North Country Biomass Energy Value Chain Baseline Assessment

ANCA is an independent not-for-profit organization working to strengthen key sectors of the economy in the Adirondack North Country.

An advisory white paper prepared for:

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Notice

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Preface

Development of this advisory white paper began in June, 2013 following discussion initiated during the North Country Clean Energy Conference (Lake Placid, NY) between members of the Governor's Executive Chamber Energy Team and ANCA. The impetus was to communicate the robust status of the "North Country biomass value chain" as an ideal incubator for State-level biomass energy market expansion and stabilization initiatives. The initial investigation targeted collection of information spanning the entire regional biomass energy value chain. During that time, as interest in the project grew, significant input and feedback from stakeholders across the regional value chain, excited by an opportunity to communicate challenges and opportunities for the biomass energy market, became the paper's focus. During the development of this document the NYS Green Bank came into existence and Governor Cuomo announced the establishment of the Renewable Heat NY initiative. As a result of these recent developments, this advisory white paper has been reorganized to emphasize stakeholder input and recommendations most significant to market animation for thermal biomass as pursued by the Chamber Energy Team through the Renewable Heat NY initiative.

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Introduction

The economic significance of biomass energy in the North Country region of New York State is growing as the transition toward a more renewable, regionally-sourced energy portfolio gains momentum. Given existing forest resources and the potential to use agricultural land to sustainably grow biomass crops, the biomass energy potential in the North Country (Clinton, Essex, Franklin, Hamilton, Jefferson, Lewis, and St. Lawrence counties) is substantial. Technological advances across all points of the energy supply system increase the relevance of this energy source and demonstrate that biomass can be a lower-carbon, lower-cost alternative to fossil fuels with multiple regional benefits. Expansion of the biomass energy market that is conscious of impacts on the health of humans and environmental systems has the potential to significantly contribute to the economic revitalization of the North Country region through business development and job creation across the supply chain as well as a "closed-loop", regionally-cycled expenditure for fuels.

The North Country is particularly well-suited to support an expanding biomass energy market. A diversified biomass energy value chain is already established and there is a notable regional alignment around biomass energy goals. Specifically, the North Country Regional Economic Development Council (NCREDC) 2011 Plan commits the region to creating the greenest energy economy in the State.[1] The Cleaner Greener Communities Sustainability Plan, awarded the Planning Excellence Award for Innovation in Sustaining Places for its success in addressing such issues as energy use and efficiency, disaster recovery, green infrastructure, resource conservation, transportation choices and impacts, compact development, density, diversity, revitalization, employment opportunities, and population impacts, takes this commitment further by specifying "the greenest and most self-reliant energy economy in the State" as a development goal.[2] Additionally, the Adirondack North Country Association (ANCA) acts as a unifying agent across all seven counties, playing a critical leadership and organizational supporting role and allowing relevant scale to be achieved by aggregating smaller projects.

With strategic market stimulation and support, the North Country can become an important regional model, demonstrating how technological advances combined with locally and sustainably produced renewable energy resources can drive the rural economy and attract investment into the region, while maintaining or improving the health of human populations and environmental systems.

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[1] North Country Regional Economic Development Council (NREDC), (2011) Transformational: Leading the Economic Renaissance of New York's Small Cities and Rural Communities, NREDC Strategic Plan. http://regionalcouncils.ny.gov/themes/nyopenrc/rc-files/northcountry/NCREDC_SMALL.pdf

[2] Adirondack North Country Association (ANCA), 2012. Our Economy: North Country Regional Sustainability Plan, prepared for North Country Planning consortium, Essex County, May 2013.

This white paper has been developed as an advisory piece for the Governor's Executive Chamber Energy Team. Emphasis is placed on biomass thermal applications due to their prominence in regional stakeholder interest, advocacy, and research and development efforts, as well as the development and deployment of the Renewable Heat NY initiative. To a lesser degree biopower (biomass-based electricity generation), anaerobic digestion, and biorefineries are also encompassed, where significant input from stakeholders across the established biomass energy value chain indicated critical issues in these biomass sectors. The value chain addressed in this report does not encompass liquid biofuels, which have been extensively studied by other parties, and other biomass energy products that are currently not produced in the North Country (Appendix A). The goals of this white paper are to:

1. Identify where biomass energy value chain stimulation and support can significantly contribute to market and/or product development, expansion and stabilization;
2. Identify where research is needed to advance such things as establishment of 'best practices', achievement of higher efficiency, sustainable management of biomass resources, etc.;
3. Establish a biomass energy value chain baseline against which progress can be measured.

