Hauling wood for the Dawson market, April 1909. (Yukon Archives/University of Washington Collection, #1263)

Wood

This article is part of a series of publications, prepared for the Cabinet Commission on Energy, on the Yukon's energy resources. It provides an overview of the extent of the Yukon's wood fuel resource and the factors affecting its development. It is intended to encourage responsible investment and to stimulate informed debate among representatives of industry, government, and members of the community. Appendices of a more technical nature accompany each of the articles in this series. You can obtain copies of these appendices through the

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Overview

The Yukon Government is committed to encouraging the development of local energy resources, as a way to:

- *reduce the outflow of money from the Yukon economy for imported petroleum products;*
- *increase economic independence;*
- *foster the growth of local energy industries;*
- *stimulate employment;*
- *minimize negative environmental impacts of energy development and use; and*
- *lower the cost of energy to consumers.*

Wood has been an important fuel throughout the Yukon's past, and shows promise as a means of continuing to keep Yukoners warm. In some cases, wood fuel may also have limited potential for export, and as a means of producing electricity.

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The forests are currently a source of commercial and residential heating fuel, and support existing small industries in sawmilling and firewood cutting. Fuelwood supplies approximately 25% of the space heating requirements of the residential sector, and its use represents approximately $4 to 5 million annually in direct employment and import substitution. As the timber harvest increases, so does the potential for generating power from wood waste, and for producing wood fuel pellets. A critical factor in these ventures is the long-term timber supply.

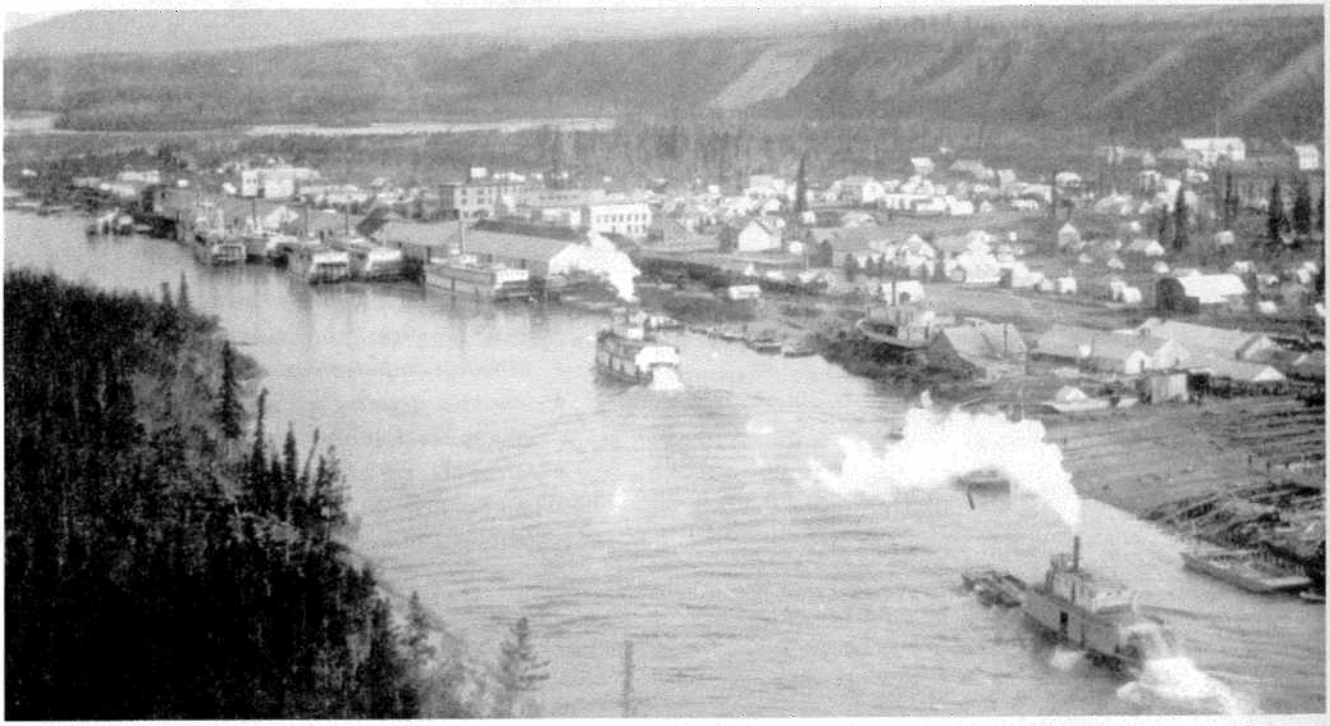
A sustainable forest management policy is currently under development, led by the Yukon Forest Commission. Its goal is to provide stable and sustainable development of the Yukon's forest resources to support economic growth, while maintaining wilderness values and ecosystems. Accurate information is required for decision-making, with public, community and First Nation involvement in all management decisions, employing a cautious approach where the risks are unknown. Capital intensive forest products industries need high volumes, and high volume production may not suit Yukon conditions. However, wood in Yukon forests has certain advantages over that of other areas where conditions might seem, at first glance, more favourable. Due to the shorter growing season, Yukon wood has a higher density, which gives it greater strength and durability. Recently the seeds of Yukon lodge pole pines were in demand in Scandinavia: during the ice ages significant portions of the Yukon were not glaciated, so Yukon trees were regenerated from stock that had adapted to the long summer days; the forests of northern Europe had not been protected from glaciation by high coastal mountains, and after the ice ages had passed, were regenerated by trees from the south, less capable of coping with northern growing seasons.

There is a need for long-term tenure when using wood wastes to generate electricity, since such systems are capital intensive and require long-term security of supply in order to obtain financing. The stable and sustainable harvest of the Yukon's timber resources will encourage capital intensive industries producing a variety of wood products. The waste material from these operations can be used to provide useful energy products, including processed wood fuel pellets and electricity.

The Resource

Historical Use

Wood has been used by the first people in the Yukon for thousands of years for warmth and cooking, and today represents an important source of home heating for many families and some small businesses.



Wood Powered Riverboats on the Yukon River (Courtesy of Yukon Archives/Vancouver Public Library Collection)

During the gold rush, riverboats were used to transport freight and passengers. From the mid thirties to the mid fifties there were five boats operating on the Yukon and Stewart Rivers, and on Bennett Lake. The boats required four cords per hour, more or less continuously from June through mid-October. Wood camps were located all along the routes, and may have produced as much as 80,000 cords per year. There were even more boats operating during the earlier part of the century.

