GREATER DELAWARE AREA

Forest Biomass Resource Analysis

REPORT FINALIZED:
MARCH 30, 2012

UPDATED:
MAY 10, 2012

COUNTIES OF INTEREST:

DELAWARE:
- KENT
- NEW CASTLE
- SUSSEX

MARYLAND:
- CAROLINE
- DORCHESTER
- KENT
- QUEEN ANNE'S
- SOMERSET
- TALBOT
- WICOMICO
- WORCESTER

VIRGINIA:
- ACCOMACK
- NORTHAMPTON

PENNSYLVANIA:
- CHESTER
- DELAWARE

Report Prepared By:

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US Forest Service Wood Education and Resource Center

Woody Biomass Consultant

This resource analysis was contracted through the Wood Education Resource Center (WERC) – contract #20483. The overall goal of this project is to maximize the utilization of forest resources through identifying production systems that can operate in one location and work together to optimize use of wood waste/forest residue.

The figures and percentages used throughout the feasibility study are subject to change depending on the conditions of future markets, supply and demand, dollar value, local, state, and national economic status, and other unforeseeable variables.

All information provided will be true to the best of RRS's knowledge and any oversight or misrepresentation is unintentional. All information is presumed to be the most up-to-date information available as of the official publication date of each individual study. Direct research should be done for the most current information when looking for specific costs/prices in months/years following the publication.

New technology and innovative practices are constantly being discovered and the most efficient systems and methods today could be outdated in the near future. This study is written to provide the most accurate information possible.

Though the specific published studies are intended for USFS Wood Education Resource Center in support of this project team's use only, it is known and understood that a large part of the information is either common knowledge or RRS' previously compiled general data.

It is known and understood that with the completion of this feasibility study, RRS is free to utilize all non-proprietary information in any future studies or reports.

USFS Wood Education Resource Center information, in support of this project team, is free to utilize the published analysis in any manner they see fit.

The Wood Education and Resource Center is located in Princeton, W.Va., and administered by the Northeastern Area State and Private Forestry unit of the U.S. Department of Agriculture Forest Service. The Center's mission is to work with the forest products industry toward sustainable forest products production for the eastern hardwood forest region. It provides state-of-the-art training, technology transfer, networking opportunities, applied research, and information. Visit www.na.fs.fed.us/werc for more information about the Center.

WERC
WOOD EDUCATION AND RESOURCE CENTER

CONTENTS

1. Biomass Sources and Procurement Area Data

Most of the biomass will be coming from a specific radius of the project location once determined. As no project location has been determined, for the purposes of this study Central Delaware was considered project center. County boundaries were used due to increased accuracy and availability of more in-depth data. As such, this report looks at Forest Inventory Analysis and other cited information for the following states and counties:

Delaware: Kent, New Castle, and Sussex; **Maryland:** Caroline, Dorchester, Kent, Queen Anne's, Talbot, Somerset, Wicomico, and Worcester; **Virginia:** Accomack and Northampton; and **Pennsylvania:** Chester and Delaware.

Table 1.1: Acres of sampled Non-Reserved Forestland by County and Ownership[1]

ST	County	Other Federal	Fish & Wildlife Service	State	Local	Other Non-Federal	Undifferentiated Private	Total
DE	Kent	0	3,279	15,460	0	0	85,340	104,079
DE	New Castle	5,006	0	12,576	268	2,855	26,155	46,860
DE	Sussex	0	0	27,124	3,813		151,190	182,127
MD	Caroline	0	0	0	0	0	47,329	47,329
MD	Dorchester	0	5,681	19,104	3,441	0	114,809	143,035
MD	Kent	0	0	10,546	0	0	39,618	50,164
MD	Queen Anne's	0	0	0	0	0	81,441	81,441
MD	Somerset	0	0	27,966	0	0	69,309	97,275
MD	Talbot	0	0	0	0	0	40,553	40,553
MD	Wicomico	0	0	23,967	0	0	107,501	131,468
MD	Worcester	0	0	16,108	0	0	102,491	118,599
PA	Chester	0	0	3,813	5,975	0	97,771	107,559
PA	Delaware	0	0	0	0	0	4,173	4,173
VA	Accomack	0	0	0	0	0	100,563	100,563
VA	Northampton	0	0	0	0	0	24,729	24,729
	Total	**5,006**	**8,960**	**156,664**	**13,497**	**2,855**	**1,092,972**	**1,279,954**

2. Types of Biomass Fuel Available and Realistic Pricing Information

There will be the opportunity to determine availability of fuel from a wide variety of sources when the project moves to the fuel procurement phase. For the purpose of this study, primary emphasis will be put on obtaining logging residue due to it being the most readily available source of woody biomass fuel.

Current Price Structure – Delivered to Plant

The following discusses the price range at which each potential raw material is available. Please note these prices are averages and vary depending upon mileage and, in the case of roundwood, certain species.

Type	Price/Ton
Roundwood (Most Species)[2]	**$20.00-$35.00**
Biomass Chips[3]	**$30.00-$50.00**
Sawmill Chips[4]	**$25.00-$40.00**
Wood Residue (Urban, Right-of-Way, Site Conversions, etc.)[5]	**$10.00-$40.00**

1 U.S. Department of Agriculture, Forest Service, North Central Research Station. Forest Inventory and Analysis National Program. 2010 Data. Counties of interest: Delaware: Kent, New Castle, and Sussex; Maryland: Caroline, Dorchester, Kent, Queen Anne's, Talbot, Somerset, Wicomico, and Worcester; Virginia: Accomack and Northampton; and Pennsylvania: Chester and Delaware.

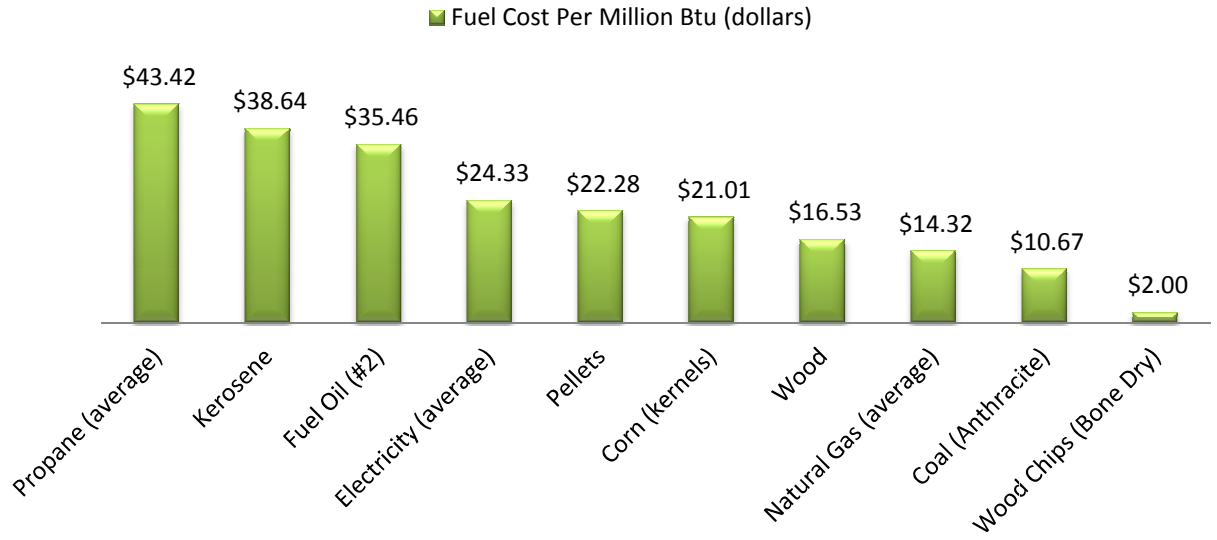
2 Eight foot pulpwood quality.

3 Very limited comparisons in this area.

4 Other forest industry residue (bark, sawdust shavings) in high demand for other products.

5 The main cost is processing and transportation , small scattered volumes make economics questionable in many cases.

Fuel Cost Per Million Btu (dollars)



Fuel Type	Heating Appliance Type	Type of Efficiency Rating [C]	Efficiency Rating or Estimate [D]	Approx. Efficiency (%)	Fuel Cost Per Million Btu (dollars)
Fuel Oil (#2)	Furnace or Boiler	AFUE	78.0	78%	$35.46
Electricity	Furnace or Boiler	Estimate	98.0	98%	$35.90
Electricity	Air-Source Heat Pump [E]	HSPF [E]	7.7	226%	$15.59
Electricity	Geothermal Heat Pump	COP	3.3	330%	$10.66
Electricity	Baseboard/Room Heater	Estimate	100.0	100%	$35.18
Natural Gas[A]	Furnace or Boiler	AFUE	78.0	78%	$14.42
Natural Gas[A]	Room Heater (Vented)	AFUE	65.0	65%	$17.30
Natural Gas[A]	Room Heater (Unvented)	Estimate	100.0	100%	$11.25
Propane	Furnace or Boiler	AFUE	78.0	78%	$39.47
Propane	Room Heater (Vented)	AFUE	65.0	65%	$47.37
Wood[B]	Room Heater (Vented)	Estimate	55.0	55%	$16.53
Pellets	Room Heater (Vented)	Estimate	68.0	68%	$22.28
Corn (kernels)[B]	Room Heater (Vented)	Estimate	68.0	68%	$21.01
Kerosene	Room Heater (Vented)	Estimate	80.0	80%	$38.64
Coal (Anthracite)	Furnace/Boiler/Stove	Estimate	75.0	75%	$10.67
Bone Dry Wood Chips[7]	At $30/per BDT: 133.34 lb. * $0.015 per lb. = $2.00 per million BTU				$2.00

A. Natural gas is typically sold to residential customers in units of "therms," but may be sold in units of hundreds of cubic feet.

B. The heat content for a cord of wood varies by tree species and is greatly affected by moisture content; 20 million Btu per cord is a rough approximation. The heat content of a unit (ton or bushel) of corn can also vary widely; see reference for Corn Burning Stoves in Efficiency Info tab/worksheet.

C. Some types of heaters do not have efficiency ratings; the ratings in the yellow cells are comparable estimates for new appliances with basic features.

D. The default values are the minimum efficiency standards set by the U.S. Department Energy. Estimated "ratings" are provided for heating equipment for which there are no DOE standards.

