

NOVA
Northern Ontario Value Added Initiative

PELLET TOOL KIT

A basic how-to guide
prior to starting
your pellet project

Why choose pellets?

Biomass is considered to be “carbon neutral”, meaning the amount of carbon released when burned is equal to the amount removed from the atmosphere when the plant is growing (Ontario Power Generation, OPG).



Pellets vs hogfuel/chips vs briquettes vs liquid fuel

The pros and cons of different biofuels

	Pellets	Hog/chip fuel	Briquettes	Liquid fuel/Syngas
Pros	<ul style="list-style-type: none"> Allows automated handling Transport friendly Clean, pleasant, convenient fuel; sophisticated boilers Relatively compact storage requirements Emerging market 	<ul style="list-style-type: none"> Low investment costs Good fuel for local industrial usage Cheap fuel, potentially suitable for self production Boilers tend to be better suited to larger or agricultural type applications 	<ul style="list-style-type: none"> Fairly low investment costs Can be used in wood stoves Reliable and repeatable process Tolerant to different moisture levels 	<ul style="list-style-type: none"> Transport effective Can be used in existing vehicles and/or applications Can be refined for further use for a wide range of value-added products
Cons	<ul style="list-style-type: none"> High initial cost 	<ul style="list-style-type: none"> Bulky (less transport friendly) 	<ul style="list-style-type: none"> Limited in allowing feed automation 	<ul style="list-style-type: none"> Expensive process

Self help DIY: Websites, Who to talk to?

- Canadian Bioenergy Association www.canbio.ca
- BioEnterprise www.bioenterprise.ca
- Biomass Magazine www.biomassmagazine.com
- Ontario Power Authority, Biomass Projects www.powerauthority.on.ca
- Ministry of Northern Development, Mines & Forestry... www.mndmf.gov.on.ca
- Ministry of Energy and Infrastructure, Biomass www.mei.gov.on.ca
- World Bioenergy Association www.worldbioenergy.org
- Natural Resources Canada www.nrcan.gc.ca
- Ontario Green Energy Act www.greenenergyact.ca

Use of pellets? – Stoves, Furnaces, BBQ, CHP, DH

In North America, most of the pellets consumed currently are for home heating in wood pellet stoves. A large number of models of pellet stoves, central heating furnaces and other heating appliances have been developed and marketed since about 1999. With the surge in the price of fossil fuels, the demand has increased, especially all over Europe, and a sizable industry is emerging. Industry is now looking into other uses of pellets including co-firing with coal or natural gas in electrical generating stations resulting in fewer emissions. Municipalities are more and more interested in the heat generated from cogeneration facilities, so-called Combined Heat and Power plants (CHP), to be used in distributed heating (DH) systems for heating purposes in hospitals, hotels, apartment buildings, schools, official buildings, offices, stores, green houses and even new and/or established residential housing sub-divisions for towns and communities. Pellets have also been more and more appreciated as an animal bedding material in stables as well as a flavoured fuel for barbequing (BBQ).

Premium	Standard/Utility	Bedding	BBQ
Residential stoves and furnaces	CHP and DH Cogeneration for electricity production	Horse bedding, pet bedding	Gives taste to barbequing with the convenience of gas

Photo 1

Distributed heating pipes under installation in Varkaus, Finland



Biomass availability and demand – Competition for biomass

Wood pellets are a type of densified wood fuel, generally made from sawdust and shavings. Lately, the use of roundwood, including tops and branches, harvested from assigned, and underutilized, unassigned harvestable timber stands has become an interesting alternative due to the reduced number of operating sawmills. This is despite the increased harvest costs for the roundwood feedstock.