During the building of the Alaska Highway, a district heating system operated in Whitehorse, supplying steam to heat numerous buildings in downtown Whitehorse.

Rising energy prices in the 1980s made wood heating very popular, and with the upsurge in woodstove installations came local woodsmoke pollution. The City of Whitehorse established an education program to teach residents to burn wood with a minimum of smoke, coupled with a bylaw to prohibit wood burning when pollution levels are forecast to rise beyond acceptable limits.

In recent years a number of wood chip fired boilers have been installed by the Yukon Government and some First Nations to heat larger buildings, and groups of buildings. Wood chips have been successfully

Producing and storing wood chips in Pelly Crossing, circa 1983. (Yukon Government photo)

Critical Factors affecting the Use of Wood Chips in Public Facilities

Infrastructure factors

- sufficient demand for wood chips to allow economy of scale in harvesting and delivery of product to markets
- quality control in fuel deliveries — although moisture content can vary considerably before it becomes a critical factor in combustion, it is important to adjust the price of the fuel accordingly
- testing of emissions to verify compliance with clean air regulations is costly, even in industrialized areas; the per unit cost of emissions testing in the Yukon is increased by the limited number of units

Technical and economic factors

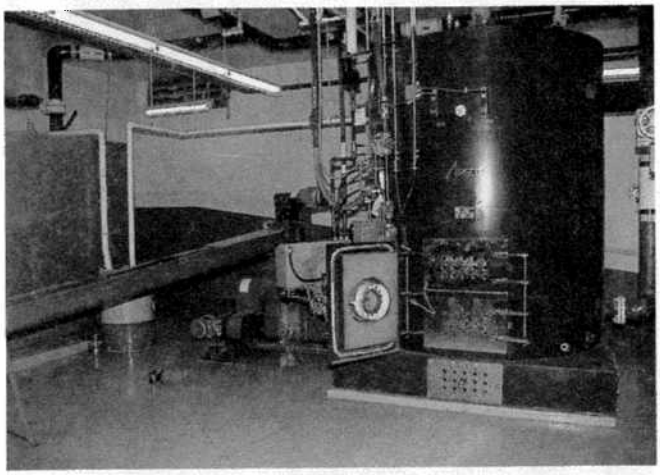
- it is difficult to feed wood chips into a combustion cell. Feed systems are costly to install and to operate. Good design and regular maintenance of the feed system is crucial to the successful operation of the system.
- although large wood-burning appliances operate with lower emissions than residential sized appliances, in many cases an order of magnitude lower, the use of wood is still a concern in areas with woodsmoke pollution
- operator commitment to the success of the wood chip boiler installation is critical. It is not as convenient to use wood chips as it is to use oil or propane.
- attention must be paid to all aspects of the heating system design to ensure compatibility, from raw wood fuel in the truck, to the heating load to be supplied: requirements vary depending on the application.

Institutional factors

- requirements for a full-time operator for larger boilers can negate any fuel cost savings
- the benefits of employment generation and import substitution need to be assessed along with capital and maintenance costs in the selection of a heating system
- factors affecting the sustained supply of forest-based fuel products must be assessed

used as an alternative to fossil fuels at the Eliza Van Bibber School in Pelly Crossing since 1983.

Since the installation of that boiler system, several more have been installed in the Yukon: at the Elijah Smith School in Whitehorse, Insert photo of boiler room at Elijah Smith School a wood-chip fired district heating system to service several buildings owned by the Champagne & Aishihik First Nations in Haines Junction, and at the Administration Building of the Little Salmon Carmacks First Nation. Others at Burwash Landing and Teslin are under construction or under consideration.



Boiler room at Elijah Smith School (Yukon Government photo)

Similar systems are in use in wood products manufacturing plants in Alberta, Winnipeg and Montréal.

Small automatically feeding wood pellet heaters are becoming increasingly popular for homes and small businesses. A pellet-burning appliance may be operated in the Whitehorse woodsmoke control zone during no-burn periods, because they emit relatively little smoke compared to most woodstoves. Heating with wood pellets currently does not offer cost savings over the use of oil; however, that situation is expected to change in the near future when wood pellets are manufactured in the Yukon. At the time of writing, a wood fuel pellet plant is being set up in Teslin. The owners expect to be producing pellets by early fall, and marketing them in the Yukon at a price considerably less than for imported pellets.

Wood Chip Boiler Systems

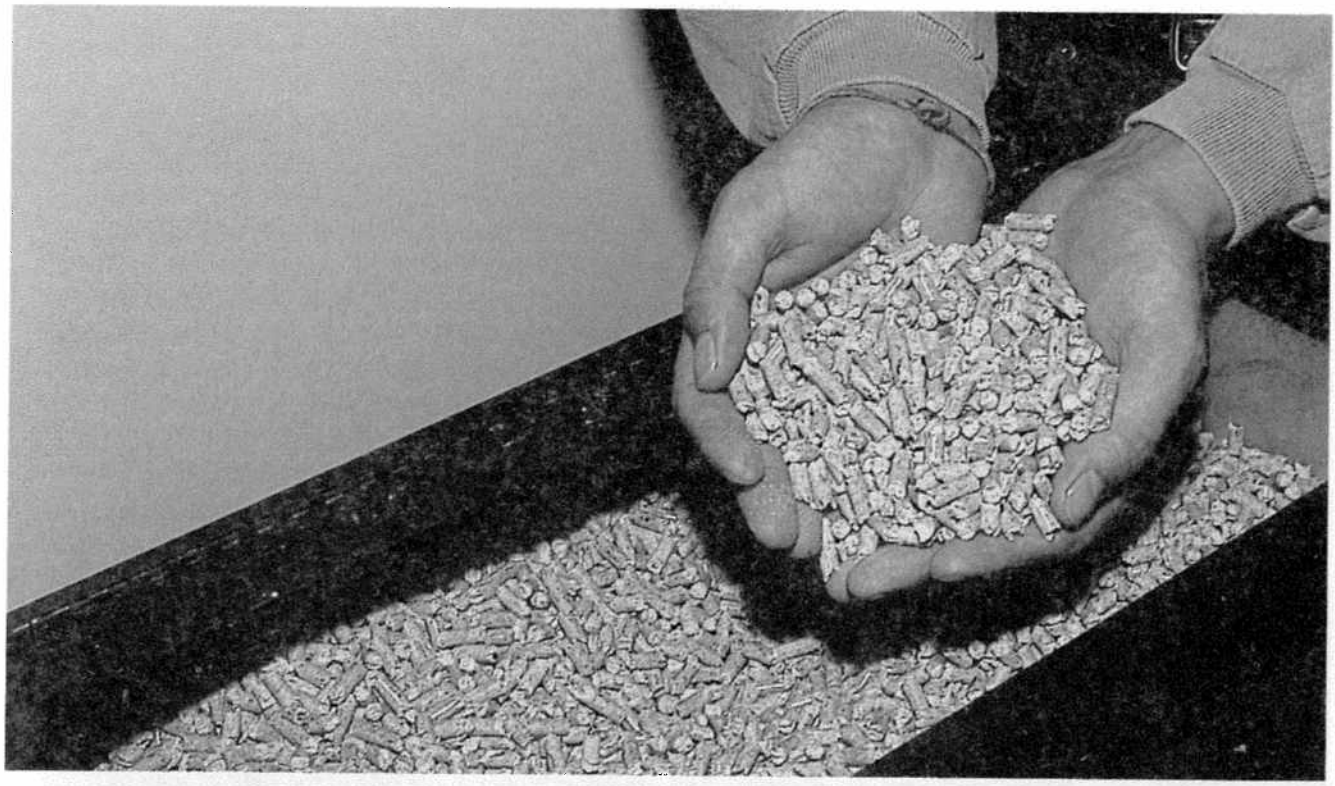
Traditional methods of producing heat from wood are well understood, as are their drawbacks: local woodsmoke pollution, potential fire hazards, effort required, and expense. However, changes in technologies available for burning wood now make it a practical option to supply much of the Yukon's space heating requirements.