North Country Biomass Resources

> *"…public versus private, residents versus outsiders, resources versus recreation…Yet beneath…is a more fundamental theme, a cycle of change, recovery, and renewal that characterizes the region's history. Whether the subject is economy, culture, habitat, or wildlife, change and recovery are both constants of the Adirondack experience…"*
>
> – Bill Weber, Director of the North America Program of the Wildlife Conservation Society, in the Preface of the Adirondack Atlas[3]

One of the most seemingly obvious but heavily debated renewable energy development options for the North Country region is biomass. Biomass energy is by no means a "new" energy alternative; the use of this resource base has a long history in New York State and currently contributes to the energy portfolio of the North Country in many ways. Forest-based industry began in the North Country region around 1800, when settlement and commercial logging were just beginning around the edges of the Adirondack Mountains. With the arrival of railroads in 1880, paper mills and steam powered sawmills expanded the industry, prompting logging efforts to expand from the surrounding lowlands to the mountain slopes in the interior and the hardwood forests between 1920 and 1940. Since the mid-20th century, when the last of the virgin forests on private lands were cut, the forestry industry has been experiencing a slow, steady decline due to changes in ownership and oversight of timberlands, loss of paper mills, and environmental

[3] Jenkins, J., A. Keal, (2004). The Adirondack Atlas: A Geographic Portrait of The Adirondack Park, Syracuse University Press, New York, Paperback.

factors such as acid rain, and significant regional storms and fires.[4] Yet, despite all of these challenges, the forest-based industry in the North Country remains a critical component of the New York State economy, where, as part of the Northern Forest (spanning, NY, VT, NH and ME) it is estimated that every 1,000 acres of forest land supports 3.0 forest-based manufacturing, forestry and logging jobs and 0.8 forest-related tourism and recreation jobs.[5] Another estimate indicates that the forest-based manufacturing industry including forestry and logging provides Statewide employment for ~57,000 people and generates an annual payroll contribution of over $2.1 billion.[6] Additionally, foresters and other stakeholders in this industry have adopted new practices that result in sustainable yields and facilitate a balance between economic value and ecosystem value within forest systems.

In the seven-county North Country region, energy statistics indicate that almost 8% of occupied housing units identify wood as their primary heating fuel, and the New York Biomass Energy Alliance indicates that the percentage of homes who obtain a *portion* of their heat from wood could be much greater than statistics indicate.[7,8] On the residential scale, cord wood and indoor stove appliances still dominate, but increasing convenience, performance, and availability associated with wood furnaces and pellet stoves is beginning to influence consumer choices. Commercial, institutional, and small industrial facilities are also beginning to explore wood as an energy source for space and hot water heating, facilitated in part by State-level initiatives supported by the 2009 New York State Energy Plan and numerous initiatives funded through the New York State Energy Research and Development Authority (NYSERDA).[9,10]

In 2009, NYSERDA funded a study entitled the *Renewable Fuels Roadmap and Sustainable Biomass Feedstock Supply for New York State (Roadmap).*[11] Research for the *Roadmap* assessed the potential for biofuel

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[4] Jenkins, J., A. Keal, (2004). The Adirondack Atlas: A Geographic Portrait of The Adirondack Park, Syracuse University Press, New York, Paperback.

[5] North East State Foresters Association, The Economic Importance and Wood Flows from New York's Forests, 2007, NEFA, published in August, 2007 using 2005 or better data as cited in Forest, Forestry, and the Forest Products Industry: Opportunities for Creative Investment, NYS Tug Hill Commission, October, 2012.

[6] New York State Department of Environmental Conservation, Forest Resource Assessment & Strategy 2010-1015, DEC, 2010 as cited in Forest, Forestry, and the Forest Products Industry: Opportunities for Creative Investment, NYS Tug Hill Commission, October, 2012.

[7] New York State Energy Research and Development Authority (NYSERDA), (2013). Patterns and Trends: New York State Energy Profiles 1996-2011.

