

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

### Self help DIY: Websites, Who to talk to?

- Canadian Bioenergy Association ..... [www.canbio.ca](http://www.canbio.ca)
- Bioentreprise ..... [www.bioentreprise.ca](http://www.bioentreprise.ca)
- Biomass Magazine ..... [www.biomassmagazine.com](http://www.biomassmagazine.com)
- Ontario Power Authority, Biomass Projects ..... [www.powerauthority.on.ca](http://www.powerauthority.on.ca)
- Ministry of Energy and Infrastructure, Biomass ..... [www.mei.gov.on.ca](http://www.mei.gov.on.ca)
- World Bioenergy Association ..... [www.worldbioenergy.org](http://www.worldbioenergy.org)
- Natural Resources Canada ..... [www.nrcan.gc.ca](http://www.nrcan.gc.ca)
- Ontario Green Energy Act ..... [www.greenenergyact.ca](http://www.greenenergyact.ca)

**Photo 1**

Distributed heating pipes under installation in Varkaus, Finland



### 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 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 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 increasingly appreciated as an animal bedding material in stables as well as a flavoured fuel for barbequing (BBQ).

PR	CSI	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

PR = Premium/Residential; CSI = Commercial/Standard/Industrial

## 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 they will 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–Feric Division.



**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](http://www.mnr.gov.on.ca)
- OPG ..... [www.opg.com](http://www.opg.com), [biomass@opg.com](mailto:biomass@opg.com)
- FPInnovations–Feric Division ..... [www.fpinnovations.ca](http://www.fpinnovations.ca)
- MOE, Ministry of the Environment ..... [www.ene.gov.on.ca](http://www.ene.gov.on.ca)
- Natural Resources Canada, Canada’s Forests.. [www.canadaforests.nrcan.gc.ca](http://www.canadaforests.nrcan.gc.ca)
- Deloitte&Touche ..... [www.deloitte.com](http://www.deloitte.com)

PR	CSI	Bedding	BBQ
White wood, no bark	Bark accepted to a certain point	Cedar and pine are usually used	Select hardwoods

PR = Premium/Residential; CSI = Commercial/Standard/Industrial

## 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.

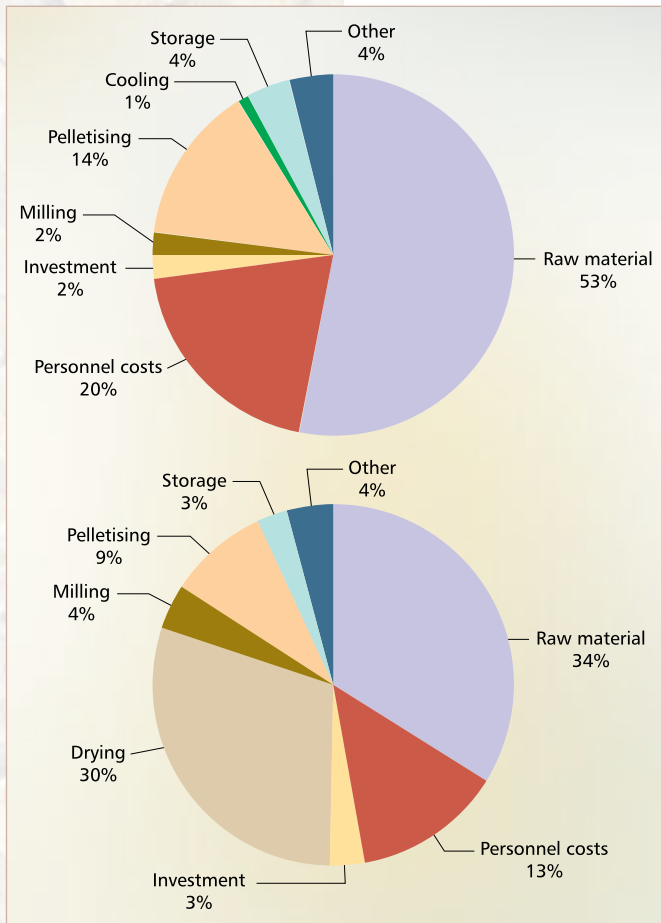
The small particles will be compacted into small pellets, usually 6 to 8 mm in diameter, and up to 38 mm in length. The friction in the process makes the pellets very hot and they need to be stabilized in the cooling process. In the screening process, the wood dust or fines will either be used as fuel 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](http://www.woodenergy.ie)*