A number of forest products companies in Ontario are implementing CHP projects to use the available fibre from their logging operations: Tembec has a CHP plant at their Chapleau sawmill using biomass to produce 7.2MW of electricity and uses the heat and steam internally. St. Mary’s Paper Corp. have announced that they are planning to build a biomass CHP plant in Sault Ste. Marie, Ontario, to convert wood waste biofibre into 30MW electricity sold to the grid and use the heat and steam internally. AbitibiBowater in Fort Frances has installed a new 47 MW unit that will ultimately consume 600,000 to 700,000 tonnes of wood waste and forest residues. These large units will greatly impact the fibre available for new pellet operations.

A new or existing pellet producer has to have a secured raw material supply. The raw material can be sourced directly from operating sawmills, via a Sustainable Forest Licence (SFL) holder or from private forest owners, etc. For a good assessment of the biomass/unmerchantable timber resource, you should consider following steps:

1. Consult the Request For Expression of Interest (RFEI) from both MNR (Ministry of Natural Resources) and OPG.
2. Additional information can be obtained from MNR’s Industrial Relations Branch and/or MNR’s Regional Head Offices.
3. Contact the Area Supervisor or Area Forester of the local SFL holder or private forest owner.
4. For more detailed biomass assessments, contact FPInnovations.



Photo 2

One man private operator in Finland chipping biomass directly on forest road and filling the container bin on the accompanying truck with chips

Self help DIY: Websites, Who to talk to?

- MNR, Industry Relations, Regional Head Offices, SFL holders www.mnr.gov.on.ca
- OPG www.opg.com, biomass@opg.com
- FPInnovations www.fpinnovations.ca
- MOE, Ministry of the Environment www.ene.gov.on.ca
- Natural Resources Canada, Canada’s Forests.. www.canadaforests.nrcan.gc.ca
- Deloitte&Touche www.deloitte.com
- Régulvar, CHP and DH, “La cité verte”, Quebec City www.regulvar.com

Premium	Standard/Utility	Bedding	BBQ
White wood, no bark	Bark accepted to a certain point	Cedar and pine are usually used	Select hardwoods

Getting the fibre to the mill gate

– Furnish cost vs. processing cost

What would be the means of processing harvested material in a cost efficient way? Average transport distance and what distance is feasible? These are important questions to consider.

Since the traditional raw material for processing pellets, i.e., from sawmills, is very limited, additional fibre is being sourced from underutilized wood baskets. This underutilized wood has to be harvested, transported, debarked, chipped and then dried. The extra handling and processing has to be managed efficiently and cost effectively for the business to be profitable.

When processing pellets made from roundwood it is usually debarked and then ground into smaller sized material prior to the drying process. Using bark as fuel makes the drying process, potentially the most expensive part of the operation, less costly. A considerable amount of water needs to be evaporated from the ground furnish depending on the incoming moisture content of the fibre. Pre-drying will lower the energy demand in the drying process. The dry material needs to be ground again or hammer milled to an even smaller particle size. Dry raw material from a different source, like shavings, can be added at this point in the process depending on particle size.

The small particles will be compacted into small pellets, usually 6 to 8 mm in diameter, and up to 38 mm in length. The friction in the process makes the pellets very hot and they need to be stabilized in the cooling process. In the screening process, the wood dust or fines will either be used as fuel or blown back and pelletized again. Animal bedding doesn't allow dust, requiring a more efficient method, vacuuming, to be done.

The finished pellets need to be stored, either in a silo or shed for bulk storage, or bagged, wrapped and placed on a skid.

Some manufacturers offer a turnkey solution where all equipment is well synchronized. If that is not the case the different equipment centres (hammermill, dryer, screens, pelletizer, etc) need to be specified so that the output from one machine matches the input for the next.

In Figure 1, the costs for pelletizing have been compared using raw material that does or does not require drying; however in both cases white wood has been used as raw material. Sawdust with a moisture content of about 50% needs to be dried, while shavings with a moisture content of about 12% do not need additional drying. In the case of using green biomass as raw material, the quantity of raw material is expected to increase while the drying cost will slightly decrease by using bark as fuel.