[8] New York State Biomass Energy Alliance (NYBEA), (2013a). Biomass Energy in New York: Residential and Commercial Heat. Accessed at http://www.newyorkbiomass.org/default.aspx?PageID=3449 February, 2013.

[9] New York State Energy Planning Board (NYSEPB), (2009). 2009 State Energy Plan Volume 1, Office of Governor David A. Paterson, December.

[10] New York State Energy Research and Development Authority (NYSERDA), (2011b). The Power of Partnerships: NYSERDA Annual Report, 2010-2011.

[11] Wojnar, Z., (2010). Renewable Fuels Roadmap and Sustainable Biomass Feedstock Supply for New York: Final Report. Prepared for NYSERDA, the New York State Department of Conservation, and New York State Department of Agriculture and Markets by Pace University Energy and Climate Center and Cornell University, NYSERDA Report 10-05. April. http://www.nyserda.org/publications/renewablefuelsroadmap/default.asp.

production in New York State, specifically focusing on evaluation of available land and the associated biomass production capacity to support a lignocellulosic ethanol industry in the State. Results of the *Roadmap* indicate that an estimated 15.8 million acres of available timberland (excluding forest areas in parks and preserves) could sustainably produce up to 6.4 million dry tons per year (MDT/yr) of woody biomass. Of that, the data show that approximately 1.1-1.5 million, or an average of ~20%, would come from the seven county North Country region.

Yet, as important as biomass resources from timberland will be to an expanding biomass energy market, these resources are also the cause of much debate in the North Country region where the patchwork of public and private lands encompassed by the Adirondack Park is a significant consideration. Many of the acres excluded from the *Roadmap* analysis due to classification as park or preserve land are located within the seven North Country counties, implying that the actual forest-based resource pool is much larger, although inaccessible. The approximately 2.6 million acres protected as Forest Preserve within the 6 million acre Adirondack Park are "forever kept as wild forest lands" under the New York State Constitution, regulated by land-use legislation and administered by a special agency. State-owned lands constitute 43% of the Park area, and 51% is held under private ownership, with the remaining acreage covered by surface waters.[12] This is the largest park in the contiguous US and due to the need for State constitutional amendment to sell timber or land, it is also "the best protected" park. This patchwork of preservation is often contentious, yet does provide a balance between economic development and the ecologically-based "value" of the North Country forest, including habitat and biodiversity preservation, carbon sequestration, influence on regional hydrology, and watershed protection. The existence of the Park within the North Country region will be a significant factor as the biomass energy market becomes more central to the State's energy portfolio.

In addition to the considerable amount of forest-based biomass resources available in the North Country, there is also notable potential for biomass resource production from regional agricultural land. Spanning from the western Tug Hill Plateau on the shore of Lake Ontario, across the Black River Valley and the Adirondack range, to the Champlain Valley in the east and from the St. Lawrence Valley, along the northern US / Canadian border, to the Mohawk Valley just south of the Adirondack dome, the seven county North Country region encompasses a rich and diverse natural and cultural landscape. Surrounding the dome of the Adirondack Mountains is a low-lying belt of fertile river valleys that have long-harbored some of the best farmland in the northeast.[13] The history of field-based agriculture in the North Country region is even more extensive than that of the forest-based industry, with the first farms being established by the earliest European settlers. An agricultural industry developed as the population of the region grew,

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[12] Jenkins, J., A. Keal, (2004). The Adirondack Atlas: A Geographic Portrait of The Adirondack Park, Syracuse University Press, New York, Paperback.

[13] ibid

and until 1870 New York had the largest number of farms in the country and was among the top producers of many agricultural products.[14]
Although the numbers of farms have significantly declined since that peak (and are continuing to disappear at significant annual rates today), NYS remains one of the top producing States (one of the top three in the nation) for many agricultural products including dairy products, maple products, apples, grapes, and more.[15] The fertile perimeter of agricultural lands in the North Country that yields these important contributions to the regional and State economies represents a notable portion of six of the seven North Country regional counties (Figure 1), and also has significant potential to produce important resources for the biomass energy market.