PR	CSI	Bedding	BBQ
White wood	Bark accepted to a certain point	Mould, fines and some wood species are not allowed	Specific hardwoods

PR = Premium/Residential; CSI = Commercial/Standard/Industrial

## 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. Pellets are presently sold mainly in two categories, depending on the amount of ash contained. The current 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	6 mm to 8 mm (1/4" to 5/16")	
Length	< 38 mm (1-1/2")	
Density	≥640 kg/m <sup>3</sup> (40 lbs/ft <sup>3</sup> )	
	Premium	Standard
Ash Content	< 1%	< 3%
Fines	< 0.5% of weight	
Chlorides	< 300 part per million	

**Table 1**

North American pellet specifications

The present pellet specifications used in North America may be changed in July 2010 and made into a standard for pellets. The Pellet Fuels Institute has suggested a new standard where basically the new Premium grade is the same as before, while the present Industrial/Standard grade will be divided into two new groups.

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](http://www.pelletheat.org)
- Wood Pellet Association of Canada ..... [www.pellet.org](http://www.pellet.org)
- OPG ..... [www.opg.com](http://www.opg.com), [biomass@opg.com](mailto:biomass@opg.com)
- European Pellet Center ..... [www.pelletcentre.info](http://www.pelletcentre.info)

PR	CSI	Bedding	BBQ
Less than 1 % ash content	Less than 3% ash content	No fines or mould	Flavour, small packages

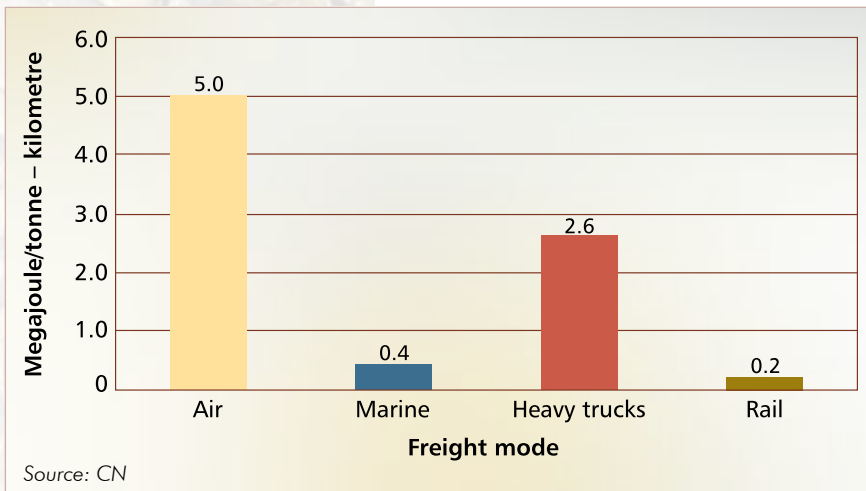
PR = Premium/Residential; CSI = Commercial/Standard/Industrial

## 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 800 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, Forest products ..... [www.cn.ca](http://www.cn.ca)
- Ontario Northland, Forest products ..... [www.ontarionorthland.ca](http://www.ontarionorthland.ca)
- Various short lines and truck transport companies
- Pellet Distributors

PR	CSI	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

PR = Premium/Residential; CSI = Commercial/Standard/Industrial

## 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
- FPInnovations–Forintek Division ..... [www.fpinnovations.ca](http://www.fpinnovations.ca)
- European Biomass Industry Association ..... [www.eubia.org](http://www.eubia.org)

