BIOMASS OPPORTUNITIES IN THE CATSKILLS

Prepared by

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BIOMASS AND GREEN SCHOOL RESOURCES BINDER

A resources binder including the following materials was given to each site that received an evaluation and to the Watershed Agricultural Council. For information about these resources, contact the Watershed Council.

- **Financing Resources**
  - Department of Energy brochure on financing Energy Smart Schools
  - Energy Star Primer for Innovative Financing Solutions
  - Financing Energy Efficiency Article
  - Municipal Leasing Corporation information
  - *Native*Energy information
  - USDA Brochures and Information
- **Efficiency Resources**
  - Reference Guide for EPA Portfolio Manager software
  - NYSERDA Information
  - DOE Energy Smart School Information
  - NYPA Information
- **Biomass – Woodchips**
  - Vendors
    - Advanced Recycling/Challenger
    - BioFuels Technologies
    - Biomass Combustion Systems
    - Chiptec
    - KOB
    - Messersmith Manufacturing
- **Biomass – Pellets**
  - Pellet equipment vendors
    - ACTbioenergy
    - Biomass Commodities Corporation
- **Biomass Energy Resources**
  - Benefits of Biomass
  - Carbon Dioxide and Biomass Energy
  - Air Emissions
  - RSG Memo on Air Quality Permitting for the Catskill Region
  - Information on Air Pollution Control Technology for Woody Biomass Boilers
  - WAC List of Potential Woodchip Fuel Suppliers
  - Sample Woodchip specification
  - Pellet Fuels Institute Brochure
- **Books**
  - Directory of Wood Products Industries in the Catskills
  - Directory of Primary Wood-Using Industry in New York State
  - Guide to Financing Energy Smart Schools
- **CD's**
  - Collaborative for High Performance Schools and Green Schools Resources
  - Woodchip Heating Systems, *A Guide for Institutional and Commercial Installations*, BERC
  - K-12 Energy Lessons and Activities, US Department of Energy
  - Green Community Technologies, Yellow Wood Associates

EXECUTIVE SUMMARY

The Watershed Agricultural Council (WAC) was incorporated in 1993 to engage in a variety of public/private partnerships aimed at protecting water quality while sustaining the economic viability of farming and forestry in the upstate watershed communities. WAC is funded by the New York City Department of Environmental Protection, the U.S. Department of Agriculture and other federal foundations and private sources.

In August 2008, the WAC Forestry Program announced its Watershed Woody Biomass project. This project offered funding to schools, hospitals, and correctional facilities in the eight county watershed region for the completion of pre-feasibility studies that assess the viability of a conversion to a woody biomass heating system. Facilities with at least 50,000 square-feet of heated space and with boilers exceeding 3 million BTU output were targeted through a formal application process.

The WAC hired Richmond Energy Associates, LLC to conduct biomass studies for a number of selected sites and to deliver educational presentations on the benefits and barriers of biomass energy technologies for institutional and commercial installation. Richmond Energy is a professional consulting firm with extensive experience in wood energy systems. Jeff Forward, principal of Richmond Energy, provides analysis and project management on specific biomass projects and he works with state, regional and federal agencies to develop initiatives to promote biomass utilization around the country.

In January 2009, Mr. Forward went to the Catskill region to conduct a number of site visits and public presentations on the benefits and barriers to biomass utilization. Richmond Energy analyzed the biomass energy opportunities for five of these facilities. Catskill Craftsmen and O'Connor Hospital received memo's outlining Richmond Energy's observations and recommendations for each site. The South Kortright Central School, Cairo-Durham Middle/High School and Onteora Middle/High School each received detailed reports summarizing Richmond Energy's findings and recommendations. All five of these facilities received a *Biomass and Green Building Resources* binder that provided information on biomass technologies, project financing opportunities and green building resources. Preliminary discussions occurred with officials at SUNY Delhi, but it was determined that the college would likely need a much more in depth study of biomass heating opportunities on the campus as part of the College's Center of Excellence in Watershed Applications of Technology enhanced Economic Revitalization.

In addition to the studies and presentations, an evaluation of current air quality regulations in New York for wood fired boilers was conducted for this project. In May Mr. Forward returned to the Catskill region to present the results of Richmond Energy's analysis and to deliver another series of public presentations.

Biomass energy is a good fit for the Catskill region. There clearly is an abundance of low grade wood in the region that could be used for woodchip fuel. Fuel oil is the predominant heating fuel in the region which tends to be relatively expensive relative to biomass fuels on a cost per BTU basis. There are many buildings with large enough heating bills to justify the expense of investing in biomass heating and fuel storage equipment. There seems to be strong interest from both potential woodchip fuel suppliers and from potential biomass energy end-users to explore biomass energy opportunities.

In addition to the economic reasons, the Watershed Agricultural Council is a key resource that can help both woodchip fuel suppliers and biomass energy end-users investigate the opportunities. Richmond Energy recommends that the WAC continue to support and champion biomass utilization. Specifically Richmond Energy recommends:

1. Watershed Agricultural Council staff should continue to identify potential New York woodchip and pellet fuel suppliers and help educate them about the opportunities and specific needs of the institutional scale biomass end-users. Consistency of particle size, shape and moisture content is important for institutional scale biomass heating installations as is reliability of deliveries. Sometimes there may be times during the day when tractor trailer deliveries could be difficult. A list of potential woodchip and pellet fuel suppliers developed by WAC is included in the appendices at the end of this report. The WAC should maintain that list and help educate potential biomass fuel suppliers as to the needs and expectations of biomass heating end-users.
2. WAC should educate potential institutional biomass end-users about the limitations of woodchip fuel suppliers. Woodchip fuel suppliers typically need some lead time for fuel deliveries and may have some challenges supplying fuel when the woods are inaccessible. Suppliers and end-users will need to work together to develop realistic chip quality standards and acceptable delivery schedules. WAC can be a valuable resource for both end-users and suppliers for information about this unique market.
3. It appears that there is more interest in preliminary feasibility analysis for biomass energy systems in the region. WAC should consider offering another round of subsidized pre-feasibility studies for the region.
4. A large user such as SUNY Delhi would help anchor woodchip fuel supply for the region. WAC should continue to help SUNY consider biomass energy options and possibly subsidize a preliminary feasibility study for the college.
5. WAC should coordinate a tour of institutional wood heated facilities in Vermont for school decision makers for the three schools that received biomass studies as well as for others that may be interested. Potential participants for a tour might include: school administrative staff; school facility staff; school board members; potential woodchip fuel suppliers; SUNY Delhi facility and administrative staff.

INTRODUCTION

The New York City Watershed encompasses approximately 2,000 square-miles of land in upstate New York and is the largest unfiltered surface water supply area in the United States. Forests cover 75% of the watershed with 85% of that in the hands of private ownership. The Watershed Agricultural Council (WAC) was incorporated in 1993 to engage in a variety of public/private partnerships aimed at protecting water quality while sustaining the economic viability of farming and forestry in the upstate watershed communities. The Forestry Program, established in 1997, has been a strong component of the Council's mission over the last ten years and focuses its work in education, outreach, and implementation through voluntary, incentive-based programs including forest management planning, logger training, guidance for use of timber harvesting best management practices, forest products utilization & marketing and nurturing a culture of stewardship on private forestlands. More information on the Watershed Forestry Program can be found in their Tenth Anniversary Publication available at

http://www.nycwatershed.org/pdfs/FP10yrAnniversary.pdf .

In August 2008, the WAC Forestry Program announced its Watershed Woody Biomass project. This project offered funding to schools, hospitals, and correctional facilities in the eight county watershed region for the completion of pre-feasibility studies that assess the viability of a conversion to a woody biomass heating system. Facilities with at least 50,000 square-feet of heated space and with boilers exceeding 3 million BTU output were targeted through a formal application process. The intended project outcomes included:

- Provide facilities with the information necessary to make sound decisions to move to the site specific design and project ready-budget phase of a wood energy system
- Increased awareness of the biomass energy resources in the NYC watershed region
- Catalyzed regional interest in renewable woody biomass and improved utilization of low-grade forest products
- Technology transfer to local businesses, communities, and governments
- Development of strong partnerships among various stakeholder groups (public institutions, local governments/agencies, foresters, wood products manufacturers, etc.)

The WAC hired Richmond Energy Associates, LLC to conduct preliminary biomass feasibility studies for a number of selected sites and to deliver educational presentations on the benefits and barriers of biomass energy for institutional and commercial installation. Richmond Energy is a professional consulting firm with extensive experience in wood energy systems. Jeff Forward, principal of Richmond Energy, provides analysis and project management on specific biomass projects and he works with state, regional and federal agencies to develop initiatives to promote biomass utilization around the country.

This report summarizes Richmond Energy's work and presents conclusions and recommendations for further action by WAC.

PROJECT ACTIVITIES

PROJECT OVERVIEW

In January 2009, Mr. Forward went to the Catskill region to conduct a number of site visits and public presentations on the benefits and barriers to biomass utilization. During this trip he visited the following sites to meet with decision makers and to collect site specific information:

- Catskill Craftsmen in Stamford
- O'Connor Hospital in Delhi
- SUNY Delhi in Delhi
- South Kortright Central School in South Kortright
- Cairo-Durham Middle/High School in Cairo
- Onteora Middle/High School in Boiceville

He also gave presentations to the South Kortright School Board and the Watershed Agricultural Council. These presentations explained some of the benefits of using biomass for energy and gave an overview of commercially available biomass technologies.

Richmond Energy then analyzed the biomass energy opportunities for five of these facilities. Catskill Craftsmen and O'Connor Hospital received memo's outlining Richmond Energy's observations and recommendations for each site. The three public schools received detailed reports summarizing Richmond Energy's findings and recommendations. All five of these facilities received a *Biomass and Green Building Resources* binder that provided information on biomass technologies, project financing opportunities and green building resources. SUNY Delhi was not analyzed for this project.

Two scenarios were analyzed for both the South Kortright and Cairo-Durham schools. The first was a woodchip scenario that included a stand-alone boiler house and chip storage facility. The second was a pellet scenario that included a containerized pellet boiler house along with an agricultural grade silo for pellet fuel storage. For the Onteora School only a woodchip scenario was analyzed.

Catskill Craftsman and O'Connor Hospital did not receive full preliminary feasibility studies. Rather Richmond Energy provided memos to each facility outlining its conclusions and recommending next steps. Catskill Craftsman is proceeding with one of Richmond Energy's recommendations and is currently pricing biomass heating equipment. O'Connor Hospital is presently engaged in a Master Planning effort that is exploring options for expanding their facility. Richmond Energy recommended that the hospital include biomass options in their planning efforts and they have instructed their architectural team to explore the possibility of adding biomass to their expansion plans.

SUNY Delhi is considerably larger than any of the other facilities involved in this project. They currently consume over 500,000 gallons of fuel oil each year. It was felt that SUNY was ready for a preliminary feasibility study at this time but would likely need a much more in depth study than the WAC project was prepared to fund. The SUNY Delhi campus has multiple buildings of which not all are on the central heating system. What this facility needs is a more detailed engineering study that considered district energy piping, the state of the current boiler plant and the college's future expansion plans. On the other hand an anchor end user like SUNY Delhi could help to establish a viable wood fuel market for the region. While SUNY Delhi was not included in this project, Richmond Energy recommends that WAC continue to encourage them to consider a biomass energy option.

In May, Mr. Forward returned to the Catskill region to present the results of Richmond Energy's analysis and to deliver another series of public presentations. Mr. Forward made presentations at the following sites:

- South Kortright School Board
- O'Connor Hospital in Delhi
- Onteora School sustainability committee in Boiceville
- Watershed Agricultural Council Forestry Committee in Walton
- Cairo-Durham School Superintendent and Facilities Director in Cairo
- Public meeting at the Durham Town Hall

What was apparent at each of these meetings was that the audience was intrigued by the results of the analysis and they were interested in further exploring the concept of biomass energy for their facility. Potential woodchip fuel suppliers attended several of these meetings and it was also evident that there was considerable interest in providing woodchip fuel for the institutional market.

In addition to the studies and presentations, WAC asked Richmond Energy to enlist Resource Systems Group (RSG), an environmental consulting firm, to conduct an evaluation of current air quality regulations in New York for wood fired boilers. RSG's summary memo was included in the *Biomass and Green Building Resources* binder given to each site and is attached to this report.

Below is a description of the assumptions that went into each analysis for the three public school facilities and the bottom line results for each school. Tables and graphs of the analysis results for each of these three schools are included in the appendices to this report.

ECONOMIC ANALYSIS ASSUMPTIONS FOR BASE CASE

Life Cycle Cost Methodology

Decision makers need practical methods for evaluating the economic performance of alternative choices for any given purchasing decision. When making a choice between mutually exclusive capital investments, it is prudent to compare all equipment and operating costs spent over the life of the longest lived alternative in order to determine the true least cost choice. The total cost of acquisition, fuel costs, operation and maintenance of an item throughout its useful life is known as its "life cycle cost." Costs that should be considered in a life cycle cost analysis include:

- Capital costs for purchasing and installing equipment
- Fuel costs
- Inflation for fuels, operational labor and major repairs
- Annual operation and maintenance costs including scheduled major repairs
- Salvage costs of equipment and buildings at the end of the analysis period.

In addition, it is useful for decision makers to consider the impact of debt service if the project is to be financed in order to get a clearer picture of how a project might affect annual budgets. When viewed in this light, equipment with significant capital costs may still be the least-cost alternative. In some cases, a significant capital investment may actually lower annual expenses, if there are sufficient fuel savings to offset debt service and any incremental increases in operation and maintenance costs.

The analysis performed for these facilities compared different scenarios over a 30-year horizon and took into consideration life cycle cost factors. A 30-year time frame was used because it is the expected life of a new boiler. The base case scenarios assumed the schools will continue to use the existing fuel oil fired boilers essentially as they are now being used. The alternative biomass scenarios envision installing new biomass boilers and fuel storage structures and included ancillary equipment and interconnection costs. Under all biomass scenarios, it was assumed that the existing fuel oil boilers would still be used to provide supplemental heat during the coldest days of the year if necessary and for the warmer shoulder season months when buildings only require a little heat during chilly weather.