NYSERDA's *Roadmap* identified 1-1.68 million acres of non-forested land (that is not currently being used to produce other crops) that could be used to produce biomass energy feedstocks, with potential yield estimates of up to 4.6 MDT/yr of grasses, 3.3 MDT/yr short rotation willow crops, and 0.3 MDT/yr of agricultural residue (as corn stover).[16] An analysis of agricultural statistics specific to the seven county North Country region estimates that ~100,000 acres of idle and marginal agricultural land exist, or about 6-10% of the total Statewide acreage identified by the *Roadmap*. Putting this land back into production will create value for landowners and infuse new sources of revenue into rural communities. This land could be used to produce woody (i.e. shrub willow) or grass biomass (i.e. switchgrass) at a rate that is 5 – 10 times greater than forest biomass production.[17] This is important for developing the renewable fuels and products industries because this means that biomass can be grown on agricultural land at high yields. As yields improve, economics improve for the farmer
Currently there are about 1,200 acres of willow biomass in production in northern NY as part of a USDA /NYSERDA-supported Biomass Crop Assistance Program (BCAP) project.[18] Efforts to support landowners with the establishment of additional willow biomass crops would yield benefits in terms of biomass supply and permanent job creation (for the next 20 or more years, which is the life of these systems). The life cycle analysis that has been done for short rotation woody crops like shrub willow that are grown on marginal land in NY has shown that these systems sequester carbon in addition to producing a renewable source of biomass. They also have a positive net energy ratio, meaning that for every unit of fossil fuel invested in the production, harvesting and transportation of this material to a facility, there are multiple units of energy in the form of wood chips when the material arrives at the plant

[14] Harvest: Access to Historical US Agricultural Collections, (2013). New York History of Agriculture at http://harvest.mannlib.cornell.edu/node/27 .
[15] New York Farm Bureau, New York's National Ranking, http://www.nyfb.org/about_nyfb/New_York_Agriculture_45_pg.htm
[16] Wojnar, (2010).
[17] Tim Volk, SUNY ESF, personal communication, (2013).
[18] Tim Volk, SUNY ESF, personal communication, (2013).

gate.[19] This positive energy balance is due to the solar energy that is collected, converted and stored as wood in this system and the relatively low fossil fuel inputs required to produce the material. This is similar to many other field-based cellulosic biomass energy crops where the biomass essentially acts like a large solar collector on the landscape that captures and stores solar energy while provide a wide array of other environmental and rural development benefits.

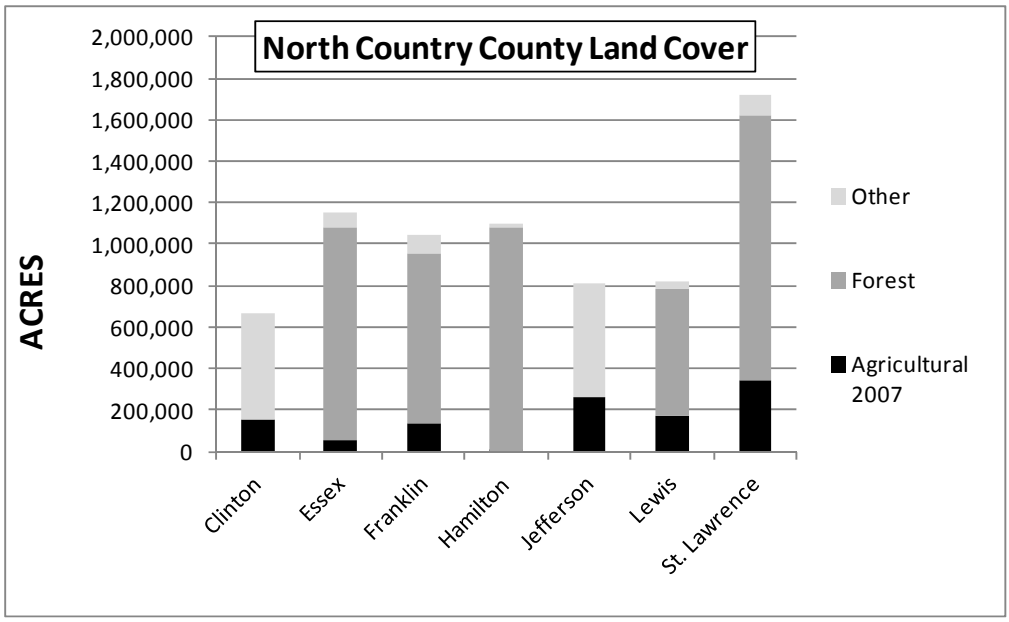

Figure 1: North Country County Land Cover.[20] Although forested land accounts for the largest land cover category in each North Country county, a significant portion of the forest resources in each county are protected within the Adirondack Park boundary. This increases the significance of the agricultural acres when assessing the potential to produce biomass for an expanded biomass energy market in the region. Note: Like the other counties, forested land in Clinton and Jefferson Counties does represent the largest land designation category, but acreage estimates were unavailable here.