Large wood chip burning boilers have been installed in a number of Yukon schools and buildings owned by First Nations. The Champagne & Aishihik First Nations operate a wood chip fired district energy system, to heat their elders' complex, youth centre, laundry, administration building and workshop. The Little Salmon Carmacks First Nation has a wood chip boiler for their Administration Building, and the Kluane First Nation has ordered another for theirs. Wood chips are also being considered as a heating source for municipal buildings in Haines Junction and Teslin.

Problems with the wood system are normally limited to the feed system. They can also be hand-fired, which ensures a reliable heating system for the building. Boilers can operate with wood of varying moisture content: testing conducted on the boiler at the Eliza Van Bibber School in Pelly Crossing showed only a slight decrease in efficiency when green cordwood and chips (30% moisture content) were burned, compared with firekilled chips (moisture content 10%). However, in fuel purchase contracts it is important to adjust the price of the fuel according to the moisture content (up to a specified maximum).

Although these units operate with few problems, they have yet to deliver on expected savings. The reasons are a lack of efficiency in fuel harvesting and fuel handling at the sites, which have elevated the cost of producing heat beyond that of using the more conventional and convenient fuels: oil and propane. A greater degree of mechanization and more competition in the sector will improve the economics.

A competent enthusiastic operator can fix problems as and before they occur. Chippers require routine maintenance and regular sharpening of knives to avoid large chips which can cause bridging and jamming of a boiler's feed system.



Wood pellets (Yukon Government photo)

Wood Chips (Yukon Government photo)

Yukon Sources of Wood Fuel

Forest fires	Between 1986 and 1992 an average of 1,200 square kilometres of forest was burned each year. While forest fires kill trees they normally don't consume them, leaving standing dead timber available for fuelwood. The energy content of the firekilled timber that becomes available each year is enough to heat every building in the Yukon for 30 years, or approximately 10 times the equivalent energy of all the hydroelectricity produced at Whitehorse Rapids and Aishihik, and all of the imported petroleum products used by all sectors of the economy for all purposes: heating, lighting, industrial processing, electricity generation and transportation. Due to limited access and high transportation costs most of this potential wood fuel remains uneconomic to recover.
Fuel reduction	The danger of forest fires and of property damage resulting from forest fires is increased by deadfall in the vicinity of communities. One solution is to create a fire break, by removing deadfall and some of the smaller trees, and use the material removed as space heating fuel.
Scrap lumber	An estimated 5,000 tonnes of trees and scrap lumber is disposed of each year at the Whitehorse landfill. This represents the energy equivalent of about 2.5 million litres of oil.
Right-of-way clearing	The Yukon has approximately 4,700 km of highways and over 2,000 km of electrical transmission and distribution lines. Normally wood wastes are disposed of by burning, in situ mulching (hydro ax) or chipping. Chips are either blown to the side of the right-of-way or transported to the landfill. Green chips are suitable for use in a wood chip boiler.
Timber Harvesting	The harvest of 1,000 cubic metres of timber normally generates approximately an equal volume of wood waste in the form of unmerchantable species, roots, branches, deadfall and wood that otherwise is not desirable for use as fibre. This wood waste has the energy content of over 200 thousand litres of oil, or enough energy to heat about 70 homes for a year.
Sawmill wastes	Slabs, bark, sawdust and shavings normally amount to a considerably greater volume from a sawmill than does its lumber output. Because of the shipping distances and the bulky nature of wood chips, it is not economic to sell them to pulp mills outside.
Land Clearing	Assuming an average density of 85 cubic metres of wood per hectare, each hectare of land cleared has the energy equivalent of 20,000 litres of oil, or the energy to heat eight homes for a year.

Economic Issues

Local Markets

The forests are currently a source of residential heating fuel, and support existing small industries in sawmilling and firewood cutting. Fuelwood use represents approximately $4 to $5 million annually in direct employment and petroleum import substitution. As the timber harvest increases, so does the potential for generating power from wood waste, and for producing wood fuel pellets. A critical factor in these ventures is the long-term timber supply.

Fuelwood consumption

During the period 1970 through 1993, the permits to harvest fuelwood averaged 52,000 cubic metres per annum, the heat energy equivalent of approximately 11 million litres of fuel oil. This represents approximately 25% of the space heating energy used by the residential sector.