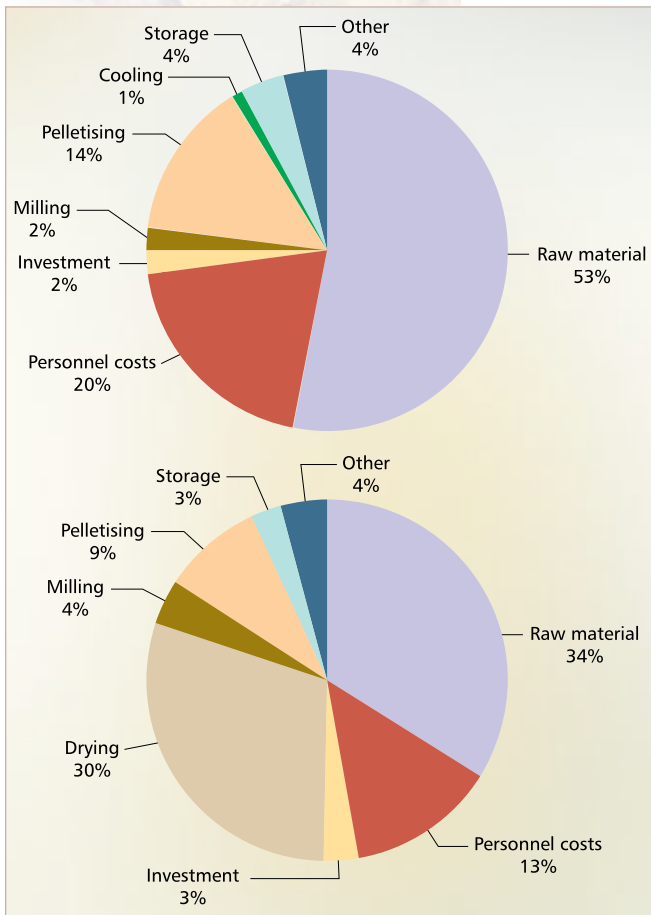


Figure 1

Pellet production costs without (top) and with drying of biomass, cost example from Finland, www.woodenergy.ie

Self help DIY: Websites, Who to talk to?

- FPIInnovations www.fpinnovations.ca
- European Biomass Industry Association www.eubia.org

Premium	Standard/Utility	Bedding	BBQ
White wood	Bark accepted to a certain point	Mould, fines and some wood species are not allowed	Specific hardwoods

Pellet products & specifications, packaging

– Current and future, OPG

Pellets can be produced in various sizes, usually between 6 to 8 mm in diameter and up to 38 mm in length. Fuel pellets are presently sold mainly in two categories, depending on the amount of ash contained. The current fuel pellet types in North America are the Premium/Residential (PR) grade and the Commercial/Standard/Industrial (CSI) grade. Sub-categories occur as well, such as BBQ pellets and animal bedding.

North American specifications' standards

	North American Grades		
Diameter	5.8 mm to 7.2 mm (0.230" to 0.285")		
Length	max 1% > 38 mm (1.5")		
Chlorides	≤300 ppm		
	Premium	Standard	Utility
Ash Content	≤1.0%	≤2.0%	≤6.0%
Fines	≤0.5%	≤1.0%	≤1.0%
Moisture Content	≤8.0%	≤10.0%	≤10.0%
Durability	≥96.5	≥95.0	≥95.0
Bulk density (kg/m ³)	640 – 738	608 – 738	608 – 738
(lbs/ft ³)	40 – 46	38 – 46	38 – 46

Table 1

North American fuel pellet grades

The US based Pellet Fuel Institute proposed a new North American pellet fuel standard, that was finally accepted by its members in autumn 2010 and features three fuel pellet grades. The new grades to be implemented are Premium, Standard and Utility grades.

Ontario Power Generation, OPG, is looking into the potential to use pellets for co-firing with coal in their cogeneration plants. OPG have presented a guidance specification in their RFEI for *Supply and Transportation of Solid Biomass Fuel*. For the latest update on pellet specifications for OPG, please visit their website.

