepts:	.45 cm - 4.5 cm	90% Maximum
Overs:	4.5 cm	5% Maximum
Fines:	.45 cm	5% Maximum
Bark & Rot		2% Maximum

WOOD CHIPS - MIXED HARDWOOD CHIPS

Maine mixed hardwood chips are harvested and produced of high quality fiber from within a 17.7 million acre wood basket in the state of Maine. Maine fiber is chosen for its unique and extremely high quality and designer suitability in the manufacture of paper & pulp, particleboard, MDF and wood pellets.

PROCESSED – VALUE ADDED

Maine mixed hardwood chips are harvested from base-cut trees, debarked, and chipped according to design specifications. They are screened and size-filtered to spec and finish as pristine softwood chips.

TYPICAL WOOD CHIP SPECIFICATIONS

Mixed Hardwood

Accepts:	.45 cm - 4.5 cm	90% Maximum
Overs:	4.5 cm	5% Maximum
Fines:	.45 cm	5% Maximum
Bark & Rot		2% Maximum

MDF MANUFACTURERS - PRODUCERS

Maine wood chips are produced from paper-quality fiber harvested from within a 17.7 million acre wood basket in the state of Maine. Maine fiber is chosen for its unique high quality and designer suitability in the manufacture and production of particleboard and MDF.

PROCESSED – VALUE ADDED

Maine chips are harvested from base-cut trees, debarked, and chipped according to design specifications. Markets served from Maine facilities include Turkey, Belgium, Germany, China and ARA.

TYPICAL WOOD CHIP SPECIFICATIONS

Medium Density Fiber

Accepts:	.45 cm - 4.5 cm	90% Maximum
Overs:	4.5 cm	5% Maximum
Fines:	.45 cm	5% Maximum
Bark & Rot		2% Maximum

PULP & PAPER MANUFACTURERS - PRODUCERS

Maine wood chips are produced from paper-quality fiber harvested from within a 17.7 million acre wood basket in the state of Maine.Maine fiber is chosen for its unique high quality and designer suitability in the manufacture of pulp and paper in both domestic and international markets. P&P Chips in Maine served Great Northern Paper, Verso, SAPPI, Georgia Pacific and now are headed to destinations such as Germany, and throughout Europe and Asia.

PROCESSED – VALUE ADDED

Maine softwood chips are harvested from base-cut trees, debarked, and chipped according to design specifications. They are screened and size-filtered to spec and finish as pristine softwood chips.

TYPICAL WOOD CHIP SPECIFICATIONS

Pulp & Paper Fiber

Accepts:	.45 cm - 4.5 cm	90% Maximum
Overs:	4.5 cm	5% Maximum
Fines:	.45 cm	5% Maximum
Bark & Rot		2% Maximum

WOOD PELLET MANUFACTURERS - PRODUCERS

Maine wood chips are produced from paper-quality fiber harvested from within a 17.7 million acre wood basket in the state of Maine Maine fiber is chosen for its unique high quality and designer suitability in the manufacture and production of wood pellets.

PROCESSED – VALUE ADDED

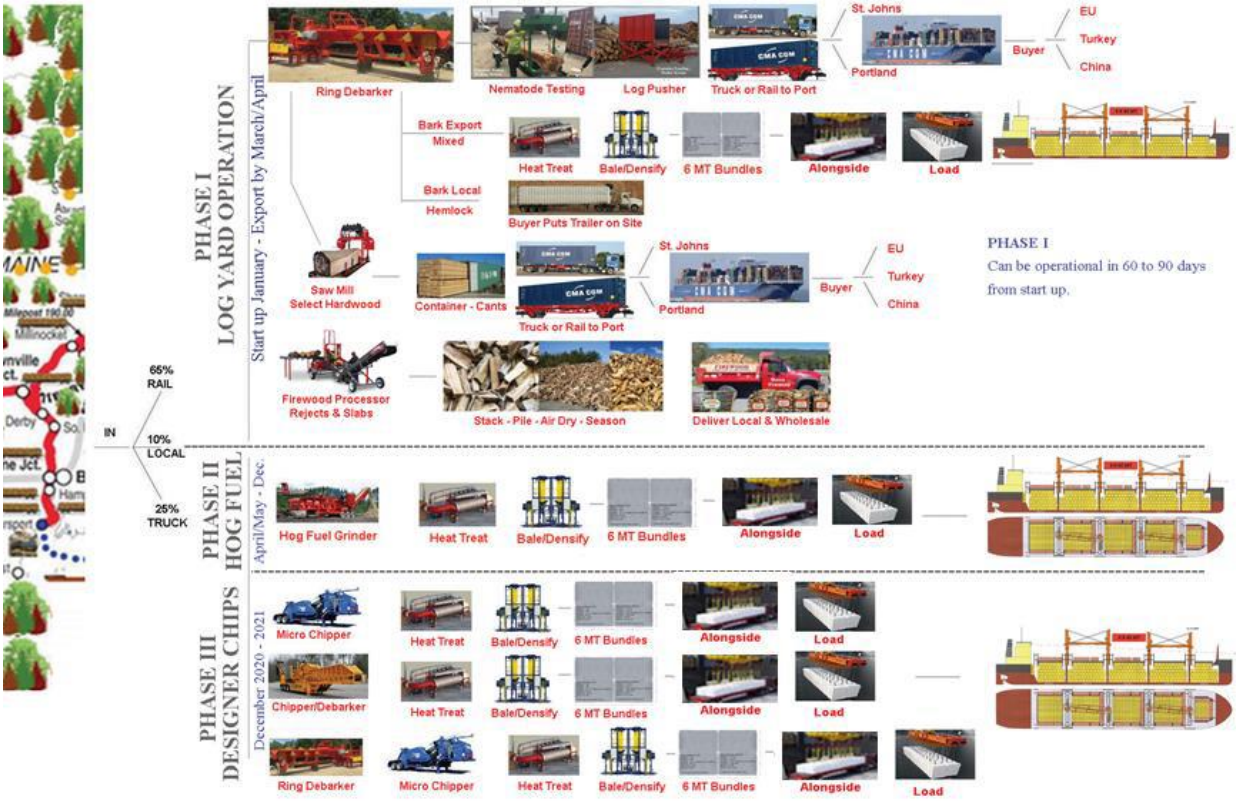
Maine chips are harvested from base-cut trees, debarked, and chipped according to design specifications. Markets served from Maine facilities include (3) domestic manufacturers and clients in the EU and Asia.