PR	CSI	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	

PR = Premium/Residential; CSI = Commercial/Standard/Industrial

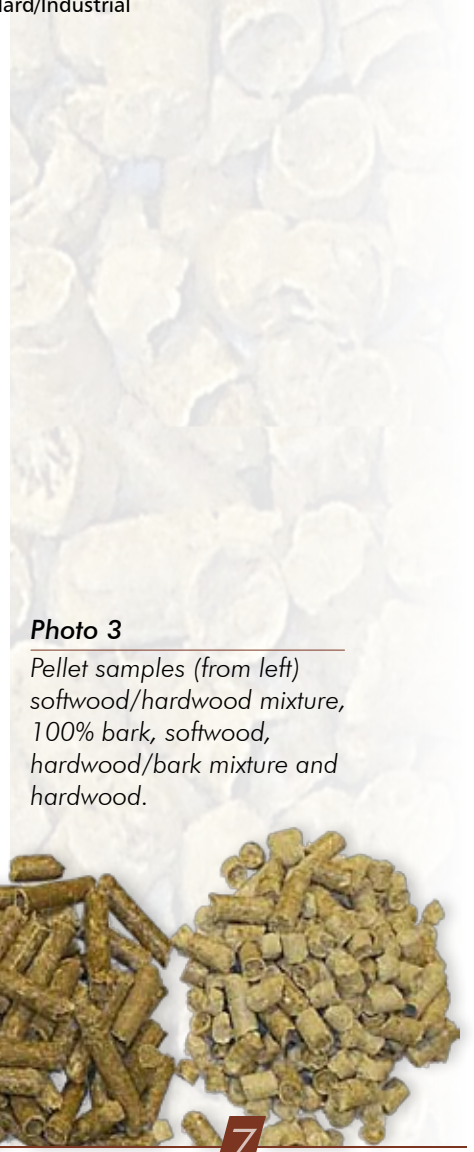
## Markets explain situation

### – 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 PR-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 high durability and a low level of fines.

Photo UNB, courtesy of HEDC



**Photo 3**

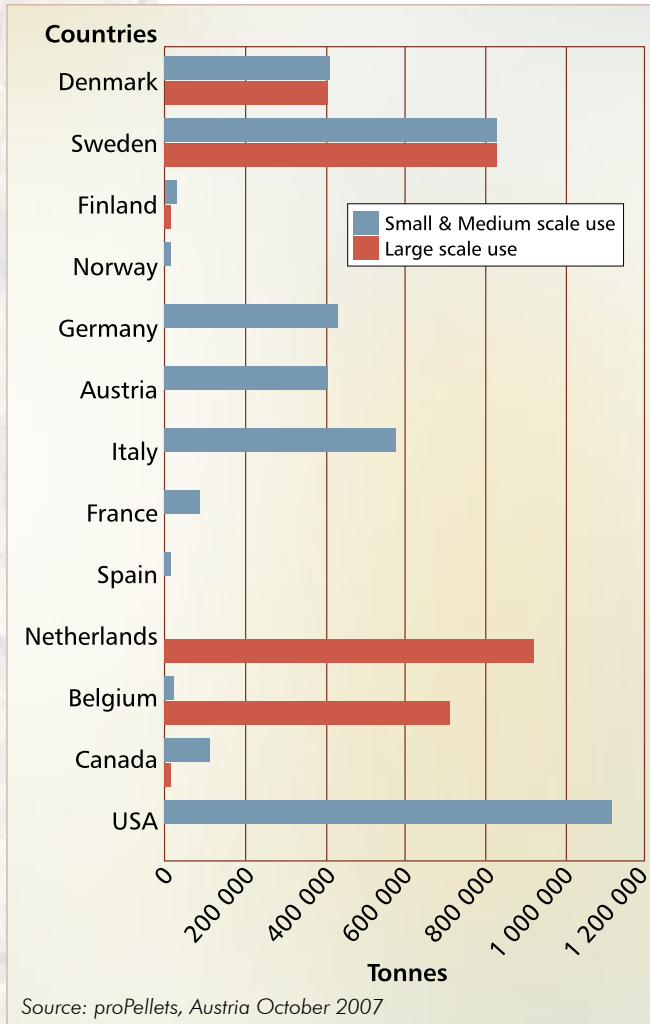
Pellet samples (from left) softwood/hardwood mixture, 100% bark, softwood, hardwood/bark mixture and hardwood.



## 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](http://www.pelletcentre.info)
- Hearth, Patio & Barbecue Association (HPBA) .... [www.hpbcanada.org](http://www.hpbcanada.org)
- University of New Brunswick ..... [www.unb.ca](http://www.unb.ca)
- Biomass Innovation Centre, Nipissing U ..... [www.biomassinnovation.ca](http://www.biomassinnovation.ca)
- Internet research

**Figure 3**  
Pellet market



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 an enhanced cooking experience. See Figure 4a, Pellet production at a glance (page 10), where flavour is added for BBQ pellets.

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.

PR	CSI	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

PR = Premium/Residential; CSI = Commercial/Standard/Industrial

**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.*

## 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, generally 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).