Other markets have other pellet standards, such as Austria, Germany and Sweden. The European Union is working on a European pellet standard.

See Figure 4b – Pellet products and markets at a glance (page 11), for detailed specifications and descriptions of North American pellet grades

Self help DIY: Websites, Who to talk to?

- Pellet Fuels Institute www.pelletheat.org
- Wood Pellet Association of Canada www.pellet.org
- OPG www.opg.com, biomass@opg.com
- European Pellet Center www.pelletcentre.info

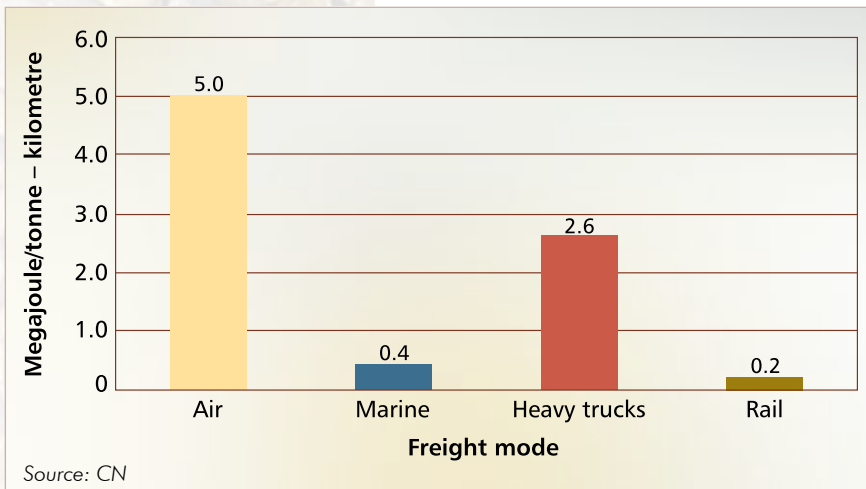
Premium	Standard/Utility	Bedding	BBQ
Less than 1 % ash content	Less than 2% and 6% ash content respectively	No fines or mould	Flavour, small packages

Storage and transportation & logistics

– Costs, seasonal variations

Pellet mills range in size from small to very large, and depending on the intended size and available raw material, infrastructure has to be planned accordingly. Small pelletizers can produce about 50 kg per hour (100 tonnes per year, one shift basis) supplying a very local market, while large facilities can have multiple pelletizers producing between 200,000 and 450,000 tonnes of pellets per year.

Pellet prices are lowest at the end of spring; however they still need to be produced and stored during the non-heating season to be able to meet the much higher demand prior to and during the heating season. Pellets are usually delivered in 40 lbs or 18 kg bags packed 55 bags per pallet (well wrapped and protected), in super bags of 700 to 1200 kg, or in bulk. Local and regional deliveries are usually done by flatbed truck or silo truck to retailers or home owners depending if they can receive pellets in bulk or not. Sales involving longer transport distances are usually sold by the truck load to wholesalers, distributors or large retailers. Larger volumes in bulk, or pallets or super bags delivered by train are the most environmentally friendly alternative and are reasonably fast. Europe (and recently Asia) receives huge quantities of pellets yearly, delivered directly to big CHP plants by ship.



CN transports considerable volume of pellets annually and one of their transport advantages is the low energy intensity it takes to move one tonne of pellets compared to other means of transportation.

The estimated transport cost is on average 10% of the final pellet price according to the consulting firm Vapo Oy, Finland.

Figure 2
Energy intensity of freight modes

Self help DIY: Websites, Who to talk to?