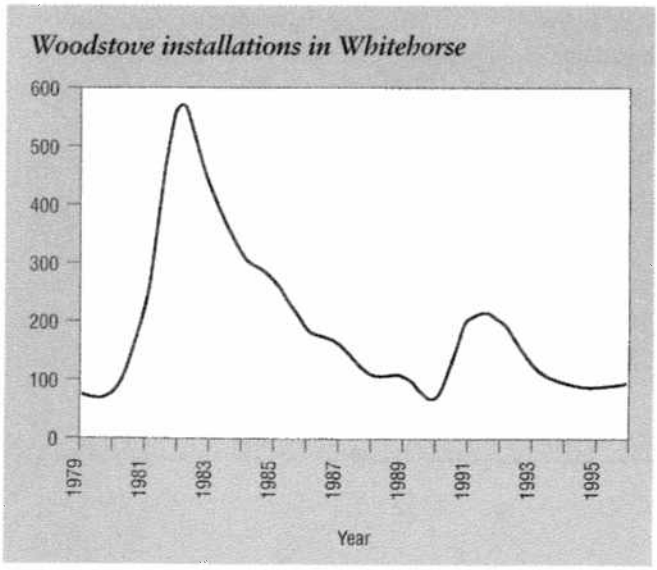
For every cubic metre of firewood burned, 220 litres of fuel oil are displaced, or at a wholesale price of $0.27 per litre this represents $60 in import substitution. At a volume of 50,000 cubic metres per annum, the average annual fuelwood harvest over the past 25 years, wood fuel represents a contribution of some $4 to $5 million to the Yukon economy, and a significant personal saving to individual consumers.

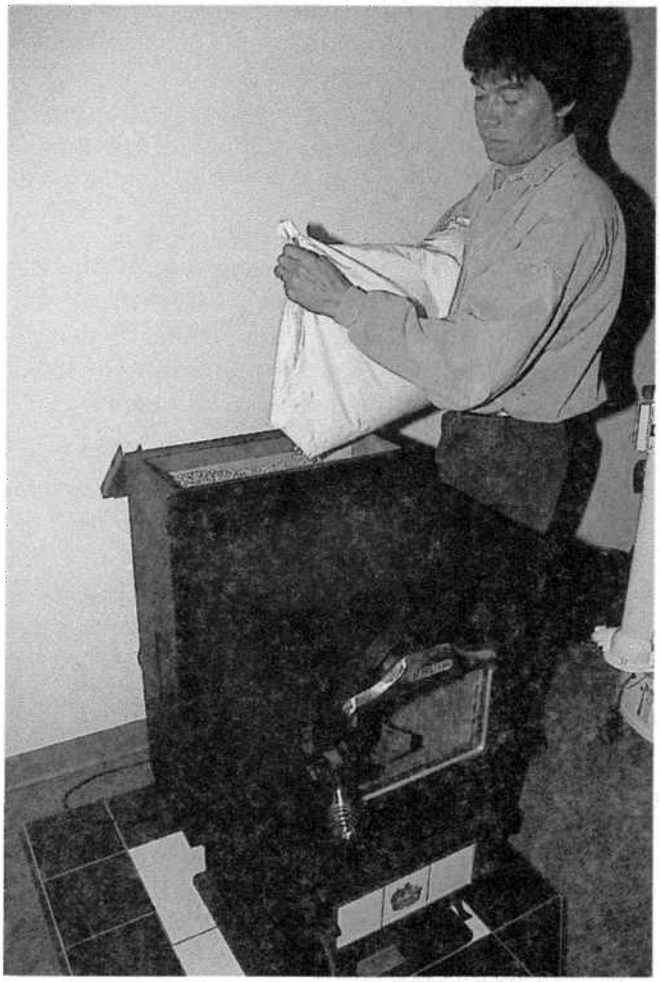
The Yukon's total annual space heating requirement of 2,635 terajoules (TJ) could be supplied by the forest residues of 340 thousand cubic metres of logging, or through the harvesting of 37 square kilometres of typical firekill. This represents approximately 3% of the total destroyed each year by fire, on average.

Between 1979 and 1996, the City of Whitehorse issued 3,406 woodstove installation permits.

Approximately 20 to 25 thousand cubic metres of fuelwood are consumed each winter in Whitehorse.

Wood could be used as an energy source in a thermal electric plant to produce electricity, although it suffers from most of the disadvantages of coal-fired power plants in the Yukon: high capital costs, the risk of stranded investment when power requirements are reduced, the need for highly skilled full time plant maintenance staff and operators, and the relatively high capital costs due to the small scale of plant required.





Loading wood fuel pellets. (Yukon Government photo)

Making Electricity from Wood Wastes

It has been estimated that the wastes from 70,000 cubic metres of saw logs could produce a steady 2 MW of electricity, or 16.8 GWh per annum. This is about 30% more electricity than is used by the community of Watson Lake.

One tonne of wood contains about 5,000 kWh. Unfortunately, it is difficult, on a small scale, to convert heat into electricity. Studies done for the Yukon Government by H. A. Simons Consulting on using coal to operate a 20 MW power plant (see Coal Resources paper) indicated that 20 MW is small by comparison with most thermal power plants, and smaller plants tend to produce expensive electricity due to the relatively high capital costs and the need for a highly skilled, full-time staff to tend the equipment. Electricity from a plant of that size would be competitive with diesel only if the plant could be operated year-round on low cost wood waste. At this time there is neither the wood waste nor the electrical load.

Smaller plants have been studied for specific applications. The sawmill in Watson Lake, operated by Cattermole Timber until the early 1980s, made use of a steam-fired turbine to produce approximately 1 MW of electricity, when the equipment was functioning, for use by the sawmill. The sawmill was burning the waste material anyway to dispose of it, and some steam was needed to heat the plant. Cattermole ceased operation in the early 1980s. When the sawmill was refurbished, the new owners examined the potential for bringing the power equipment up to standard, but concluded that it would be too costly. They also examined the potential for generating 6 MW to supply virtually all of the electricity needed for the mill and the community, but again concluded that the pay-back period was too long. A critical factor in generating wood-fired electricity is the long-term supply of fuel at a very low cost. Only if the sawmill were operating would there be low cost wood waste.

A study was done for the community of Pelly Crossing in the early 1990s. Although the use of wood fuel to generate electricity has the potential to create long-term jobs in fuelwood harvesting, the cost of producing electricity in this manner is several times that of using diesel generators, due to the high capital costs, the cost of harvesting wood fuel, the inefficiency of conversion of the energy in wood to electricity, the need for round-the-clock, highly skilled plant operators, and the limited demand for electricity in the community.