E. Air-Source Heat Pump Ratings: The actual heating efficiency and seasonal performance of a "conventional" air-source heat pump may vary significantly from its rated heating season performance factor (HSPF). Below is a procedure for determining an adjusted HSPF for your location for an air-source heat pump that uses only electric resistance heating as the auxiliary heat source. There are so-called "dual-fuel" or "hybrid" heat pump systems that are basically a heat pump integrated with a forced-air combustion appliance that uses natural gas, fuel oil or propane. In general, these systems use the heat pump for heating until outside temperatures reach the low 40's/high 30's (F), then switch to the combustion appliance for heating.

See Appendix V for more information on fuel cost comparison.

[6] Heating Fuel Cost Calculator. US Energy Information Agency. Last updated 3/8/2012. www.eia.gov/neic/experts/**heat**calc.xls.

[7] Forester's Co-Op - Professional Forestry & GIS Services. Fuel Cost Comparison: Wood Vs. Natural Gas. http://www.forco-op.com/project/wood_fuel_comp.pdf.

FEEDSTOCK AVAILABILITY CONSTRAINTS

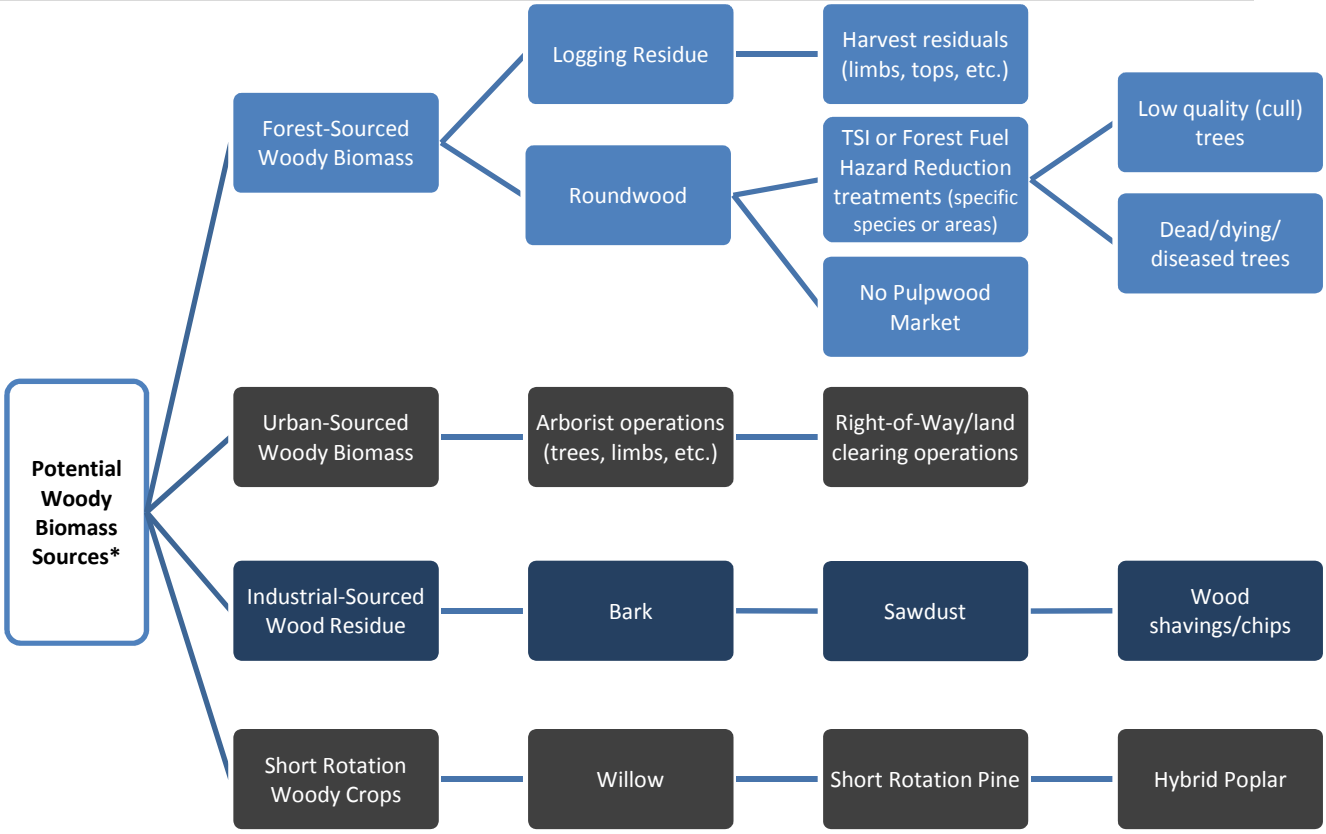
When social, economical, ecological, technological, political, and other logistical constraints are applied to biomass supply, the availability/sustainability of the supply is reduced considerably when compared to physical inventory alone. [8]

Another constraint on biomass supply is the fragmentation and parcelization of forestland throughout the DELMARVA Peninsula. Fragmentation and parcelization makes coordinating management decisions and actions across multiple parcels and landowners a necessity, significantly increasing the difficulty and challenging the economic viability of conducting forest management practices.

Emphasis should be placed on the continued/enhanced health and vitality of the forests and their resources. Where applicable, it is highly recommended that state specific forest-based woody biomass harvesting guidelines be upheld as they take management of all resources into consideration.

To account for the above constraints, the assumptions of availability made herein are calculated using a percentage or ratio based on the above factors.

FIGURE 2.1: POTENTIAL WOODY BIOMASS SOURCES



*Adapted from Kittler et al., 2010[2]

[8] The Potential for Sustainable Wood-Based Bioenergy in Maryland - *Developing Safeguards for Woody Biomass Harvests and Evaluating Wood-Based Bioenergy Markets.* Brian A. Kittler & Christopher M. Beauvais. 2010

3. Potential Woody Biomass Harvest Volumes Available

2010 Forest Resource Availability From All Ownerships[9] – Counties of Interest

Table 3.1: Delaware

Average Annual Net Growth of Growing Stock (Cubic Feet)		Green Tons (Converted from Cubic Feet)	
23,441,360	Gross Annual Growth	682,470	Gross Annual Growth
1,958,478	Removal	57,019	Removal
6,314,135	Mortality	183,829	Mortality
15,168,747	**Net Annual Growth**	**441,622**	**Net Annual Growth**

88,324.35	green tons of biomass could be available if only 20% of net annual net growth was harvested for biomass
36,765.85	green tons of biomass could be recovered if only 20% of mortality volume was salvaged for biomass

Table 3.2: Maryland

Average Annual Net Growth of Growing Stock (Cubic Feet)		Green Tons (Converted from Cubic Feet)	
74,355,331	Gross Annual Growth	2,164,775	Gross Annual Growth
22,891,663	Removal	666,466	Removal
14,654,490	Mortality	426,650	Mortality
36,809,178	**Net Annual Growth**	**1,071,659**	**Net Annual Growth**

214,331.92	green tons of biomass could be available if only 20% of net annual net growth was harvested for biomass
85,329.94	green tons of biomass could be recovered if only 20% of mortality volume was salvaged for biomass

Table 3.3: Pennsylvania

Average Annual Net Growth of Growing Stock (Cubic Feet)		Green Tons (Converted from Cubic Feet)	
15,336,442	Gross Annual Growth	446,504	Gross Annual Growth
2,819,332	Removal	82,082	Removal
225,840	Mortality	6,575	Mortality
12,291,270	**Net Annual Growth**	**357,847**	**Net Annual Growth**

71,569.42	green tons of biomass could be available if only 20% of net annual net growth was harvested for biomass
1,315.02	green tons of biomass could be recovered if only 20% of mortality volume was salvaged for biomass

Table 3.4: Virginia

Average Annual Net Growth of Growing Stock (Cubic Feet)		Green Tons (Converted from Cubic Feet)	
23,880,344	Gross Annual Growth	695,251	Gross Annual Growth
2,093,027	Removal	60,936	Removal
2,704,864	Mortality	78,749	Mortality
19,082,453	**Net Annual Growth**	**555,566**	**Net Annual Growth**

111,113.02	green tons of biomass could be available if only 20% of net annual net growth was harvested for biomass
15,749.84	green tons of biomass could be recovered if only 20% of mortality volume was salvaged for biomass

Table 3.5: Total

Average Annual Net Growth of Growing Stock (Cubic Feet)		Green Tons (Converted from Cubic Feet)	
137,013,477	Gross Annual Growth	3,989,000	Gross Annual Growth
29,762,500	Removal	866,503	Removal
23,899,329	Mortality	695,803	Mortality
83,351,648	**Net Annual Growth**	**2,426,694**	**Net Annual Growth**

485,339	green tons of woody biomass could be available if **20%** of the cumulative total net annual growth was harvested for biomass within target area
139,161	green tons of woody biomass could be available if **20%** of the cumulative total mortality was harvested for biomass within target area

[9] U.S. Department of Agriculture, Forest Service, North Central Research Station. Forest Inventory and Analysis National Program. 2010 Data. Counties of interest: Delaware: Kent, New Castle, and Sussex; Maryland: Caroline, Dorchester, Kent, Queen Anne's, Talbot, Somerset, Wicomico, and Worcester; Virginia: Accomack and Northampton; and Pennsylvania: Chester and Delaware.

4. Potential Logging Residue Available

Using a ratio of 0.24 green tons of biomass per green ton other products removed, the following table was derived using removal volumes from 2010.

Table 4.1: Green Tons of Logging Residue Generated by Industrial Roundwood Harvesting on All Ownerships[10] (2010) - Counties of Interest

State	Total Softwoods	Total Hardwoods	All Species
Delaware	-	13,684.56	13,684.56
Maryland	87,112.09	72,839.79	159,951.88
Pennsylvania	-	19,699.64	19,699.64
Virginia	9,737.83	4,886.87	14,624.70
Total	**96,849.92**	**111,110.86**	**207,960.78**

5. Other Potential Residue Sources

Volume of Industrial Wood Residue (Green Tons)^ – Counties of Interest*[11]

Table 5.1: Delaware 2008 (Kent, New Castle, Sussex Counties)

	Bark		Coarse		Fines	
	SFTWD	HRDWD	SFTWD	HRDWD	SFTWD	HRDWD
Residential Fuelwood	--	336.26	--	1,755.31	--	--
Miscellaneous	--	307.80	--	723.60	--	2,635.88
Mulch	--	1,282.16	--	2,049.39	--	--
Total	**--**	**1,926.22**	**--**	**4,528.30**	**--**	**2,635.88**

Table 5.2: Maryland 2008 (Caroline, Dorchester, Kent, Queen Anne's, Somerset, Talbot, Wicomico, Worcester Counties)

	Bark		Coarse		Fines	
	SFTWD	HRDWD	SFTWD	HRDWD	SFTWD	HRDWD
Fiber products	0.00	0.00	25,603.10	0.00	0.00	0.00
Industrial fuel	0.00	502.70	11,039.50	2,412.00	182.50	0.00
Miscellaneous	0.00	2,116.70	22,726.90	28,330.30	32,275.60	17,309.80
Mulch	30,077.60	11,126.00	0.00	2,010.00	0.00	1,755.00
Not used	17.10	11.40	234.40	26.80	23.40	15.60
Total	**30,094.70**	**13,756.80**	**59,603.80**	**32,779.10**	**32,481.50**	**19,080.40**

Table 5.3: Pennsylvania 2006[12] (Chester County only; no data available for Delaware County)

	Bark		Coarse		Fines	
	SFTWD	HRDWD	SFTWD	HRDWD	SFTWD	HRDWD
Fiber products	0	0	0	349	0	0
Industrial fuel	0	116	0	0	0	0
Miscellaneous	0	87	0	291	0	408
Mulch	0	0	0	0	0	0
Not used	0	29	0	87	0	0
Total	**0**	**232**	**0**	**727**	**0**	**408**

^The tables review total industrial wood residue produced and do not necessarily reflect available residue.
*No data available for Delaware County, Pennsylvania or the State of Virginia (Accomack and Northampton Counties) due to no movement of wood occurring in any of these counties.