- Canadian National, CN, Forest products www.cn.ca
- Ontario Northland, ONR, Forest products www.ontarionorthland.ca
- Various short lines and truck transport companies
- Pellet Distributors

Premium	Standard/Utility	Bedding	BBQ
55 40 lbs bags on a pallet; truckloads of pallets Super bags, local bulk deliveries Hook-on forklift on flatbed trailer	Bulk deliveries by train, truck and/or ship. Stored in silos and sheds	55 40 lbs bags on a pallet; truckloads of pallets	110 20 lbs bags (or 220 10 lbs bags), on a pallet; truckloads of pallets

Equipment and volumes – Mobile, stationary

The available raw material mix and the intended size of pellet operation will decide the type of equipment to be used. Some equipment manufacturers offer turn-key solutions while others offer individual units that have been incorporated into the production layout. There are equipment manufacturers from North America, Europe and Asia offering various solutions where one concept could work better than another in a certain environment. A well-planned production layout is essential especially since the amount of fines generated increases every time the pellet has to be transferred or handled. See Figure 4a, Pellet production at a glance (page 10), for a flow chart describing the manufacturing processes for the different types of pellets. Usually the pellets are blown into silos, transported by a

loader or conveyed to new location and depending on the durability the pellets tend to lose some fibre or fines.

Self help DIY: Websites, Who to talk to?

- Various pellet and biomass equipment manufacturers
- FPIInnovations www.fpinnovations.ca
- European Biomass Industry Association www.eubia.org
- The Pellet Handbook, Earthscan www.earthscan.co.uk

Premium	Standard/Utility	Bedding	BBQ
Small, medium and large plants depending on access to bark-free raw material	Medium to very large pellet plants accepting bark	Mould, fines and some wood species are not allowed.	Small plant with bagging and wrapping facility
Bagging and wrapping facility	Bulk (silo or shed) storage of considerable volumes	Bagging and wrapping facility	

Markets explain situation

– Current capacity and expected demand for Canada, US, World

The largest pellet market in the world is in Europe and that market is still increasing. British Columbia exports most of its volumes to Europe; however in recent years some volumes also found a market in Asia. In North America there is an increasing in demand as well, especially in the Premium grade bagged pellet market; however for Northern Ontario producers, bulk deliveries to distributors located near major markets, would likely be the most feasible way to proceed. The distributor can then either do bulk deliveries via silo trucks or bag the pellets and then deliver 55 + bags/pallet to retailers and/or end-users via a flatbed truck.

Prior to planning your plant layout and selecting equipment, it is important to have a certified laboratory analyze the raw material to be used. In some cases this work will include pelletizing as well to provide more information about the product and process. The result will help determine what kind of pellet products can be produced and that in turn will decide the target market. An important part of pellet product development and ongoing production is to adjust the fibre input to find the optimum mixture with the best characteristics, like: pine/spruce; hardwood/softwood; wood/agricultural waste; peat/wood bark; etc. In some situations extra lignin has to be added to the furnish to get a pellet that bonds satisfactorily, has a high durability and a low level of fines.

Photo UNB, courtesy of HEDC

Photo 3

Pellet samples (from left) softwood/hardwood mixture, 100% bark, softwood, hardwood/bark mixture and hardwood.



Self help DIY: Websites, Who to talk to?

- Distributors, wholesalers, traders, stove and furnace dealers, BBQ dealers, animal supply dealers
- Pellets@las www.pelletcentre.info
- Hearth, Patio & Barbecue Association (HPBA) www.hpbcanada.org
- University of New Brunswick www.unb.ca
- Biomass Innovation Centre, Nipissing U www.biomassinnovation.ca
- Internet research