The analysis then projects current and future annual fuel oil heating bills and compares that cost against the cost of operating a biomass system plus debt service for the local cost share of new equipment over a 30-year horizon. Savings are presented in today's dollars using a net present value calculation. Net present value (NPV) is defined as the present dollar value of net cash flows over time. It is a standard method for using the time value of money to compare the cost effectiveness of long-term projects.

Capital Cost Assumptions

It was not the intent of this project nor was it in the scope of work to develop detailed cost estimates for biomass boiler facilities. It is recommended that for projects of this scale, the facility owner should hire a qualified design team to refine the project concept and to develop firm local cost estimates. Therefore the capital costs used for the biomass scenarios are generic estimates based on Richmond Energy's experience.

State School Construction Aid

Biomass boilers are generally eligible for New York state school construction aid[1]. However, the New York Facilities Planning Division for the State Department of Education (SED) does not like to fund new boilers until the existing boilers are fully depreciated. SED generally considers boilers fully depreciated after fifteen years although they do recognize that boilers can last a good deal longer. For the analysis in this project, it was assumed that these projects would receive the same state aid reimbursement that each school would receive for any other capital improvement project and that the local share would be financed through a twenty year bond.

Financing Assumptions

Financing costs were included in the analysis to give school decision makers a sense of how the biomass project may impact their annual budget. Public institutions typically have access to long-term, low interest bond financing. It was assumed that all three school districts will be able to obtain a twenty year bond for their share of the capital costs for either biomass project at an annual interest rate of 5%. The bond payment schedule that was used has fixed principal payments and variable interest payments. Other financing schedules could create even more favorable cash flows depending on how much of the project costs are financed and how the remaining financing is structured. If a school were to forego financing and pay for the project outright, the annual savings would be considerably greater.

Fuel Oil Cost Assumptions

Richmond Energy average several years of fuel consumption and used this average as the base case for each analysis.

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[1] Each school district should consult with state officials about any planned construction project and get their determination on state aid directly from SED. The contact at SED is Carl Thurnau and he can be reached at (518) 474-3906 or emscfp@mail.nysed.gov .

Inflation Assumptions

Estimating future fuel costs over time is difficult at best. Over the past few years it has become even more difficult as fuel prices have jumped dramatically. Nevertheless, in order to more accurately reflect future costs in a thirty year analysis, some rate of inflation needs to be applied to future fuel costs.

Richmond Energy looked retrospectively over the last 20-years (1988 – 2008) using US Energy Information Agency data and found that the average annual increase for fuel oil in New York was 7.5% per year. This average annual inflation rate for fuel oil was projected forward over the thirty year analysis period for each school.

The starting price for fuel oil in year one of each analysis was based on NY Office of General Services net fuel prices for #2 fuel oil in Greene, Ulster and Delaware counties. Richmond Energy averaged the price on the first day of the month for each county for every month from April 1, 2008 – April 1, 2009. Richmond Energy then used this average price as a starting point for the analysis and inflated each year at 7.5%. Since a portion of the winter heating needs for each biomass scenario is assumed to come from fuel oil, the same inflation assumptions were used for the fuel oil portion in the biomass scenarios as well.

The overall Consumer Price Index for the period between 1988 and 2008 increased an average of 2.9% annually. This is the annual inflation rate that was used in projecting all future labor costs, operations and maintenance costs and scheduled major repair costs for the biomass scenarios.

Operation and Maintenance Assumptions

Under any biomass scenario, a case could be made that the existing fossil fuel boilers will require less maintenance and may last longer since they will only be used for a small portion of the heating season. However, all boilers should be serviced at least annually no matter how much they are used. Additionally it is very difficult to estimate how long the replacement of the fuel oil boilers might be delayed. For these reasons, no additional annual maintenance, scheduled repair or planned replacement costs for the existing fuel oil boilers were taken into consideration as these are considered costs that the school would have paid anyways. It was assumed that all costs for operation and maintenance of biomass boilers are incremental additional costs.

ECONOMIC ANALYSIS ASSUMPTIONS FOR WOODCHIP SCENARIOS

Typically with woodchip systems, the larger the heating bills the better the return on investment. The space needed for woodchip fuel storage, the equipment needed for woodchip fuel handling and the robust nature of woodchip boilers all translate into fairly significant up front costs. However, the cost per BTU for woodchips is very low. In order to offset the high first cost of a woodchip system, fuel bills need to be large enough so that the fuel cost savings justify the capital expense.

Capital Cost Assumptions

The woodchip scenario that was analyzed for each site included installing a woodchip hot water boiler and building a stand-alone boiler house and chip storage facility. It was assumed that the existing boilers would remain to provide back-up heat for the shoulder seasons and supplemental heat during the coldest nights of the year if necessary.

Hot water from the woodchip boiler house would be tied into the existing boiler rooms and heating distribution systems via underground insulated piping. Costs for a 70-foot stack were included to ensure good emissions dispersal. Costs for an underground woodchip storage bin were included, as below grade chip storage bins are less likely to freeze in the coldest winter weather and chip delivery using self unloading trailers into below grade bins is fast and easy.

A healthy construction contingency, standard general contractor mark-up and professional design fees were also included.

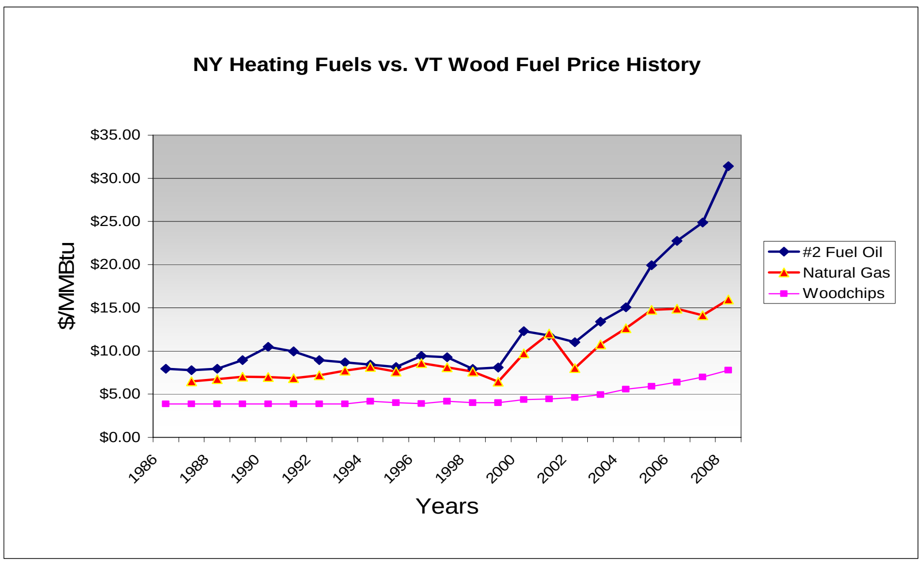
Figure 1 Typical School Woodchip Boiler Plant

Woodchip Fuel Cost Assumptions

Frequently, operators of institutional woodchip systems don't fire up their biomass boilers until there is constant demand for building heat. During the fall and spring, fossil fuel boilers are often used as they are easier to start up and turn down. Woodchip boilers are typically used in place of fossil fuel boilers for the bulk of the winter heating season.

The cost of woodchips used for heating fuel tends to increase more slowly and has historically been much more stable in price over the past two decades than fossil fuels. From 1987 - 2007 in Vermont for example, the statewide average woodchip fuel price for institutional biomass heating systems rose from $25/ton to $45/ton. The average annual increase during this period was about 3.7% annually[2] with the greatest increases happening recently. Because woodchip fuel is locally produced from what is generally considered a waste product from some other forest product business, it does not have the same geopolitical pressures that fossil fuels have. Over the past twenty years woodchip fuel costs have been far less volatile than fossil fuels.

Figure 2 Woodchip and Fuel oil Inflation



After consulting with the Watershed Agricultural Council who spoke with potential local woodchip fuel providers and the NY DEC Forests and Lands staff, Richmond Energy is projecting a first year cost of $55 per ton for woodchips which is equivalent to about $.85 per gallon for fuel oil. For this analysis, $55 per ton was the assumed first-year woodchip fuel cost, and that price was inflated each year at 3.7% annually.

The woodchip scenarios assumed each facility will meet 85% of its winter heating needs with woodchips. This is the average annual woodchip fuel utilization for all the wood heated schools in Vermont. The costs for fuel oil and woodchips are then adjusted for inflation each year over the thirty year horizon.

2 Extrapolated from Vermont Superintendent Association School Energy Management Program data

Operation and Maintenance Assumptions

It is typical for operators of fully automated woodchip heating systems of this size to spend 15-30 minutes per day to clean ashes[3] and to check on pumps, motors and controls. For the woodchip scenario it was assumed that existing on-site staff would spend on average approximately one half-hour per day in addition to their current boiler maintenance for 150 days per year and 20 hours during the summer months for routine maintenance.

Another operations and maintenance cost that is included in the analysis is periodic repair or replacement of major items on the boiler such as the furnace refractory. It is reasonable to anticipate these types of costs on a 10-15 year cycle. For this analysis, $25,000 of scheduled maintenance was anticipated in years 10, 20 and 30 and then annualized at $2,500 per year to simulate a sinking fund for major repairs. This $2,500 was then inflated at the general annual inflation rate. Since the Onteora School would require a somewhat larger district energy plant for multiple buildings, these cost estimates were increased proportionally.

ECONOMIC ANALYSIS ASSUMPTIONS FOR PELLET SCENARIOS

Pellet fuel heating equipment is much less expensive than woodchip heating equipment. It requires a much smaller footprint building and pellet fuel is much easier to store and to handle. This results in lower first costs for pellet systems than for woodchip systems. The downside with pellets is that pellet fuel is about twice as expensive per BTU as woodchips. This is because pellets are much more energy intensive to produce than woodchips meaning they cost more to produce. And since there are far fewer locations where pellets are processed, pellets often need to be trucked greater distances which mean transportation costs can be higher per truckload for pellets than for woodchips.

Capital Cost Assumptions

Energy Cabin is an Austrian boiler manufacturer that markets a system with an integrated solar hot water system to pre-heat boiler water. The manufacturer claims that the solar pre-heat system boosts the efficiency of the overall system to 95%. There is a US boiler manufacturer, ACTbioenergy out of Schenectady, NY that is currently marketing these systems in the US and is planning to manufacturer a similar product within the next year. Below are pictures of both the Energy Cabin system and ACTbioenergy systems.

[3] Wood ash is generally not considered a hazardous material in most states and can be land filled or land applied as a soil amendment by farmers or on-site maintenance staff.

Figure 3 Energy Cabin containerized pellet boiler system with integrated solar hot water

Figure 4 ACTbioenergy containerized pellet boiler system

The pellet scenarios that were analyzed envisioned stand alone containerized pellet boiler houses with 1.7 MBTU pellet boilers and integrated solar thermal panels to pre-heat boiler water and to provide domestic hot water during summer months. 1.7 MBTU's is considerably smaller than each school's existing boilers. To account for the difference in size, Richmond Energy assumed that the pellet boiler system would cover a smaller percentage of the annual heat load for the building and the existing boilers would cover the remaining load. It was assumed that with the integrated solar hot water panels, the overall seasonal efficiency of the pellet system would be 90%.

Also included in the assumed capital costs for the pellet scenarios are: a 30 ton grain silo for pellet fuel storage; automated fuel handling equipment; an exhaust stack; underground insulated piping and interconnection to the existing boiler room.

A healthy construction contingency, standard general contractor mark-up and a modest budget for professional design fees were also included in the capital cost assumptions.

Pellet Fuel Cost Assumptions

Pellets are energy intensive to produce and therefore are more expensive than woodchips on a cost per BTU basis. There are also far fewer locations that produce pellets than woodchips which can impact transportation costs. There are two pellet plants relatively close to the Catskill region, one in Schuyler, NY and another is proposed for Moreau, NY.

Contrary to woodchips which are typically a waste product from a forest products activity, pellet fuel is a manufactured commodity that competes directly with fossil fuels. Consequently pellet fuel prices act much more like commodity prices than woodchips. Pellets prices fluctuate more dramatically than woodchips and the cost has risen and fallen sharply over the past year. However, pellets are still a relatively local product so they won't likely have the same geopolitical pressures as fossil fuels. After consulting with the NY DEC Forests and Lands staff, Richmond Energy is projecting a first year cost of $225 per ton for pellets which is equivalent to about $2 per gallon for fuel oil. This price is then inflated at 5% per year, higher than general inflation, but less than fossil fuel inflation.

Operation and Maintenance Assumptions

Pellet boilers require very little maintenance in comparison to woodchip boilers. It is typical for operators of fully automated pellet heating systems of this size to spend 30 to 60 minutes per week to clean ashes and to check on pumps, motors and controls. For the pellet scenario it was assumed that existing on-site staff would spend on average approximately one hour per week in addition to their current boiler maintenance for 26 weeks per year and 20 hours during the summer months for routine maintenance. At a loaded labor rate of $25/hr this equals $1,150 annually. An additional $1,000 in annual operational costs was assumed for electricity to run pumps and motors.

Another operations and maintenance cost that is included in the analysis is periodic repair or replacement of major items on the pellet boiler such as the furnace refractory. It is reasonable to anticipate these types of costs on a 10 to 15 year cycle. For this analysis, $15,000 of scheduled maintenance was anticipated in years 10, 20, and 30 and then annualized at $1,500 per year to simulate a sinking fund for major repairs. This $1,500 was then inflated at the general annual inflation rate.

ANALYSIS RESULTS

South Kortright Central School

The woodchip analysis for the South Kortright School District indicated that they could save more than $2.9 million in today's dollars in operating costs over the next 30 years by installing a woodchip heating system even if the school financed the local cost share of the system. Annual fuel savings alone are projected to be more than $66,000 per year in the first year and would increase over time as fuel oil prices continue to climb. With state school construction aid, the local district will see a positive cash flow from the very first year of the project.