- Delaware County, PA is a very densely populated area: 184 square miles with 3,040 people/square mile (US Census Bureau, 2010), which could account for no wood movement.

Table 5.4: Total of Tables Above

	Bark		Coarse		Fines	
	SFTWD	HRDWD	SFTWD	HRDWD	SFTWD	HRDWD
Total	**30,095**	**15,915**	**59,604**	**38,034**	**32,482**	**22,124**

[10] Data extrapolated from [10] U.S. Department of Agriculture, Forest Service, North Central Research Station. Forest Inventory and Analysis National Program. 2010 Data. Counties of interest.
[11] USDA Forest Service. Sourced from Northern Research Station (direct contact).
[12] USDA Forest Service. Timber Product Output (TPO) Reports. RPA report years: 1996 (aka 1997), 2001 (aka 2002), 2006 (aka 2007) only.

6. VOLUME REALISTICALLY/ECONOMICALLY AVAILABLE

Biomass extraction on all properties can have a number of variables that affect it on site:

- → Soil Type
- → Topography
- → Soil Conditions (wet, dry, frozen)
- → Long Skid Distance
- → Other Uses For Tops (firewood, trail armoring)
- → Logging Company Is Not Equipped For Biomass Harvesting
- → Landowner Goals For The Property

Off site variables that can affect biomass extraction:

- → Price Paid By Receiving Plant
- → Distance To Plant
- → Availability/Ease Of Use Of Incentive Programs
- → Other Markets For Product
- → Biomass Harvesting Guidelines
- → Buyer Specifications (i.e. species, form, moisture content, etc.)
- → Competition Among Buyers and Buyer Needs

LOGGING RESIDUES

This table shows the volume of recoverable logging residue based on procuring certain percentages of available logging residue. These percentages allow for competition and lack of biomass removal for various reasons. Totals below were developed using a ratio of .24 green tons of biomass per green ton of other products removed annually derived using USFS FIA removal volumes from 2010 (See Table 4.1).

TABLE 6.1: LOGGING RESIDUE AVAILABILITY

	Green Tons		
State (Specified Counties)	**Total Logging Residue**	**25% Recovered**	**50% Recovered**
Delaware	13,685	3,421	6,842
Maryland	159,952	39,988	79,976
Pennsylvania	19,700	4,925	9,850
Virginia	14,625	3,656	7,312
Total	**207,961**	**51,990**	**103,980**

In addition to the residue aforementioned, other sources of woody biomass may include primary and secondary forest industry companies, untreated waste (pallets), urban or R.O.W. tree removals/trimmings, and landfill brush dumps. This also does not include wood available from dead trees caused by weather events, insects, or disease as these volumes cannot be planned for or counted on in a specific year. In some years, it could account for a significant percentage of the woody biomass used at a woody biomass using facility. Additionally, wood available from other non-harvest activities (site preparation for planting, plantation release, invasive tree/shrub control, etc.) is not included in this figure. Once a site is chosen and fuel procurement planning begins, these additional sources would need to be contacted for potential fuel, but many of these sources already have markets for their residue/waste and, though it is assumed a percentage of the fuel would come from these sources, logging residue would most likely be the primary fuel source.

TIMBER STAND IMPROVEMENT/SALVAGE

This table shows the volume of recoverable forest mortality for timber stand improvement/salvage. Totals below were developed using a salvage ratio of 20% per green ton of annual forest mortality derived using USFS FIA removal volumes from 2010 based on procuring certain percentages (See Tables 3.1-3.4).

TABLE 6.2: TIMBER STAND IMPROVEMENT/SALVAGE

	Green Tons		
State (Specified Counties)	**Total Mortality**	**25% Recovered**	**50% Recovered**
Delaware	36,766	9,191	18,383
Maryland	85,330	21,332	42,665
Pennsylvania	1,315	329	658
Virginia	15,750	3,937	7,875
Total	**139,161**	**34,790**	**69,580**

BIOMASS HARVESTING – GROWING STOCK

This table shows the volume of biomass available through dedicated biomass harvesting. Totals below were developed using a harvest ratio of both 10% and 20% per green ton of net annual forest growth derived using USFS FIA growing stock volumes from 2010 based on procuring certain percentages (See Tables 3.1-3.4).

TABLE 6.3: BIOMASS HARVESTING – GROWING STOCK

	Green Tons		
State (Specified Counties)	Total Net Annual Growing Stock	Total Growing Stock	
		10%	20%
Delaware	441,622	44,162.17	88,324
Maryland	1,071,660	107,165.96	214,332
Pennsylvania	357,847	35,784.71	71,569
Virginia	555,565	55,556.51	111,113
Total	**2,426,694**	**242,669.35**	**485,339**

7. DETAILED RISK ASSESSMENT

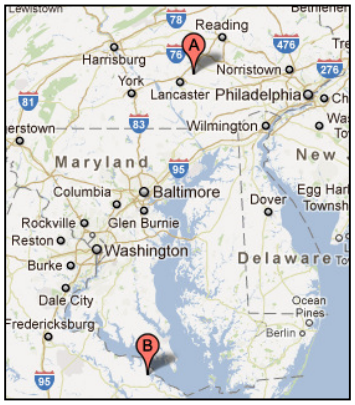
CURRENT AND PROJECTED COMPETITION

See Appendix II for more information on wood using facility density.

TABLE 7.1: WOOD PELLET PLANTS WITHIN A 100-MILE RADIUS*

MILES	COMPANY NAME	CITY	STATE
A. 94	Ironstone Mills	Leola	PA
B. 76	Potomac Supply Corp	Kinsale	VA

*Straightline distance from Greenwood, DE.



Map data 2012© Google

TABLE 7.2: PULPMILLS WTIHIN A 100-MILE RADIUS*

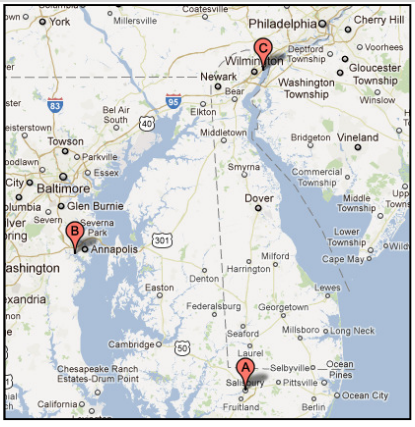
MILES	COMPANY	TYPE	CITY	ST
100	GLATFELTER PULP WOOD COMPANY	PULPMILL	SPRING GROVE	PA

*Straightline distance from Greenwood, DE.

TABLE 7.3: MULCH AND SHAVINGS COMPANIES WITHIN A 100-MILE RADIUS*

MILES	COMPANY	PRODUCT	CITY	ST
A. 31	EASTERN SHORE FOREST PRODUCTS	SAWDUST & SHAVINGS	SALISBURY	MD
B. 53	JOHNSON LUMBER	SAWMILL/MULCH	EDGEWATER	MD
C. 65	HOLLAND MULCH	MULCH	EDGEMOOR	DE

*Straightline distance from Greenwood, DE.



Map data 2012© Google

TABLE 7.4: COMBINED HEAT & POWER UNITS[13] WITHIN A 100 MILE RADIUS*

Miles	Organization Name	City	ST	Year Op.	Capacity (kw)	Fuel Type ^
42	Md. Dept. Of General Services - Eastern Correctional Inst.	Princess Anne	MD	1988	4,000	WOOD

*Straightline distance from Greenwood, DE.

^Definitions of fuel types from source[7]:

WOOD: Wood, Wood Waste

ELECTRIC UTILITIES

Electric utilities are another potential viable market, with many having already tested and demonstrated various types of biomass co-firing systems. The reported challenges with most of the pilot projects could be mitigated by the use of wood pellets. In addition, current state laws requiring reductions in carbon emissions and future possible carbon fees and caps are in favor of wood pellet fuels.

INCREASED COMPETITION

Without knowing a specific location, assessing the true potential for increased competition must be a statewide speculation as project size, location, and geographic limitations/benefits all affect the assessment's outcome.

STATE AND FEDERAL BIOMASS POLICY

"A GUIDE TO FOREST BIOMASS HARVESTING AND RETENTION IN MARYLAND"

In September 2010, the Pinchot Institute for Conservation released the "A Guide to Forest Biomass Harvesting and Retention in Maryland" that was developed in collaboration with the Maryland Department of Natural Resources Forest Service, the Maryland Department of the Environment, the Maryland Energy Administration, the Baltimore County Department of Environmental Protection & Resource Management, the University of Maryland Extension Service, the University of Maryland Department of Agricultural and Resource Economics, the Nature Conservancy, the USDA Natural Resources Conservation Service, private forest landowners, and consulting foresters.

Overview[14]

> "These guidelines are based on a comprehensive review of the potential ecological risks associated with biomass harvesting and a review of Maryland's existing forest management programs. It should be noted that many of the recommended practices contained within this document are standard forest management operations, whereas other practices contained herein may be new to many.
>
> Forest biomass removal will likely accompany traditional timber harvests and will thus be subject to a number of regulatory and non-regulatory programs already active in Maryland. However, the removal of additional woody material is not wholly addressed by existing forest management programs, and biomass harvests may negatively impact forest health and productivity if precautions are not taken.
>
> These guidelines are meant to work in concert with existing forest management plans, Best Management Practices (BMPs), and other natural resource management programs to provide for the protection of forest health and productivity, and environmental quality through the use of scientifically credible management practices."