Thermal power plants that convert steam to electricity require high temperature high pressure steam in order to obtain reasonable efficiencies. Typically the very best thermal power plants convert fuel to electricity at an efficiency of about 40%, roughly the same efficiency as a well maintained base load diesel engine. The 30 MW coal-fired fluidized bed power plant at Piney Creek, Pennsylvania, operated by Tampella Power (see Coal Resource paper) operates at an efficiency of about 30%. By comparison, reciprocating steam engines can have efficiencies less than 10%, due to the use of lower temperature steam and the difficulty of transferring heat from the cylinders. During the time of their active service, the riverboats typically used steam at close to atmospheric pressure and then condensed it in the cylinder, pulling the piston in with the vacuum. The riverboats used a lot of wood, typically 4 cords per hour; in other words each boat consumed energy faster than all of the diesel power plants in the Yukon's off-grid communities.

There may soon be a better way to produce electricity from wood fuel, however. Research is being conducted on a power plant that uses hot gas in a turbine to produce electricity. While it is still in the early development stage, this method of turning the thermal energy in wood to electricity has the potential to produce electricity at efficiencies of about 25%, with another 50% of the wood energy available for heating buildings. Because no high pressures are involved, the plants can be designed to operate unattended.

Comparison of Electricity Generation Options

	Advantages	Drawbacks

Diesel	• Low capital cost
	• High salvage value — portable
	• No surprises — technology readily understood, parts and labour available
	• Waste heat available for space or industrial process heating
	• Simple to add incremental capacity
	• Can run on locally produced oil resources.
		• Currently using imported fuel
		• Moderate to high fuel cost
		• Risk of fuel price increase
		• Environmental considerations
		  • acid gas emissions (NO_x,So_x)
		  • greenhouse gas emissions
		  • potential fuel spills
		• Moving parts, high maintenance costs

Natural Gas Turbine	• Low capital cost
	• High salvage value — portable
	• Technology readily understood, parts and labour available
	• Waste heat available for space or industrial process heating
	• Incremental capacity (megawatt range) can be added
	• Indigenous resource, although not currently available in communities
	• Relatively low fuel cost
		• Environmental considerations
		  • acid gas emissions (NO_x,So_x)
		  • greenhouse gas emissions
		• Moving parts, maintenance costs

Wind	• No fuel purchases required • Winter availability • Does not emit greenhouse gases • Indigenous resource • Simple to add incremental capacity • Potential to export expertise in developing this technology for use in similar climates	• Technical difficulties related to winter weather conditions • Storage or standby capacity required during calm periods • High capital cost • Risk of stranded investment
Wood	• Abundant indigenous resource • Local employment • Low fuel cost if in conjunction with forest industry operations • Waste heat available for space or industrial process heating	• High capital cost • High risk of stranded investment • Generally economic at scales larger than required in the Yukon at this time
Coal	• Indigenous resource • Relatively low fuel cost • Waste heat available for space or industrial process heating	• High capital cost • High risk of stranded investment • Emission of greenhouse gases • Generally economic at scales larger than required in the Yukon at this time
Hydro	• Indigenous resource • No fuel purchases required • Plant longevity • Low maintenance • Potential to export expertise in developing this technology for use in similar climates	• Very high capital cost • High risk of stranded investment • Sit specific • Habitat affected by changes in upstream and downstream water levels and flows • Winter availability poor without storage, usually created by flooding

Export Markets

At best a tonne of wood displaces about $150 worth of oil in a residential market. Normally, because of its bulk, wood fuel normally cannot be economically transported for more than a few hundred kilometres.

The cost of transporting a tonne of various waste wood sources a distance of 100 km

Sawmill waste	$13
Right of Way clearing	$13
Land Clearing	$13
Export logging waste	$20
Landfill	$25
Logging waste	$28
Thinning	$30

Compared to cordwood or raw wood wastes, processed wood fuels are less sensitive to transportation costs. A tonne of pellets occupies only about one quarter the space, and can sell for half again as much, as cordwood.

Yukon logs have been exported in recent years, to a greater and lesser extent, depending on market fluctuations. Policies to determine the extent of the allowable cut and products to be exported are being developed in consultation with stakeholders. Wood wastes from logging and milling operations, available for energy, will vary depending on the export product.

Employment

Firewood sells for between $100 and $200 per cord in the Yukon, depending on location. The bulk of the money spent on firewood goes to wages, and is spent within the community.

Wages account for approximately half of the cost of producing wood pellet fuel. The production of 1,000 tonnes of wood pellet fuel creates 2 to 3 person years of direct employment. Employment is created at every step of the process, from the harvesting of wood wastes at logging sites, to transport of wastes, pellet manufacturing, sales, and delivery.

Other Benefits

The harvest of fuelwood is an important family tradition for many Yukoners, and provides not only a source of warmth but a sense of accomplishment and shared activity.

Why install a pellet-burning stove?

- Personal taste and aesthetic considerations
- The likelihood of soon being able to buy cheaper, made-in-the-Yukon wood pellets. Burning wood can provide local jobs
- Burning wood fuel does not make a net contribution to atmospheric carbon dioxide levels.
- Wood pellet stoves can be clean-burning and contribute little to local woodsmoke pollution; a pellet burning stove may be operated in the woodsmoke control zone during a no-burn period
- Wood pellets selling at about $215 per ton (including GST) can be competitive with oil; at about $160 per ton they compete with cordwood.

Other considerations:

An oil-fired space heater is smaller, slightly cheaper to install, at the time of writing costs less to operate (although with pellets manufactured in the Yukon that situation is expected to change), is quieter, more convenient, and will not cause an increase in fire insurance premiums.

Since 1993 there have been approximately 150 wood pellet stoves installed in Whitehorse and over 300 conventional woodstoves. Pellet-burning appliances represent about 30% of new installations.

Processed wood pellets can be conveniently loaded into a van with a forklift, and backhauled to points south. Markets outside may provide local pellet manufacturers with an important outlet for their product while sales build in the Yukon to levels that can sustain a manufacturing plant.

To be sure that a pellet stove is both clean-burning and efficient, check to see that it has been tested and met EPA Phase II or CSA B415 standards.

Safety

Proper installation of wood combustion appliances is specified by the *National Building Code of Canada*, which is enforced by the public safety departments of the territorial or municipal governments. Clearances from combustibles must be observed at all times. Routine inspection and cleaning of the chimney should be conducted to ensure that the buildup of creosote does not exceed 5 to 10 mm.