The pellet analysis indicated that the South Kortright Central School District could save more than $1.15 million in today's dollars in operating costs over the next 30 years by installing a pellet fuel heating system even if the school financed the entire local cost share of the system. Annual fuel savings alone are projected to be more than $19,000 per year in the first year and would increase over time as fuel oil prices continue to climb.

Cairo-Durham School District

The woodchip analysis the Cairo-Durham School District indicates the district could save more than $2.4 million in today's dollars in operating costs over the next 30 years by installing a woodchip heating system even if the school financed the entire local cost share of the system. Annual fuel savings alone are projected to be more than $52,000 per year in the first year and would increase over time as fuel oil prices continue to climb. With state school construction aid, the local district will see a positive cash flow from the very first year of the project.

The pellet analysis indicates that the Cairo-Durham School District could save more than $1.3 million in today's dollars in operating costs over the next 30 years by installing a pellet fuel heating system even if the school financed the entire local cost share of the system. Annual fuel savings alone are projected to be more than $20,000 per year in the first year and will increase over time as fuel oil prices continue to climb.

Onteora School District

Only a woodchip scenario was analyzed for the Onteora School because their heat load was so large that it made a pellet installation unlikely. The scenario that was analyzed envisioned building a stand-alone boiler house and woodchip storage building that would provide heat for both the Onteora Middle/High School Complex and the Bennett Elementary School. The analysis showed that the district could save nearly $8 million in today's dollars in operating costs over the next 30 years by installing a woodchip heating system even including debt service on the local share cost of the system. Annual fuel savings alone are projected to be more than $188,000 per year in the first year and will increase over time as fuel oil prices continue to climb. The district would see a positive cash flow from the very first year of the project.

The most significant recommendation for the Onteora School District was that the existing steam heating distribution system at the middle/high school should be converted to hot water whether or not they pursue a biomass heating option. Best practice for most schools now is hot water heating distribution. The building is over 50 years old and the existing heating distribution system is reaching the end of its useful life. Richmond Energy recommends investigating the costs and the potential energy savings that might be gained from upgrading this basic infrastructure system before investing in a biomass energy system.

CONCLUSIONS AND RECOMMENDATIONS

Biomass energy is a good fit for the Catskill region. There clearly is an abundance of low grade wood in the region that could be used for woodchip fuel. Fuel oil is the predominant heating fuel in the region which tends to be relatively expensive relative to biomass fuels on a cost per BTU basis. There are many buildings with large enough heating bills to justify the expense of investing in biomass heating and fuel storage equipment. There seems to be strong interest from both potential woodchip fuel suppliers and from potential biomass energy end-users to explore biomass energy opportunities.

In addition to the economic reasons, the Watershed Agricultural Council is a key resource that can help both woodchip fuel suppliers and biomass energy end-users investigate the opportunities. Richmond Energy recommends that the WAC continue to support and champion biomass utilization. Specifically Richmond Energy recommends:

1. Watershed Agricultural Council staff should continue to identify potential New York woodchip and pellet fuel suppliers and help educate them about the opportunities and specific needs of the institutional scale biomass end-users. Consistency of particle size, shape and moisture content is important for institutional scale biomass heating installations as is reliability of deliveries. Sometimes there may be times during the day when tractor trailer deliveries could be difficult. A list of potential woodchip and pellet fuel suppliers developed by WAC is included in the appendices at the end of this report. The WAC should maintain that list and help educate potential biomass fuel suppliers as to the needs and expectations of biomass heating end-users.
2. WAC should educate potential institutional biomass end-users about the limitations of woodchip fuel suppliers. Woodchip fuel suppliers typically need some lead time for fuel deliveries and may have some challenges supplying fuel when the woods are inaccessible. Suppliers and end-users will need to work together to develop realistic chip quality standards and acceptable delivery schedules. WAC can be a valuable resource for both end-users and suppliers for information about this unique market.
3. It appears that there is more interest in preliminary feasibility analysis for biomass energy systems in the region. WAC should consider offering another round of subsidized pre-feasibility studies for the region.
4. A large user such as SUNY Delhi would help anchor woodchip fuel supply for the region. WAC should continue to help SUNY consider biomass energy options and possibly subsidize a preliminary feasibility study for the college.
5. WAC should coordinate a tour of institutional wood heated facilities in Vermont for school decision makers for the three schools that received biomass studies as well as for others that may be interested. Potential participants for a tour might include: school administrative staff; school facility staff; school board members; potential woodchip fuel suppliers; SUNY Delhi facility and administrative staff.

APPENDICES

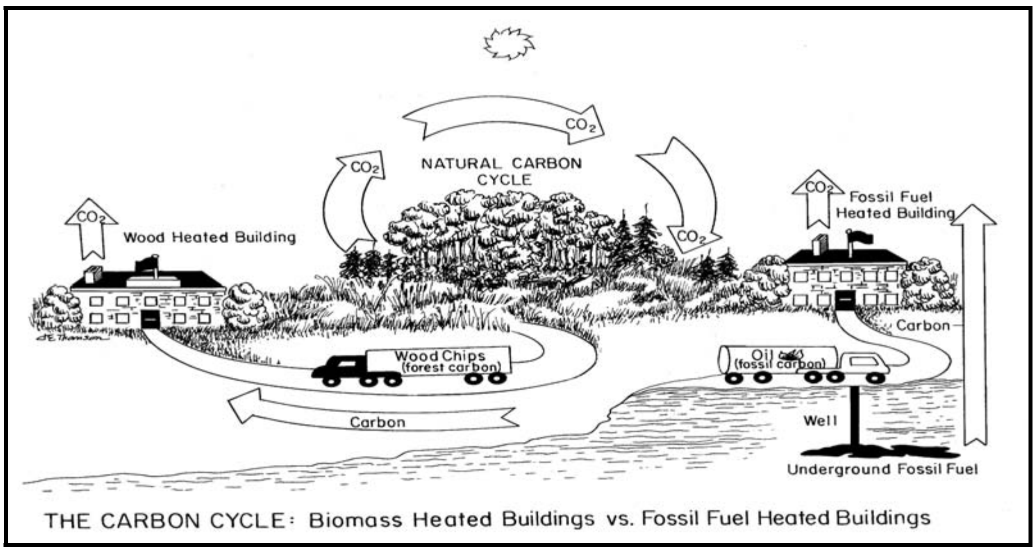
BENEFITS OF BIOMASS

There are many benefits of using biomass in place of fossil fuels like oil and gas for providing heat. The following are some of the important benefits of using woodchips or pellets for heating a school or other institutional building:

- Unlike fossil fuels, biomass is a renewable energy source that can be sustainably harvested.
- Biomass typically comes from the waste of some other forest product activity, such as sawmill residues or timber harvesting residues. Merchantable saw logs have much more value when they are used for making lumber. However, even a saw log is 25% waste. And in every timber harvest, some trees are going to be cut that are too crocked or rotted to use as saw logs. Using biomass for energy not only offsets fossil fuel use, it is an effective waste management strategy.
- If a market can be created for low grade wood, then it becomes more likely that low value trees will be thinned from forest stands. Just as thinning weeds improves production from a garden, thinning low value trees from a forest can improve the growth and production from a forest.
- Biomass and particularly woodchips are a relatively low density energy source. Consequently, it is only practical to truck biomass fuels from relatively close by. This means that biomass fuels by definition must be purchased locally which helps sustain local business and keeps energy dollars circulating in the local economy.
- Biomass fuel prices are remarkably stable. Since biomass fuel is produced locally it is not subject to the same global geopolitical pressures as fossil fuels. Over the past twenty years the cost of wood fuel for the institutional market in Vermont has increased on average about 3.7% per year. This is much less than the 6-7% annual increase fuel oil has seen in the northeast. And biomass fuels have not fluctuated like fossil fuels. Since biomass fuel contracts are typically made with local business people instead of large multi-national companies, prices tend to remain stable throughout the year and increase at a much slower rate than fossil fuels
- One of the most compelling reasons for considering biomass for local decision makers is the cost of fuel. Woodchips are about one-quarter to one-third the cost of fuel oil on a cost per BTU for delivered heat. Pellets are a processed fuel and require energy to produce. Consequently they are more costly than woodchips, about twice the cost per BTU. If a building owner is spending tens of thousands of dollars to heat their building, there is potentially tens of thousands of dollars worth of savings if biomass is used instead of fossil fuels for heating.

- Using biomass for energy is an excellent greenhouse gas reduction strategy. Fossil fuels are made of carbon that has been sequestered for literally millions of years below ground. When they are burned they release this carbon into the atmosphere in the form of CO_2. Biomass on the other hand is made from carbon that is already in the carbon cycle. When it burns it recycles that carbon into the atmosphere. And since most biomass is produced from the waste of some other activity like sawmill residues or timber harvesting residues, the carbon in biomass fuels would likely wind up in the atmosphere very soon either through slash burning or simple decomposition. The Intergovernmental Panel on Climate Change considers using biomass for energy to be CO_2 neutral.

Figure 5 Carbon Cycle Illustration[4]



There is no better way for many building owners to reduce their greenhouse gas emissions than to replace a fossil fuel heating system with one that burns biomass.

[4] Illustration taken from a handout produced by the Biomass Energy Resource Center

DISCUSSION OF BIOMASS FUELS

Purchasing wood fuel is a different exercise than purchasing fuel oil. While fuel oil is delivered to the site with little interaction from facility managers, biomass fuel suppliers will need to be cultivated and educated about the type of fuel needed, its characteristics and the frequency of deliveries. Concurrently with designing a wood-energy system, the school should also be cultivating potential biomass fuel suppliers.

Pellet Fuel

Wood pellets are made from wood waste materials that are compressed into pellets under heat and pressure. Natural plant lignin holds the pellets together without glues or additives. Wood pellets are of uniform size, shape and composition making them easy to store and to burn.

Much of the pellet fuel market is geared toward supplying 40 pound bags for residential scale pellet stoves and boilers. Commercial scale systems typically have bulk storage of pellet fuel that can then be fed into the boiler automatically. Therefore pellet fuel suppliers for a commercial scale system need to have the ability to deliver in self unloading trucks. Commercial scale pellet consumers should identify several pellet fuel manufacturers within a 200 mile radius that have the capability to deliver pellet fuel in bulk.

Figure 6 Typical pellet fuel storage and delivery[5]

[5] Photo taken from *Wood Pellet Heating Guidebook* published by Massachusetts Division of Energy Resources

It is best to secure a supplier that will guarantee supply for at least a complete heating season. Distance from the manufacturer will affect cost so generally the closer the supplier, the better the delivered price.

Woodchip Fuel

In the case of woodchips, potential wood fuel suppliers include sawmills, loggers, chip brokers and large industrial users such as paper mills or power plants. Many of these forest products producers already make woodchips for pulp and to reduce waste, but may not have much experience dealing with the needs of smaller volume customers. Woodchips produced for institutional biomass boilers have more stringent specifications than those produced for large industrial customers. And woodchip fuel may need to be delivered in different trailers.

When talking to potential woodchip fuel suppliers, it is important to have the wood fuel specification in mind. A one to three inch square chip is ideal. If possible woodchips for institutional biomass systems will come from logs that are debarked prior to chipping because bark produces more ash which translates into a little more daily maintenance. Pieces or small branches that are six inches or longer can jam augers and conveyors which will interrupt the operation of automated fuel handling equipment. Institutional scale biomass boiler systems in the Northeast are typically designed to operate with wood fuel that is within a 35% and 45% range for moisture content.

Typically institutional biomass systems of this scale have limited chip storage capacity which means they may need deliveries on relatively short notice. Woodchip fuel suppliers will need to be within a 100 to 150 mile radius or so of the user, the closer the better, as transportation costs will affect price. Chip deliveries are typically made in "live bottom" trailers that will self unload into below-grade chip storage bins. Therefore, potential suppliers must have access to a self-unloading trailer for deliveries.

It is possible to design a wood-energy system that uses any one of a variety of biomass fuels, but green hardwood chips make the best fuel. If it is readily available, it should be the fuel of choice. In addition, users should focus on reliability of supply and consistency of the fuel rather than just lowest cost. The goal should be to minimize maintenance and optimize system performance.

Whichever fuel is used, the fuel type needs to be part of the combustion system design process, and the wood system should be operated using the fuel it is set up to use. Ideally, sample fuel chips should be sent to the manufacturer of the biomass heating equipment so that they can design the fuel handling equipment around the type of fuel and calibrate the system properly when setting the system up. No system handles widely varying fuel types at the same time very well. A system can be re-calibrated for a different fuel type, but the most practical approach is to stick with one fuel type, at least for a given heating season. If for some reason that fuel type becomes unavailable, the manufacturer of the equipment should be consulted to help reconfigure or retune the system for another fuel.

It is best to try to locate several potential suppliers. By doing so, the facility will have the security of knowing there will be back-up in case of an interruption from their primary supplier. This will also generate some competition. A list of relatively local potential fuel suppliers is included in the appendices. For help identifying other potential wood-fuel suppliers, facility managers may want to contact Collin Miller with the Watershed Agricultural Council. He can be reached at (607) 865-7790 ext. 112 or collinmiller@nycwatershed.org. A Directory of Wood Products Manufacturers in the Catskills was also included with the *Biomass and Green Building Resources* binder accompanying the original reports.

The bottom line is that both the end-user and fuel suppliers need to clearly understand the characteristics of fuel needed for their particular system. Consistent particle size and moisture content is particularly important for institutional customers, and facility mangers should insist on the quality of the chip. A sample fuel specification was included in the *Biomass and Green Building Resources* binder to give an idea of the types of characteristics to look for in woodchip fuel. Below is a description of the advantages and disadvantages of different types of biomass fuels in order of preference.

Green Hardwood Chips

A consistent green hardwood chip is the easiest fuel for institutional scale automated biomass heating systems to handle. Rarely will they jam an auger or conveyor. Green chips burn somewhat cooler than most other biomass fuels making it easier to control the combustion. With proper controls they burn very cleanly with minimal particulate emissions and little ash. They have less dust than other biomass fuels so they are less messy and safer to handle. Ideally moisture content will be between 35% and 45% on a wet basis. Green hardwood chips can come from sawmill residues or timber harvest operations.