For a complete copy of "A Guide to Forest Biomass Harvesting and Retention in Maryland", visit the Pinchot Institute's website or use the following link www.pinchot.org/gp/Maryland_Biomass.

[13] US DOE – EEA. http://www.eea-inc.com/chpdata/states/

[14] "A Guide to Forest Biomass Harvesting and Retention in Maryland". September 2010. www.pinchot.org/gp/Maryland_Biomass

Forest Stewardship Council™ (FSC®)[15]

As proposed, the FSC® U.S. National Standard covers much of the same ground that other biomass guidelines do, although at a more general level since they are nationwide. The main sections that affect biomass harvest are the habitat (Indicators 6.3.c; 6.3.d), dead wood (6.3.i), and retention sections (6.3.j). For example, Indicator 6.3.i of the guidelines requires that "management in all stands maintains, enhances, or restores habitat components, and associated stand structures, including…live trees with decay or declining health, snags, and well-distributed coarse down and dead woody material." This proposed requirement would place some limits on biomass removal. Since FSC® guidelines are not focused solely on biomass harvests, they go beyond other biomass guidelines in areas such as habitat connectivity. By the same token, because FSC® guidelines cover many different types of harvest in many different forest types with diverse forest management objectives, the standards do not contain many guidelines that are specific to biomass harvest.

The FSC® standards are considered to be outcome focused. For example, one element that shows up in some biomass guidelines is re-entry. Missouri's guidelines advise, "Do not re-enter a harvested area [for the purposes of biomass harvesting] once the new forest has begun to grow," which is a sentiment echoed in the Minnesota and Pennsylvania guidelines. The FSC® standards, however, do not specifically advise against re-entering a stand for the purpose of biomass harvesting. Rather than prescribing how to achieve desired outcomes, they allow a variety of practices to be used, so long as the management objectives and the FSC standards are not compromised.

Sustainable Forestry Initiative (SFI®)

The *SFI® 2010-2014 Standard* is a research and science-based standard that takes careful consideration of social, economical, and environmental issues related to forest management as well as the interests in the marketplace. Through its continual improvement process, the SFI® program often builds new requirements into its standard that reflect new information and science as it becomes available.

Bioenergy feedstocks are not new products from managed forests; however, there is growing interest in such products given government policies and positions to promote renewable energy. The SFI Standard provides the same assurances regardless of the final product, whether it is solid wood building products, paper products, or feedstocks for bioenergy. In addition, the requirements for forest management and *fiber sourcing* are the same regardless of whether the end-user is a traditional forest or paper product company or an emerging bioenergy production company.

The SFI® 2010-2014 Standard applies to management of forests throughout North America where management intensities are characterized by managed natural forests and plantation forestry, regardless of the forest products derived from management of such forests. Short rotation woody crop operations and other high intensity forestry operations, while they may serve a role in the production of bioenergy feedstocks, are beyond the scope of the SFI® 2010-2014 Standard.

American Tree Farm System

Established in 1941, the American Tree Farm System (ATFS) is the United States' oldest family forest certification program. ATFS certification is now internationally-recognized, meets strict third-party verification and auditing standards, and meets eight standards of sustainability and is managed for multiple purposes: water, wildlife, wood and recreation. Wood harvested from ATFS certified lands can be claimed under the Programme for the Endorsement of Forest Certification (PEFC) schemes, Canadian Standards Association (CSA) and the Sustainable Forestry Initiative's (SFI) Chain of Custody Systems. As such, not only do landowners have to follow their written forest management plan for their property that addresses all forest management activities, they must follow PEFC, CSA, or SFI (see above) standards, including woody biomass removal.

[15] Evans, Alexander M.; Perschel, Robert T. An Assessment of Biomass Harvesting Guidelines.

LAWS/LEGISLATION

DELAWARE RENEWABLE ENERGY PORTFOLIO STANDARDS ACT [16]

(143rd General Assembly, Senate Bill No. 74 and amendments)

The Renewable Portfolio Standards established by this Act require electricity suppliers to supply a percentage of their total annual electricity sales from renewable energy resources. The percentage incrementally increases from 1% in 2007 to 10% by 2019. Renewable energy credits (RECs) derived from eligible resources are used to track and verify compliance. Eligible renewable energy resources include solar electric power, wind energy, geothermal energy, ocean energy, fuel cells, small hydropower, landfill gas and sustainable biomass. Alternative compliance payments and purchases of RECs from within the PJM territory can be used, with restrictions, to satisfy the RPS requirement.

CHAPTER 289, FORMERLY SENATE BILL NO. 280 – INCINERATOR LAW

As amended by House Amendment No.'s 3, 5, 7, 8 and 11 and Senate Amendment No.'s 1, 2, and 10

Approved April 25, 2000

BE IT ENACTED BY THE GENERAL ASSEMBLY OF THE STATE OF DELAWARE

Section 1. Amend § 6002, Title 7 of the Delaware Code, by inserting therein, between subsections (9) and (11) thereof, a new subsection designated as subsection (10), and by redesignating the remaining subsections as appropriate, as follows:

"(10) 'Incinerator,' 'incinerator structure or facility,' and 'waste incinerator,' include any structure or facility operated for the combustion (oxidation) of solid waste, even if the byproducts of the operation include useful products such as steam and electricity. 'Incinerator' shall not include the following activities: 1) crematoriums; 2) disposal of the bodies of animals through incineration; 3) the burning of poultry waste or poultry manure at the same site where the waste or manure was generated, which shall include the burning of poultry waste or poultry manure generated upon an adjacent farm; 4) disposal of all materials used in the discovery, development, and manufacture of veterinary products, medicines and vaccines; or 5) the disposition of mortalities from poultry operations in facilities approved by the Delaware Department of Natural Resources and Environmental Control which comply with United States Department of Agricultural Natural Resources Conservation Service Interim Conservation Practice Standard Incinerator 769, or any successor standard."

Section 2. Amend § 6003(c), Title 7 of the Delaware Code, by inserting a colon (":") immediately after the word "and" as it appears therein.

Section 3. Further Amend § 6003(c), Title 7 of the Delaware Code, by designating the phrase, "no permit may be granted unless the county or municipality having jurisdiction has first approved the activity by zoning procedures provided by law" as subsection (1) thereof, by striking the period at the end thereof and by substituting in lieu thereof the phrase, "; and".

Section 4. Further Amend § 6003(c), Title 7 of the Delaware Code, by adding thereto the following new subsection:

"(2) no permit may be granted to any incinerator unless:

a. the property on which the incinerator is or would be located is within an area which is zoned for heavy industrial activity; and shall be subject to such process rules, regulations or ordinances as the county, municipality or other government entity shall require by law, such as a conditional use, so that conditions may be applied regarding the health, safety and welfare of the citizens within the jurisdiction; and
b. every point on the property boundary line of the property on which the incinerator is or would be located is (i) at least 3 miles from every point on the property boundary line of any residence, (ii) at least 3 miles from every point on the property boundary line of any

[16] http://www.seu-de.org/docs/Section_E.pdf

residential community, and (iii) at least 3 miles from every point on the property boundary line of any church, school, park, or hospital."

Section 5. Amend § 6003, Title 7 of the Delaware Code, by adding thereto the following new subsection:

"(i) No county, municipality, or other governmental entity shall issue any building, placement, storage, or occupancy permit or license to any person intending to operate an incinerator unless:

(1) the property on which the incinerator is or would be located is within an area which is zoned for heavy industrial activity; and shall be subject to such process rules, regulations or ordinances as the county, municipality or other government entity shall require by law, such as a conditional use, so that conditions may be applied regarding the health, safety and welfare of the citizens within the jurisdiction; and

(2) every point on the property boundary line of the property on which the incinerator is or would be located is:

a. at least 3 miles from every point on the property boundary line of any residence;

b. at least 3 miles from every point on the property boundary line of any residential community; and

c. at least 3 miles from every point on the property boundary line of any church, school, park, or hospital."

Section 6. Amend § 6002(23), Title 7 of the Delaware Code, by inserting therein, between the term 'refuse,' and the phrase 'sludge from a waste treatment plant,' the phrase, 'refuse-derived fuel, demolition and construction waste wood,'.

Section 7. Further Amend § 6002(23), Title 7 of the Delaware Code, by adding thereto at the end of said subsection, the following sentence:

"Bi-products of a uniform and known composition produced as a result of a production process are not solid wastes when incinerated on-site. All incinerators under State permit as of 3/1/00, and renewal permit applications for these incinerators shall not come under the provisions of this bill."

Section 8. The Delaware Nutrient Management Commission will review the needs of the agriculture community regarding disposal of various waste or byproducts and the existing technology and means for such disposal. This committee shall report to the Governor and General Assembly its findings and recommendations including any proposed legislation relating to incinerators no later than March 15, 2002.

AVAILABILITY OF ADDITIONAL FUEL TYPES

Insect, disease, weather events, and wildfires can provide additional supplies of woody biomass at any time. Dead, damaged, and scarred wood that would not be viable for other markets will generally be accepted for biomass and, in some cases, even preferred due to reduced moisture content.

Some of the other sources aforementioned (forest industry, manufacturing residue, urban/R.O.W. tree removal/thinning waste, brush dumps, etc.) could increase availability of potential fuel depending on a number of variables.

TRANSPORTATION

Sustained increases in diesel fuel prices will affect operational costs for the logging equipment, processing equipment, and for trucking. Obtaining biomass from sources as close as possible to the end-using facility will help minimize the trucking expense/raw material cost fluctuation.

SUMMARY

With the "incinerator law" in effect in Delaware, there is a decided lack of information available regarding the potential for a wood energy project(s) in Delaware. Consequently, to seriously look at the possibilities and potential for a wood energy project(s) in Delaware, the "incinerator law" needs to be amended to allow for commercial applications of wood energy that would in fact be more environmentally friendly than fossil fuel options.