TYPICAL WOOD CHIP SPECIFICATIONS

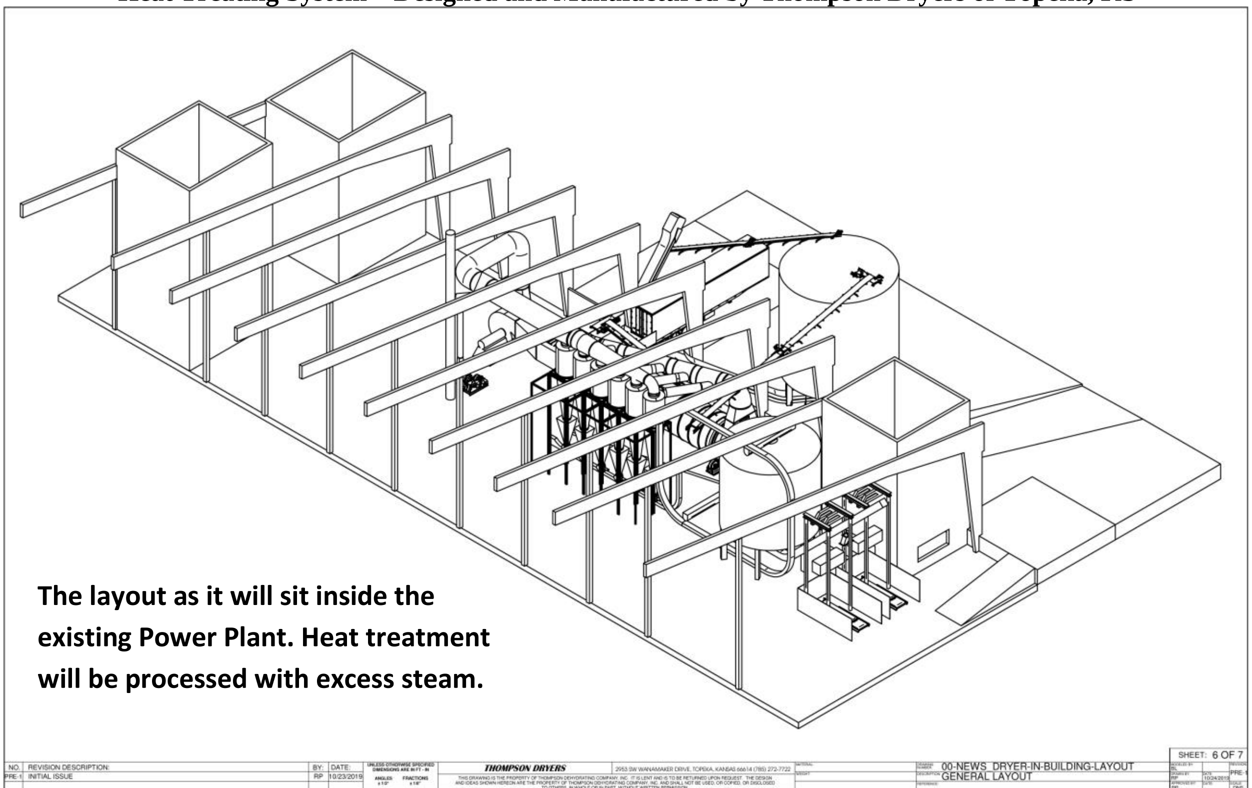
Wood Pellet Requirements

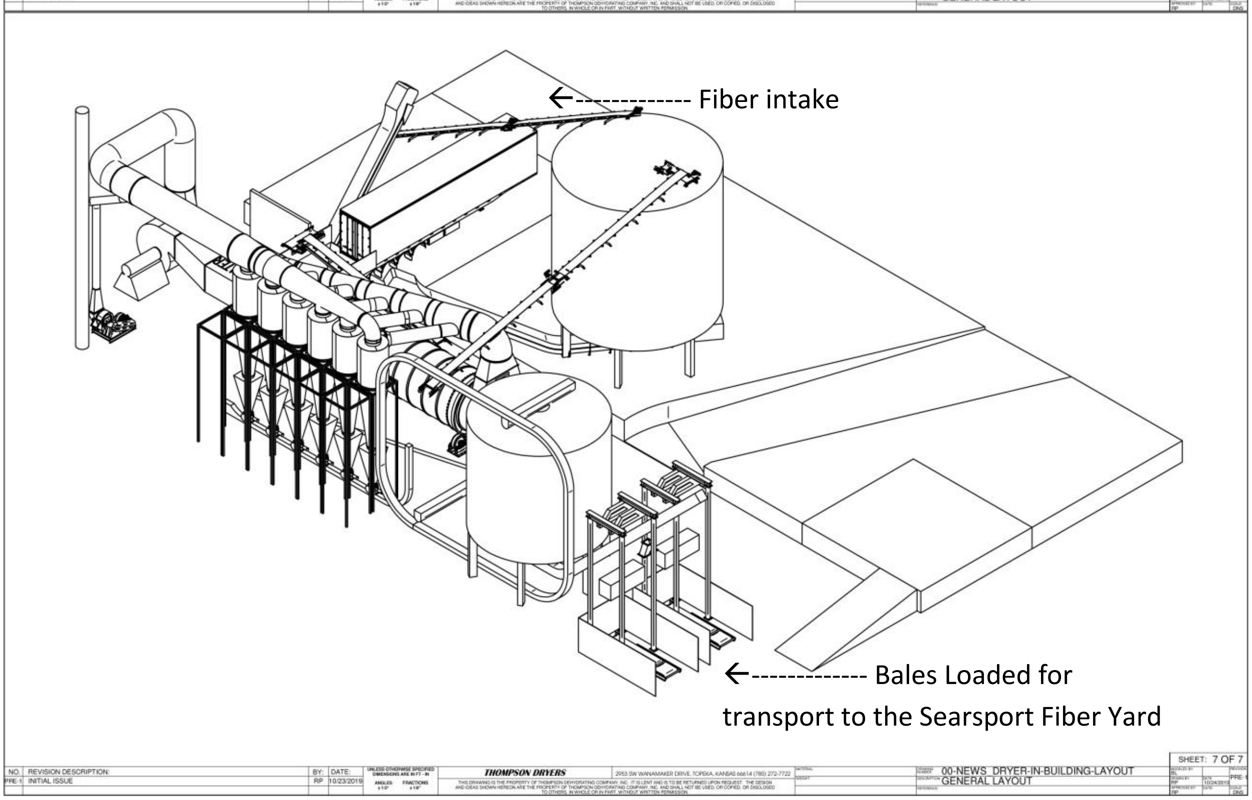
Accepts:	.45 cm - 4.5 cm	90% Maximum
Overs:	4.5 cm	5% Maximum
Fines:	.45 cm	5% Maximum
Bark & Rot		2% Maximum

T.S. Laurent - Fiber Hub - Processing:



Heat Treating System – Designed and Manufactured by Thompson Dryers of Topeka, KS





The Heat Treating Production Facility – Orrington, Maine

http://biomassmagazine.com/articles/16544/helping-meet-eu-renewable-targets-with-wood-chips
By New England Woodchip Solutions |
October 23, 2019
Reprint w/Permission

Helping Meet EU Renewable Targets with Wood Chips

The newly established New England Woodchip Solutions LLC will house a state-of-the-art phytosanitary system that will meet EU import requirements and include a process to densify wood chips for improved ocean freight stowage.

The European Union has adopted a revised directive establishing a new renewable energy target for 2032 that requires at least 32 percent of its generated energy to be derived from renewable sources. Biofuels, including wood chips, will be instrumental in helping the EU meet the new standard. Focused on opportunity, several U.S. companies and a port in Maine are poised to not only take advantage, but also demonstrate a technological advancement in wood chip processing and supply.

New England is home to an enormous wood basket. Maine alone is 90 percent forested and can sustainably supply more than 2 million tons of low-cost residual wood fiber annually. The challenge, however, is processing the wood into chips that meet EU standards, and then economically delivering them to European markets. That's where a new partnership comes in into play, which will take advantage of existing infrastructure, innovative technology and an abundant, sustainable resource.

Thompson Dryers, which has been in industrial drying for 75 years, is installing its Thompson Phytosanitary System at New England Woodchip Solutions LLC, colocated at the site of Orrington, Maine-based Penobscot Energy Recovery Co.

Penobscot Energy Recovery Company is a waste-energy-facility in Orrington, Maine, near Bangor. PERC has been operating successfully since 1988, repurposing municipal and commercial waste into electricity, as well as steam for use in commercial ventures. Recent system upgrades and process streamlining has opened 30,000 square feet of space at PERC for other commercial opportunities. The newly established New England Woodchip Solutions LLC will be utilizing that space for a wood chip processing facility, which will house a state-of-the-art phytosanitary system that will meet EU import requirements and include a process to densify wood chips for improved ocean freight stowage.

Thompson Dryers, a 75-year-old company internationally known for its industrial drying systems, will install its Thompson Phytosanitary System at the facility. The Thompson system, which has been approved by the USDA and is recognized as the most cost-effective sanitizing method available today, will heat wood chips for the required amount of time to kill pathogens without the use of chemicals.

With easy access to rail transportation and Maine's wood fiber resource, the Port of Searsport, Maine's second-largest deep-water port, will play an important role in the venture. Located on Penobscot Bay less than 25 miles from the NEWS facility, the port can easily load the packaged wood chips onto ocean-going cargo ships for transport to the EU.

Collectively, this approach to provide wood chips to the EU is straightforward. Raw wood fiber is collected from the forests of Maine and delivered to a centralized woodlot adjacent to the Port of Searsport. Here, the raw wood fiber is sorted and classified by species and quality, air dried, then chipped to standard EU woodchip specifications. After chipping, the wood chips are delivered to the NEWS facility, where they are phytosanitized using the Thompson system.

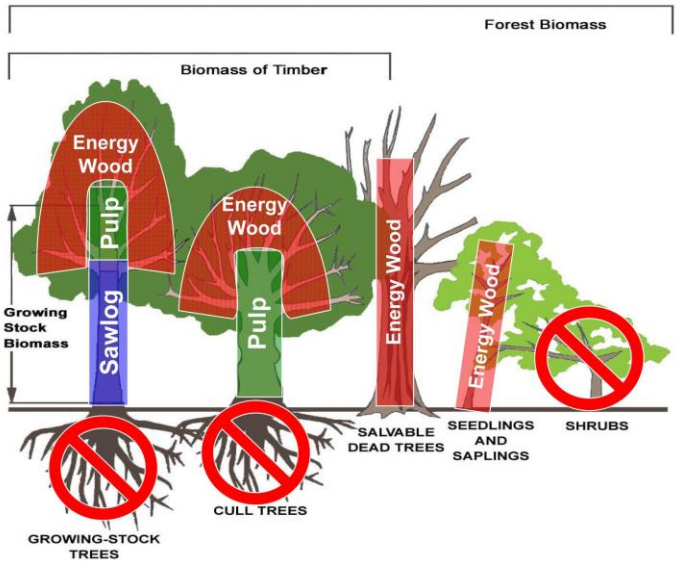
After the wood chips are phytosanitized, they are packaged and transported back to the central woodlot at Searsport for storage and shipping. The packaging protects the wood chips, which extends their useful life significantly, and also allows them to be easily loaded into cargo ships. Once delivered in the EU, the sanitized wood chips can be efficiently added to the current fuel supply at the power facilities that receive them.

The process that has been developed by NEWS and its partners has many benefits. Wood chips require 50 percent less raw wood fiber than wood pellets, and the cost to produce the chips is lower, as the steam and electricity needed for the Phytosanitation process is being provided by PERC—therefore, there is no need to invest millions of dollars in building a new power facility. And because PERC is considered a renewable energy facility, the carbon footprint is significantly lower compared to other competing systems.

The EU is leading the world in finding ways to effectively use renewable energy to transition away from fossil fuels. NEWS, Thompson Dryers, and PERC are working to help reach its ambitious goals.

Fiber Sourcing:
The fiber sourcing process takes advantage of long-term relationships with forest professionals, certified State Licensed Foresters, a state wide network of loggers, trucking companies and licensed scalers and inspection professional. Landowners plan a year or more in advance regarding when and where they will harvest merchantable forest products. We take advantage of acquiring slash, residuals, tree tops and other portions of trees to make up the supply of virgin, raw fiber for biomass.

We have access to in excess of 3 million US tons of raw residual fiber state-wide however we will procure from primarily the Northern and Eastern regions of the state. From those two regions we have access to a minimum of 1.5 million US tons annually. One mega landowner alone can provide bankable fiber in the approximate volume of 800,000 US tons per year. The bulk of this fiber can be attained by rail – with low carbon foot print inland transport costs.