Market types: Heat, power & combined

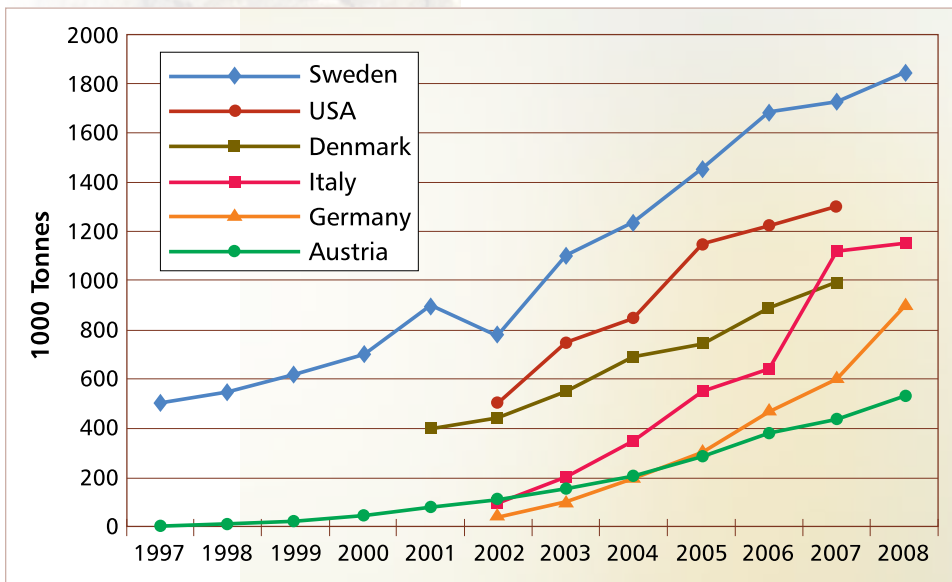
The BBQ pellets are usually made from hardwood adding a characteristic taste to the cooking. Flavour like garlic or onion can be added prior to the pelletizing process for enhanced cooking experience. See Figure 4a, Pellet production at a glance (page 10), where flavour is added for BBQ pellets.

In 2009, 3.4 million tonnes of pellets were exported from North America to Europe. These pellets are to be burned in coal-fired power stations for production of “sustainable electricity”. The major importing countries are Holland, Belgium, Denmark and England.

If only 50% of the 800 new coal-fired power plants to be built in Asia by 2015 will be co-firing, Asia is likely to become leader in pellet consumption (400,000,000 tonnes/year) according to EBES AG, Austria.

Figure 3

Pellet demand in the most important markets



Source: proPellets, Austria October 2007

Premium	Standard/Utility	Bedding	BBQ
Slow growing residential market in Canada, a bit faster growing in the US and still fast growing in Europe	Huge potential in Ontario if OPG realizes their plans of using pellets as fuel in their cogeneration facilities CHP plants in Europe are always hungry for pellets Asia is a new fairly fast growing market	Animal bedding is a small growing niche market	A small seasonal niche market that is growing

What's next? – Torrefaction, VA-pellets, research

Torrefaction – TOP Pellet

Torrefaction is a technology that is developing more and more interest, especially with the recent increases in transportation costs. Biomass torrefaction is a pre-treatment process of the furnish done at 200 to 300°C in the absence of oxygen. Besides making the biomass bone dry, the resultant thermal decomposition reactions at this temperature cause the biomass to lose its cohesiveness and its fibrous structure. The superior fuel quality of torrefied biomass makes it very attractive for combustion and gasification applications, in general because the thermal efficiencies of these applications can be improved due to the high calorific value of the torrefied biomass. A combination of torrefaction and pelletization has been introduced by the Energy Research Centre of the Netherlands (ECN) as TOP-pellets. It is a high energy, dense, and mechanically strong fuel with water repellent characteristics.

Canadian certified professional education schemes

Similar to the European Computing Drivers License ECDL that has become a widely accepted standard it should be considered to establish an “EU (and Canadian?...) biomass heating drivers license” for installers, that makes sure that all key issues for the efficient installation and operation of biomass heating systems are known (*A Pellet Road Map For Europe, European Biomass Association*).

Future development and Process optimization

Research is being done on various advanced technologies like X-ray fluorescence (XRF) which could help detect ash elements in the biomass and Near infrared spectroscopy (NIRS) that can detect the moisture content online of biomass or pellets. Research is also being done on biofuel hybrids where a pellet fueled engine could be used as power line in a vehicle or a power plant.

Go Pellets Canada is a pellet promotion initiative driven by a dedicated group of companies and individuals who see the merit in using pellets for heating Canadian homes, businesses and institutions.