Despite the lack of information specific to Delaware, there is very current information available for Maryland. Many of the statements and conclusions made in a February 2012 report by the Maryland Wood Energy Coalition entitled, "A Prospectus for Advancing Biomass Thermal Energy in Maryland"[17], are equally applicable to Delaware and make a regional approach to wood energy usage an interesting scenario. As such, the following are three key areas discussed in this report that are equally applicable to Delaware:

Sustainability

A concern often brought up concerning woody biomass usage for energy production is sustainability. This was also very well addressed in this report:

> "Biomass harvests can be a valuable tool to meet multiple forest management objectives when forest management planning and careful harvests are undertaken. Maryland's 2008 Climate Action Plan states that, '*all biomass products will be sustainably harvested without depriving soils of important organic components for reducing erosion and maintaining soil nutrients and structure, nor depleting wildlife habitat or jeopardizing future feedstocks in quantity and quality*'.
>
> To address this charge, a multi-stakeholder working group led by the Department of Natural Resources Forest Service developed Maryland's Forest Biomass Harvesting and Retention Guidelines to educate Maryland's logging industry about their opportunities to harvest biomass in an ecologically responsible manner. Biomass markets can provide an incentive for forest landowners to manage their forests sustainably, encouraging a balanced approach to forest management. Markets for low-grade wood are vital to keeping Maryland's forests healthy and energy markets represent the largest new potential market of this kind. University of Maryland Forestry Extension, Maryland's Master Logger Training Program and other outreach mechanisms are helping stakeholders understand the opportunities and responsibilities involved with biomass removal."

Economic and Social Impact

A concern across the nation is that state of local economies/communities and what can be done to improve them. The following looks at the economic and social impact of woody biomass used for energy production:

> "Thermal biomass strengthens the local economy. The northeast uses ~84% of the nation's heating oil, with Maryland being the 5th largest consumer nationwide. As much as 11% of Maryland's residential thermal energy is currently supplied by heating oil. A recent study found that shifting roughly 18.5% of northeast's thermal energy demand to biomass by 2025 would inject $4.5 billion annually into the regional economy, retain $1.6 billion dollars, and create 140,000 permanent jobs.*
>
> *Heating the Northeast with Renewable Biomass: A Vision for 2025. Presented by the Biomass Thermal Energy Council, Alliance for Green Heat, Maine Pellet Fuels Association, New York Biomass Energy Alliance, and the Pellet Fuels Institute. April 28, 2010.
>
> Each link in the biomass supply chain retains and creates local green jobs. Maryland's wood products industry provides 27,610 jobs and $3 billion in economic output annually. At present ~2,500 – 5,000 of these jobs depend greatly on wood harvested in Maryland, while about 9,000 –

[17] Maryland Wood Energy Coalition. "A Prospectus for Advancing Biomass Thermal Energy in Maryland - Developed By the Maryland Wood Energy Coalition". February 2012.

10,000 of these jobs depend on wood imported from nearby states. Building local biomass supply chains for thermal energy systems will build jobs that harness Maryland's resources. Supply chain jobs will come from tree care crews, arborists, land clearing companies, public works agencies, and municipal waste recycling operations, licensed loggers, and biomass aggregators. Creating green jobs in rural communities can be significantly more important to the economy at large than adding service jobs to the more densely populated areas.

Thermal biomass is more likely to supplement, not supplant, other industries. Distributed and appropriately scaled projects are less likely to result in competitive economics that may negatively affect existing wood users. In fact, pellet production and biomass thermal can positively influence the existing forest products industry if scaled appropriately.

Thermal biomass can help reduce greenhouse gas emissions. Biomass thermal has the lowest life-cycle greenhouse gas emissions of all biomass energy options and as a result the greenhouse gas reduction benefits of using biomass are achieved fastest through thermal technologies.

Thermal biomass is the most efficient use of wood fuel. Energy efficiency is a comparison of fuel input to usable energy output. Modern and commercially viable biomass heating, cooling, and combined heat and power (CHP) technologies can reach efficiencies of up to 80 – 90%, while electric power plants only reach 25 – 30%, releasing three quarters of the energy produced into the air and/or surrounding water bodies.

Potential

"Institutional scale wood chip boiler projects are Maryland's low hanging fruit; the state should select a few pilots and see these through from start to finish. If successful, a 'Fuels for Schools and Beyond' program would be a natural progression, as it has been for Pennsylvania, Vermont, Maine, Missouri, North Dakota, Montana, Wyoming, Idaho, Utah, and Nevada."

"Researchers at the University of Maryland are determining the most advantageous locations for growing short rotation wood crops for energy. The cost of production notwithstanding, more than 600,000 green tons of wood could be available from short rotation wood energy crops cultivated on Maryland's idle lands annually. Environmental co-benefits, such as improved water quality in Chesapeake Bay, could result."

"A boiler conversion program in Pennsylvania has led to big savings. […] The Elk Regional Health Center utilizes 2,785-tons of clean wood chips from local forests at around $89,000 annually. By converting from natural gas to biomass in 2008, the Health Center saved more than $94,000 in fuel costs in its first 6 months of operation. Even with the price of natural gas falling significantly, biomass projects like this can still pencil out economically."

OPPORTUNITIES

POULTRY PRODUCTION

There is a significant opportunity found in poultry farms, with approximately 5,100 poultry houses (900 of which are in Delaware) located on the Delmarva Peninsula. According to a wood energy study conducted by the Pinchot Institute for Conservation[18]:

> "New wood energy capacity may prop up the existing forest products industry, and other wood using industries (e.g. poultry production), retaining and creating jobs in the process, if new wood energy infrastructure is scaled appropriately. […] Wood biomass could potentially fit in agricultural areas where propane and heating oil are used to heat buildings and in food processing.

[18] The Potential for Sustainable Wood-Based Bioenergy in Maryland - *Developing Safeguards for Woody Biomass Harvests and Evaluating Wood-Based Bioenergy Markets.* Brian A. Kittler & Christopher M. Beauvais. 2010.

For instance, the dry heat offered by wood pellets or dry wood chips could reduce ammonia levels in poultry houses when compared to the wet heat from propane. This promotes flock health and productivity.

[The approximate] 5,100 poultry houses on Delmarva would need an estimated supply of over 200,000 tons of wood chips or 163,200 tons of wood pellets annually. This collective fuel switching would represent a savings of more than $49 million annually to the Delmarva poultry industry and a reduction of over 175,000 metric tons of fossil-based CO2 annually, not to mention a reduction in ammonia emissions, an additional win for the region's air and water quality. This assumes that:

- The average poultry house consumes 6,000 gallons of propane per year at a cost of $2.67/gallon = $16,020 per year
- It takes 40 tons of wood chips or 32 tons of pellets to offset 6,000 gallons of propane
- Energy grade semi-dry wood chips cost ~$60/ton and bulk pellets cost ~$200/ton = $6,400 per year – a fuel savings of $9,620 per year over propane"

A better bottom line for poultry producers could also mean a big win in terms of regional job retention/creation above and beyond those realized in the forest industry/support industries through use of wood fuel. According to a University of Maryland study, each job in the poultry processing industry creates 7.2 jobs elsewhere and jobs directly and indirectly dependent upon the broiler chicken industry, which represents over one out of every 12 jobs in the region.

RENEWABLE ENERGY PORTFOLIO STANDARDS ACT

Although this Act includes all renewable energy sources, the "Incinerator Law" aforementioned and addressed below, precludes woody biomass being considered as a renewable energy source in almost all locations in Delaware.

STATE OF THE ECONOMY

There is a need for diverse, stable forest markets. According to the Delaware Forest Service[19]:

> "Landowners must have the ability to generate income from their forestland; otherwise, they are much more likely to convert their forestland to other uses (such as development). Many of the traditional wood products markets (sawmills and pulp mills) in Delaware and the surrounding states are suffering due to a weak economy and global competition; this has reduced the income that forest landowners receive. Other potential markets, however, are emerging, such as carbon and wetland mitigation (ecosystem services). A combination of traditional and new markets is needed to provide landowners with sufficient income opportunities."

ENCUMBRANCES

DELAWARE CHAPTER 289 (INCINERATOR LAW)

Aforementioned, before anything else can move forward with regard to a wood energy project, this must be changed to allow for sustainable, environmentally friendly wood energy projects.

FRAGMENTATION AND PARCELIZATION

Another encumbrance on logging generated woody biomass supply is the fragmentation and parcelization of forestland throughout DELMARVA Peninsula. Fragmentation and parcelization make coordinating management decisions and actions across multiple parcels and landowners a necessity, significantly increases the difficulty and jeopardizes the economic viability of conducting any forest management practices.

[19] Delaware Forest Service. "Strategic Plan – A Vision for the Future". 2010.

This is especially true in Delaware. According to the Delaware Forest Service[20]:

> "Delaware continues to lose forests to development – from 2002 to 2007, developments that included over 14,000 acres of forestland were approved throughout Delaware. This rate of loss cannot continue within a state that only has 380,000 forested acres. Furthermore, our remaining woodlands are owned by more and more landowners – this increased parcelization (more landowners owning smaller forested areas) also hinders our ability to manage our forestland"

According to Maryland's Strategic Forest Lands Assessment (SFLA):

> "Over the past 50 years, U.S. Forest Service statistics show, Maryland has lost an average of 7,200 acres of forest per year to non-forest uses. In addition to this outright loss of forest, a continuous threat to forest health and vitality is the fragmentation of large, contiguous blocks of forest into many smaller, isolated patches."

TOTAL POTENTIAL BIOMASS AVAILABLE – COUNTIES OF INTEREST

	Green Tons		
Source	**Total Generated/Available**	**25% Recovered**	**50% Recovered**
Logging Residue Recovery (From Existing Removals)	**207,961**	**51,990**	**103,980**
Timber Stand Improvement (Mortality/Salvage)	**139,161**	**34,790**	**69,580**
Totals	**347,122**	**86,780**	**173,560**

[20] Delaware Forest Service. "Strategic Plan – A Vision for the Future". 2010.

APPENDIX I: DELAWARE COMMERCIAL FOREST PLANTATION ACT

The Delaware Commercial Forest Plantation Act (Title 3, Chapter 26) was established to give landowners a property tax exemption for forests that are managed for timber production. In order to qualify for this thirty (30) year exemption, landowners must have at least 10 contiguous forested acres and follow a forest management plan approved by the Delaware Forest Service.

- Any owner of a Commercial Forest Plantation may apply to the Department of Agriculture to have such land listed for tax exemption. In applying, such owner shall file with the Department of Agriculture a sworn statement of compliance with this chapter together with the location, description and acreage of the planted lands or the naturally reforested lands. Additionally, all applications for tax exemption must be accompanied by a forest management plan approved by the State Forester. The Department of Agriculture, upon receipt of such application, shall direct the State Forester to make or cause to be made a thorough examination of the property described in the application and report the findings to the Department of Agriculture.