The Searsport fiber hub receives all fiber, tests and inspects (with reliance upon SGS) by third party entity to verify species, quantities, mixtures, moisture content and all other specifications or classification desired by our buyers. This fiber is delivered to the heat treatment facility (11 miles from the process yard) on just in time JIT scheduling, on live bottom (walking bed) trailers. The wood chips enter the HT process through the plant's infeed receptor, processed through the system and then transported back to the fiber hub yard, at the Port of Searsport, where it is prepared for loading alongside vessel at the appropriate time.

A very significant price control opportunity for any buyers is for that buyer to develop a strategic alliance with the Searsport Fiber Hub where the 17 acre site could be dedicated to the buyer on an exclusive basis, where fiber can be accumulated for prior natural drying and Gj appreciation by air drying only. Natural drying of raw fiber can earn a buyer alliance in excess of 5% per month ROI on fiber purchases. Having this type of fiber source can also provide a buyer with a bankable source of import fiber, that can be used for enhance financing in the EU.

The Phytosanitation process:
As wood chips are delivered to the infeed receptors, they are moved directly, by conveyors, toward the drum dryers for heating. The dryer (one production line) is name-plated for 330,000 MT of HT wood chips per year. We use the 300,000 MT per year figure so we remain conservative on the projected output. Within one year of commissioning of the number 1 production line, it is anticipated that line number 2 will begin construction and be fully operations for 2021. With both systems running, the annual output is estimated to be 600,000 MT.

As the dryer heats the wood chips, they are moved to the rear end of the system and conveyed directly into wood fiber silos where the wood chips will be held at above 60° Celsius for 45 minutes (far exceeding the low benchmark set by the EU at 56° Celsius for 30 minutes). While in the wood chips are housed in the silo, they are independently monitors and inspected by two third party entities to ensure compliance with EU mandates. On a 24/7/365 schedule, the USDA will have digital readouts of temperatures and time in the silo reports necessary for their issuance of Phyto Certification. For foundational purposes, we have successfully exported HT wood chips to Germany, to Mercer International, for paper manufacturing.

Upon release from the silo the wood chips will automatically be fed into compaction and bale wrapping equipment where the material is compacted to as high as a 60% compaction rate, thereby increasing density efficiencies dramatically, and making the delivered product equivalent in vessel density as wood pellets.

The underlying premise for our approved Phyto process is grounded upon the banning of chemical fumigation practice and toward a universal process of heat treatment is the alternative. Several attempts at this process have been made and failed – not because the science regarding heating was flawed but, specifically because the concept of providing heat treated wood chips by utilizing fossil fuel, LP or other fuels, and or even by burning wood chips as a heat source – are all counter intuitive to maintaining a low-carbon foot print in the procedure. The Phytosanitation process we perform utilizes clean, low cost and abundant exhaust steam.

The Baling process:
This is accomplished with an Apollo Super Baler system as manufactured by Apollo, of the Netherlands – a 175 year old company dedicated to designing and building material handling equipment used for peat moss, bark and mulch, animal bedding and various refuse materials – now wood chips. We are affiliated with Apollo and one of their long-term Baler System owners and operators (J.D. Irving Mill of NB, CA). Bale sizes can vary according to buyer needs. The structural integrity of the baled material is “like a rock” in that it holds its shape even after the wrapping is stripped.

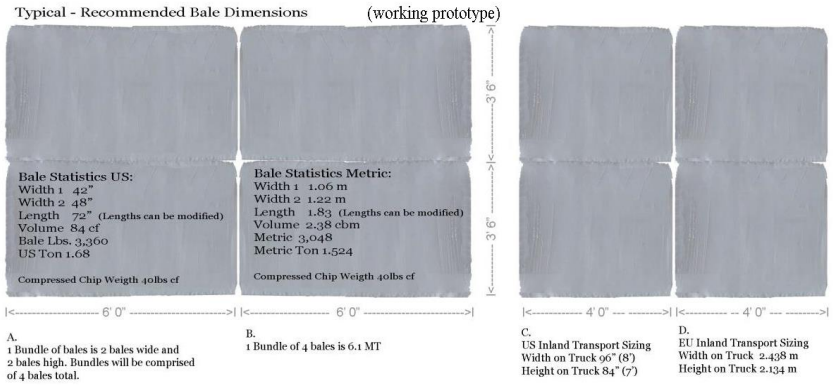
Typical Bale Photos:

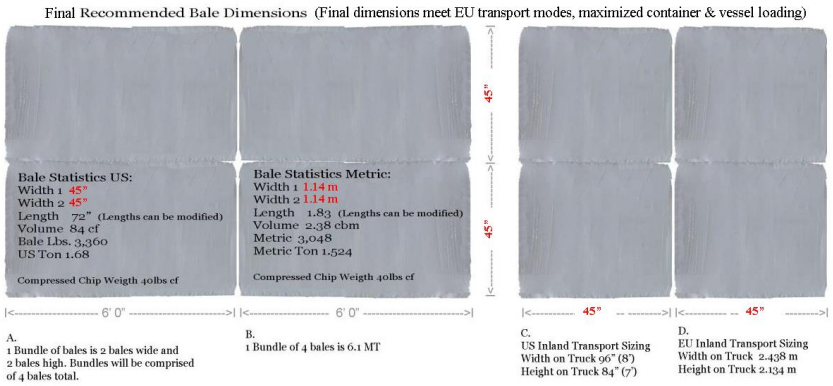
In this yard, the bales are placed on pallets to be moved around the yard with fork truck.

Examining a Bale for Firmness

Bales accomplish very significant tasks: 1.) The compression inside the bales is such that we consistently obtain a density similar to wood pellets; 2.) The bale wrapping prevents fiber from any future exposure to the environment or elements during the deliver from plant to furnace; 3.) Bales do not require buildings or storage facilities at the port or on the fiber yard as bales have in excess of year-long shelf lives; 4.) Once at the destination port, these bales are lifted out of the vessel hold and set on yards for an extended time frame to meet demand for movements on site; 5.) Bales are easily sliced open by a provided bale opener, where the chips fall directly into the furnace and the wrapping is selected out for recycling; and 6.) Fiber is protected from off-gassing (like pellets) and they eliminate dust and fiber degradation.

The Vessel Loading process:
Bales will be brought alongside the vessel, under hook and lifted to the holds by on-sight Liebherr crane and also under the hook of ship rigging. Testing calculations, utilizing one crane only, can (conservatively) load 4,000 to 6,000 MT per day. With an assist from at least one vessel crane the loading rate can meet or exceed 6,000 to 9,000 MT per day. We worked the loading statistics with the assumptions made by loading a Vessel – Ansac Pride. Other data is provided below. The Ansac Pride is a Small Handy sized vessel with a cargo load of more than 28,000 MT. Because the bale sizes are scalable by inputting a height constraint, we can design a bale to meet varied sizes so as to fill every void possible in a vessel, especially if we have name of vessel and its loading characteristics and arrangements in advance. Bale dimensions tested are 40" x 48" x varied heights from 6' to 8' tall. Bales leave the baler upright but are tilted to their side for bundling of four (4) bales per bundle – then lifted to trailer and then on to the vessel, with the strapping included for rapid unloading of the bales in the reverse manner.



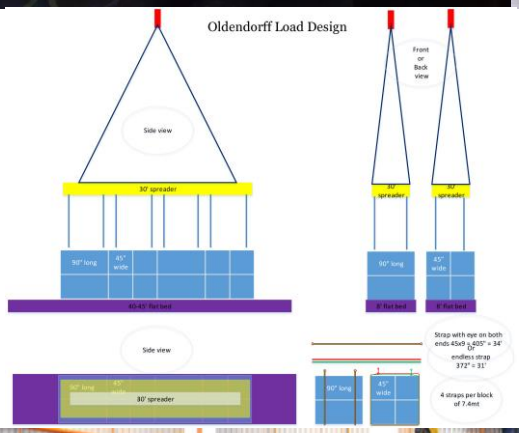


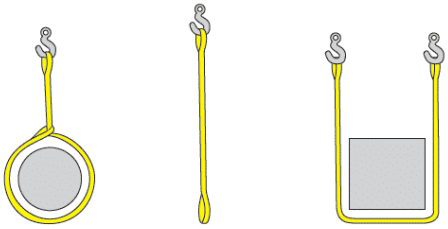
Vessel Loading – Typical of Paper Loading

A uniquely promising backhaul opportunity will be bundled in the same manner, loaded and unloaded in the same process, baled material as well, and in equal volume so as to make the vessel costs more affordable. In the case where a buyer has its own vessels, and or has significant relationships with vessel owners or operators, this reciprocal backhaul opportunity can provide significant savings for a buyer who wants to control (by privy contracting with vessels) the costs of shipping and handling.

The typical cart equipment required to deliver bales alongside the vessel for loading or to receive the bales as they are unloaded from the vessel.

The typical equipment required to lift bales to load onto the trailers or carts.


Oldendorff Load Design
Side view
30' spreader
90" long
45" wide
40-45' flat bed
Front or Back view
8' spreader
8' flat bed
Side view
30' spreader
Strap with eye on both ends 45x9 = 405" = 34' endless strap 372" = 31'
4 straps per block of 7.4mt


CHOKER
VERTICAL
BASKET


SAUR
Cap. Máx.