Mill Residues vs. Harvest Residues

Woodchips can be produced at sawmills or other primary wood products industrial sites as part of their waste wood disposal process. Mill residues are typically the most desirable source of fuel woodchips. Mills can produce a bark-free chip with few long pieces or branches that can jam augers and fuel conveyors. A mill supplier can easily calculate trucking costs and can negotiate dependable delivery at a consistent price.

Another potential type of wood fuel is whole tree chips which are produced as part of tree harvesting. Whole tree chips tend to be a dirtier fuel than sawmill residues and may contain small branches, bark, twigs and leaves. The longer pieces can jam the relatively small augers of an institutional scale biomass system and can add to the daily maintenance because they produce more ash.

The bole of a tree is the de-limbed trunk or stem. Chips made from boles are in-between the quality of a sawmill chip and a whole tree chip. Bole-tree chips tend to have fewer twigs and long stringers than whole tree chips. Both bole-chips and whole-tree chips can be potentially good sources for biomass fuels, although they have a greater likelihood of including oversized chips and they will produce somewhat more ash, compared to mill residues.

Softwood Chips

Green softwood chips will generally have less energy and more water content per truckload, and therefore they will be more expensive to transport than hardwood chips. As long as the combustion and fuel handling equipment is properly calibrated for softwood chips, an automated woodchip heating system can operate satisfactorily with softwood chips. Softwoods tend to have higher moisture contents and can range up to 60% moisture on a wet basis. The best biomass fuel will have less than 50% moisture. One species to avoid altogether is white pine. It has a very high moisture content and therefore relatively low bulk density. The experience in Vermont schools with white pine is that it is a poor biomass fuel for institutional-scale woodchip systems.

Dry Chips vs. Green Chips

Dry chips (less than 20% moisture on a wet basis) burn considerably hotter than green chips and typically have more dust. The increased operating temperature can deteriorate furnace refractory faster increasing maintenance costs slightly. The dust can make for a somewhat dirtier boiler room which will be a problem for some maintenance staff. Dry chips are also easier to accidentally ignite in the fuel storage bin or fuel handling system. If dry chips are used, the combustion equipment needs to be carefully calibrated to handle these higher temperatures. Dry chips are not generally recommended for institutional settings.

Bark

Bark has a high energy value, but it also comes with significant maintenance costs. It produces a considerable amount of ash that needs disposal; it can create more smoke than green chips; and it can cause other routine maintenance problems such as frequent jamming of augers from rocks. Bark can be an inexpensive fuel, but the additional maintenance costs make it unattractive for institutional biomass systems.

Sawdust and Shavings

Sawdust and shavings should be ruled out for the institutional wood heating market. Dry sawdust can be dusty to handle and raises fire safety and explosion issues. Shavings are also dusty and easily ignited and are difficult to handle by typical fuel handling equipment. This fuel type can work fine in an industrial setting, but institutions typically do not have the maintenance staff that can provide the supervision that these fuels need.

PROJECT FUNDING OPPORTUNITIES

CARBON OFFSETS

While fossil fuels introduce carbon that has been sequestered for millions of years into the atmosphere, the carbon dioxide emitted from burning biomass comes from carbon that is already above the ground and in the carbon cycle. Biomass fuels typically come from the waste of some other industrial activity such as a logging operation or from sawmill production. The carbon from this waste would soon wind up in the atmosphere whether it was left to decompose or if it were burned as slash. There are few measures a facility could undertake that would have a greater impact on reducing its carbon footprint than to switch from #2 heating fuel to a biomass fuel.

Carbon offsets help fund projects that reduce greenhouse gas emissions. Carbon offset providers sell the greenhouse gas reductions associated with projects like wind farms or biomass projects to customers who want to offset the emissions they caused by flying, driving, or using electricity. Selling offsets is a way for some renewable energy projects to become more financially viable. Buying offsets is a way for companies and individuals to compensate for the CO_2 pollution they create.

For a biomass heat only project, it is assumed a BTU-for-BTU displacement of fuel oil (based on historic purchase records) will be displaced by the project's thermal energy output, over the project's assumed operating life. CO_2 avoidance is based on the emissions profile (Lbs. CO_2 /BTU) of the displaced fuel. The US EPA calculates that 22.2 lbs. of CO_2 is produced from each gallon of fuel oil consumed. The market value of this type of offset is between $3/ton and $5/ton. These offsets can be negotiated as either a lump sum offset for up to 10 years or can be paid out as an annual payment.

There are a number of companies that are interested in contributing to the construction of new sources of clean and renewable energy through carbon offsets. Information about Native*Energy*, a nationally recognized company that buys and sells carbon offsets, was included in the ***Biomass and Green Building Resources*** binder accompanying each report.

MUNICIPAL LEASE / PURCHASE

As municipal entities, school districts may be eligible for a municipal lease/purchase arrangement to finance the anticipated project costs for a biomass heating system. A municipal lease is a contract that has many of the characteristics of a standard commercial lease, with at least two primary differences:

- In a municipal lease, the intent of the lessee is to purchase and take title to the equipment. The financing is a full payout contract with no significant residual or balloon payments at the end of the lease term.
- The lease payments include the return of principal and interest, with the interest being exempt from Federal income taxation to the recipient. Because the interest is exempt from federal tax, a municipal lease offers the lessee a significant cost savings when compared to conventional leasing.

It may be possible to negotiate a more favorable payment schedule with a tax-exempt lease than with a conventional general obligation bond and tax-exempt leases tend to have lower transaction costs.

There are a number of companies that provide municipal leases. Information from one such company, Municipal Leasing Consultants was included in the *Biomass and Green Building Resources* Binder accompanying each report.

USDA FUNDING OPPORTUNITIES

2008 Farm Bill

The 2008 Farm Bill has a number of provisions that may help rural communities consider and implement renewable energy and energy efficiency projects.

- **Section 9009** provides grants for the purpose of enabling rural communities to increase their energy self-sufficiency.
- **Section 9013** provides grants to state and local governments to acquire wood energy systems.

Rural Community Facilities Grant and Loan Program

The USDA provides grants and loans to assist the development of essential community facilities. Grants can be used to construct, enlarge or improve community facilities for health care, public safety and other community and public services. The amount of grant assistance depends on the medium household income and the population of the community where the project is located.

These grants and loans are also competitive and highest priority projects are those that serve small communities, those that serve low-income communities and those that are highly leveraged with other loan and grant awards.

All of these USDA grants and loan guarantee programs are competitive. The rules governing the program and the application dates have not yet been released. For more information about USDA programs and services interested parties should check with their local USDA office to express interest and to get program roll-out updates. Information on programs and contact information was provided in the *Biomass and Green Building Resources* binder accompanying each report.

ADDITONAL ISSUES TO CONSIDER

Energy Management and Energy Efficiency

In order to effectively manage energy use and to identify efficiency opportunities in buildings it is very important to track energy usage. Unless energy consumption is measured over time, it is difficult or impossible to know the impact of efficiency improvements or renewable energy investments. The Environmental Protection Agency developed a public domain software program called *Portfolio Manager* that can track and assess energy and water consumption across an entire portfolio of buildings. *Portfolio Manager* can help set efficiency priorities, identify under-performing buildings, verify efficiency improvements, and receive EPA recognition for superior energy performance. Richmond Energy recommended that each facility input several years' worth of energy and water use data into *Portfolio Manager* as soon as it can. The EPA *Portfolio Manager* software can be downloaded at the following address:

http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager

Regardless of whether any of the school districts move forward with a biomass project, they should all consider engaging the New York State Energy Research and Development Authority (NYSERDA) and/or the New York Power Authority (NYPA). Both have well developed energy efficiency programs and both could help with the evaluation of energy efficiency opportunities. NYSERDA and/or NYPA can perform an energy audit on the school and they can provide cash incentives to upgrade and improve equipment efficiencies. A Case Study for the NYSERDA Energy

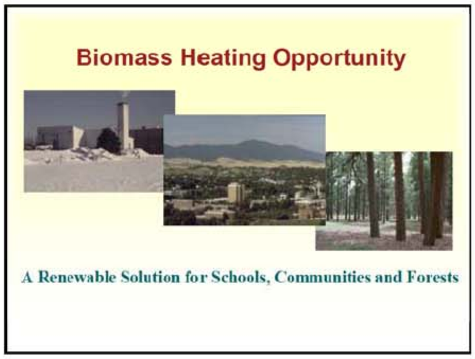
Smart Schools Program and general information on NYSERDA and NYPA programs was included in the *Biomass and Green Building Resources* binder accompanying each report.

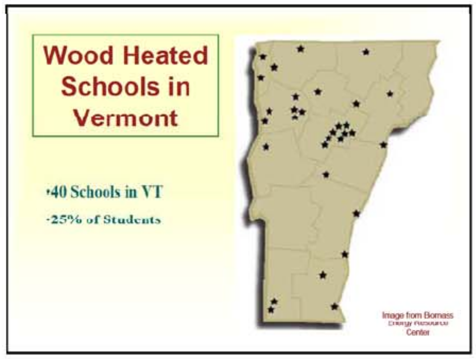
Capital Planning and a School Energy Initiative

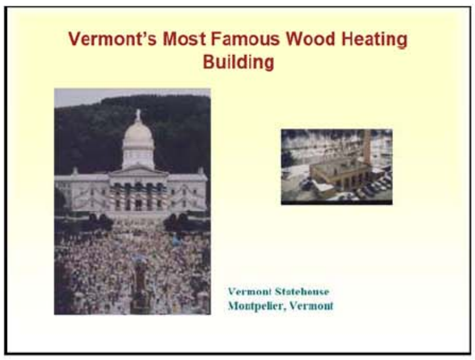
Biomass energy projects fit well into a capital planning process. For school districts it is wise to contact the NY State Education Department and get a determination of when their boilers will be considered fully depreciated and plan for a biomass project as soon after that time as possible. Energy efficiency projects also should be included in a capital plan. NYSERDA can help identify and prioritize appropriate energy efficiency projects that will improve the schools infrastructure and save money.

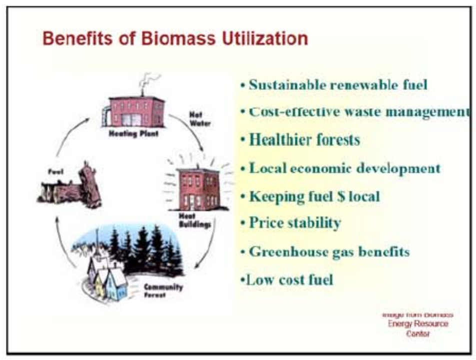
If NYSERDA identifies energy efficiency improvements that require significant capital investments, school district may want to consider incorporating a biomass project into a larger energy initiative to put before voters. The savings from a biomass energy project will more than offset its costs and it could help to leverage other energy improvement projects.

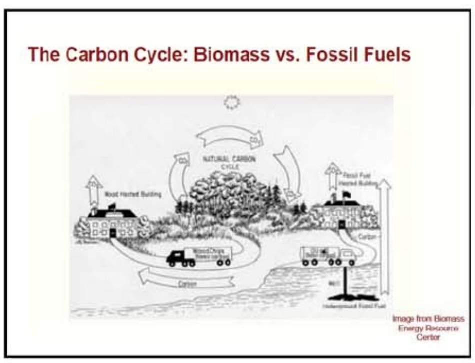
BIOMASS HEATING OPPORTUNITY POWERPOINT PRESENTATION

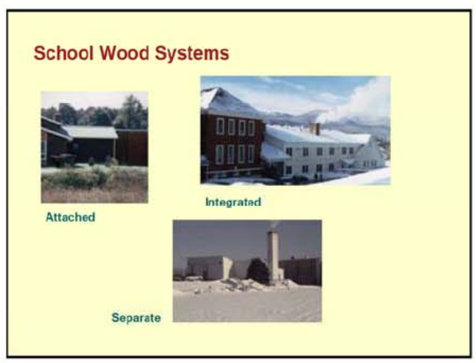












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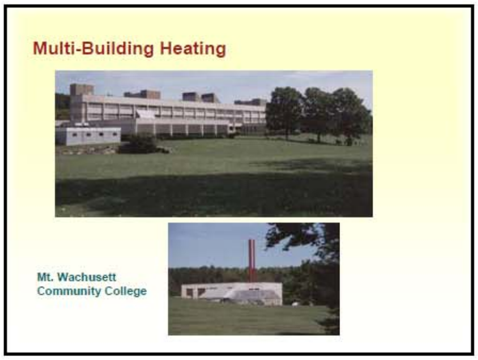
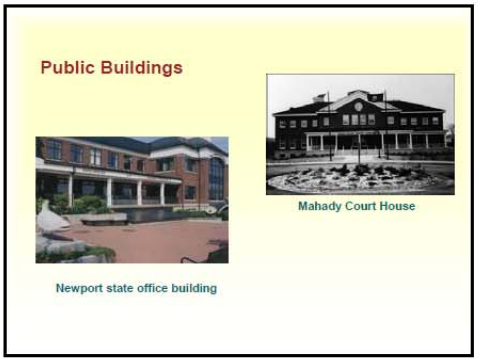
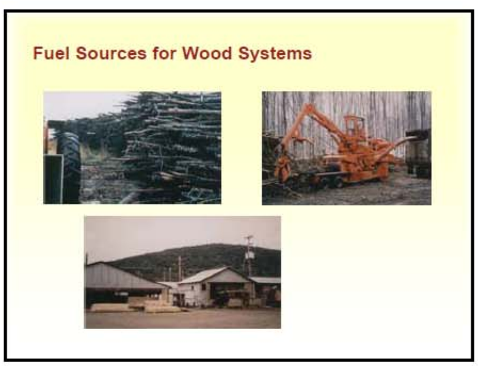

Multi-Building Heating
Mt. Wachusett
Community College


Community District Energy - Campuses
Northwest Missouri State
Maryville, Missouri
Maryville College
Maryville, Tennessee