Industrial boilers larger than 2 MW require an operator. Electricity generation normally involves pressures and temperatures that necessitate a First Class steam engineer. The use of large boilers is regulated under the *Yukon Pressure Vessels Act*.

Splitting wood fuel (Yukon Government photo)

Possible Export Products

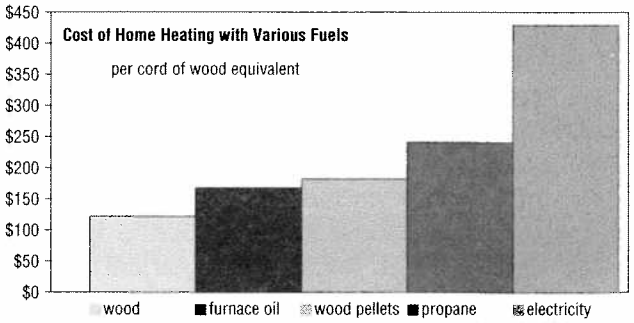
Pulp quality chips (bark-free, rot-free, species sorted, uniformly-sized) are sold to pulp mills in bone dry units (BDU). A BDU is 2,400 pounds. It takes approximately 3 cubic metres of log to produce one BDU of chips. In producing one BDU of chips, there is approximately one third of a cubic metre of bark available to be used as fuel, which has the energy equivalent of 65 litres of oil.

While many forest industry products are energy intensive, their production creates an opportunity to use wood wastes to produce much, if not all, of the power required in their operation. A report on Forest Industry Development Options, prepared for the Department of Economic Development, estimated the power requirements of a plant producing 150,000 cubic metres of MDF (medium density fibreboard) at 68 GWh of electricity per annum, or about 10 MW. The bark alone from the 400,000 cubic metres of wood required could produce over one quarter of that power. Given an opportunity to harvest other waste wood in the logging and milling operation, it is likely that such a plant could produce all of its energy from wood wastes and have surplus power for sale to other customers.

Competing Resources

Each of the fuels has its advantages and drawbacks. The need for backup should be considered with any heating source, since each, with the exception of cordwood, depends on electricity to work.

The figure to the right shows the cost of heating a home in Whitehorse using various fuels.



	Advantages	Drawbacks

Cordwood	• Least expensive fuel
	• No net contribution to atmospheric CO_2 levels
	• Local fuel, harvesting can be a family operation
	• Can provide radiant heat, considered by many to be comfortable and aesthetically pleasing
	• Combustion air requirements cause drying of indoor air reducing winter moisture problems (maybe too dry)
		• Fuel handling, i.e. Some or all of: falling, bucking, hauling, stacking, hauling, floor sweeping, loading, tending, chimney cleaning, ash hauling
		• Space requirements:
		  • indoor clearances
		  • fuel storage
		• Potential fire hazard; insurance premiums may increase
		• Local woodsmoke pollution, indoors and outdoors
		• Installation costs can be high
		• Need for backup heating system
		• Can make indoor air excessively dry

Furnace oil	• Convenient • Efficient inexpensive appliances are available that require little regular maintenance	• Currently a little more costly than purchased cordwood, but prices subject to vagaries of international markets • Fuel must be brought in from outside the Yukon - leakage from local economy • Non-renewable resource, contributes to greenhouse effect
Wood pellets	• Relatively convenient to operate and maintain pellet burning heater. Pellet fuel is sold in 18 kg (40 lb) bags • Pellets are expected soon to be manufactured in the Yukon from sawmill wastes. If so, prices are likely to decrease. • Clean burning - pellet burning appliances may be operated in woodsmoke control zones during no-burn periods • Relatively inexpensive to purchase and install pellet burner - about the same installed cost as a high efficiency oil space heater.	• Requires periodic cleaning, every few days to weekly • Insurance premiums may increase • Rely on electricity: cannot be used during power outages • Regular (approximately daily) loading of pellets is required
Propane	• Convenient • Efficient clean-burning appliances • Appliances require little maintenance • Relatively low installation costs	• Fuel is costly to purchase • Fuel must be stored in pressurized tanks, which must be heated during extreme cold temperatures to allow fuel to vapourize
Electricity	• Convenient • Relatively low installation costs • Zero maintenance cost • Quiet • Emits no pollutants at point of use	• Very costly to purchase electricity to operate • Requires adequate service connections

Regulatory Issues

Forest Policy and Administrative Control of Yukon Forests

The Federal and Yukon Governments, in conjunction with Yukon First Nations, are developing a Yukon Forest Strategy which will help guide the development of a *Yukon Forest Act.*

The administrative control of the forest resources will pass at that time from the Federal to the Yukon Government. The transfer is currently due to take place October 1, 1998.

For further information on the Yukon Forest Strategy and related forest management publications contact the Yukon Forest Commission at 393-6424, or visit the web site at:

www.yukonweb.com/government/forest/

Permiting Process

Timber harvesting requires either a timber permit or a timber harvesting agreement, either of which is currently issued by the Department of Indian Affairs and Northern Development (DIAND).

All forest harvesting activity must comply with regulations governing land use, protection of historic sites, workers' compensation, health and safety, water use, waste disposal, and fuel storage, among others.

Development Assessment Process (DAP)

The Environment Assessment and Review Process (EARP) was replaced in January 1995 by the *Canadian Environmental Assessment Act (CEAA).* The Development Assessment Process (DAP) will be the Yukon's new assessment process once legislation is in place, and will cover the same types of projects now addressed under CEAA, including land use, water, socio-economic, and environmental impacts of development projects, such as road upgrading and power line construction. DAP is specified by the *Umbrella Final Agreement on Yukon First Nations' Land Claims.*

Small-scale harvesting will be assessed by the designated offices in the communities. Larger projects will be assessed by the Yukon Development Assessment Board in Whitehorse.

Environmental Issues

Environmental Impacts of Harvesting Fuelwood

Environmental impacts of course vary considerably depending on the forest type, the terrain, the climate, and the state of the forest. Salvaging insect-damaged or firekilled timber has a distinctly different impact when compared with logging green timber stands. Many of the impacts listed below can be mitigated through silviculture and good forest management practice.

Visual impacts

Considering the importance of tourism to the economy, and the sensitivities of many Yukoners, the visual impact of logging cuts cannot be overlooked.