Typical Biomass Chip Classification – Woody Biomass

Table 1. Classification of 1 Woody biomass (EN 14961-1)[5]

1.1 Forest, plantation and other virgin wood	1.1.1 Whole trees without roots	1.1.1.1 Broadleaf
		1.1.1.2 Coniferous
		1.1.1.5 Blends and mixtures
	1.1.2 Whole trees with roots	1.1.2.1 Broadleaf
		1.1.2.2 Coniferous
		1.1.2.5 Blends and mixtures
	1.1.3 Stemwood	1.1.3.1 Broadleaf
		1.1.3.2 Coniferous
		1.1.3.3 Blends and mixtures
	1.1.4 Logging residues	1.1.4.3 Stored, Broadleaf
		1.1.4.4 Stored, Coniferous
		1.1.4.5 Blends and mixtures
	1.1.5 Stumps/roots	1.1.5.1 Broadleaf
		1.1.5.2 Coniferous
		1.1.5.5 Blends and mixtures
	1.1.6 Bark (from forestry operations) [a]	

Design Mixture shall approximate 70% Deciduous (Broadleaf) and 30% Coniferous.
[a] Max 4% bark only from logging operations - residuals on site.
No short rotation coppice, no ash species, no brush or bushes, no leaves, no needles.

Typical Biomass Chip Specifications – Hog Fuel

Annex 2 – Specification of hog fuel based on EN 14961-1 .[5]

	Master table		
	Origin: According to 6.1 and Table 1.		Woody biomass (1)
	Traded Form		Hog fuel
Normative	**Dimensions** (mm) EN 15149-1, EN 15149-2		
	Main fraction (minimum 75 w-%), mm [a]		Coarse fraction, w-% (max. length of particle, mm) [b]
	P45	3,15 ≤P ≤ 45 mm	≤ 10 % > 63 mm and all < 350 mm
	Fine fraction (< 3,15 mm), % of weight EN 15149-2		
	F10	≤ 10 %	
	Moisture, M (w-% as received) EN 14774-1, EN 14774-2		
	M40	≤ 40 %	
	Ash, A (w-% of dry basis) EN 14775		
	A1.5 A2.0	≤ 1,5 % ≤ 2,0 %	Sample data provided Appendix 1 Maximum 2% - can be reduced with reduction of bark use by design.
	Net calorific value, Q (MJ/kg as received) or **energy density, E** (kWh/m^3 loose) EN 14918		Minimum stated value 10.6 Gj/t 7.77 Gj m^3
Normative / informative	**Nitrogen, N** (w-% of dry basis) EN 15104		
	N1.0	≤ 1,0 %	Sample data provided Appendix 1
	Chlorine, Cl (w-% of dry basis) EN 15289		
	Cl0.02	≤ 0,02 % <0.005 As Received and Dry Basis	Sample data provided Appendix 1
Informative	**Bulk density (BD)** as received (kg/m^3) EN 15103		
	BD450 BD450+	≥ 450 > 450 (minimum value Projected 510 stated)	Densified/compacted Heat Treated - Sanitized Wood Chips Mitigate: off-gassing, dust, rehydration, combustion in-transit and storage and protection.
	Ash melting behaviour (°C) EN 15370		Deformation temperature, DT should be stated

[a] The numerical values (P-class) for dimension refer to the particle sizes (at least 75 w-%) passing through the mentioned round hole sieve size (EN 15149-1).
[b] The cross sectional area of the oversized particles shall be P16 < 1 cm², for P45 < 5 cm², for P63 < 10 cm² and P100 < 18 cm².

NOTE Special attention should be paid to the ash melting behaviour for some biomass fuels, for example eucalyptus, poplar, short rotation coppice.

NOTE 2: No use of ash fiber, eucalyptus, poplar, short rotation coppice is intended.

Wood Fuel Characteristics

Finnish Wood Fuel Characteristics: http://www.woodenergy.ie/woodasafuel/listandvaluesofwoodfuelparameters-part1/

	Logging residue chips[a)]	Whole tree chips	Log Chips	Stump Chips	Softw ood bark	Birch Bark	Wood Residue Chips
Moisture content, w -% (fresh chips)	50-60	45-55	40-55	30-50	50-65	45-55	10-50
Average	55	50	47.5	40	57.5	50	30
Net calorific value in dry matter, MJ/kg	18.5-20	18.5-20	18.5-20	18.5-20	18.5-20	21-23	18.5-20
Average	19.25	19.25	19.25	19.25	19.25	22	19.25
Net calorific value as received, MJ/kg	6-9	6-9	6-10	6-11	6-9	7-11	6-15
Average	7.5	7.5	8.0	8.5	7.5	9	10.5
Bulk density as received, kg/loose m3 *(a)*	380	380	380	380	350	350	350
Bulk density as received, kg/ 40%densified/compacted m3	532	532	532	532	490	490	490
Energy density, MWh/m3 of bulk volume	.7-.9	.7-.9	.7-.9	.8-1	.5-.7	.6-.8	.7-.9
Average	0.8	0.8	0.8	0.9	0.6	0.7	0.8
Ash content in dry matter, w -%	1-3	1-2	.5-2	1-3	1-3	1-3	.4-1
Average	2	1.5	1.25	2	2	2	0.7
Hydrogen content in dry matter (H), w -%	6-6.2	5.4-6	5.4-6	5.4-6	5.7-5.9	6.2-6.8	5.4-6.4
Average	6.1	5.7	5.7	5.7	5.8	6.5	5.9
Sulphur content in dry matter (S), w -%	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nitrogen content in dry matter (N), w -%	.3-.5	.3-.5	.3-.5	.3-.5	.3-.5	.5-.8	.1-.5
Average	0.4	0.4	0.4	0.4	0.4	0.65	0.3

http://www.woodenergy.ie/woodasafuel/listandvaluesofwoodfuelparameters-part1/

(a) Wood chips, dry weighs 0.38 gram per cubic centimeter or 380 kilogram per cubic meter, i.e. density of wood chips, dry is equal to 380 kg/m³. In Imperial or US customary measurement system, the density is equal to 23.72 pound per cubic foot [lb/ft³], or 0.22 ounce per cubic inch [oz/inch³].

Weight of 2.6 cubic meters of Wood chips, dry

carat	4 940 000	ounce	34 850.67
gram	988 000	pound	2 178.17
kilogram	988	tonne	0.99
milligram	988 000 000		

Carbon CO_2 Equivalencies

For a full, detailed analysis and comparison of the emission characteristics between the utilization of brown coal versus wood chips we would require a review of existing and or planned boiler systems intended to be in place in the CHP plant. Preliminary comparison of CO_2 between biomass and coal is similar. Output for coal at a MC of 50% is 125.49 (kg/MMBTU) and for wood chips at about 30% MC is 122.09 (kg/MMBTU). Upon direct and qualified request for a scientific review of this matter we will produce such an analysis.

Sample of Lab Results – Various Species Mixtures for Biomass
Note: MC and GJ Values are before Heat Treatment is Applied

Analysis of Various Biomass Wood Chips from Maine, USA

Species	Mixture		MC as Received	Ash as Received	Volatiles as Received	Fixed Carbon as Received	GCV as Received	NCV cV as Received	NCV cP as Received	Carbon as Received	Hydrogen as Received	Nitrogen as Received	Oxygen as Received	Sulfur as Received	Chlorine as Received
			ISO 18134-1	ISO 18122	ISO 18123	By Difference	ISO 18125	ISO 18125	ISO 18125	ISO 16948	ISO 16948	ISO 16948	ISO 16948	ISO 16948	ISO 16948
			%	%	%	%	GJ/Tonne	GJ/Tonne	GJ/Tonne	%	%	%	%	%	< %
Birch/Maple	66% Birches	33% Maple	40.06	0.18	52.51	7.24	11.77	10.11	10.01	30.05	3.57	0.07	26.07	0.01	0.005
Mixed - Hog Fuel w/Bark	70% Deciduous	30% Coniferous	27.93	2.50	57.88	11.66	13.56	12.02	11.93	33.76	4.34	0.26	31.17	0.02	0
Fresh cut Hemlock	100% Hemlock	0	52.54	0.20	39.02	8.23	9.83	8.02	7.92	24.60	2.89	0.11	19.65	0.01	0.005
Mixed Conifers	50% Hemlock	25% Spruce 25% Fir	28.96	2.66	56.77	11.59	13.28	11.74	11.65	33.68	4.22	0.32	30.14	0.02	0
Mixed Conifers	60% Pine / 25%	Spruce / 15% Fir	43.59	0.28	45.22	10.9	11.77	10.07	9.97	29.75	3.37	0.07	22.94	0.01	0.005
Birch: Betula	50% W. Birch	50% Y. Birch	42.92	0.16	50.01	6.90	11.19	9.50	9.40	28.47	3.41	0.08	24.96	0.0100	0.005
Mixed - Hog Fuel <5% Bark	70% Deciduous	30% Coniferous	23.62	0.98	62.58	12.81	15.56	14.04	13.96	38.89	4.71	0.26	31.54	0.01	0
	Calculations prior to Heat Treatment		37.09	0.99	52.00	9.904285714	12.42	10.79	10.69	31.31	3.79	0.17	26.64	0.01	0.0029
	Estimated Adjusted After Heat-Treated		**30.00**				**12.60**								