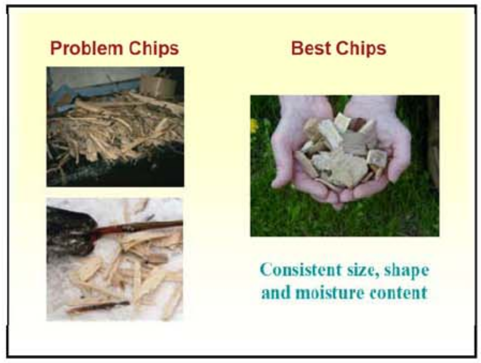

Public Buildings
Mahady Court House
Newport state office building


Public Buildings:
Correctional Facilities
Half of Vermont's 10 correctional
facilities are heated with wood
St. Johnsbury
Newport

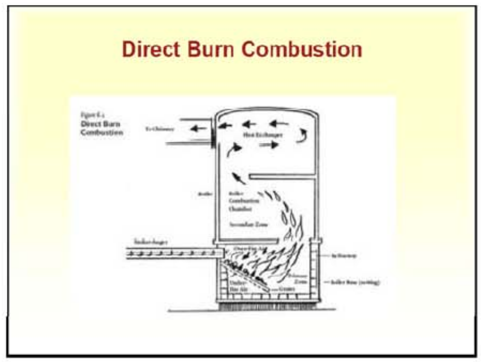

Fuel Sources for Wood Systems

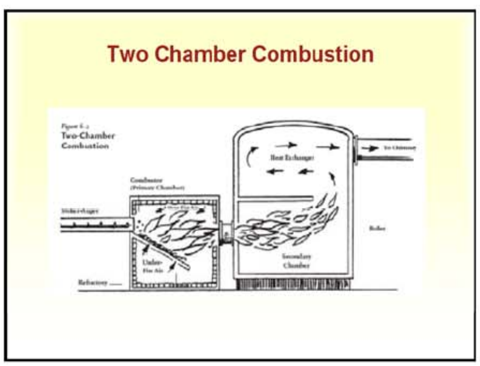

Fuel Transport and Delivery

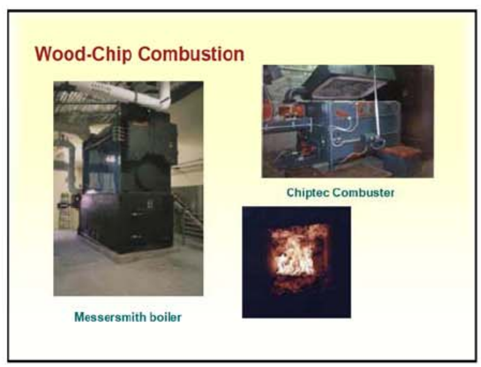

Fuel Transport and Delivery
Dump truck
"Walking floor" trailer


Problem Chips
Best Chips
Consistent size, shape
and moisture content

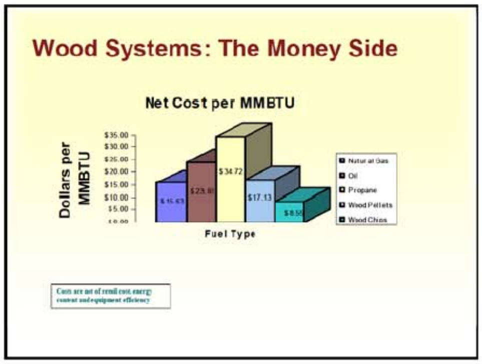

Automated Fuel Handling

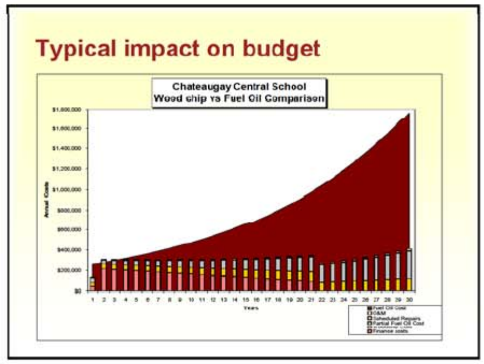

Direct Burn Combustion


Two Chamber Combustion

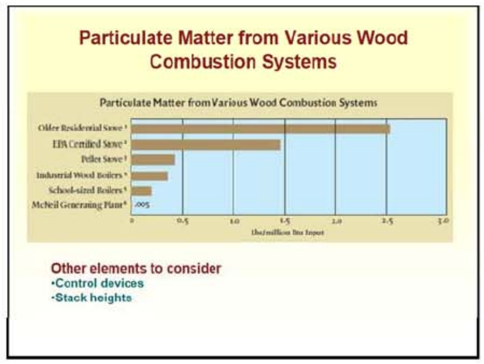

Wood-Chip Combustion
Chiptec Combuster
Messersmith boiler

3


Wood Systems: The Money Side
Net Cost per MMBTU
Dollars per MMBTU
$35.00
$30.00
$25.00
$20.00
$15.00
$10.00
$5.00
$34.72
$17.13
Fuel Type
Natural Gas
Oil
Propane
Wood Pellets
Wood Chips


Typical impact on budget
Chateaugay Central School
Wood chip vs Fuel Oil Comparison
Years


Fuel Prices
NY Heating Fuels vs. VT Wood Fuel Price History
$/MMBtu
Years
#2 Fuel Oil
Natural Gas
Woodchips


Particulate Matter from Various Wood Combustion Systems
Particulate Matter from Various Wood Combustion Systems
Older Residential Stove
EPA Certified Stove
Pellet Stove
Industrial Wood Boilers
School-sized Boilers
McNeil Generating Plant
.005
0
0.5
1.0
1.5
2.0
2.5
3.0
Other elements to consider
•Control devices
•Stack heights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4

PERMITTING

Modern biomass boiler technology is both clean and efficient. Controls moderate both the biomass fuel and air to create either a small hot fire or a large hot fire depending on heat demand from the building. Under full load, modern woodchip boilers routinely operate at steady state efficiencies of 70% - 75% and pellet boilers at 80% - 85% efficiencies. Operating temperatures in commercial scale biomass boilers can reach up to 2,000 degrees and more, completely eliminating creosote and the need to clean stacks. The amount of ash produced from a 25 ton tractor trailer load of green hardwood chips can fit in a 25 gallon trash can, is not considered a hazardous waste and can be used as a soil amendment on lawns, gardens and playing fields.

As with any combustion process, there are emissions from biomass boilers. The pollutant of greatest concern with biomass is particulates (PM_{10}). While biomass compares reasonably well with fuel oil, biomass boilers do generate more particulates. That is why it is important to install appropriate pollution control equipment. But the emissions from a modern woodchip boiler are much less than most people think.

Table 1 Comparison of Boiler Emissions Fired by Woodchips and Distillate Oil[6]

	Wood	Distillate Oil
	(Pounds per million BTU output)	
PM_{10}	0.1	0.014
NO_X	0.165	0.143
CO	0.73	0.035
SO_2	0.0082	0.5
TOC	0.0242	0.0039
CO_2	gross 220 (net 0)	159

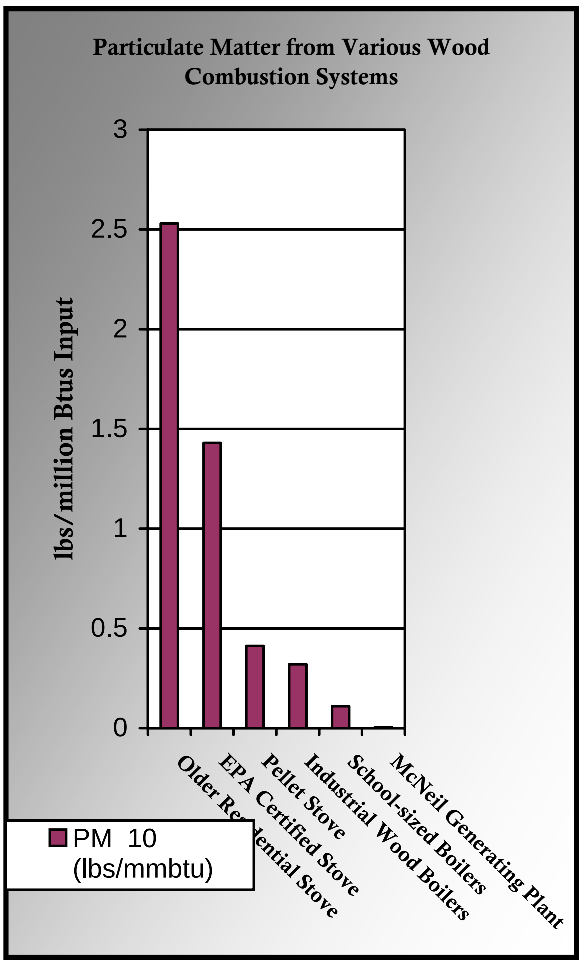
One of the most common misconceptions about institutional biomass energy systems comes from the experience people have with residential wood stoves and outdoor wood furnaces. In general, an institutional-scale wood energy system emits only one fifteenth (seven percent) the PM_{10} of the average wood stove on a BTU basis. Over the course of a year, a large, woodchip heated school in a northern climate like New York may have the same particulate emissions as four or five houses heated with wood stoves.

[6] Data excerpted from the paper *An Evaluation of Air Pollution Control Technologies for Small Wood-Fired Boilers* prepared by Resource Systems Group, Inc. White Rive Jct., VT, for the New York Department of Public Service and others, Revised September 2001.

In order to install new woodchip boiler, schools may still need an air quality permit or an amendment to their existing permit if they have one. For a woodchip boiler the permit will likely include requirements for pollution control equipment, such as a multi-cyclone along with a requirement for a tall stack to help with dispersion. Costs for a multi-cyclone and a 70 foot tall stack were included in the cost estimates for each woodchip analysis. Other permit conditions might include testing for emissions and efficiency, keeping records of fuel consumption and test results and making periodic submittals to regulatory agencies.

If a facility needs to obtain an air quality permit, it is advisable to retain a professional consulting firm that has experience with permitting institutional scale biomass boilers. Resource Systems Group in White River, Vermont is one such consulting firm.

Table 2 Particulate Emissions[7]



Commercial scale pellet fuel boilers are typically smaller than woodchip boilers and most will fall below the threshold where they will need air quality permits. Pellet boilers have not had as much emissions testing as woodchip boilers in the United States so there is less concrete data about performance and emissions. However, pellet fuel boilers are much more common in Europe and testing there indicates that pellet boilers have fewer lbs/MBTU of particulate emissions than woodchip boilers.

Below is a memo prepared by Resource Systems Group for this project that summarizes current air quality permitting regulations that might apply to biomass installations in the Catskill region.

[7] Excerpted from a handout produced by the Biomass Energy Resource Center

MEMORANDUM

To: Jeffrey W. Forward, *LEED*®AP
From: John Hinckley, Q.E.P.
Subject: Air Quality Permitting for the Catskills Region
Date: 9 April 2009

INTRODUCTION

At your request, RSG evaluated the permitting landscape for new wood-fired boilers in the Catskills region of New York State (Delaware, Greene, Sullivan, and Ulster counties). For purposes of analysis, we evaluated modern wood chip boilers, burning clean wood chips, and having a design heat input of approximately 6 million Btu's per hour (MMBtu/hr). We understand this is the approximate type and size biomass boiler that facilities in the Catskills region would implement. While this study focused on wood chip boilers, its findings can be generally extrapolated to wood pellet boilers.

EXISTING AIR QUALITY

Existing (background) air quality is evaluated by assessing the level (concentration) of various air pollutants in the atmosphere of a given area. The critical pollutant for wood boilers is particulate matter, which is an umbrella term including solid and liquid particles which can be inhaled. Particles less than 2.5 microns, known as "PM2.5" or "PM Fine" are widely considered the most critical and the most limiting pollutant when planning and designing wood boiler projects. Therefore, the analysis for this study was limited to PM2.5.

The Environmental Protection Agency (EPA) monitors PM2.5 concentrations at numerous locations in New York. Information from the air quality monitoring stations tells us to the extent which background pollutant concentrations meet National Ambient Air Quality Standards (NAAQS), which were instituted by EPA to protect human health and welfare. Figure 1 was taken from the EPA website and shows the Catskills Region is currently "in attainment" with the NAAQS for PM2.5.8

[1]According to the EPA website, attainment status was last determined in December, 2008. http://www.epa.gov/air/data/monvals.html

55 Railroad Row ■ White River Junction, Vermont 05001
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Figure 1: Nonattainment Areas as of December, 2008

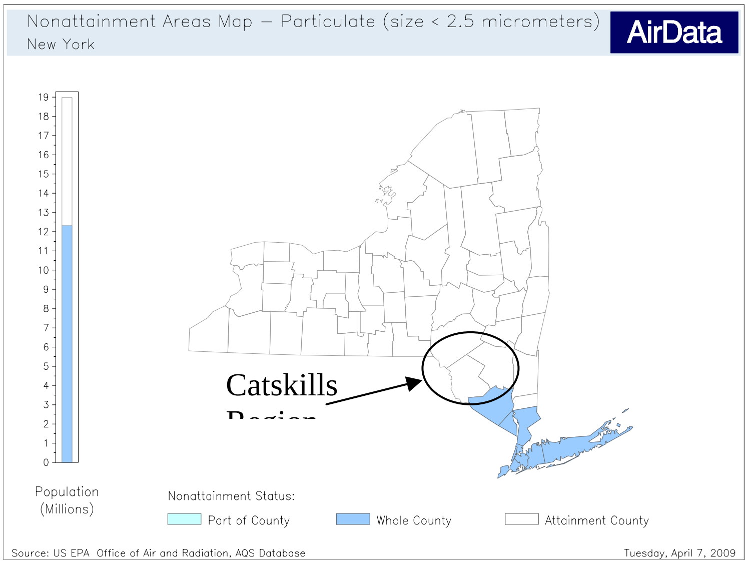


Figure 2 shows the 2008 98th percentile 24-hour concentrations measured in New York counties in color. The 98th percentile value is used by EPA and is widely considered a worst-case (conservative) estimate of existing PM2.5 concentrations because concentrations are less than it 98% of the year. As shown, all 98th percentile concentrations in 2008 were less than 35 micrograms per cubic meter (ug/m3), which is the current 24 hour limit.