Soil Erosion

The loss of tree cover on slopes can cause the loss of soil materials. This impact can be reduced through encouraging ground cover and by replanting with seedlings.

Changes to water retention

Trees act as a natural sponge and play a vital role in maintaining the water balance in the soil, by holding snow during winter and allowing it to enter the ground in the spring.

Loss of habitat

Trees provide vital habitat for many forest dwelling creatures, by providing both food and shelter.

Changes to soil fertility

The removal of timber, even firekilled timber, from the forest affects soil fertility.

Changes to climate

Deforestation on a major scale leads to changes in the climate itself, as can be seen in the Amazon Basin. The Sahara Desert was once a forest.

Environmental Impacts of Burning Wood

Local Woodsmoke Pollution

Residential woodstoves can produce high levels of respirable particulate matter. In densely populated areas, woodsmoke tends to accumulate during certain weather conditions, notably temperature inversions with little wind and at a temperature of

about -10° to -30°C. Woodsmoke has been identified as a health threat by organizations such as the Yukon Medical Association and the US Environmental Protection Agency (EPA). High levels of woodsmoke can lead to acute health problems, especially in children and the elderly, resulting in increased school absenteeism, hospitalization, and risk of death from respiratory causes.

Woodsmoke is composed of fine particles, many of which are small enough to be deposited in the lungs, where, over time, they can set up an inflammatory condition leading to cough, asthma and shortness of breath that in turn can lead to chronic bronchitis, emphysema and possibly cancer.

The Yukon Medical Association advises that health effects increase with woodsmoke levels, and that people experiencing worse than normal symptoms should consult their physician.

The City of Whitehorse has responded to the problem of woodsmoke pollution with a program of education on how to operate a woodstove with a minimum of smoke. The City has also passed bylaws which specify maximum opacity, and when necessary, prohibit burning, to keep pollution at acceptable levels. Since April 1997 all new woodstove installations in Whitehorse must meet CSA (Canadian Standards Association) and US Environmental Protection Agency (EPA) emission standards.

Level (ug/m^3) TSP	Health Effect
30–60	Sore throats, cough, headaches and nausea may be experienced in sensitive people, especially children, the elderly, and those with lung and heart disease.
60–110	Sore throats, cough, headaches and nausea may be experienced even in healthy adults. Sensitive individuals should stay indoors and reduce physical activity.
>110	No Burn Period is in effect. Avoid outdoor exposure.

Woodsmoke pollution in Riverdale (Yukon Government photo)

Greenhouse Gases

The issue of climate change was addressed by a Convention and Declaration at Rio de Janeiro in 1992. Canada has established a Voluntary Climate Change Action Plan and Registry Program. Both the Canadian Electricity Association and the Coal Association of Canada have signed a Memorandum of Understanding with Natural Resources Canada.

Greenhouse gases are emitted when any fossil fuel is burned. They are also emitted during the stages of exploration, extraction, transport, refining and distribution.

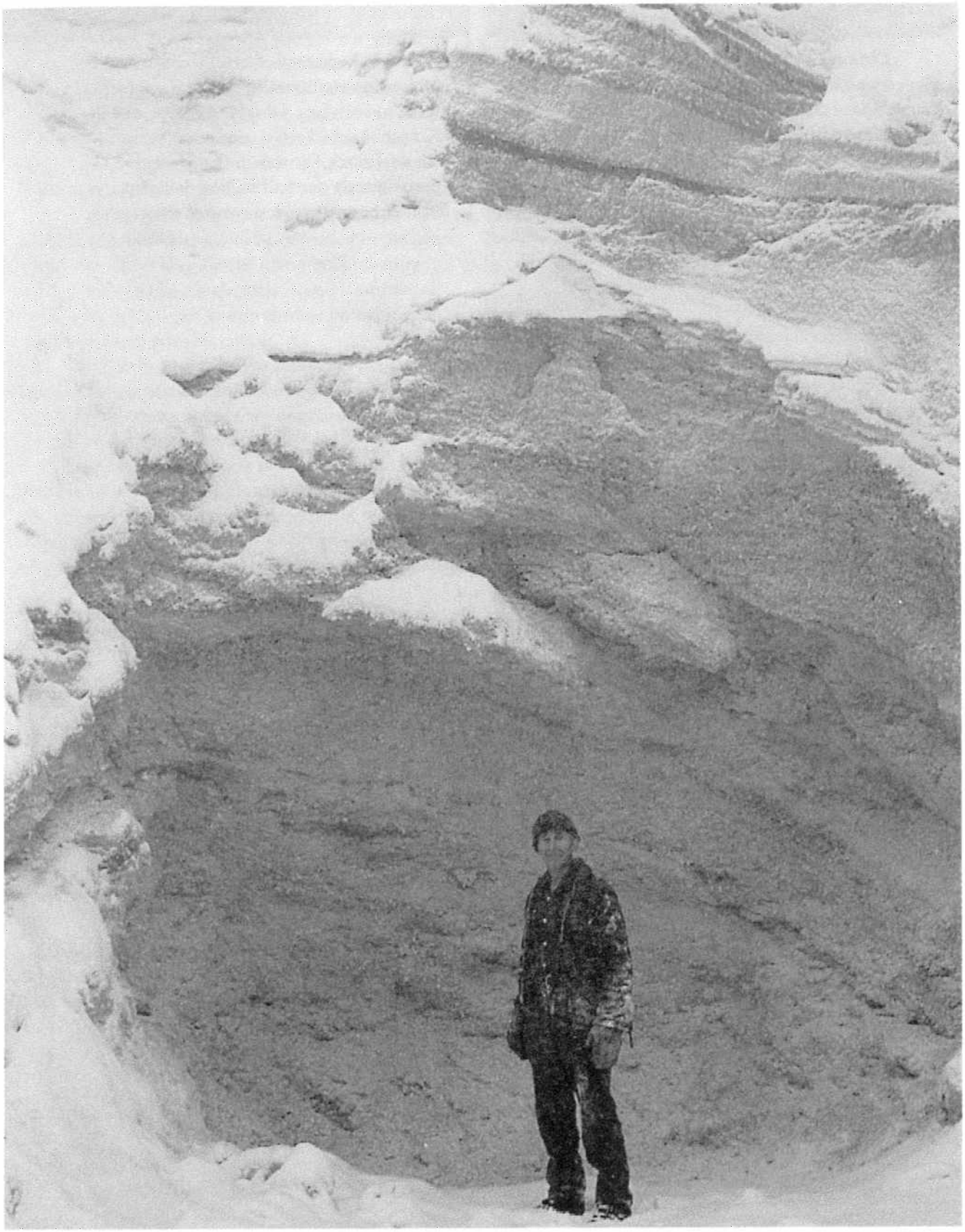
When wood fuel is burned there is no net increase in greenhouse gas emissions, provided that a tree grows in place of the one that was cut down. In the case of firekilled wood, the same carbon dioxide is released regardless, whether immediately when the wood is burned in a stove, or over a period of years when the wood decomposes and returns to the soil.