Energy by Weight, Volume and Moisture Content

HHV - of biomass and some selected fuels are indicated below:	
Material	**HHV (KJ/kg)**
Bituminous Coal	17000 - 23250
Charcoal	29600
Coniferous w/bark	22000
Coniferous no bark	21000
Poplar	20700
Beech	20300
Equcalypus grandis	19400
Wheat straw	17500
Sugar cane bagasse	17300
Rice straw	15800
Rice hulls	15300

https://www.engineeringtoolbox.com/biomass-fuels-hhv-d_1818.html

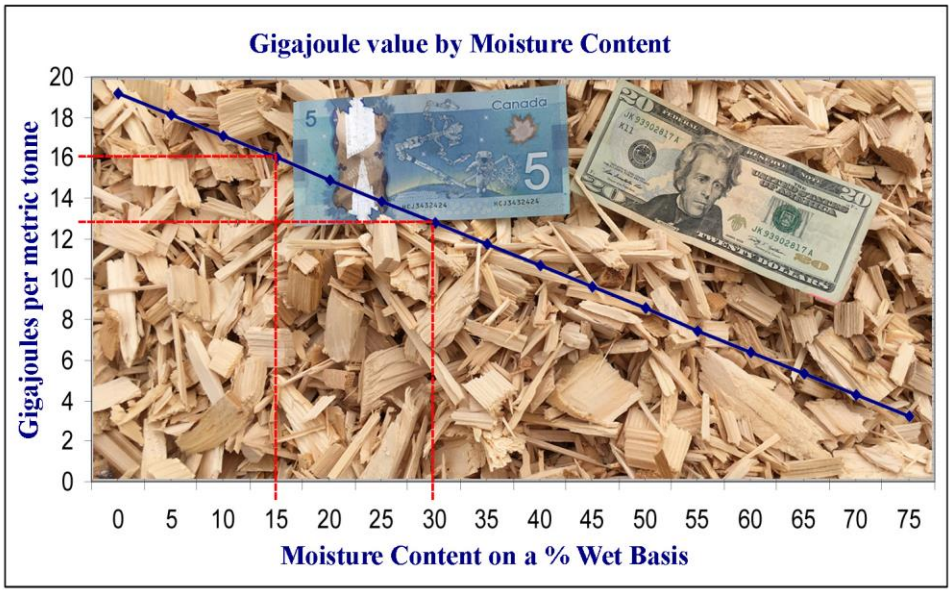
Moisture Content and Usable Energy

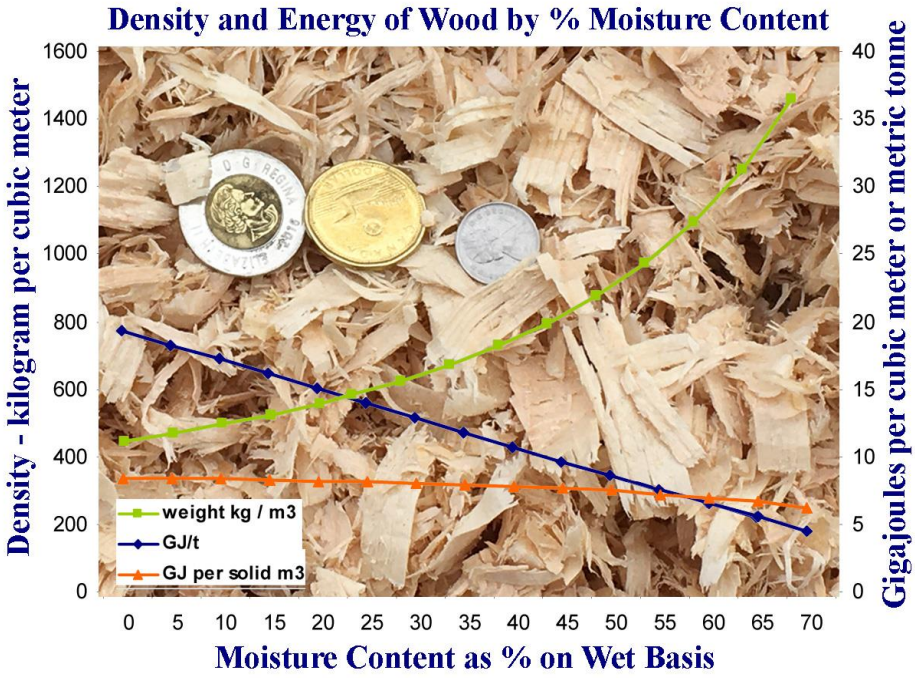
Moisture Content and Usable Energy

Moisture Content	Energy by Volume Unit	Energy per Weight Unit
%	%	%
0 (oven dry)	100.0	100.0
20 (air-dry)	97.0	81.0
30 (air-dry)	95.8	74.7
40 (air-dry)	93.3	68.3
50 (green)	92.0	62.0
100 (wet)	85.0	42.0

Note that

Energy Equivalencies





Specific Gravity Calculations

	Specific Gravity	Density (lb/ft^3)	Weight per Cord (lb/cord)	Specific Gravity	Density (lb/ft^3)	Weight per Cord (lb/cord)
Sampled Softwood						
Spruce, Canadian		34		0.45	28.0	
Pine, Northern White		36			25.0	
Fir, Balsam		45			25.0	
Hemlock, Eastern		50			28.0	
				Average SW	26.5	
Representative Hardwood						
Oak, Red	0.98	61	4886	0.67	42.0	3350
Beech, American		54			45.0	
Birch, Paper		50			38.0	
Bur oak	0.99	62	4923	0.69	43.0	3475
Maple, silver		45			33.0	
Maple, Soft	0.8	50	3960	0.53	33.0	2640
				Average HW	39.0	
				Average SW	26.5	
				Variance	12.5	47.2%

Bale Compaction Testing Statistics
Bale Compaction – Density Testing
Multiple Testing – Softwoods and Hardwoods – Hog Fuel

Calculations Based on Typical Coniferous - Softwood - Spruce

Spruce: 15% MC - Micro Chips					Loose CF	Loose LB	Baled LBS	Compact	LB p/CF	US-T	MT
#	W1 "	W2 "	H Ft	CB - Baled	CF WC			%			
1	40	48	7.0	93.33	9.44	881.1	1450.0	60.8%	153.6	0.73	0.66
2	40	48	7.5	100.00	9.44	944.0	1507.0	62.6%	159.6	0.75	0.69
3	40	48	8.0	106.67	9.44	1006.9	1624.0	62.0%	172.0	0.81	0.74
		Avergaes:	7.5	100.0	9.4	944.0	1527.0	61.8%	161.8	0.76	0.69

Spruce: 50% MC Large G40 Chips					Loose CF	Loose LB	Baled LBS	Compact	LB p/CF	US-T	MT
#	W1 "	W2 "	H Ft	CB - Baled	CF WC			%			
1	40	48	8.0	106.67	16.80	1792.0	2358.0	76.0%	140.4	1.18	1.07
2	40	48	8.0	106.67	16.80	1792.0	2453.0	73.1%	146.0	1.23	1.12
3	40	48	8.0	106.67	16.80	1792.0	2521.0	71.1%	150.1	1.26	1.15
		Avergaes:	8.0	106.7	16.8	1792.0	2444.0	73.4%	145.5	1.22	1.11

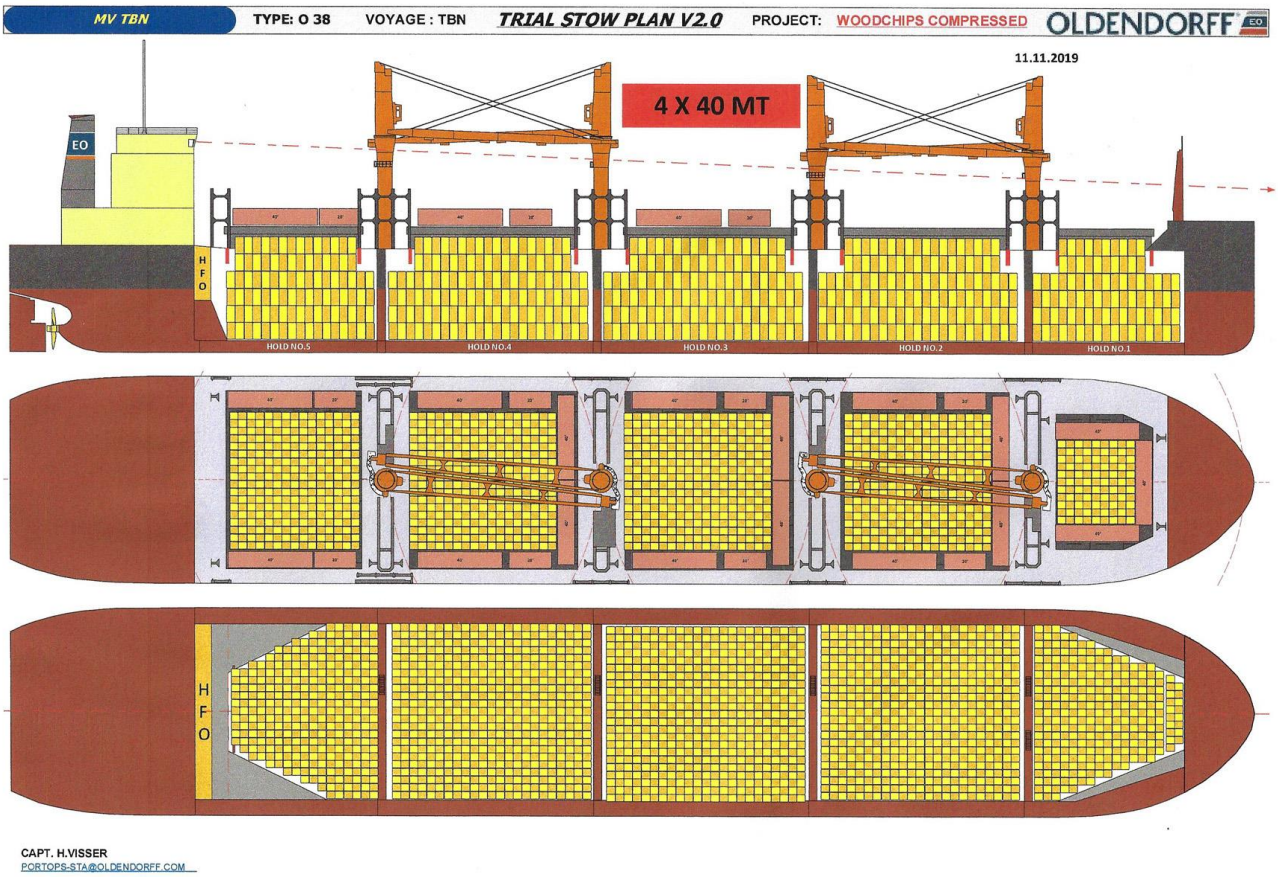
Spruce: 35% MC					Loose CF	Loose LB	Baled LBS	Compact	LB p/CF	US-T	MT
#	W1 "	W2 "	H Ft	CB - Baled	CF WC			%			
1	40	48	8.0	106.67	16.00	1706.7	3250.0	52.5%	203.1	1.63	1.48
2	40	48	8.0	106.67	16.00	1706.7	3207.0	53.2%	200.4	1.60	1.46
3	40	48	8.0	106.67	16.00	1706.7	3215.0	53.1%	200.9	1.61	1.46
		Avergaes:	8.0	106.7	16.0	1706.7	3224.0	52.9%	201.5	1.61	1.47