TABLE A1.1: DE CFP LAND – VOLUME HARVESTED BY HARVEST TYPE BY YEAR (GREEN TONS)[21]

	Pine		Hardwood		Total	
	Total Green Tons	*Avg/Acre*	*Total Green Tons*	*Avg/Acre*	*Total Green Tons*	*Avg/Acre*
2009	72,411	72.3	42,676	42.6	**115,087**	**115.0**
2010	105,717	57.5	54,876	29.9	**160,592**	**87.4**
2011	43,843	48.4	53,580	59.2	**97,423**	**107.6**
Average Annual Total	**73,990**	**59.4***	**50,377**	**43.9***	**124,367**	**103.3***

*Not weighted averages

The Commercial Forest Plantation Act currently covers 33,106 acres (approximately 400 properties) of private forestland in Delaware. Using the three year average above, it can be deduced that 73,988 green tons of pine and 50,377 green tons of hardwood forest products are annually removed from landowner members' property, equaling an average total of 124,365 green tons of forest products annually removed.

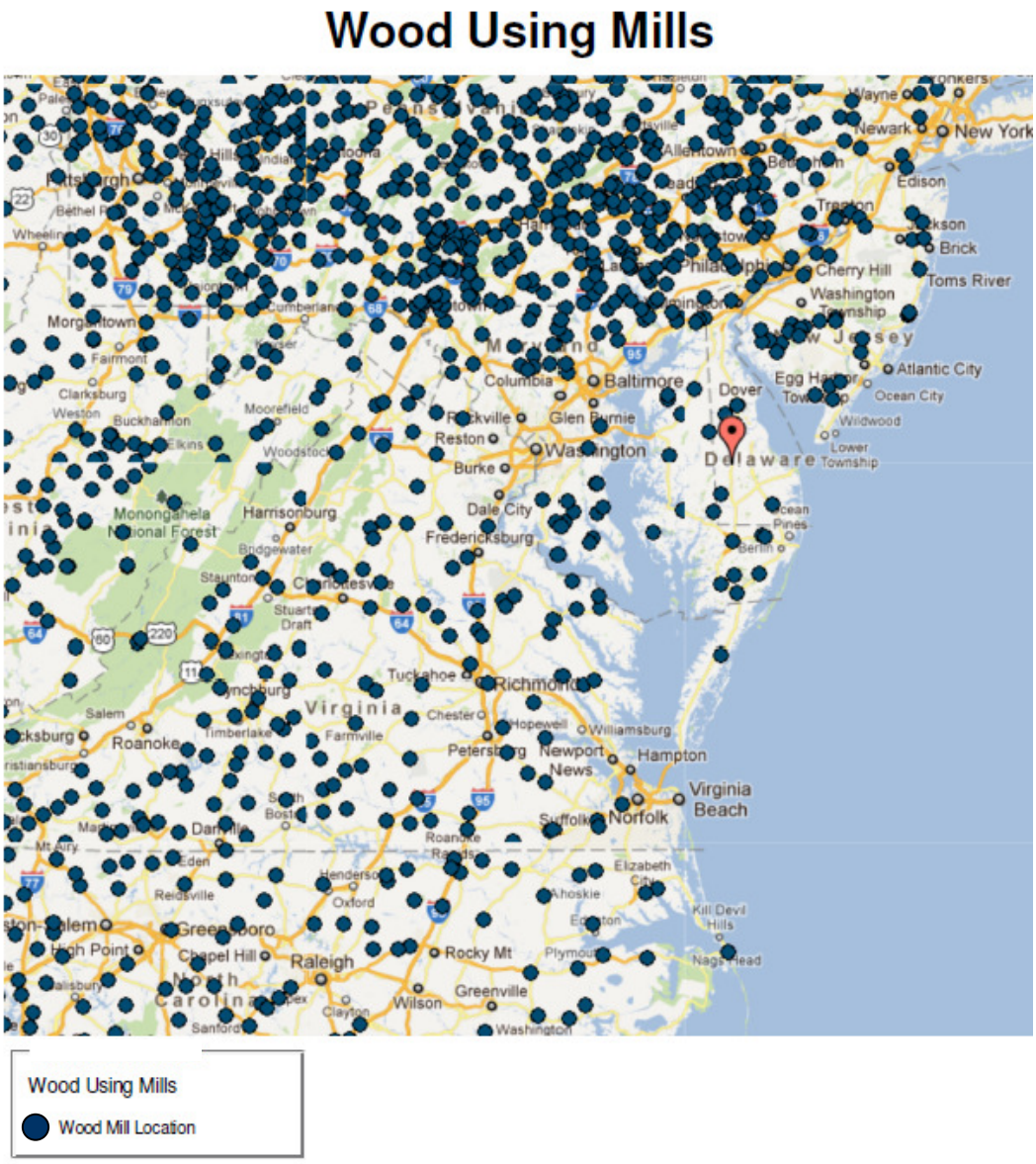
[21] Data received from Wood Utilization & Marketing Specialist, Delaware Forest Service. 3/22/2012.

APPENDIX II: REGIONAL DENSITY/AVAILABILITY

The following figures were produced using the National Renewable Energy Laboratory's BioPower Tool.

WOOD USING MILLS (PRIMARY AND SECONDARY)

Greenwood, DE Flagged



APPENDIX III: CERTIFICATION SYSTEMS

FOREST STEWARDSHIP COUNCIL™ (FSC®)

The following numbers show FSC© density in the region and pertain to **all** certified companies in each particular state and **do not** reflect products produced or county of operation.

FSC® CERTIFIED COMPANY DENSITY*

Delaware

Chain of Custody.....13

1. AlphaGraphics- US177
2. American Cedar and Millwork
3. Associates International, Inc.
4. Delaware
5. Farley Printing Company
6. Fessenden Hall - Dover
7. Jari Pulp LLC
8. NORKOL
9. Orsa Florestal LLC
10. Stanton Door Company
11. Union Wholesale Company
12. University of Delaware/University Printing
13. Wholesale Millwork, Inc.

Forest Management/Chain of Custody 0

Maryland

Chain of Custody.....95

Forest Management/Chain of Custody 3

1. Eastern Shore
2. Nassawango Creek Preserve (MD)
3. Maryland Department of Natural Resources – Forest Service

Pennsylvania

Chain of Custody.....246

Forest Management/Chain of Custody 11

1. Anna Abolalla
2. Gardeau
3. Brockway Borough Municipal Authority
4. Clarion
5. Working Woodlands Network - West Branch Forest
6. DGL Bear Mountain
7. Foundation for Sustainable Forests
8. CF/FIA Holding, LLC
9. Commonwealth of Pennsylvania, DCNR Bureau of Forestry
10. Pennsylvania Timber, L.P.
11. Chagrin Land Limited Partnership

Virginia

Chain of Custody.....134

Forest Management/Chain of Custody 5

1. ASD Austin
2. Allegheny Forestlands, LLC.
3. Bishop
4. Clinch River Forestry Conservation Program
5. Gail & Harry Groot

* Forest Management/Chain of Custody Certificates are not differentiated by state in the FSC® database so it is not possible to pull accurate acreage amounts as many certificates certify land in multiple states.

SUSTAINABLE FORESTRY INITIATIVE (SFI®)

The following numbers show SFI® density in the region and consist of **only pertinent** certified companies in each particular state and **do not** reflect county of interest.

TABLE A3.1: SFI CERTIFIED LANDS IN DE, MD, PA, VA (STATEWIDE)

Certified Organization	State	Certified Acres	Certificate Type	
DE Wild Lands	DE	7,876	SFI 2010-2014	Total SFI® Certified Acreage in DE, MD, PA, and VA (statewide): 494,450 acres
Glatfelter Pulp Wood Company	DE	10,000	SFI 2005-2009	
	DE Total	**17,876**		
MD DNR Forest Service	MD	211,000	SFI 2010-2014	
	MD Total	**211,000**		
Glatfelter Pulp Wood Company	PA	13,402	SFI 2005-2009	
Hancock Forest Management	PA	115,629	SFI 2005-2009, SFI 2010-2014	
Plum Creek Timber Company, Inc.	PA	228	SFI 2010-2014	
Forest Investment Associates	PA	3,528	SFI 2005-2009	
	PA Total	**132,787**		
Glatfelter Pulp Wood Company	VA	10,814	SFI 2005-2009	
Hancock Forest Management	VA	124,424	SFI 2005-2009, SFI 2010-2014	
Plum Creek Timber Company, Inc.	VA	332	SFI 2010-2014	
Forest Investment Associates	VA	90,172	SFI 2005-2009	
Westervelt Company, The	VA	20,718	SFI 2005-2009	
MWV	VA	144,172	SFI 2010-2014	
Conservation Forestry LLC	VA	15,920	SFI 2005-2009	
Total	**VA Total**	**132,787**		

TABLE A3.2: SFI CERTIFIED CHAIN OF CUSTODY IN DE, MD, PA, VA*

Certified Organization	State	Organization Type	Certificate Type
Enviva, LP	MD, VA	Bioenergy Producer	SFI COC, PEFC CoC, SFI 2010-2014
Rock-Tenn Company	MD, VA	Pulp & Paper Producer	SFI COC, SFI Fiber Sourcing Label User, PEFC CoC, SFI 2005-2009, SFI 2010-2014
TWP Enterprises dba TW Perry	MD, VA	Wood Manufacturer	SFI COC
Domtar Paper Company LLC	PA	Pulp & Paper Producer	SFI COC, SFI Fiber Sourcing Label User, PEFC CoC, SFI 2010-2014
Verso Paper Corp.	PA	Pulp & Paper Producer	PEFC CoC, SFI 2010-2014
Glatfelter	PA	Pulp & Paper Producer	SFI COC, PEFC CoC
American Eagle Paper Mills (Team Ten LLC)	PA	Pulp & Paper Producer	SFI COC
United Corrstack LLC	PA	Pulp & Paper Producer	SFI COC, SFI Fiber Sourcing Label User
JELD-WEN Windows and Doors	PA	Wood Manufacturer	SFI COC
Eastern Engineered Wood Products	PA	Wood Manufacturer	SFI COC
Hearne Hardwoods	PA	Wood Manufacturer	SFI COC, PEFC CoC
Hoff Enterprises Inc.	PA	Wood Manufacturer	SFI COC
Allegheny Plywood Company	PA	Wood Merchant/Broker	SFI COC
Oakworks Inc.	PA	Wood Merchant/Broker	SFI COC, PEFC CoC
Plum Creek Timber Company, Inc.	PA, VA	Forest Landowner	SFI COC, SFI Fiber Sourcing Label User, PEFC CoC, SFI 2010-2014
International Paper Company	PA, VA	Pulp & Paper Producer	SFI COC, SFI Fiber Sourcing Label User, PEFC CoC, SFI 2005-2009, SFI 2010-2014
Graphic Packaging Corporation	PA, VA	Pulp & Paper Producer	SFI COC, SFI Fiber Sourcing Label User, PEFC CoC, SFI 2010-2014
Georgia-Pacific LLC	PA, VA	Pulp & Paper Producer	SFI COC, SFI Fiber Sourcing Label User, PEFC CoC, SFI 2010-2014
Westervelt Company, The	VA	Forest Landowner	SFI COC, PEFC CoC, SFI 2005-2009
MWV	VA	Pulp & Paper Producer	SFI COC, PEFC CoC, SFI 2010-2014
Sonoco Products Company	VA	Pulp & Paper Producer	SFI COC, PEFC CoC, SFI 2005-2009
Greif Packaging LLC - Riverville Mill	VA	Pulp & Paper Producer	SFI COC, PEFC CoC
Moulding & Millwork Manufacturing Group	VA	Wood Manufacturer	PEFC CoC
Forest City Trading Group, LLC	VA	Wood Merchant/Broker	SFI COC
Richmond International Forest Products	VA	Wood Merchant/Broker	SFI COC

*Many organizations listed above claim COC in states additional to those in project area.