Wood Ash

Wood ashes in too great a concentration represent an environmental hazard, but spread evenly on the soil can be a valuable fertilizer. In New Hampshire wood ash is used as an environmentally sound fertilizer. Farmers in that state save approximately one half million dollars per year in fertilizer costs through the use of wood ashes.

Wood Burning Tips

- Start your fire with small pieces of dry kindling.
- Burn dry well-seasoned wood. Store fuel wood under cover.
- Do not overload your stove.
- Avoid smouldering fires that waste energy and create more woodsmoke: keep the air intake open enough to maintain a hot clean fire.
- Check for creosote buildup in the chimney.
- Make your house more energy efficient.
- When choosing a woodstove make sure that it is certified by the US Environmental Protection Agency, that it is the proper size for its intended use, and that it is installed according to building codes and standards.
- Some woodstoves burn exhaust gases more completely by routing them through a honeycomb-shaped catalytic converter. Advanced combustion stoves create the conditions necessary to burn combustible gases by maintaining a high temperature and an adequate air supply. In response to new regulations to protect air quality, and consumers' desire for greater efficiency in wood burning appliances, manufacturers have developed advanced combustion woodstoves that in some cases can cut a winter's fuelwood requirements in half, and smoke by 80% or more.
- Pellet stoves can burn more cleanly than most cordwood stoves by matching the fuel with the air supply in the combustion chamber for an optimal burn rate, although this is not a given: many pellet stoves are exempted from EPA-type emission regulations because of high excess air, (they are really high tech fireplaces) which immediately lowers their efficiency dramatically. In its research, the Canadian Combustion Research Laboratory has also tested some pellet stoves that do not burn cleanly. To be sure that a pellet stove is both clean-burning and efficient, check to see that it has been tested and met EPA Phase II or CSA B415 standards.



Sawmills create significant quantities of wood wastes that can be converted to high quality wood pellet fuel or burned directly in a wood chip boiler. (Yukon Government photo)

Did You Know?

A cord of firekilled (or other well seasoned) spruce or pine weighs about one tonne and contains about 18 GJ (gigajoules) of energy, or 5,000 kWh. Well seasoned air dried wood contains about 10 to 12% moisture by weight.

Hardwoods (deciduous trees) contain more energy per cord or per cubic metre than softwoods, because they are denser (poplar being an exception). Softwoods contain slightly more energy per kilogram because they have a higher hydrocarbon content (pitch).

Moisture in wood is reported either on a wet or dry basis. Wet basis refers to the percentage of the total weight that is water; thus it cannot exceed 100%. On a dry basis water is reported as a percent of the weight of the dry wood fibre, in which case it could exceed 100%. Fifty percent moisture wet basis would equal 100% moisture dry basis.

A bone dry unit (BDU) of pulp chips weighs 2,400 pounds, and normally takes approximately 3 cubic metres of log to produce.

Bark contains approximately the same energy content per kilogram as does wood. However, bark contains considerably more ash. In manufacturing fuel pellets, care must be taken to keep most bark out of the feedstock, to stop the ash from fusing in the pellet stove's normally small combustion chamber.

A cubic metre of green wood at 50% moisture content (wet basis) weighs approximately 760 kg. In other words, it has a specific gravity of 0.76.

In 1992, eight wood-fired power plants generated 10 percent of the electricity in the state of New Hampshire, while displacing 68 million barrels of oil, creating 800 jobs, and providing an economic benefit of $282 million statewide.

One kilotonne of wood with a moisture content of 30% (wet basis), producing electricity at an efficiency of 25%, can make one GWh of electricity.

A wood pellet plant producing 3 tons per hour, operating for one shift per day would produce approximately 6,000 tons of wood fuel pellets in a year. Since each stove burns about 6 tons per annum, one small plant could supply nearly 1,000 pellet stoves.

Glossary of Energy Terms

gigawatt hour (GWh)	Giga means 10^9 or 1,000,000,000 or one billion. One gigawatt hour equals one million kilowatt hours.
joule (J)	A joule is a unit of energy, equal to a newton of force exerted through a metre. One newton will accelerate a mass of one kilogram at a rate of one metre per second, every second. Raising a sandwich from your plate to your mouth requires approximately one joule of energy. Note that because a bite of sandwich can contain approximately 100 kilojoules of food energy (1 kJ = 1,000 joules), excessive repetitions of this action can result in jowls.
kilowatt	A kilowatt is a unit of power, equal to one thousand watts.
kilowatt hour (kWh)	A kilowatt hour is a unit of energy. One kilowatt hour equals 3.6 million joules. The product of power and time is energy. A person can work steadily at an output of approximately 100 watts, and therefore a day's hard labour results in about one kilowatt hour of work. At a wage of $10 per hour, human powered energy would cost approximately $100/kWh.
megawatt (MW)	A megawatt equals one million watts or one thousand kilowatts. The peak electrical demand of all customers in the Yukon is approximately 100 MW.
Opacity	A measure of the ability to look through a smoke plume. A hot clean burning fire is close to 0% opacity with only heat waves visible immediately above the chimney outlet. The maximum opacity allowed in Whitehorse is 50%.
Stranded investment	Investment in projects that become obsolete due to changing conditions. In the example of a power plant built to supply a remote operation that has ceased to require power, most of the assets must still remain in place, the capital repayments must still be made, but the power cannot be sold.
Watt (W)	A watt is a unit of power, equal to one joule per second.

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Prepared for the Cabinet Commission on Energy

by the

Department of Economic Development

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Wood Pile (Yukon Government photo)

Sternwheeler "Dawson" taking on cordwood at a wood camp on the Yukon River, July 1900.
(Yukon Archives/MacBride Museum Collection, Volume II, #4017)

Yukon
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