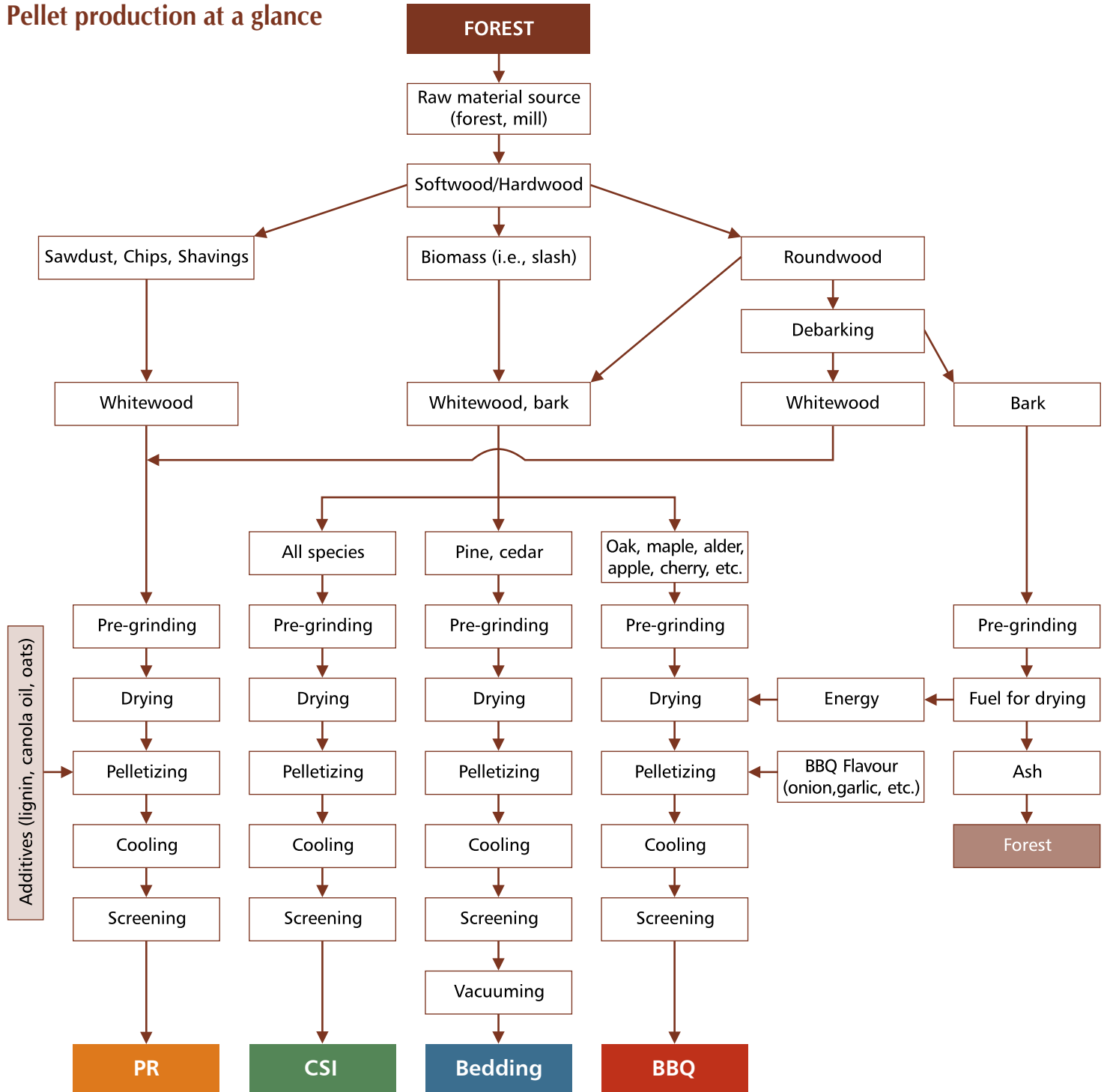
### Future development and Process optimization

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.

## Self help DIY: Websites, Who to talk to?

- European Biomass Association ..... [www.aebiom.org](http://www.aebiom.org)
- Canadian Biomass Innovation Network ..... [www.cbin-rcib.gc.ca](http://www.cbin-rcib.gc.ca)
- ECN ..... [www.ecn.nl](http://www.ecn.nl)
- Precer ..... [www.precer.com](http://www.precer.com)
- Internet search