The North Country Opportunity

[19] Caputo, J., S. Balogh, T.A. Volk, L. Johnson, M. Puettman, B.R. Lippke, E. Oneil. 2013. Incorporating uncertainty analysis into life-cycle analysis (LCA) of short-rotation willow biomass (*Salix* spp.) crops. Bioenergy Research . DOI 10.1007/s12155-013-9347-y

[20] United States Department of Agriculture National Agricultural Statistics Service (NASS), (2009). Census of Agriculture, 2007 Census Volume 1, Chapter 2: County Level Data, Table 8: Farms, Land in Farms, Value of Land and Buildings, and Land Use: 2007 and 2002. Available at www.agcensus.usda.gov/Publications/2007/Full_Report/Volume_1,_Chapter_2_County_Level/New_York/

"The local parts of the [ADK Futures] strategy increase spending within the Park on local food, energy, forest products and other regionally produced goods, so we send less of our wealth outside the Park. By increasing the use of biomass from private forests, we reinforce the self-reliance that has traditionally been part of this region's character, lowering our use of fossil fuels."

- Vision Statement, ADK Futures Project[21]

New York State's North Country is a prime region to pilot mechanisms to support, stabilize and expand a biomass energy market. It's regional history with biomass-based industries, the high regional alignment of sustainability goals that include biomass energy, the existence of strong, established supporting organizations, the considerable biomass resource base, and the heavy reliance on fossil fuels are all significant factors that contribute to this conclusion. A more detailed look at the existing North Country biomass energy value chain, supporting organizations, and relevant policies is presented in Appendix B.

History and Familiarity with Biomass-Based Industries

The North Country region has seen a decline in its historically strong forestry and agricultural markets, both of which would benefit from an expansion in the use of biomass resources for regional energy requirements. However, these historic markets have also fostered a close connection to the land for residents and communities of the seven North Country counties, creating a notable level of comfort with "working the land and the landscape" to harvest and utilize biomass resources within the regional economy. The long history of logging and expertise in the timber industry in both wood product production and pulp production for the paper industry, as well as the equally extensive experience and investment in the agricultural sector in the Adirondack North Country have established an indigenous level of familiarity with harvesting and utilizing biomass resources. This provides an important foundation for the proliferation of biomass energy applications and a transition toward more efficient, "cleaner" biomass energy technologies.

Additionally, the decline in the traditional forest products industry in the State means that there are large quantities of lower-value forest biomass no longer being utilized. This creates opportunities to make use of this material for renewable sources of energy in the form of heat, power and biofuels as well as new higher value bioproducts such as chemicals that are currently made from fossil fuels. Creating markets and demand for this lower value forest biomass would improve the overall management and health of the forests in NY while producing renewable products. Currently, most forest harvesting operations focus on removing only the highest value products (typically large, high value trees that can be used for saw timber), and leave behind the lower quality material. This material is not removed due to the lack of markets, which has been exacerbated with the decline in the pulp and paper industry over the past several

[21] ADK Futures Project Vision Statement, http://adkfutures.files.wordpress.com/2013/07/adk-futures-vision.pdf

decades.[22] This approach of "taking the best and leaving the rest" degrades the quality of NY's forests, their capacity to provide other ecosystem services, and reduces the future potential value that landowners can generate from the forest, making these areas vulnerable to fragmentation and conversion to other uses. Thus, developing renewable systems based on biomass that make use of some of the lower quality material from forests will create opportunities for improved management and increase the overall health and productivity of NY's forests. The US Forest Service published a review of forests in New York State in 2007, indicating that more strategic management of forestland in the State could simultaneously increase materials extraction and improve the health of the forest ecosystem. [23] Additionally, the New York Wood Products Development Council formed in 2010 has indicated that additional markets for forest products including feedstocks for the biomass energy value chain could stabilize the *entire* wood products industry that has declined and become uncertain over the past few decades due to the impacts of changing federal tax laws, foreign competition, changing attitudes and perceptions associated with timber harvest, and a shift in demographics.[24]

The other main source of biomass in NY is from marginal/idle agricultural land. Putting this land back into production will create value for landowners and infuse new sources of revenue into rural communities. As indicated in the North Country Sustainability Plan, growing investment in biomass-based energy benefits the farms and forests of the North Country and moves the region toward its goal of creating the "greenest and most self-reliant energy economy in New York State." The abundant and underutilized resources in the rural parts of New York State have the potential to increase self-sufficiency not only in those rural areas, but also in more urban parts of the State.