APPENDIX IV: POTENTIAL SUPPLIERS

TABLE A4.1: COMPANIES ADVERTISING AS SOURCES FOR WOOD CHIPS/SAWMILLS WITHIN 100 MILES*

*100-mile straightline radius of Greenwood, DE

Mi	Company	City	ST
5	J & T Logging	Bridgeville	DE
5	Ken's Logging and Land	Bridgeville	DE
8	Kaye Construction		DE
8	Wellhouse Logging Inc.	Harrington	DE
12	Crawford W. Matthews, Sr. & Sons Inc.	Seaford	DE
12	Mid Shore Timber	Federalsburg	MD
12	Tom Mitchell Logging	Federalsburg	MD
14	Gatewood Inc.	Georgetown	DE
14	Pete's Pulpwood	Georgetown	DE
14	Delaware Tree Company	Felton	DE
15	Jensen Frederick H & Sons Inc	Milton	DE
17	Delmarva Hardwood	Laurel	DE
21	Mike Biddle Logging LLC	Henderson	MD
21	Mike Davidson Enterprises LLC	Camden-Wyoming	DE
22	Willow Grove Sawmill	Wyoming	DE
22	Timber Harvest, Inc.	Cordova	MD
24	Egolf Forest Harvesting, Inc.	Delmar	DE
24	Whitetail Country Logging, Inc.	Delmar	DE
24	Glatfelter Pulp Wood Co	Delmar	MD
25	M & P Logging	Dover	DE
26	Lambert, Vernon L.	Hartly	DE
26	Swartzentruber Sawmill Company	Hartly	DE
26	Yoder's Sawmill	Hartly	DE
26	Johnson Logging Co Inc	Easton	MD
26	Johnson Lumber Co., Inc.	Easton	MD
27	Dorchester Lumber Co., Inc.	Linkwood	MD
31	Eastern Shore Forest Products Inc	Salisbury	MD
31	Glasgow Logging	Salisbury	MD
31	Glasgow Logging	Salisbury	MD
31	Glatfelter Pulpwood Company	Salisbury	MD
31	Stevenson Ota Inc	Salisbury	MD
31	Vision Forestry	Salisbury	MD
32	Cropper Brothers	Willards	MD
32	Forest Friendly Logging, Inc.	Willards	MD
33	Klunk Forestry Services Inc	Queenstown	MD
34	Hardwood Mills Inc	Millington	MD
34	Hardwood Mills, Inc.	Millington	MD
34	Urban Forest Mngmt Inc	Saint Michaels	MD
41	Naylor Logging	Townsend	DE
45	Millville Lumber Company	Snow Hill	MD
45	Paul M Jones Lumber Company, Inc.	Snow Hill	MD
48	American Wood LLC	Westover	MD
50	Coastal Resources Inc	Baltimore	MD
51	Allinder Forestry Services	Pocomoke City	MD
Mi	**Company**	**City**	**ST**
51	St Laurent Forest Products Corp	Pocomoke City	MD
52	Chesapeake Forest Products Co	Chesapeake Beach	MD
53	Baliko Rudolph J	Lee	MD
56	Leena Hardwoods Millhouse	Davidsonville	MD
57	Certified Stake	Elkton	MD
57	Eastern Enterprises	Elkton	MD
57	Grady G Moretz	Elkton	MD
58	Rising Sun Log Corp	North East	MD
58	Wards Tree Service	Pocomoke	MD
60	Chesapeake Forest-Land Services	Lexington Park	MD
64	Coastal Resources Inc	Annapolis	MD
65	American Timber Brokerage	Wilmington	DE
65	Wright BROS Sawmill	Wilminton	DE
66	Frank Thomas Sawmill	Fallston	MD
66	Sawyer Logging & Tree Removal	Fallston	MD
66	James Laird Veneer Logs	Darlington	MD
66	Laird James K	Darlington	MD
66	Laird James K	Darlington	MD
66	Miller C D Sawmill	Darlington	MD
67	Goad Lumber Co Inc	Hughesville	MD
67	Timberlands Management, Inc.	Greenville	DE
67	EDER DANIEL F	Conowingo	MD
71	Forest Management Associates, Inc.	Oxford	PA
71	Crown Hardwood Co., Inc.	West Grove	PA
71	White Forest Products	West Grove	PA
72	Mazepink Forestry	Lincoln University	PA
72	Quality Firewood & Logging Inc.	Waldorf	MD
73	Allstate Veneer Corporation	Hunt Valley	MD
74	Ndrg LLC Co Forester Management Company	Hyattsville	MD
80	Guy Bowers	West Chester	PA
81	D&D Enterprises	Reisterstown	MD
81	Beiler Sawmill	Quarryville	PA
84	Hoff Brothers Lumber Corp	Sykesville	MD
85	D&D Enterprises	Upperco	MD
88	Russell J Harrison Sawmill & Logging	Woodbine	MD
91	Higgins Saw Mill	Glen Rock	PA
93	Clements Sawmill	Mount Airy	MD
94	Andrew J de Marco Hauling	Elverson	PA
96	Universal Forest Products	New Windsor	MD
99	R C Bloch Timber Harvesting	Valley View	PA

APPENDIX V: FUEL COST COMPARISON

US ENERGY INFORMATION AGENCY - HEATING FUEL COST CALCULATOR [22]

For full information and to use the calculator (Excel), visit: www.eia.gov/neic/experts/heatcalc.xls

OVERVIEW

This calculator allows you to compare fuel prices on the basis of dollars per millions of Btu of the fuel and the "cost" of the fuel based on the efficiency of the heating system. Default values are presented for initial comparison.

This calculator was developed to assist in the comparison of fuels and heating system types and the effect of heating system efficiency on the cost of heating fuels. There are numerous factors that are important when deciding on the type of heating system to purchase besides the price of fuels at a specific point in time and system efficiency ratings.

Below are explanations for the items in the columns.

Fuel Unit - This is the physical unit by which the fuel is normally sold.

Price Per Unit - The Prices per Unit that are already in the yellow cells are the most current average national prices available as of the date indicated at the upper left corner of the calculator and are for examples only. Links to price data sources are at the right and also in the ENERGY PRICES tab below.

For electricity prices, which are normally expressed in cents per kilowatt-hour (kWh), type in the decimal equivalent; for example 10 cents per kWh = 0.10 dollars per kWh.

Your local fuel prices can and will vary substantially from the national average. For the greatest accuracy, you should use local prices from a recent bill or local retailers/providers. Use the total delivered price including taxes. For example, divide your total bill by the total units (gallons, kWh, therms, etc) consumed or delivered during the period of the bill.

Fuel Heat Content - Fuel Heat Content per Unit is the British Thermal Units (Btu) of heat contained in a single unit of the fuel.

Price per Million Btu - The Calculator calculates the price in dollars per million Btu based on price per unit and fuel heat content per unit.

Heating Appliance Type - This is the type of heating appliance or system that you have or considering buying. Furnace means a forced-air, central heating system with a furnace that heats air that is distributed in ducts and includes a fan or blower to move heated air through duct system. Boiler is a hydronic central heating system with a boiler that heats water (or produces steam) and that uses pipes and radiators for heat distribution. Heater/stove is a stand-alone heating appliance without heat distribution ducts or pipes normally used to heat a single room. Air-Source heat pumps are central heating systems that remove latent heat from the outside air and use a fan and duct work to distribute the heat. This Calculator applies specifically to air-source heat pumps that use only electric resistance heat as the auxiliary heat source. Geothermal heat pumps are types of heat pumps that use heat from the earth or water in the ground, ponds, lakes etc. Heat pumps also provide cooling in the summer. Consult with local heating and cooling contractors regarding heating (and cooling) system options.

Type of Efficiency Rating - Central heating systems (gas and oil fired furnaces and boilers and heat pumps) are rated on the efficiency by which they convert energy/fuels to useful heat. There are different ratings used depending on the type of heating appliance. There are definitions and more detail on the ratings in the EFFICIENCY INFO tab at the bottom of the Calculator. Because there are no efficiency ratings for electric resistance heating systems (such as electric baseboard, stand-alone room heaters, radiant heaters, etc), or for kerosene, wood, pellet, corn and coal burning heaters, estimated “ratings” are provided.

Efficiency Rating or Estimate - This is the actual, adjusted or estimated efficiency rating for the heating appliance. The default ratings are the minimum allowable efficiencies as required by law at the time when this Calculator was

[22] Heating Fuel Cost Calculator. US Energy Information Agency. Last updated 3/8/2012. www.eia.gov/neic/experts/**heat**calc.xls.

last updated. Some types of heating appliances are not subject to minimum efficiency standards, and for those types of appliances an estimate default efficiency is provided.

The rated HSPF of an air-source heat pump should be adjusted to account for the effects of climate on the operating performance of the system. See footnote 5 of the calculator and the procedure for obtaining an adjusted air-source HSPF.

If you want to change the rating, type in the rating you obtain into the yellow-colored cells. For example, if the AFUE for a specific model of a natural gas-fired boiler is 90, type 90 into the yellow-colored cell for that fuel and appliance type. Do not type in 0.90

Approx. Efficiency (%) - This is the approximate system efficiency expressed as a percentage and is calculated.

Cost Per Million Btu This is the "cost" of the fuel in dollars per million Btu as determined by the price of fuel and the efficiency of the heating appliance.