Mixed HW: 35% MC				CF Per Bale	Loose CF	Loose LB	Baled LBS	Compact	LB p/CF	US-T	MT	*Stow - Density* MT/CBM
1	40	48	8.0	106.67	22.40	2389.3	4550.00	52.9%	203.1	2.28	2.07	3.25
Mixed Hog Fuel: 35% MC				**CF Per Bale**	**Loose CF**	**Loose LB**	**Baled LBS**	**Compact**	**LB p/CF**	**US-T**	**MT**	***Stow - Density*** **MT/CBM**
1	40	48	8.0	106.67	21.60	2304.0	4513.60	52.9%	209.0	2.26	2.05	3.35

HANDYSIZE CARRIERS: 28000-30000 tons DWT

HANDYSIZE CARRIERS: 28000-40000 tons DWT – Potential Size

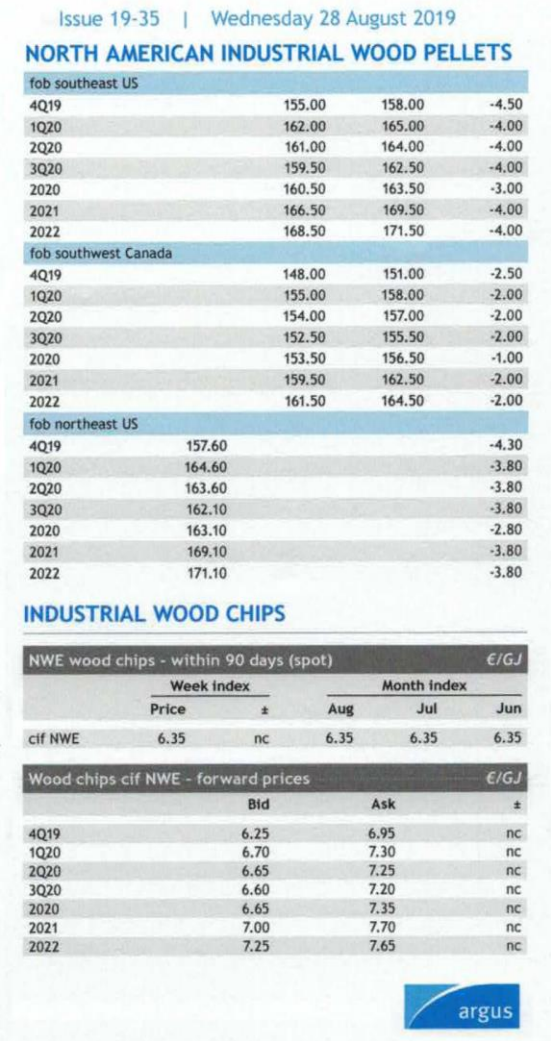
As example the Oldendorff Vessel – General Arrangement



This vessel can load approximately 28,500 MT of Baled Wood Chips (under and above hatch). Minimum load rate utilizing one crane will load in excess of 4,000 MT per day (load rate can be doubled with ships crane assist). Projected maximum days in port ~ 4 Days.

Port of Searsport

Energy Value – Price Comparisons – Wood Chips vs. Wood Pellets
CIF – EU from Northeastern USA



Issue 19-35 | Wednesday 28 August 2019

NORTH AMERICAN INDUSTRIAL WOOD PELLETS

fob southeast US			
4Q19	155.00	158.00	-4.50
1Q20	162.00	165.00	-4.00
2Q20	161.00	164.00	-4.00
3Q20	159.50	162.50	-4.00
2020	160.50	163.50	-3.00
2021	166.50	169.50	-4.00
2022	168.50	171.50	-4.00
fob southwest Canada			
4Q19	148.00	151.00	-2.50
1Q20	155.00	158.00	-2.00
2Q20	154.00	157.00	-2.00
3Q20	152.50	155.50	-2.00
2020	153.50	156.50	-1.00
2021	159.50	162.50	-2.00
2022	161.50	164.50	-2.00
fob northeast US			
4Q19	157.60		-4.30
1Q20	164.60		-3.80
2Q20	163.60		-3.80
3Q20	162.10		-3.80
2020	163.10		-2.80
2021	169.10		-3.80
2022	171.10		-3.80

INDUSTRIAL WOOD CHIPS

NWE wood chips - within 90 days (spot)					€/GJ
	Week index		Month index		
	Price	±	Aug	Jul	Jun
cif NWE	6.35	nc	6.35	6.35	6.35

Wood chips cif NWE - forward prices			€/GJ
	Bid	Ask	±
4Q19	6.25	6.95	nc
1Q20	6.70	7.30	nc
2Q20	6.65	7.25	nc
3Q20	6.60	7.20	nc
2020	6.65	7.35	nc
2021	7.00	7.70	nc
2022	7.25	7.65	nc

argus

		Wood Chips - MC		Hog Fuel		Pellets
MC		15%	30%	30%		10%
Gj Value		16.0	12.8	12.8		17.0
CIF/NEW € p/GJ						
	2020	6.75	6.75	6.35	$	163.10
	2021	7.00	7.00	6.75	$	169.10
Average- €		6.88	6.88	6.55	$	166.10
Price - €		110.00	88.00	83.84		
Price US		$ 122.65	$ 98.12	$ 93.49	$	166.10
GJ Per MT CIF $ USD		$ 7.67	$ 7.67	$ 7.30	$	9.77
GJ Per MT CIF € Euro		6.88	6.88	6.55		8.76

Benefits of Wood Chips

No building/storage required
No off-gassing
No dust and Degradation
Less that 1/2 Raw Fiber Required
No standing trees harvested
Only raw virgin residuals used

NOTE: The above pricing example is based solely upon forward looking price indications as published in ARGUS Wednesday August 28, 2019. This is to be used as a reference point in determining the comparison of a delivered Gj cost per MT of wood chips vs. wood pellets. Where densification of wood chips/baled becomes a balancing measure – aligning density/stowage between wood chips and pellets; the choice of fiber is clearly in the direction of wood chips. Take into consideration that 1 million MT of wood pellets requires 2.3 million US tons of fiber to produce.

Preferential pricing and services will be tailored to buyers' needs once detailed specification and a procurement agreement is negotiated. Actual costs would be measurably lower than depicted above. Once a dialog is established between TSL and buyer we can get to a workable agreement beneficial to the buyer.

Appendix 1
Indigenous Species to Maine

Phytosanitary Export Database (PExD) https://pcit.aphis.usda.gov/pcit/faces/pcit_home.jsf

Deciduous:	**Scientific Name: EU/Poland Approved Species**
Maples:	*Acer: spicatum; rubrum; pensylvanicum*
Basswood:	*Tilia Americana*
Beech:	*Fagus grandifolia*
Birch:	*Betula: populifolia; cordifolia; Papyrifera; lenta; And alleghaniensis*
Balsam Poplar:	*Populus balsamifera; Populus tremuloides*
Willows:	*Salix nigra*

Coniferous:	**Scientific Name: EU/Poland Approved Species**
Eastern Hemlock	*Tsuga canadensis*
Eastern White Pine	*Pinus strobus*
Red Spruce	*Picea rubens*
Balsam Fir	*Abies balsamea*

European Union*

Austria; Belgium; Bulgaria; Croatia; Cyprus; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Ireland; Italy; Latvia; Lithuania; Luxembourg; Malta; Montenegro; Netherlands; Poland; Portugal; Romania; Slovakia; Slovenia; Spain; Sweden; United Kingdom

Country Information: Poland *Last Updated: September 23, 2019*

Notice: Change in European Union Regulations 05/30/2019

- Beginning in **December of 2019**, the European Union will require a phytosanitary certificate for all plant parts and plant products unless indicated otherwise in a commodity summary.
- The European Union additional declarations will change from their current format to plain English statements.
- Beginning in **December 2020**, the option to fumigate with Methyl Bromide will no longer be allowed for any commodity

Treatments

Phytosanitary Certificate (PC) is required.