Figure 2: 98th Percentile Background Concentrations in New York State in 2008

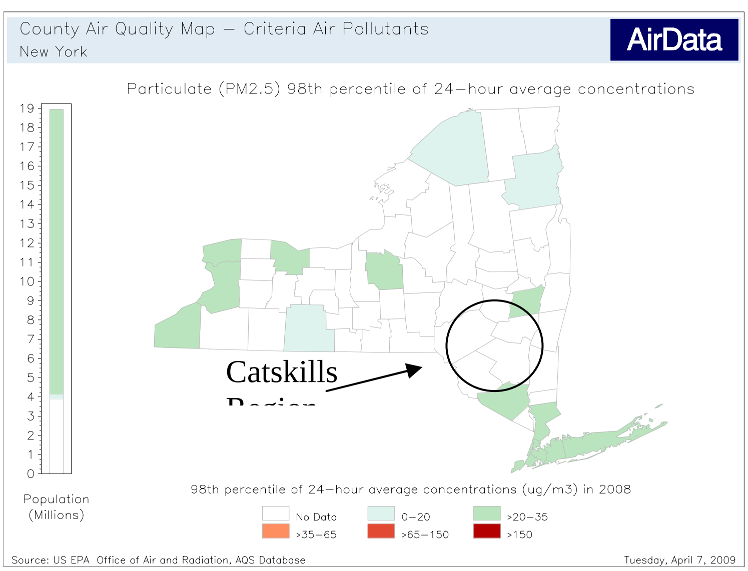
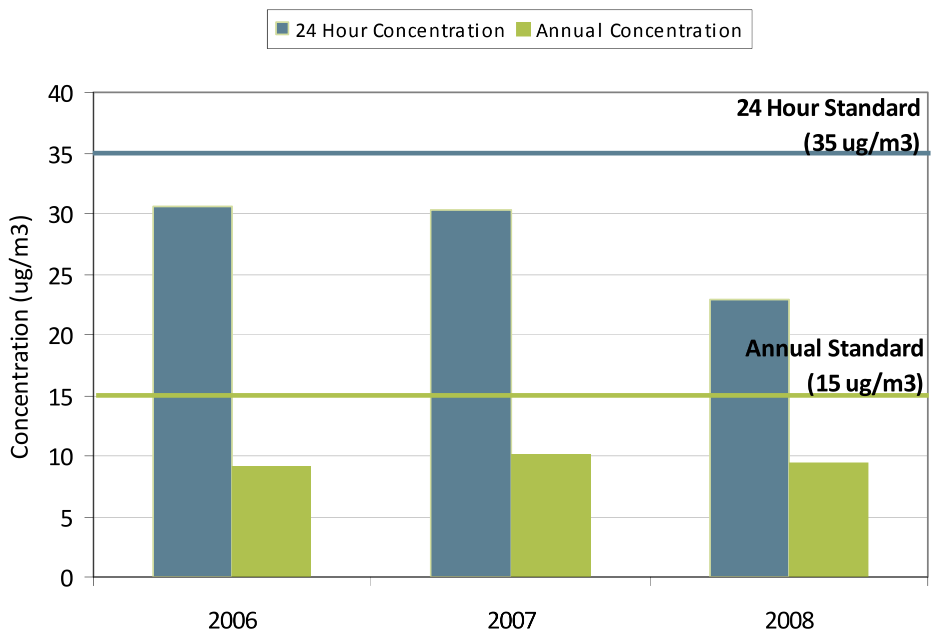


Figure shows the 98th percentile PM2.5 24-hour concentrations and annual average concentrations as measured in Albany County for the last three years. There are no monitoring stations in the Catskills counties, so Albany County data was selected as it is adjacent to the Catskills region. It can also be considered a conservative proxy for PM2.5 concentrations in the Catskills region as it contains a higher population density as well as more commercial and industrial activity than counties in the Catskills.

Figure 3: Albany County Background Concentrations Compared with Air Quality Standards



As shown above, PM2.5 concentrations did not exceed the 24-hour and annual standards. Further, the three year 24-hour and annual averages are 27.9 ug/m3 (20% below the standard) and 9.5 ug/m3 (37% below the standard) respectively. One way to generally think about this is that annual emissions in the areas affecting the Albany County airshed would have to increase by 37% before the annual standard would be violated.

PERMITTING THRESHOLDS

Any wood boiler with a design heat input greater than 1.0 MMBtu/hour must obtain a permit in New York.[1] There are three types of air quality permits, which are triggered by different levels of emissions. The design considered for this study would trigger a "Minor Facility Registration", the permit corresponding to the smallest quantity of emissions considered by the New York State Department of Environmental Conservation (NYSDEC). A "State Facility Permit" and "Title V Permit" are two other types of permits required for more facility emissions. A Minor Facility Registration is a one page document with minimal permit requirements (relative to State Facility and Title V permits).

NYSCEC has a policy document called "CP-33", which addresses how PM2.5 emissions should be handled.[2] This policy deems PM2.5 emissions from a given project to be "insignificant" if annual PM10 emissions are less than 15 tons per year. Actual PM10 emissions from the wood boiler design considered for this study would range from approximately 1.5 to three tons per year.

EXISTING AND FUTURE PERMIT REGULATIONS

According to Regulation 227-1.2, New York currently requires the emission rate of all particulates not to exceed 0.6 pounds per million Btu's of heat input (lb/MMBtu). The average wood boiler in the northeast emits less than this, even without pollution control. Actual emission rates are further discussed in a later section.

New York also has a nuisance regulation which could be applied to wood boiler exhaust (Regulation 211.2) which states:

> *No person shall cause or allow emissions of air contaminants to the outdoor atmosphere of such quantity, characteristic or duration which are injurious to human, plant or animal life or to property, or which unreasonably interfere with the comfortable enjoyment of life or property. Notwithstanding the existence of specific air quality standards or emission limits, this prohibition applies, but is not limited to, any particulate, fume, gas, mist, odor, smoke, vapor, pollen, toxic or deleterious emission, either alone or in combination with others.*

There is also a visibility standard (Regulation 211.3) which states:

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[1] Permitting requirements can change, so the state air quality office should be contacted regardless of size.

[2] "Policy CP-33: Assessing and Mitigating Impacts of Fine Particulate Matter Emissions. NYSDEC Division of Air Resources Commissioner's Policy, New York State Department of Environmental Conservation, Issued 12/29/2003. http://www.dec.ny.gov/chemical/8912.html

> *Except as permitted by a specific part of this Subchapter and for open fires for which a restricted burning permit has been issued, no person shall cause or allow any air contamination source to emit any material having an opacity equal to or greater than 20 percent (six minute average) except for one continuous six-minute period per hour of not more than 57 percent opacity.*

Other states have similar nuisance and visibility standards, which are currently being met by the wood boilers in those states.

We are not aware of any new state regulations that would affect wood boilers. However, the EPA is planning to propose regulations by July 15, 2009 that will potentially affect all institutional/commercial boilers. There will be a public comment period following the proposed rule change. The rule will be made final one year after it is proposed.

The intent of the rule change is to further control emissions from wood boilers. It is unclear at this point what effect this will have on small wood boilers (< 10 MMBtu/hr heat input). Work is underway to advise EPA regarding cost-effectiveness of air pollution controls.

POTENTIAL POLLUTION CONTROLS

The type and degree of pollution control depends on the location, the type of facility being served by the wood boiler and the respective state's emission limits. Wood combustion emissions can be controlled with an array of operating practices and add-on (end of pipe) pollution controls. Examples of the former include good combustion conditions (sufficient residence time, turbulence and temperature for combustion byproducts) and automated combustion controls to maintain the proper air to fuel ratios. Examples of the former include mechanical collectors,[3] baghouses and ESPs.[4] Add-on pollution controls are summarized in Table 1 below.

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[3]Examples of mechanical collectors include cyclones, multi-cyclones, core separators and high efficiency multi-cyclones.

[4] ESPs are being considered for implementation on small wood boilers in the US. However, there are currently no demonstrated applications of ESPs on small wood boilers in the US.

Table 1: Summary of Potential Add-On Pollution Controls (Partial List)

Type	Control Method	Where Used	Cost and Control Effectiveness
Mechanical collectors	Inertial separation	Most wood boilers < 10 MMBtu/hr	Low to medium cost & low to medium emission control
Baghouses	Fabric filtration	Most wood boilers > 10 MMBtu/hr	High cost and high degree of emission control
Electrostatic precipitators	Electrostatic attraction	Utility scale boilers approx. > 100 MMBtu/hr	High cost and high degree of emission control

RECENT STACK EMISSION TEST INFORMATION

A significant number of existing wood boilers have been tested in the past few years, mainly in the Northeast and Rocky Mountain regions. A stack test is the process of measuring the emissions of various pollutants, typically according to EPA reference methods. Some tests are performed for demonstrating compliance with state permit emission limits, while others are performed for research purposes. These tests have covered many different fuel types including wood chips with bark, without bark, and wood pellets. Overall, stack test results are showing the following:

1) Particulate emissions from burning wood without bark could be 25% less than burning wood with bark.
2) Actual emissions are typically less than standard EPA emission factors for external combustion wood boilers.
3) Facilities are meeting their permit emission limits.

Table 2 provides a summary of recent stack test results in the Northeast and Rocky Mountain regions for facilities with a number of different add-on pollution controls. All results are provided for clean wood chips unless otherwise noted. Much more emission data is expected to become available at the conclusion of this heating season.

Table 2: Summary of Recent Stack Test Results for Total Particulate Matter

Test Type	Total Particulate Emissions (lb/MMBtu)
Uncontrolled emissions (dirty wood)	≈ 0.45
Uncontrolled emissions	≈ 0.40
Controlled with multi-cyclone	≤ 0.25
Controlled with core separator	≤ 0.17
Controlled with baghouse	< 0.10

While all the emission levels reported above meet the New York emission limit of 0.60 lb/MMBtu, they do not necessarily guarantee compliance with ambient air quality standards. Therefore, further analysis may be warranted when designing a wood boiler system. Air dispersion modeling is a widely used tool which predicts ambient air pollutant concentrations using building geometry, stack geometry & exhaust parameters, topography, land use and regional meteorology in addition to emission rates.

CONCLUSIONS

- The 24-hour and annual background concentration of PM2.5 in the Catskills region are likely to be in compliance with the 24-hour and annual National Ambient Air Quality Standards (NAAQS), based on our evaluation of monitoring data collected in Albany.
- The type of boiler evaluated for this study will require a Minor Facility Registration air permit from NYSDEC.
- There are many different methods and technologies available for controlling wood combustion emissions.
- Stack test results from wood boilers in operation throughout the U.S. indicate the New York particulate matter emission limit can be met with an adequate margin of safety.
- Additional consideration should be given to designing systems and stacks to meet ambient air quality standards through the use of dispersion modeling.
- The information reviewed indicates a favorable landscape for implementing new wood boilers in the Catskills region.

ANALYSIS INPUTS / SAVINGS TABLES AND GRAPHS

Table 3 South Kortright Woodchip Scenario Analysis Assumptions

Capital Cost Assumptions	
4.0 MBTU wood hot water boiler system including installation	$450,000
2,000 square foot boiler house and chip storage building @$250/SF	$500,000
70 ft. Stack	$35,000
Interconnection with existing heating systems	$50,000
Buried underground insulated pipe to existing boiler room 375 ft @ $250/LF	$93,750
Multi-cyclone pollution control device	$75,000
Construction contingency at 15%	$180,563
GC markup at 15%	$207,647
Design at 10%	$138,431
Total estimated project costs	$1,730,391
New York State School Construction Aid	70%
Net local share cost to district	$519,117
Fuel Cost Assumptions	
Current annual oil use (gal)	43,123
Assumed oil price in 1st (per gal)	$2.94
Projected annual fuel oil bill at $2.94/gallon	$126,782
Oil (gal)/chip (ton) ratio	62
Assumed wood price in 1st year (per ton)	$55
Projected 1st year wood fuel bill	$32,425
Projected 1st year supplemental fuel oil bill	$19,017
Inflation Assumptions	
General inflation rate (twenty year average CPI)	2.9%
Oil inflation rate (twenty year average EIA)	7.5%
Wood inflation rate (Average increase in VT from 1987 - 2007 is 3.7%)	3.7%
O&M Assumptions	
Annual Wood O&M cost, including labor	$6,000
Major repairs (annualized)	$2,500
Savings	
Net 1st year fuel savings including increased O&M	**$66,839**
Total 30 year NPV cumulative savings	**$2,952,798**