HEAT CONTENT

For information on the content of different fuels, view the pages listed below

For petroleum products (heating oil, propane, kerosene): http://www.eia.gov/totalenergy/data/monthly/pdf/sec13_1.pdf Note that there are 42 U.S. gallons in a barrel. **For natural gas:** http://www.eia.gov/totalenergy/data/monthly/pdf/sec13_4.pdf **For electricity:** http://www.eia.gov/totalenergy/data/monthly/pdf/sec13_6.pdf	**For coal:** See Anthracite, Bituminous, Lignite, and Subbituminous in Glossary at: http://www.eia.doe.gov/glossary/index.html Average annual coal heat contents by consuming sectors: http://www.eia.gov/totalenergy/data/monthly/pdf/sec13_5.pdf **Wood, Pellet, Corn (kernel)** see below

LINKS TO OTHER CONVERSION FACTORS

Metric conversion factors, prefixes, and other conversion factors:
http://www.eia.gov/totalenergy/data/annual/#appendices

DEFINITIONS FOR APPLIANCE EFFICIENCY RATINGS

AFUE, Annual Fuel Utilization Efficiency, is the measure of the seasonal or annual efficiency of a gas or oil furnace or boiler. It takes into account the cyclic on/off operation and associated energy losses of the heating unit as it responds to changes in the load, which in turn is affected by changes in weather and occupant controls. The higher the AFUE, the higher the efficiency.

HSPF, Heating Season Performance Factor, is the measure of the seasonal efficiency of an air-source heat pump in heating mode. It takes into account the variations in temperature that can occur within a season and is the average number of Btu of heat delivered for every watt-hour of electricity used by the heat pump over a heating season. The higher the HSPF, the higher the efficiency.
Note: Air-Source Heat Pumps are also rated on their cooling efficiency in terms of SEER (Seasonal Energy Efficiency Ratio). The SEER rating cannot be used in this spreadsheet to estimate heating costs.

COP, Coefficient of Performance, is a measure of the energy efficiency of geothermal heat pumps in heating mode, and is the ratio of the average heating capacity to the amount of electrical energy input. The higher the COP, the higher the efficiency.
Note: Geothermal Heat Pumps are also rated on their cooling efficiency in terms of EER (Energy Efficiency Ratio). The EER rating cannot be used in this spreadsheet to estimate heating costs.

Estimated, because no official or standardized testing and rating system in place for measuring heating efficiency.

TECHNICAL NOTE: AIR-SOURCE HEAT PUMPS, WITH ELECTRIC RESISTANCE AUXILIARY HEAT
The actual heating efficiency and seasonal performance of an air-source heat pump that uses electric resistance heating as the auxiliary heat source may vary significantly from the rating it receives when tested under the standard procedures and conditions that manufacturers use to determine heat pump efficiency. […] The method in the form of the regression equations presented in that paper is used in this "calculator" for calculating an adjusted

HSPF for "conventional" air-source heat pumps - those that use only electric resistance heating as the auxiliary heat source. This method is assumed to provide a rough approximation of the actual HSPF that a conventional air-source heat pump will experience in different locations in the USA.

SOLID-FUEL - WOOD, PELLET, CORN, COAL - HEATING SYSTEMS

There are no existing U.S. standards for the heating efficiency of solid-fuel combustion appliances. The U.S. Environmental Protection Agency sets standards for emissions from wood burning appliances. However, these do not directly correspond to the efficiency standards set by the U.S. Dept. of Energy for heating equipment using electricity, heating oil, natural gas, and propane. The following are U.S. Environmental Protection Agency's documents with information on wood heater "efficiencies":

- *List of Certified Wood Stoves*
  http://www.epa.gov/Compliance/resources/publications/monitoring/caa/woodstoves/certifiedwood.pdf
- *Guidance for Quantifying and Using Emission Reductions from Voluntary Woodstove Changeout Programs in State Implementation Plans*
  http://epa.gov/ttn/oarpg/t1/memoranda/guidance_quantfying_jan.pdf

In lieu of another available published source, the default efficiencies used in this Calculator are the "net efficiencies" listed in "Table B-1 Summary of Woodstove Net Efficiencies" in the EPA *Guidance...* document above.

LINKS TO ADDITIONAL RESOURCES

This list is provided solely as a service to our customers, and therefore should not be construed as advocating or reflecting any position of the EIA or the U.S. Government. In addition, EIA does not endorse, recommend, or guarantee the content or accuracy of any information presented in the linked site.

DOE Appliance Energy Efficiency Standards Program
http://www1.eere.energy.gov/buildings/appliance_standards/

DOE/EPA Energy Star Program
http://www.energystar.gov

DOE Information for Consumers On Space Heating, etc
www.energysavers.gov

Federal Trade Commission - Appliance Labeling
www.ftc.gov/bcp/conline/edcams/eande/index.html

Residential Heating and Cooling Appliances - All Types
Directory of Certified Performance
http://www.ahridirectory.org/ahridirectory/pages/home.aspx
published by the Air-Conditioning, Heating, and Refrigeration Institute http://www.ahrinet.org/

Geothermal Heat Pumps

- Geothermal Heat Pump Consortium (GHPC)
  www.geoexchange.org
- International Ground Source Heat Pump Association (IGSHPA)
  www.igshpa.okstate.edu
- National Ground Water Association (has information on "water-source" geothermal heat pumps)
  www.ngwa.org

Wood, Pellet, Corn (kernel) and Coal Heaters

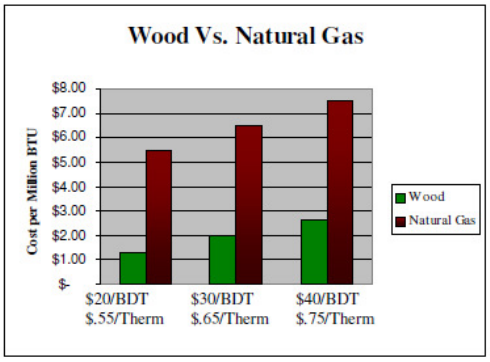
- U.S. Environmental Protection Agency
  http://www.epa.gov/burnwise
- Hearth Education Foundation
  http://heartheducation.org
- Hearth Net
  http://hearth.com
- Wood Heat.org
  www.woodheat.org
- *Heating With Wood*, Clemson (University) Extension, 2004.
  http://www.nasdonline.org/docs/d001201-d001300/d001235/d001235.html
- Pellet Fuels Institute
  http://pelletheat.org
- Corn (kernel) Burning Stoves
  http://energy.cas.psu.edu/energycontent.html

Professional Trades Associations
Air Conditioning Contractors of America (ACCA)
www.acca.org

American Society of Heating, Refrigerating, and Air-Conditioning Engineers
www.ashrae.org

Air-Conditioning, Heating, and Refrigeration Institute
http://www.ahrinet.org/

Fuel Cost Comparison: Wood Vs. Natural Gas



Wood:
Assume: Dry chips contain 7,500 BTU/lb
Fuel Value: 1,000,000 BTU / 7500 BTU per lb. = 133.34 lbs per million BTU
Wood Cost:
At $20/ per BDT (Bone Dry Ton)=$0.01 per lb.
At $30/ per BDT (Bone Dry Ton)=$0.015 per lb.
At $40/ per BDT (Bone Dry Ton)=$0.02 per lb.

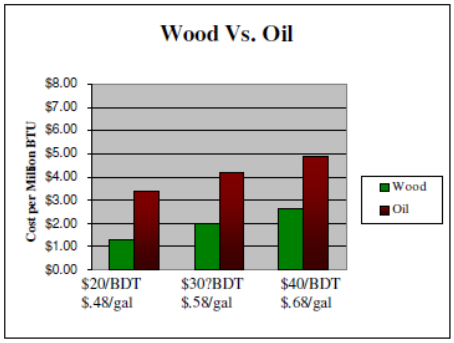
Cost per Million BTU:
At $20/per BDT: 133.34 lb. * $0.01 per lb. = $1.33 per million BTU
At $30/per BDT: 133.34 lb. * $0.015 per lb. = $2.00 per million BTU
At $40/per BDT: 133.34 lb. * $0.02 per lb. = $2.67 per million BTU

Natural Gas:
Assume: 10 therm of natural gas contains 1,000,000 BTU
Cost per Million BTU:
At $.55/per therm: 10 therm * $.55/per therm = $5.50 per million BTU
At $.65/per therm: 10 therm * $.65/per therm = $6.50 per million BTU
At $.75/per therm: 10 therm * $.75/per therm = $7.50 per million BTU

**Note: This is only a guide and is subject to change depending on location and the market price for the two fuels. The wood cost is an average range of current local market prices. The natural gas cost was based on a average monthly bill in Grass Valley from PG&E. Natural gas is not used at the camp.

Forester's Co-Op - Professional Forestry & GIS Services, 415 Colfax Ave, Grass Valley, CA 95945, www.forco-op.com

Fuel Cost Comparison: Wood Vs. Oil



Wood:
Assume: Dry chips contain 7,500 BTU/lb
Fuel Value: 1,000,000 BTU / 7500 BTU per lb. = 133.34 lbs per million BTU
Wood Cost:
At $20/ per BDT (Bone Dry Ton)=$0.01 per lb.
At $30/ per BDT (Bone Dry Ton)=$0.015 per lb.
At $40/ per BDT (Bone Dry Ton)=$0.020 per lb.

Cost per Million BTU:
At $20/per BDT: 133.34 lb. * $0.01 per lb. = $1.33 per million BTU
At $30/per BDT: 133.34 lb. * $0.015 per lb. = $2.00 per million BTU
At $40/per BDT: 133.34 lb. * $0.02 per lb. = $2.67 per million BTU

Oil:
Assume: 1 gallon of #2 oil contains 140,000 BTU
Fuel Value: 1,000,000 BTU / 140,000 BTU per gallon = 7.14 gallons per million BTU
Cost per Million BTU:
At $.48/per gallon: 7.14 gallons * $.48/per gallon = $3.41 per million BTU
At $.58/per gallon: 7.14 gallons * $.58/per gallon = $4.16 per million BTU
At $.68/per gallon: 7.14 gallons * $.8/per gallon = $4.87 per million BTU

**Note: This is only a guide and is subject to change depending on location and the market price for the two fuels. The wood cost is an average range of current local market prices. The oil cost was based on an average monthly rate of spot prices of Heating Oils during Jan -April 2002. Oil is not used at the camp.

Forester's Co-Op - Professional Forestry & GIS Services, 415 Colfax Ave, Grass Valley, CA 95945, www.forco-op.com

[23] Forester's Co-Op - Professional Forestry & GIS Services. Fuel Cost Comparison: Wood Vs. Natural Gas. http://www.forco-op.com/project/wood_fuel_comp.pdf.