Heat treatment

Concentration	Temperature	Duration	Comm
	56 C	30 Minutes	

Additional Declaration

- Consignment complies with Annex IV.I A, point **1.2 option (a)** of EC Plant Health Directive 2000/29/EC.

AND

- The wood is free from bark.

OR

- The wood has a protective covering to ensure that infestation with ***Bursaphelenchus xylophilus*** or ***Monochamus spp.*** cannot occur.

Appendix 2

Lab Report Analysis – Sample Species:

Report of Analysis

BEL2690
OSAHADA OF MAINE, LLC
177 East Main Street RT 1
Searsport, ME 04974

Company Contact: Art House

BEL ID Number:	BEL190244-2	**Sample Weight (kg):**	1.32
Product / Commodity:	Wood Chips Fresh Cut	**Sample Received:**	2/11/2019
Sample Designation:	33% White Birch - 33% Yellow Birch - 33% Silver Maple	**Report Date:**	2/21/2019
Date Sampled:	2/19/2019	**Report Code:**	
		Purchase Order #:	

Parameter	As-Received	Dry Basis	Analytical Method
Total Moisture (%)	40.06		ISO 18134-1
Ash (%)	0.18	0.29	ISO 18122
Volatiles (%)	52.51	87.61	ISO 18123
Fixed Carbon (%)	7.24	12.09	By Difference
GCV (GJ/Tonne)	11.77	19.63	ISO 18125
NCV cV (GJ/Tonne)	10.11	18.41	ISO 18125
NCV cP (GJ/Tonne)	10.01	18.34	ISO 18125
Carbon (%)	30.05	50.13	ISO 16948
Hydrogen (%)	3.57	5.95	ISO 16948
Nitrogen (%)	0.07	0.12	ISO 16948
Oxygen (%)	26.07	43.50	ISO 16948
Sulfur (%)	0.01	0.01	ISO 16994
Chlorine (%)	< 0.005	< 0.005	ISO 16994

All samples cut in Waldo and Hancock County - Maine. All samples were air dried for 30 days then debarked and chipped on day 32. Samples were then sent to the lab for testing.

Prepared By:

David Robles - Assistant Laboratory Manager

All samples cut in Waldo and Hancock County - Maine. All samples were air dried for 30 days then debarked and chipped on day 32. Samples were then sent to the lab for testing.

1641 Sigman Road
PO Box 919
Conyers, GA 30012
1-770-922-8000 ext 164
www.biomassenergylab.com

Report of Analysis

Maine Woods Biomass Exports, LLC
Stephenson Lane
Belfast, Maine 04915

Company Contact: Arthur House

BEL ID Number(s):	BEL121299	**Sample Weight (kg):**	6.09
Product/Commodity:	Wood Chips - Mixed Species	**Sample Received:**	7/31/2012
Sample Designation:	Biomass - Hog Fuel	**Report Date:**	8/8/2012
Packaging:	Plastic Bag	**Report ID:**	BEL121299-1
Date Sampled:	N/A	**Purchase Order #**	N/A

Compositional Analysis: Proximate/Ultimate Analysis

Parameter	As-Received	Oven Dry	Analytical Method
Total Moisture (%)	27.93		CEN/EN 14774-1
Ash (%)	2.51	3.49	CEN/EN 14775
Volatiles (%)	57.88	80.31	CEN/EN 15148
Fixed Carbon (%)	11.66	16.17	By Difference
Gross Calorific Value (GJ/Tonne)	13.56	18.81	CEN/EN 14918
Net Calorific Value (cV)(GJ/Tonne)	12.02	17.57	CEN/EN 14918
Net Calorific Value (cP)(GJ/Tonne)	11.93	17.50	CEN/EN 14918
Carbon (%)	33.76	46.85	CEN/EN 15104
Hydrogen (%)	4.34	6.03	CEN/EN 15104
Nitrogen (%)	0.26	0.36	CEN/EN 15104
Sulfur (%)	0.02	0.03	CEN/EN 15289
Oxygen (%)	31.17	43.25	By Difference
Chlorine (ppm)			ASTM D6721

Prepared By: Chris Wiberg

1641 Sigman Road
Conyers, GA 30012
www.biomassenergylab.com

Report of Analysis

BEL-ME201111
Osahada of Maine
177East Main Street
Searsport, ME 04974

Contact: Arthur House

BEL ID Number:		**Sample Weight (kg):**	4.95
Product / Commodity:	ME201111	**Sample Received:**	3/24/2019
Sample Designation:	Wood Chips	**Report Date:**	3/31/2019
Date Sampled:	Fresh Cut Hemlock Chips 3/12/2019	**Report Code:** **Purchase Order #:**	

Parameter	As-Received	Dry Basis	Analytical Method
Total Moisture (%)	52.54		CEN/EN 14774-1
Ash (%)	0.20	0.43	CEN/EN 14775
Volatiles (%)	39.02	82.21	CEN/EN 15148
Fixed Carbon (%)	8.23	17.35	By Difference
GCV (GJ/Tonne)	9.83	20.71	CEN/EN 14918
NCV cV (GJ/Tonne)	8.02	19.46	CEN/EN 14918
NCV cP (GJ/Tonne)	7.92	19.39	CEN/EN 14918
Carbon (%)	24.60	51.84	CEN/EN 15104
Hydrogen (%)	2.89	6.09	CEN/EN 15104
Nitrogen (%)	0.11	0.23	CEN/EN 15104
Sulfur (%)	< 0.01	0.01	CEN/EN 15104
Oxygen (%)	19.65	41.41	CEN/EN 15104
Chlorine (%)	< 0.005	< 0.005	CEN/EN 15289

Prepared By:

Christopher Cox - Laboratory Manager

1641 Sigman Road
Conyers, GA 30012
www.biomassenergylab.com

Report of Analysis

Osahada of Maine
177 East Main Street
Searsport, ME 04974

Company Contact: Art House

BEL ID Number(s):	BEL190101	**Sample Weight (kg):**	5.67
Product/Commodity:	Wood Chips	**Sample Received:**	7/31/2018
Sample Designation:	Mixed Conifers	**Report Date:**	8/8/2018
Packaging:	Plastic Bag	**Report ID:**	BEL-ME190101
Date Sampled:	N/A	**Purchase Order #**	N/A

Compositional Analysis: Proximate/Ultimate Analysis

Parameter	As-Received	Oven Dry	Analytical Method
Total Moisture (%)	28.96		CEN/EN 14774-1
Ash (%)	2.66	3.74	CEN/EN 14775
Volatiles (%)	56.77	79.91	CEN/EN 15148
Fixed Carbon (%)	11.59	16.32	By Difference
Gross Calorific Value (GJ/Tonne)	13.28	18.69	CEN/EN 14918
Net Calorific Value (cV)(GJ/Tonne)	11.74	17.47	CEN/EN 14918
Net Calorific Value (cP)(GJ/Tonne)	11.65	17.40	CEN/EN 14918
Carbon (%)	33.68	47.41	CEN/EN 15104
Hydrogen (%)	4.22	5.94	CEN/EN 15104
Nitrogen (%)	0.32	0.46	CEN/EN 15104
Sulfur (%)	0.02	0.03	CEN/EN 15289
Oxygen (%)	30.14	42.42	By Difference
Chlorine (ppm)			ASTM D6721

Prepared By: Chris Wiberg

1641 Sigman Road
PO Box 919
Conyers, GA 30012
1-770-922-8000 ext 303
www.biomassenergylab.com

Report of Analysis

BEL2690
OSAHADA OF MAINE, LLC
177 East Main Street RT 1
Searsport, ME 04974

Company Contact: Art House

BEL ID Number:	BEL190245-1	**Sample Weight (kg):**	1.38
Product / Commodity:	Wood Chips Fresh Cut	**Sample Received:**	2/11/2019
Sample Designation:	60% Pine - 25% Spruce - 15% Fir	**Report Date:**	2/21/2019
Date Sampled:	2/19/2019	**Report Code:**	
		Purchase Order #:	

Parameter	As-Received	Dry Basis	Analytical Method
Total Moisture (%)	43.59		ISO 18134-1
Ash (%)	0.28	0.49	ISO 18122
Volatiles (%)	45.22	80.16	ISO 18123
Fixed Carbon (%)	10.90	19.34	By Difference
GCV (GJ/Tonne)	11.77	20.87	ISO 18125
NCV cV (GJ/Tonne)	10.07	19.63	ISO 18125
NCV cP (GJ/Tonne)	9.97	19.56	ISO 18125
Carbon (%)	29.75	52.73	ISO 16948
Hydrogen (%)	3.37	5.98	ISO 16948
Nitrogen (%)	0.07	0.12	ISO 16948
Oxygen (%)	22.94	40.67	ISO 16948
Sulfur (%)	0.01	0.01	ISO 16994
Chlorine (%)	< 0.005	< 0.005	ISO 16994

All samples cut in Waldo and Hancock County - Maine. All samples were air dried for 30 days then debarked and chipped on day 32. Samples were then sent to the lab for testing.