Alignment of Regional Sustainability Goals

There is a significant alignment of sustainable development goals that highlight the importance of biomass resources and the biomass energy market for regional economic recovery and growth. The following regional plans and initiatives emphasize biomass energy as a central part of a sustainable future economy for the North Country:

- **North Country Sustainability Plan (http://issuu.com/anca_1955/docs/final-report-6-14-13)**, developed under guidance/leadership of ANCA & Essex County through the NYS Cleaner Greener Communities program;

[22] United States Forestry Service (USFS) (2012). New York's Forests: 2007. Co-sponsored by the United States Department of Agriculture, Northern Research Station Research Bulletin NRS-65, March.

[23] ibid

[24] New York Wood Products Development Council (WPDC) (2011). New York Wood Product Development Council Annual Report, 2010-2011.

- **North Country Regional Economic Development Council Strategic Plan (http://regionalcouncils.ny.gov/content/north-country)**, developed by the North Country Regional Economic Development Council, one of 10 Regional Councils established by Gov. Andrew Cuomo to develop long-term strategic plans for economic growth for their regions.
- **Adirondack Climate and Energy Action Plan (http://www.adkcap.org/)**, facilitated by the Wild Center in Tupper Lake, for people living in and around the Adirondacks who want to cut energy costs and emissions, build a more resilient local economy by finding the best ways to decrease waste in energy, decrease our use of carbon fuels, and invest the money we save in the long-term;
- **ADK Futures (http://adkfutures.org/)**, a pro-bono project for the Adirondack Common Ground Alliance, developing a vision, strategy and implementation plan for the Adirondack Park.

Regional Energy Profile

The North Country is already a national leader in renewable power generation (with a majority of the 94% renewable portfolio generated at hydropower sites across the region supplemented by some significant wind farms and a few biomass-fueled facilities[25]); electricity is a very versatile energy carrier that can be utilized by all end-use sectors. As such, increasing the generation of renewable biomass-based electricity in the region could contribute to the displacement of imported fossil fuels in multiple ways, such as increased electrification of the transportation sector, utilization of electricity to power industrial equipment, or electricity for space and hot water heating.

The *Roadmap,* though focused primarily on cellulosic biofuels, indicates that another probable growth area for New York biomass demand is the production of heating fuels. Due to the region's heavy dependence on oil for this purpose, consumers are exposed to significant price volatility for an essential annual expenditure. The NYS Patterns & Trends Report released annually by NYSERDA indicates that the residential use of petroleum-based fuels and natural gas accounts for ~14.5% of total energy use in the State, a majority of which is for space and hot water heating (although some residential use of LPG and NG is for cooking and clothes drying). [26] A summary analysis of the heating fuel portfolio specifically for the seven North Country counties indicates that over 70% of regional households utilize some form of fossil fuel as their primary heating fuel. Therefore, the need to look at the thermal energy potential of biomass resources is important, especially for the North Country region (Figure 2).

It is important to note, however, that biomass energy is not without its drawbacks. Unlike other forms of renewable energy such as wind and solar, biomass requires harvesting resources grown on the land, which

[25] New York State Energy Research and Development Authority (NYSERDA), (2013). Patterns and Trends: New York State Energy Profiles 1997-2011, June.