Wood Pellet Association of Canada, together with several partners, is doing research and development in partnership with the University of British Columbia (Biomass and Bioenergy Research Group) in a variety of research topics.

CHPP – Combined Heat, Power and Pellet plants. CHPP uses excess heat in the summer months to dry biomass which in turn will be pressed into pellets. The pellets are then sold to residential or commercial users, even to centrally located CHP plants running on pellet fuel where transport traffic has to be minimized.

Sun & Pellets, a 100% renewable energy combination for residential heating. This is a climate smart solution using pellets in the winter months and sun heat during the summer, storing heat in water tanks. This kind of solution becomes more and more attractive in Northern Europe when changing from oil fuel heating.



Photo 4

Pellet user in Finland.

The small building to the right contains pellet storage; the other contains the pellet furnace, control system and a back-up system.

The unit heats up the buildings connected to the distributed heating system.

Self help DIY: Websites, Who to talk to?

- European Biomass Association www.aebiom.org
- Canadian Biomass Innovation Network www.cbin-rcib.gc.ca
- ECN www.ecn.nl
- Precer www.precer.com
- Internet search
- The World Council for Renewable Energy www.wcre.de
- Go pellets Canada, CanBio www.canbio.ca
- Biomass and Energy Research Group www.biomass.ubc.ca
- CHPP concept, GreenExergy www.greenexergy.com
- Centre for research & innovations in the bio-economy, CRIBE www.cribe.ca