Prepared By:

David Robles - Assistant Laboratory Manager

1641 Sigman Road
PO Box 919
Conyers, GA 30012
1-770-922-8000 ext 303
www.biomassenergylab.com

Report of Analysis

BEL2690
OSAHADA OF MAINE, LLC
177 East Main Street RT 1
Searsport, ME 04974

Company Contact: Art House

BEL ID Number:	BEL190243-1	**Sample Weight (kg):**	1.24
Product / Commodity:	Wood Chips Fresh Cut	**Sample Received:**	2/11/2019
Sample Designation:	50% White Birch - 50% Yellow Birch	**Report Date:**	2/21/2019
Date Sampled:	2/19/2019	**Report Code:**	
		Purchase Order #:	

Parameter	As-Received	Dry Basis	Analytical Method
Total Moisture (%)	42.92		ISO 18134-1
Ash (%)	0.16	0.28	ISO 18122
Volatiles (%)	50.01	87.62	ISO 18123
Fixed Carbon (%)	6.90	12.09	By Difference
GCV (GJ/Tonne)	11.19	19.61	ISO 18125
NCV cV (GJ/Tonne)	9.50	18.38	ISO 18125
NCV cP (GJ/Tonne)	9.40	18.31	ISO 18125
Carbon (%)	28.47	49.88	ISO 16948
Hydrogen (%)	3.41	5.97	ISO 16948
Nitrogen (%)	0.08	0.13	ISO 16948
Oxygen (%)	24.96	43.72	ISO 16948
Sulfur (%)	0.01	0.01	ISO 16994
Chlorine (%)	< 0.005	< 0.005	ISO 16994

All samples cut in Waldo and Hancock County - Maine. All samples were air dried for 30 days then debarked and chipped on day 32. Samples were then sent to the lab for testing.

Prepared By:

David Robles - Assistant Laboratory Manager

1641 Sigman Road
PO Box 919
Conyers, GA 30012
1-770-922-8000 ext 164
www.biomassenergylab.com

Report of Analysis

BEL2690
OSAHADA OF MAINE, LLC
177 East Main Street RT 1
Searsport, ME 04974

Company Contact: Art House

BEL ID Number(s):	BEL12	**Sample Weight (kg):**	3.65
Product/Commodity:	Biomass – Mixed Species	**Sample Received:**	8/7/2018
Sample Designation:	Hog Fuel Dry - Maine	**Report Date:**	8/14/2018
Packaging:	Plastic Bag	**Report ID:**	BEL12
Date Sampled:	N/A	**Purchase Order#**	N/A

Compositional Analysis: Proximate/Ultimate Analysis

Parameter	As-Received	Oven Dry	Analytical Method
Total Moisture (%)	23.62		CEN/EN 14774-1
Ash (%)	0.98	1.29	CEN/EN 14775
Volatiles (%)	62.58	81.93	CEN/EN 15148
Fixed Carbon (%)	12.81	16.78	By Difference
Gross Calorific Value (GJ/Tonne)	15.56	20.37	CEN/EN 14918
Net Calorific Value (cV)(GJ/Tonne)	14.04	19.10	CEN/EN 14918
Net Calorific Value (cP)(GJ/Tonne)	13.96	19.03	CEN/EN 14918
Carbon (%)	38.89	50.91	CEN/EN 15104
Hydrogen (%)	4.71	6.16	CEN/EN 15104
Nitrogen (%)	0.26	0.33	CEN/EN 15104
Sulfur (%)	0.01	0.01	CEN/EN 15289
Oxygen (%)	31.54	41.29	By Difference
Chlorine (ppm)			ASTM D6721

Prepared By: Chris Wiberg

Laboratorium SGS Polska
Pracownia Paliw Stałych (PPS)
ul. Kopalniana 11
43-225 Wola, tel./fax: (32) 211 80 80

AB 313

SPRAWOZDANIE Z BADAŃ NR: 90/05/12					Legenda:
Numer ident.próbki: **B-90**	data dostarczenia:	28.05.12	Strona: 1 z 1		a-stan analityczny
Rodzaj próbki: **biomasa**	data pobrania:	-	Liczba stron: 1		r-stan roboczy
Zamawiający: **CMI 56 Stephenson Lane Belfast, Maine 04915 USA**	data wykonania badań:	29-31.05.12	Liczba załączników: 0		d-stan suchy
Numer próbki Zamawiającego: -	Numer zamówienia:	20B/12/29-2001	Wola,dn.	31.05.12	daf-stan suchy i bezp.

Przedstawione wyniki badań dotyczą wyłącznie próbki pobranej i dostarczonej przez Zamawiającego.

Metoda badawcza	Badana cecha (Oznaczenie)	j.m.	Wynik	niep. pomiaru +/-
PN-EN 14774-3:2010	Zawartość wilgoci w próbce analitycznej (M_{ad})	%	7,6	-
PN-EN 14774-1:2010 p.8.2.	**Zawartość wilgoci całkowitej (M_{ar})**	%	**17,4**	-
PN-EN 14775:2010 ~~PN-ISO 1171:2002~~	Zawartość popiołu (A_{ad})	%	0,6	-
	Zawartość popiołu (A_{ar})	%	**0,6**	-
	Zawartość popiołu (A_d)	%	0,7	-
^PN-EN 14918:2010	Ciepło spalania ($Q_{gr,v,ad}$)	kJ/kg	18299	-
	Ciepło spalania ($Q_{gr,v,ar}$)	kJ/kg	16358	-
	Ciepło spalania ($Q_{gr,v,d}$)	kJ/kg	19804	-
	Ciepło spalania ($Q_{gr,v,daf}$)	kJ/kg	19934	-
	Wartość opałowa ($Q_{net,v,ad}$)	kJ/kg	-	-
	Wartość opałowa ($Q_{net,v,ar}$)	kJ/kg	**14985**	-
	Wartość opałowa ($Q_{net,v,d}$)	kJ/kg	18627	-
	Wartość opałowa ($Q_{net,v,daf}$)	kJ/kg	-	-
ISO19579:2006 ~~PN-G-04584:2001~~	Zawartość siarki całkowitej (S_{ad},S_t^a)	%	0,01	-
	Zawartość siarki całkowitej (S_{ar},S_t^r)	%	0,01	-
	Zawartość siarki całkowitej (S_d,S_t^d)	%	0,01	-
ISO 562:2010 PN-G-04516:1998 PN-EN 15148:2010	Zawartość części lotnych (V_{ad},V^a)	%	-	-
	Zawartość części lotnych (V_{ar},V^r)	%	-	-
	Zawartość części lotnych (V_d,V^d)	%	-	-
	Zawartość części lotnych (V_{daf},V^{daf})	%	-	-
PN-EN 15104:2011, ~~PN-G-04571:1998~~	Zawartość wodoru całkowitego (H_{ad},H_t^a)	%	5,28	-
PN-EN 15104:2011 PN-G-04571:1998	Zawartość pierwiastka C (C_{ad},C_t^a)	%	-	-
	Zawartość pierwiastka C (C_{ar},C_t^r)	%	-	-
	Zawartość pierwiastka C (C_d,C_t^d)	%	-	-
PN-G-04534:1999 p.2.7.2	Zawartość chloru (Cl^a)	%	-	-
	Zawartość chloru (Cl^r)	%	-	-
	Zawartość chloru (Cl^d)	%	-	-

^ Nawazka 0,25-0,40g. Powtarzalność metody 1,23% wyniku średniego.

Przedstawione wyniki badań odnoszą się wyłącznie do badanej próbki. Względna rozszerzona niepewność standardowa pomiaru dla współczynnika rozszerzenia k=2, wyznaczona dla poziomu ufności 0,95

Informacje dodatkowe:

Opis próby: Zrębki leśne "Hog Fuel". Miejsce pobrania próbki Maine USA, data ścięcia 07.05.12.
Próbka dostarczona w kartonowym pudełku.

SGS Polska Sp. z o.o.
Autoryzował, Data i podpis
Pracownia Paliw Stałych
31.05.12
mgr inż. Magdalena Szmoszyn
z up.

Appendix 3
Sustainability Statistics
Considering all Four (4) Mega Forest Regions

Certifications

Major Landowners Harvest Acreage

Certifications	Acres	Owners
FSC	1,548,319	11
SFI	2,831,237	7
FSC & SFI	3,257,579	1
	7,637,135	**19**

Every landowner has cutting plans, sustainability plans and works with licensed, certified Forester to define annual cuts and to oversee all required to supply fiber from the land through licensed logging companies.

Logging Contractors and Trucking Firms

Total	**86**	
Within 50 mi	53	62%
Beyond 50 mi	33	38%

5,000,000	US Tons Available
4,508,500	Metric Tons Available

Sustainable Forest Management Philosophy

The underlying strategy and determination is to harvest, manufacture and provide end products in an efficient and sustainable process to not only ensure clients of optimal performance, quality and pricing but, also to do so in such a manner as to be consistent with the needs and expectations of reducing our Carbon Footprint in our global environment. In adhering to the norms, and terms of the 1993 Helsinki resolution, we pledge to conduct all business in the spirit of 'Good Practices' and to ensure "the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfill, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems".

Phytosanitation Heat Treatment

Phytosanitation – Heat Treatment of wood chips from any location in North America is the only approved process of "sanitation" or "pasteurization" of wood chips allowed for importation into any EU country. The heat treatment process is accomplished with the use of waste steam produced by an existing power generating plant. The heat treatment system, designed, patented and manufactured by Thompson Dehydrating Co., shall operate within its walls. The HT operation is tolled (processed) through the HT facility. Pursuant to the EU's global shift away from chemical based fumigation, the following was published throughout the EU:

"On June 17, 2014 the European Union published amendments to its principle plant health directive (Council Directive 2000/29/EC) which regulates the import of plants and plant products including forestry products. Member countries of the European Union are to adopt the requirements within their laws, regulations, etc. by 30 September 2014. The Requirements will come into force for imports arriving on or after October 1, 2014. Wood must be: - heat Treated or, chemical pressure impregnated using approved products. At present the E.U. has not approved any fumigation products. Heat treatment is defined as the application of 56°C for a minimum duration of 30 continuous minutes throughout the entire profile of the wood (including at its core)."