Figure 7 South Kortright Annual Cash Flow Graph for Woodchip Scenario

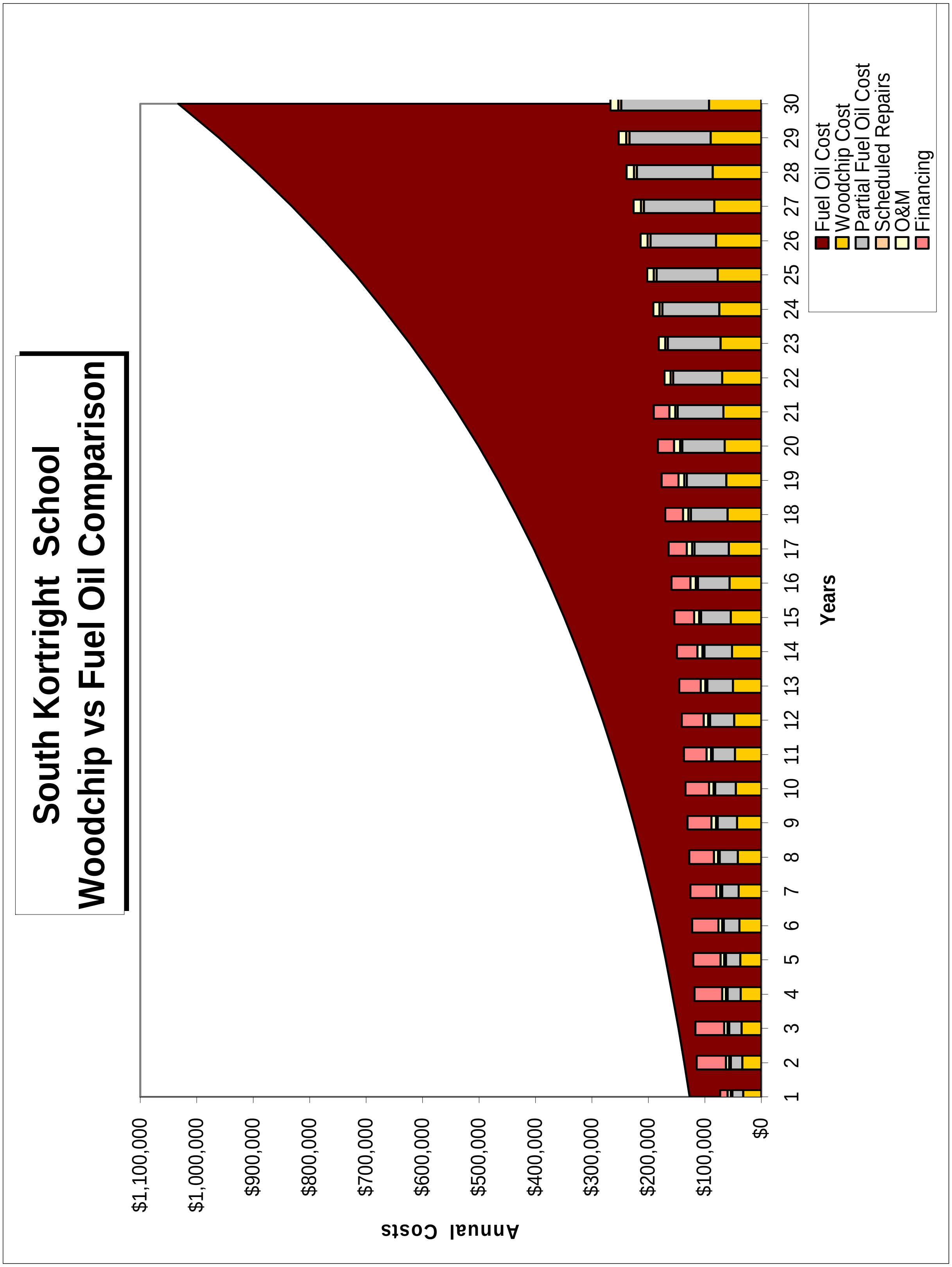


Table 4 South Kortright Pellet Scenario Analysis Assumptions

Capital Cost Assumptions	
1.7 Million Btu pellet boiler, containerized boiler room, controls and 30 ton pellet storage silo	$200,000
Solar hot water pre-heat system	$50,000
Buried underground insulated pipe to existing boiler room 50 ft @ $250/LF	$12,500
Interconnection with existing heating system	$50,000
Construction contingency at 15%	$46,875
GC markup at 15%	$53,906
Design at 5%	$17,969
Total estimated project costs	$431,250
New York State School Construction Aid	70%
Net local share cost to district	$129,375
Fuel Cost Assumptions	
Current annual oil use (gal)	37,762
Oil price in 1st (per gal)	$2.94
Projected annual fuel oil bill at $2.81/gallon	$111,020
Oil (gal)/pellet (ton) ratio	135
Pellet price, 1st year (per ton)	$225
Projected 1st year pellet fuel bill	$31,499
Projected 1st year supplemental fuel oil bill	$55,510
Inflation Assumptions	
General inflation rate (twenty year average CPI)	2.9%
Oil inflation rate (twenty year average EIA)	7.5%
Estimated pellet inflation rate	5.0%
O&M Assumptions	
Annual Pellet O&M cost, including labor	$3,000
Major repairs (annualized)	$1,500
Savings	
Net 1st year fuel savings including increased O&M	**$19,511**
Total 30 year NPV cumulative savings	**$1,153,813**

Figure 8 South Kortright Annual Cash Flow Graph for Pellet Scenario

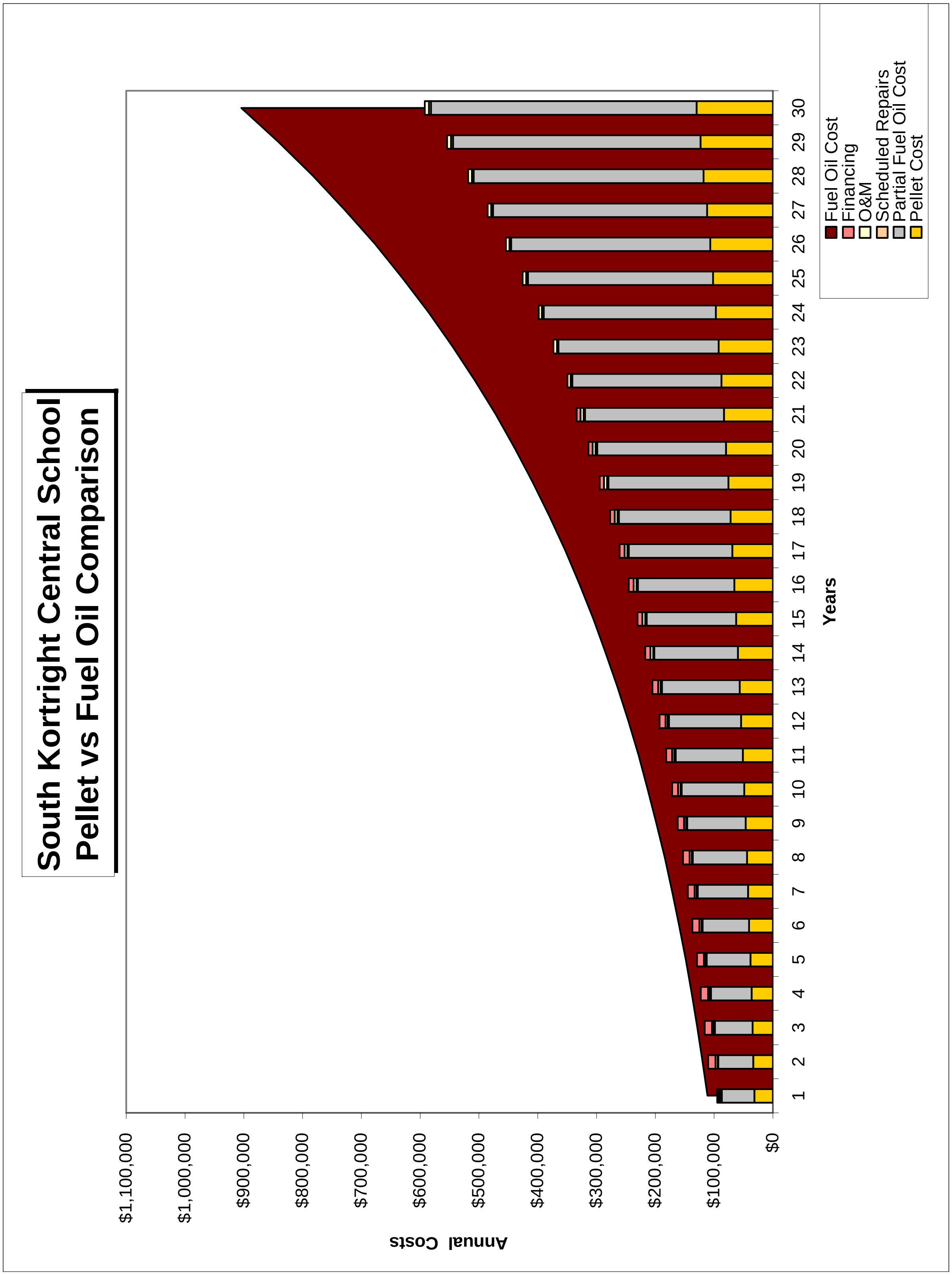


Table 5 Cairo-Durham Woodchip Scenario Analysis Assumptions

Capital Cost Assumptions	
5.0 MBTU wood hot water boiler system including installation	$450,000
2,000 square foot boiler house and chip storage building @$250/SF	$500,000
70 ft. Stack	$35,000
Interconnection with existing heating systems	$50,000
Buried underground insulated pipe to existing boiler room 50 ft @ $250/LF	$12,500
Multi-cyclone pollution control device	$75,000
Construction contingency at 15%	$168,375
GC markup at 15%	$193,631
Design at 10%	$129,088
Total estimated project costs	$1,613,594
New York State School Construction Aid	77.4%
Net local share cost to district	$364,672
Fuel Cost Assumptions	
Current annual oil use (gal)	37,224
Assumed oil price in 1st (per gal)	$2.81
Projected annual fuel oil bill at $2.81/gallon	$104,476
Oil (gal)/chip (ton) ratio	62
Assumed wood price in 1st year (per ton)	$55
Projected 1st year wood fuel bill	$27,989
Projected 1st year supplemental fuel oil bill	$15,671
Inflation Assumptions	
General inflation rate (twenty year average CPI)	2.9%
Oil inflation rate (twenty year average EIA)	7.5%
Wood inflation rate (Average increase in VT from 1987 - 2007 is 3.7%)	3.7%
O&M Assumptions	
Annual Wood O&M cost, including labor	$6,000
Major repairs (annualized)	$2,500
Savings	
Net 1st year fuel savings including increased O&M	**$52,316**
Total 30 year NPV cumulative savings	**$2,432,108**

Figure 9 Cairo-Durham Annual Cash Flow Graph for Woodchip Scenario

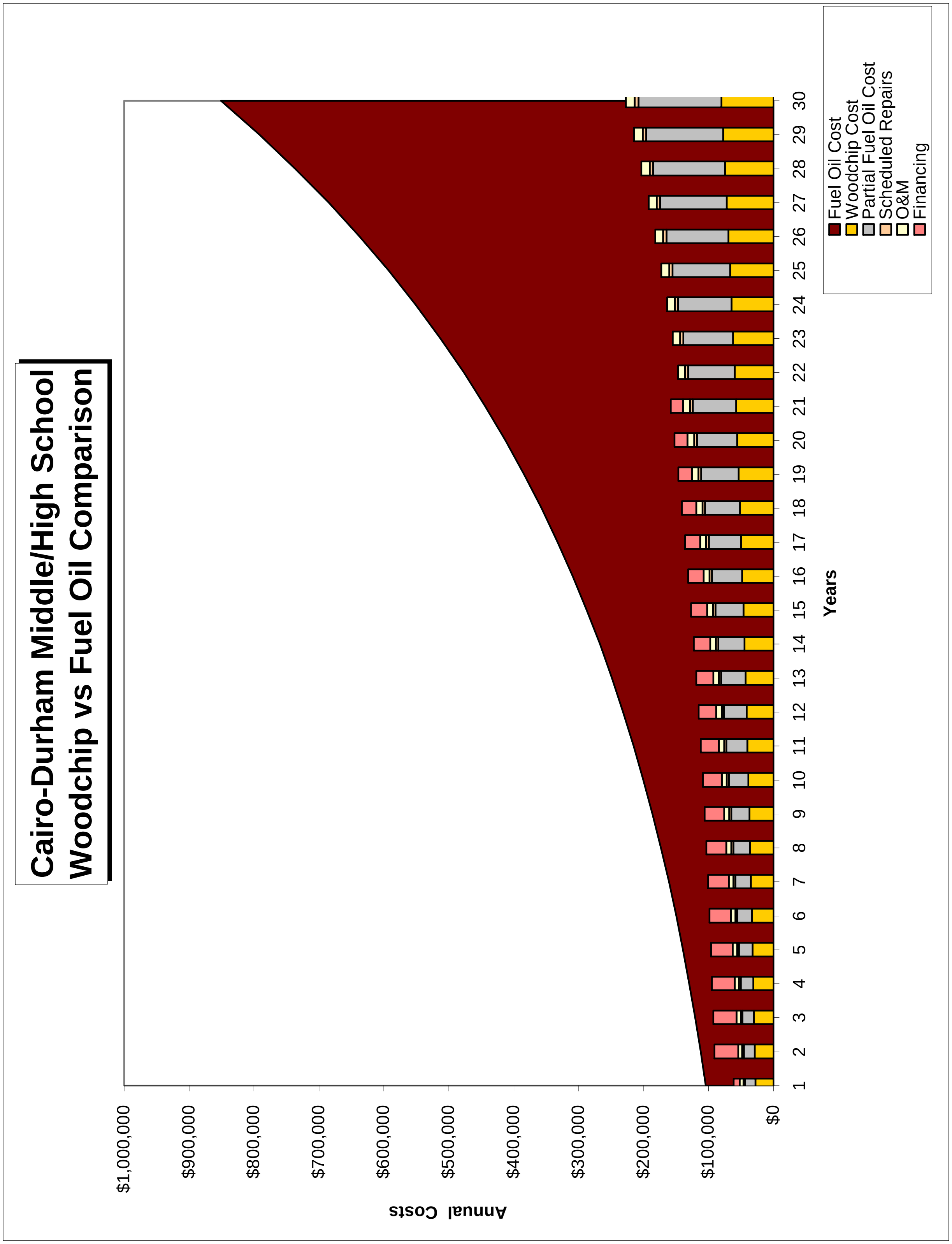


Table 6 Cairo-Durham Pellet Scenario Analysis Assumptions

<u>Capital Cost Assumptions</u>	
1.7 Million Btu pellet boiler, containerized boiler room, controls and 30 ton pellet storage silo	$200,000
Solar hot water pre-heat system	$50,000
Buried underground insulated pipe to existing boiler room 50 ft @ $250/LF	$12,500
Interconnection with existing heating system	$50,000
Construction contingency at 15%	$46,875
GC markup at 15%	$53,906
Design at 5%	$17,969
Total estimated project costs	$431,250
New York State School Construction Aid	77.4%
Net local share cost to district	$97,463
<u>Fuel Cost Assumptions</u>	
Current annual oil use (gal)	37,224
Oil price in 1st (per gal)	$2.81
Projected annual fuel oil bill at $2.81/gallon	$104,476
Oil (gal)/pellet (ton) ratio	135
Pellet price, 1st year (per ton)	$225
Projected 1st year pellet fuel bill	$37,260
Projected 1st year supplemental fuel oil bill	$41,791
<u>Inflation Assumptions</u>	
General inflation rate (twenty year average CPI)	2.9%
Oil inflation rate (twenty year average EIA)	7.5%
Estimated pellet inflation rate	5.0%
<u>O&M Assumptions</u>	
Annual Pellet O&M cost, including labor	$3,000
Major repairs (annualized)	$1,500
<u>Savings</u>	
Net 1st year fuel savings including increased O&M	**$20,926**
Total 30 year NPV cumulative savings	**$1,314,772**