Pellet production at a glance

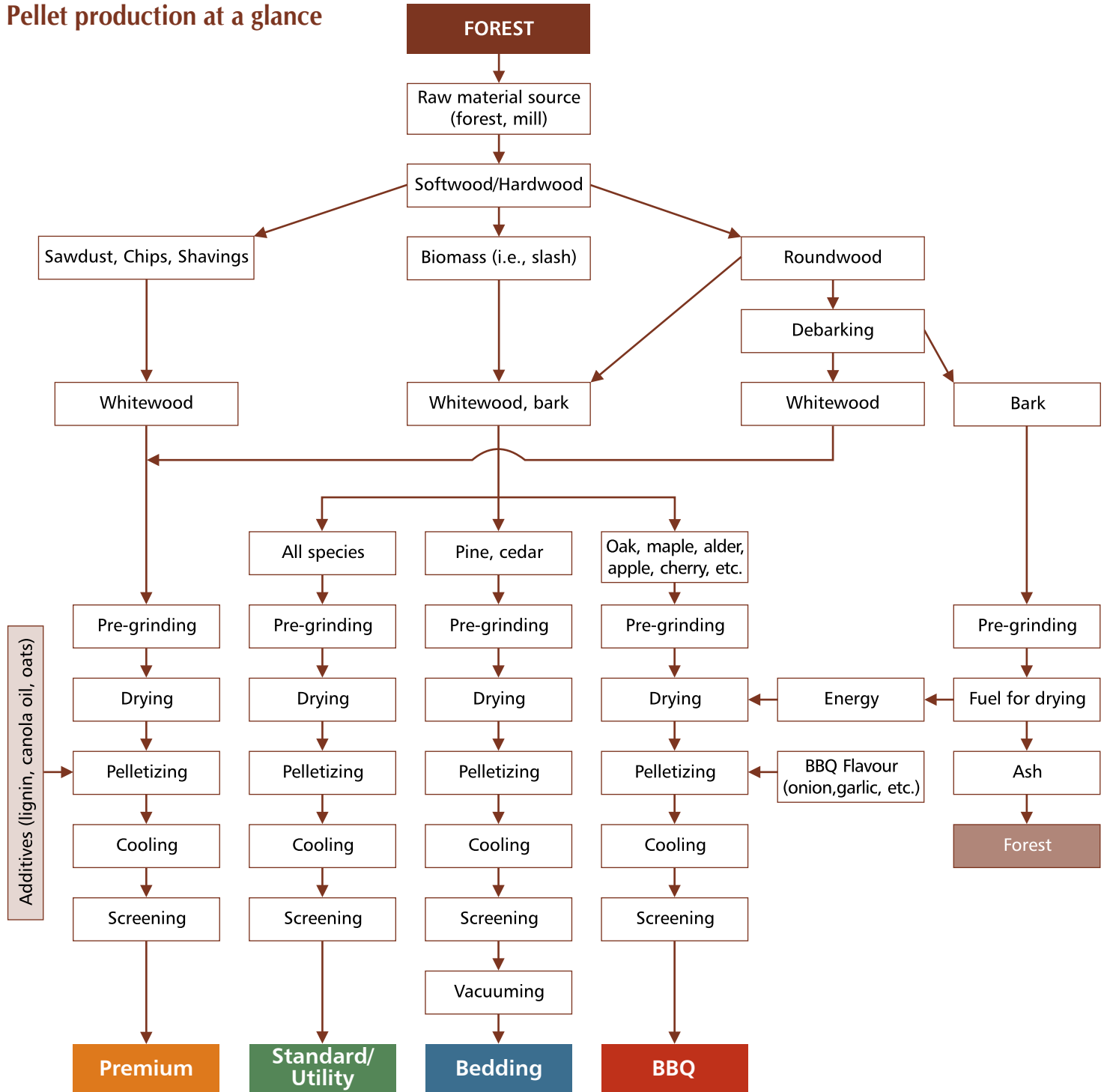


Figure 4a
Pellet processing

Pellet products and markets at a glance

New Standard (2010 –)					
	Premium	Standard	Utility	Bedding	BBQ
PARAMETERS					
Bulk density (lb/ft ³)	40–46	38–46	38–46		
Durability	≥ 96.5	≥ 95	≥ 95		
Fines (%)	≤ 0.5	≤ 1.0	≤ 1.0	0.0	≤ 2.0
Ash (%)	≤ 1.0	≤ 2.0	≤ 6.0		≤ 2.0
Moisture (%)	≤ 8.0	≤ 10.0	≤ 10.0		
Chloride (ppm)	≤ 300	≤ 300	≤ 300		
Mould (%)				0.0	
END USERS					
• Residential	Yes				
• Industrial, small grid	Yes	Yes			
• CHP, Cogen		Yes	Yes		
• Stables				Yes	
• BBQ					Yes
PACKAGING					
• Bulk container	Yes	Yes	Yes		
• Super bag (1 tonne)	Yes	Yes	Yes		
• 40 lb (18 kg) bags on pallet (55 bags)	Yes			Yes	
• 20 lb (9 kg) bags on pallet (110 bags)					Yes
• 10 lb (4.5 kg) bags on pallet (220 bags)					Yes
STORAGE					
• Silo	Yes	Yes	Yes		
• Shed	Yes	Yes	Yes		
• UV protective plastic bags on a paper protected pallet all double shrink-wrapped	Yes			Yes	Yes
TRANSPORT					
Delivery truck with boom or forklift	Yes			Yes	Yes
Silo truck with hose system	Yes	Yes	Yes		
Flat bed truck with forklift	Yes			Yes	Yes
Train box car (80 tonnes)	Yes			Yes	Yes
Train bulk car 100 tonnes	Yes	Yes	Yes		
Intermodal shipping		Yes	Yes		
DISTRIBUTION					
• Reloading	Yes			Yes	Yes
• External packaging	Yes				
• Bag delivery	Yes			Yes	Yes
• Bulk delivery	Yes	Yes	Yes		
• Direct end user	Yes	Yes	Yes	Yes	
SALES NETWORK					
• Retailers	Yes			Yes	Yes
• Wholesalers	Yes			Yes	Yes
• Distributors	Yes			Yes	Yes
• Dealers	Yes			Yes	Yes
• Traders (OPG, overseas)		Yes	Yes		
• Local end user	Yes	Yes	Yes	Yes	
• Large end users		Yes	Yes		

Figure 4b
Pellet grades