## Pellet production at a glance



PR = Premium/Residential; CSI = Commercial/Standard/Industrial

Figure 4a  
Pellet processing

## Pellet products and markets at a glance

Present Specifications (– 2010)						
	PR		CSI	Bedding	BBQ	
<b>PARAMETERS</b>						
Bulk Density	≥ 640 kg/m <sup>3</sup> (40 lbs/ft <sup>3</sup> )		≥ 640 kg/m <sup>3</sup> (40 lbs/ft <sup>3</sup> )			
Durability						
Fines (%)	≤ 0.5		≤ 0.5	0.0	≤ 2.0	
Ash (%)	≤ 1.0		≤ 3.0		≤ 2.0	
Moisture (%)						
Chloride (ppm)	≤ 300		≤ 300			
Mould (%)				0.0		
New Standard (2010 –)						
	Super	Premium	Standard	Utility	Bedding	BBQ
<b>PARAMETERS</b>						
Bulk density (lb/ft <sup>3</sup> )	40–46	40–46	38–46	38–46		
Durability	≥ 97.5	≥ 97.5	≥ 95	≥ 95		
Fines (%)	≤ 0.5	≤ 0.5	≤ 0.5	≤ 0.5	0.0	≤ 2.0
Ash (%)	≤ 0.5	≤ 1.0	≤ 2.0	≤ 6.0		≤ 2.0
Moisture (%)	≤ 6.0	≤ 8.0	≤ 8.0	≤ 10.0		
Chloride (ppm)	≤ 300	≤ 300	≤ 300	≤ 300		
Mould (%)					0.0	
<b>END USERS</b>						
• Residential	Yes	Yes				
• Industrial, small grid		Yes	Yes			
• CHP, Cogen			Yes	Yes		
• Stables					Yes	
• BBQ						Yes
<b>PACKAGING</b>						
• Bulk container	Yes	Yes	Yes	Yes		
• Super bag 800 kg		Yes	Yes	Yes		
• 40 lb (18 kg) bags on pallet (55 bags)	Yes	Yes			Yes	
• 20 lb (9 kg) bags on pallet (110 bags)						Yes
• 10 lb (4.5 kg) bags on pallet (220 bags)						Yes
<b>STORAGE</b>						
• Silo	Yes	Yes	Yes	Yes		
• Shed	Yes	Yes	Yes	Yes		
• UV protective plastic bags on a paper protected pallet all double shrink-wrapped	Yes	Yes			Yes	Yes
<b>TRANSPORT</b>						
Delivery truck with boom or forklift	Yes	Yes			Yes	Yes
Silo truck with hose system	Yes	Yes	Yes	Yes		
Flat bed truck with forklift	Yes	Yes			Yes	Yes
Train box car	Yes	Yes			Yes	Yes
Train bulk car	Yes	Yes	Yes	Yes		
Intermodal shipping			Yes	Yes		
<b>DISTRIBUTION</b>						
• Reloading	Yes	Yes			Yes	Yes
• External packaging	Yes	Yes			Yes	Yes
• Bag delivery	Yes	Yes			Yes	Yes
• Bulk delivery	Yes	Yes	Yes	Yes		
• Direct end user	Yes	Yes	Yes	Yes	Yes	
<b>SALES NETWORK</b>						
• Retailers	Yes	Yes			Yes	Yes
• Wholesalers	Yes	Yes			Yes	Yes
• Distributors	Yes	Yes			Yes	Yes
• Dealers	Yes	Yes			Yes	Yes
• Traders (OPG, overseas)			Yes	Yes		
• Local end user	Yes	Yes	Yes	Yes	Yes	
• Large end users			Yes	Yes		

Figure 4b  
Pellet grades

## References and Resources

1. Analysis of the global pellet market, Including major driving forces and possible technical and non-technical barriers, pellets@tlas-2009.
2. Analyzing Ontario Biofuel Options: Greenhouse Gas Mitigation, Efficiency and Costs, Resource Efficient Agricultural Production (REAP)-Canada-2008.
3. An Assessment of the Viability of Exploiting Bio-Energy Resources Accessible to the Atikokan Generating Station in Northwestern Ontario, Ontario Ministry of Energy-2006.
4. Expediting Biomass to Energy Facilities in Ontario, Felder & Associates-2006.
5. Estimated Production, Consumption and Surplus Mill Wood Residues in Canada, Natural Resources Canada-2004.
6. The Northern Ontario Biotechnology Initiative, Submission to the Biotechnology Cluster Innovation Program, SHI Consulting-2004.
7. Switchgrass Fuel Pellet Production In Eastern Ontario: A Market Study, Resource Efficient Agricultural Production (REAP)-Canada-2001.

## NOTES:

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