Figure 10 Cairo-Durham Annual Cash Flow Graph for Pellet Scenario

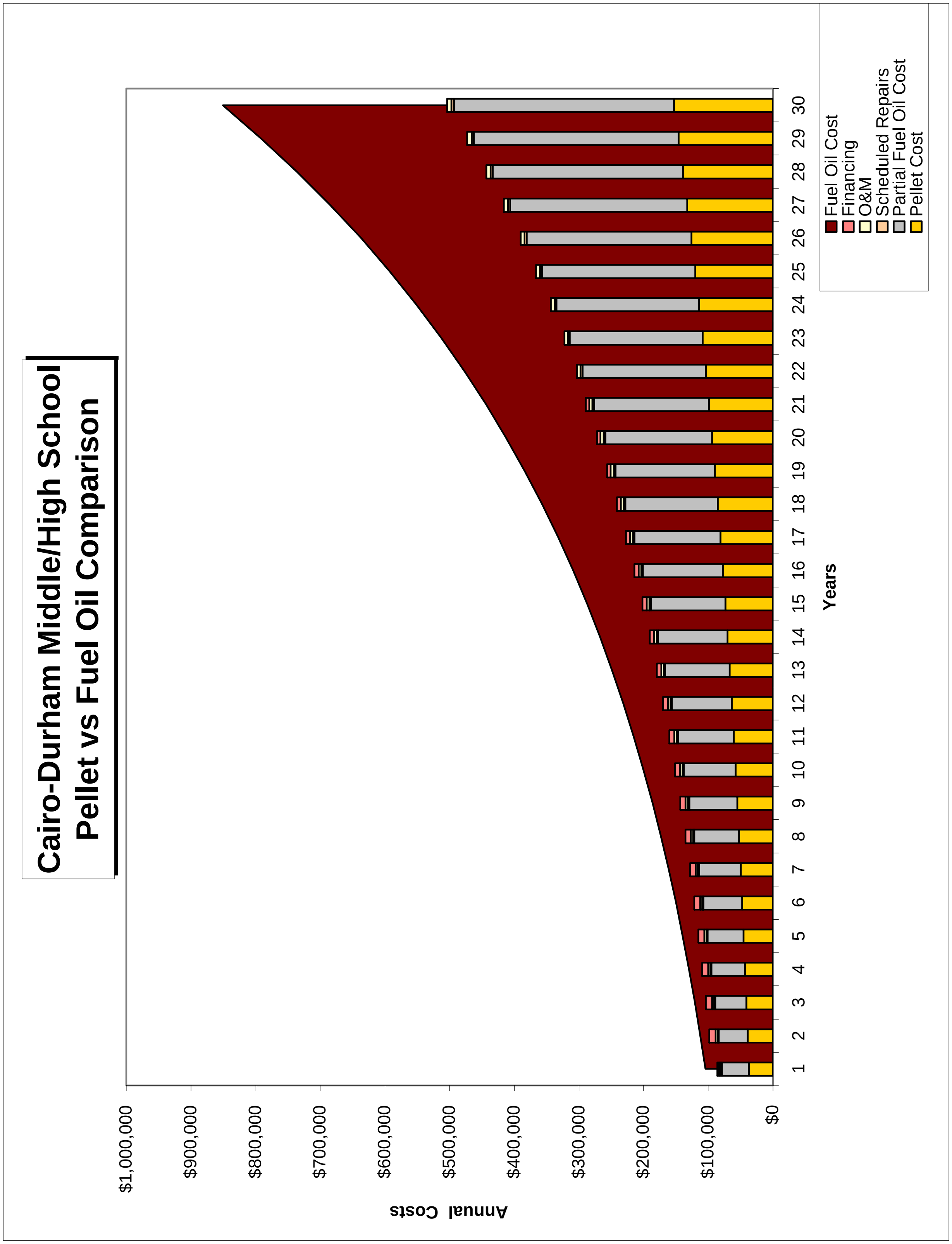
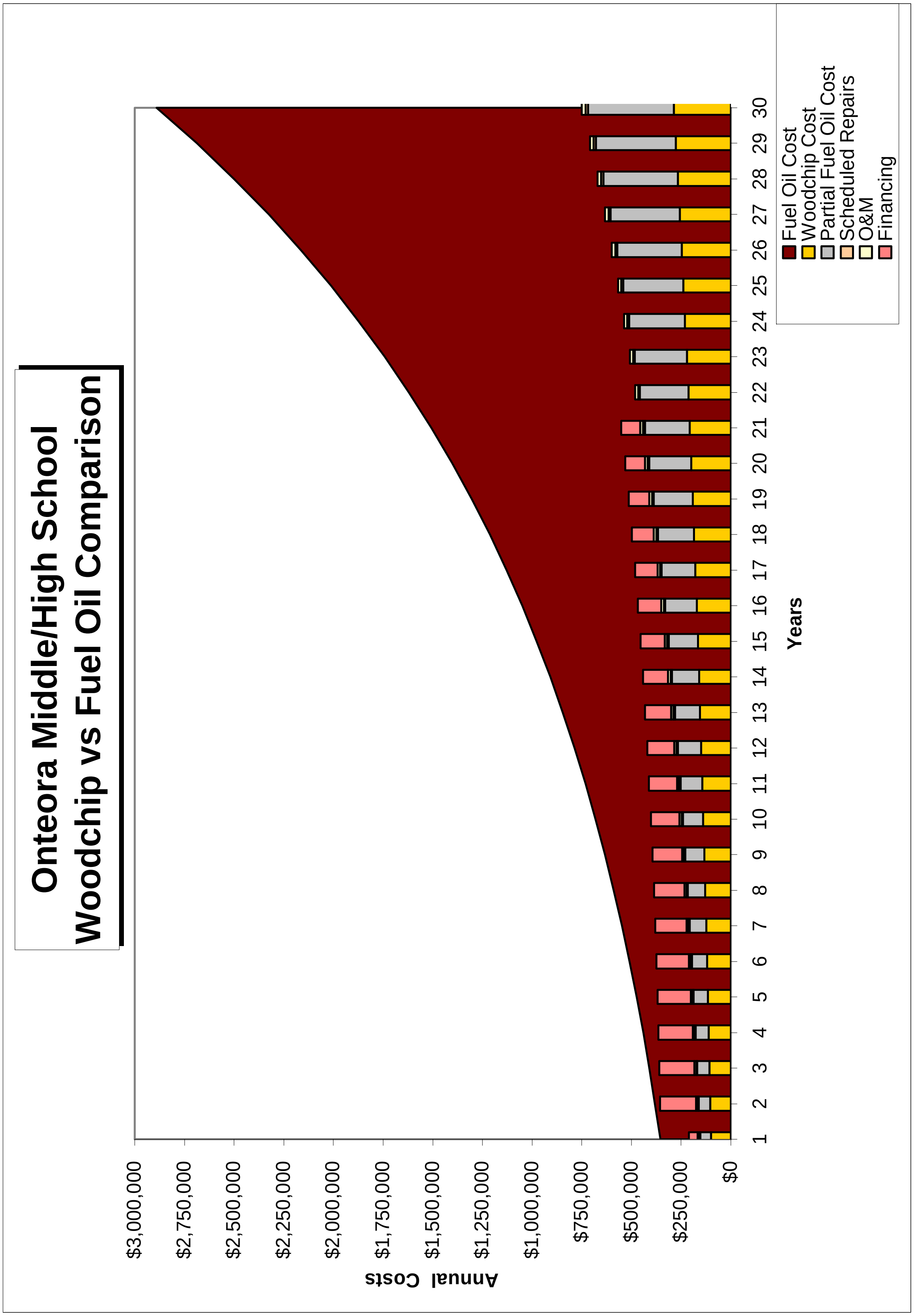


Table 7 Onteora Woodchip Scenario Analysis Assumptions

Capital Cost Assumptions	
9.0 MBTU wood hot water boiler system including installation	$750,000
2,500 square foot boiler house and chip storage building @$250/SF	$625,000
70 ft. Stack	$35,000
Interconnection with existing heating systems	$100,000
Buried underground insulated pipe to existing boiler room 750 ft @ $250/LF	$187,500
Baghouse pollution control device	$125,000
Construction contingency at 15%	$273,375
GC markup at 15%	$314,381
Design at 10%	$209,588
Total estimated project costs	$2,619,844
New York State School Construction Aid	31%
Net local share cost to district	$1,807,692
Fuel Cost Assumptions	
Current annual oil use (gal)	132,700
Assumed oil price in 1st (per gal)	$2.67
Projected annual fuel oil bill at $2.67/gallon	$354,815
Oil (gal)/chip (ton) ratio	62
Assumed wood price in 1st year (per ton)	$55
Projected 1st year wood fuel bill	$99,780
Projected 1st year supplemental fuel oil bill	$53,222
Inflation Assumptions	
General inflation rate (twenty year average CPI)	2.9%
Oil inflation rate (twenty year average EIA)	7.5%
Wood inflation rate (Average increase in VT from 1987 - 2007 is 3.7%)	3.7%
O&M Assumptions	
Annual Wood O&M cost, including labor	$8,500
Major repairs (annualized)	$5,000
Savings	
Net 1st year fuel savings including increased O&M	**$188,313**
Total 30 year NPV cumulative savings	**$7,923,342**

Figure 11 Onteora Annual Cash Flow Graph for Woodchip Scenario



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B&B Forest Products	251 Route 145	Cairo	NY	12413	Bill Fabian	(518) 622-8019
N.E. Timberland Investments LLC	PO Box 406	Russell	MA	01071	Michael Fahey	(860) 428-2057
J&J Tree Service	1795 Route 212	Saugerties	NY	12477	Jesse Reimer	(845) 679-7034
Leatherstocking Timber Products, Inc.	359 County Highway 11	Oneonta	NY	13820	Matt Kent	(607) 436-9082
John R. Deschaine Logging Inc.	4283 Route 9	Hudson	NY	12534	John Deschaine	(518) 828-9360
Rancourt Tree LLC	42 Palmer Circle	Paughquag	NY	12570	Claude Rancourt	(845) 206-1260
Tremson Corporation	21 Branch Road	Brewster	NY	10509		(845) 278-9383
Sawmills						
Andrews Forest Products	158 La Barre Street	Hancock	NY	13783	Matt Andrews	(607) 637-2236
Cannonsville Lumber, Inc.	199 Old Route 10	Deposit	NY	13754	Terry Leonard	(607) 467-3380
Cooksburg Lumber Co., Inc.	PO Box 559	Preston Hollow	NY	12469	Andrew Juliano	(518) 239-4324
J&J Log & Lumber	PO Box 1139					
McGraw Lumber Co.	589 Benton Hollow Rd	Woodbourne	NY	12788	Patrick McGraw	(845) 434-3020
Meltz Lumber	483 Route 217	Hudson	NY	12534	Jeff Meltz	(518) 672-7021
Rothe Lumber	1451 Route 212	Saugerties	NY	12477	Mike Rothe	(845) 246-5202
Waruch Lumber, Inc.	125 Upper Cherry Town Rd	Kerhonkson	NY	12446	David Waruch	(845) 626-4049
Wood Pellet & Briquette Manufacturuers						
Enviro Energy, LLC	2265 State Route 7	Unadilla	NY	13849	Bob Miller	(607) 988-9013
Catskill Craftsmen (Hearthside Wood Pellets, Ltd.)	15 West End Ave	Stamford	NY	12167	Ken Smith	(607) 652-7321

Prepared by: Watershed Agricultural Council Forestry Program (607) 865-7790 ext 112
www.nycwatershed.org

Balance of State

Business Name	Address	Town	State	Zip	Contact Name	Telephone
Chipping Contractors						
RWS, Inc.		Queensbury	NY		Peter Ashline	(518) 745-4222
Waters Creek Pulpwood Yard (chip mill pending)		Hampton	NY		David Waters	(518) 222-6009
PA Pellet and Chipping		Ulysses	PA		Luke Watson	(814) 848-9944
Various whole tree and flail chip chipping contractors in Adirondacks/North Country region--Call for list						
Sawmills (see state sawmill directory--http://www.dec.ny.gov/lands/33306.html)						
Secondary Wood Processors (see state directory---http://www.dec.ny.gov/lands/33307.html)						
Woodchip Brokers						
Ecostrat		Toronto	Ont., Canada		Maria Naccarato	(416) 968-8884
Green Energy Resources					Joe Murray	(631) 375-7921
Chenango Renewable Energy	158 Growers Lane	Sherburne	NY	13460	Peter Babich	(315) 559-2242
Tree Source Solutions LLC	7107 Snell Road	Lowville	NY	13367	Jack Santamour, CF	(315) 323-4882
Mesa Reduction Engineering & Processing, Inc.	6030 East Lake Road	Auburn	NY	13021	Matt McArdle	(315) 704-0004
Wood to Fuel, LLC		Buffalo	NY		Teresa Reile	(716) 440-8900
Leatherstocking Timber Products, Inc.	359 County Highway 11	Oneonta	NY	13820	Matt Kent	(607) 436-9082
Wood Pellet & Briquette Manufacturers						
New England Wood Pellet,LLC - Schuyler	172 Diamond Drive	Schuyler	NY	13340	Gabe Vincelette	(315) 724-7166
Excelsior Alternative Fuels, Inc. (Briquettes)	19 Prospect Ave	Amenia	NY	12501	Kenneth Lango	(845) 373-4234
Woodstone Pellets	350 Lincoln St., Suite 2260	Hingham	MA	02043	Justin Moran	(781) 741-8090
Dry Creek Pellets		Arcade	NY			(585) 492-2990
InstantHeat Pellets		Addison	NY		Kevin Chilson	(607) 359-2270
Associated Harvest		Lafargeville	NY		Coleen Walldroff	(315) 658-2926
Curran Renewable Energy		Massena	NY		Pat Curran	(315) 769-5970

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www.dec.ny.gov/lands/4963.html