[26] New York State Energy Research and Development Authority (NYSERDA), (2013). Patterns and Trends: New York State Energy Profiles 1997-2011, June.

can have adverse impacts on the environment if not done in a conscientious and sustainable manner. Although not uniquely attributable to the energy resources derived therefrom, improper biomass/timber harvest practices in general can lead to loss of habitat and biodiversity, degradation of soils, increased erosion, sedimentation of surface waters, reduction in primary productivity, and loss of carbon sequestration capacity. Additionally, biomass energy is a form of potential energy stored in the chemical bonds of the plant material and therefore some action is required to release that energy to make it available for use. Typically, combustion is utilized to achieve this purpose, which also has the potential to create harmful impacts on the environment, particularly in the form of atmospheric pollutants. Particulate matter, black carbon, acidification precursors (sulfur and nitrogen oxides), carbon monoxide, and greenhouse gasses including carbon dioxide, nitrous oxides and methane are just a few of the air pollutants that can result from biomass use. Therefore, the largest challenges to the expansion of the biomass heating industry are increasing appliance efficiency, reducing combustion emissions, and protecting public and consumer health. Additional information outlining some of the challenges posed by increasing utilization of biomass energy, including significant research findings, is presented in Appendix C.

However, it is also important to keep the impacts of any particular energy resource framed within the 'big picture'. Biomass energy has significant advantages over fossil-based energy sources. These should not be overlooked as work to overcome the challenges continues. This potentially renewable, sustainable, and carbon-neutral energy resource is locally abundant and could significantly contribute to achieving development goals that transcend the regional perspective. With the advent of high-efficiency biomass heating systems, the potential to transition many of our homes, businesses, and institutional buildings from heating with oil to efficiently and cleanly heating with wood is one of the top priorities of the North Country Plan due to the economic, environmental, and social, benefits that can be realized. For example, the NCREDC Plan recognizes that "it is the region's potential to generate renewable biomass that holds the most promise" and establishes a transition to locally-produced biomass as a source of stationary fuel used to heat buildings as a specific goal.[27] Increasing the use of biomass as a primary thermal energy source is one of many ways in which a stronger, more stable and dynamic biomass energy value chain will advance the North Country region, and the State, toward a more renewable, regionally-sourced energy portfolio.

Final Thoughts

In the North Country, there is much in the way of existing infrastructure, pre-established businesses, research institutions, supporting organizations and market dynamics that will enable the region to

[27] North Country Regional Economic Development Council (NREDC), (2011) Transformational: Leading the Economic Renaissance of New York's Small Cities and Rural Communities, NREDC Strategic Plan. http://regionalcouncils.ny.gov/themes/nyopenrc/rc-files/northcountry/NCREDC_SMALL.pdf

successfully expand its biomass energy market (Appendix B). Of all the renewable energy options, biomass energy offers the greatest long-term employment and positive rural economic impact potential. This will not only stimulate economic development in the region but will provide economic opportunity. The jobs that will be created by an expanded and stabilized biomass energy market will be diversified, providing excellent opportunities for residents from a broad cross section of the North Country region to find long-term employment. Additionally, with more biomass energy available for local/regional consumption, fossil fuels can be displaced in the consumer sector and a portion of the significant amount of money spent by North Country residents each year on fossil fuels will stay within the regional economy. Appendix D presents a "snapshot analysis" of some sectors of the biomass energy market, including some broad-stroke estimates of economic impact and job creation numbers based on stakeholder data and input

How Does the North Country Heat?

(Jefferson, Lewis, St. Lawrence, Franklin, Essex, Clinton, Hamilton Counties)

Sources: 2010 US Census, US EIA; NYSERDA

Fuel	# Households	%	Cost	Wealth Exported from NYS
Heating Oil	**67,574**	**41**	**$201 MILLION** @ $3.72/gal and 800 gal/home avg.	**$161 MILLION** @ 80%
Propane	**13,008**	**8**	**$48 MILLION** @ $3.08/gal and 1,200 gal/home avg.	**$38 MILLION** @ 80%
Natural Gas	**37,683**	**23**	**$54 MILLION** @ $11.77/MCF AND 122 MCF/home avg.	**??**
Wood & Wood Pellets	**18,877**	**11**	**$17 MILLION** @ $225/ton/cd and 4 tons/cds/home avg	**$0 (minimal)**
Electricity	**26,418**	**16**	**??**	**??**
Other/No Fuel	**1,986**	**1.4**	**??**	**??**

Figure 2: A summary of the wealth transfer from the seven county North Country due to the importation of fossil heating fuels. Although heating oil utilization is declining, there is significant economic opportunity associated with displacing imported energy sources with local/regionally sources energy for

space heating.[28] Note: @80% indicates these values represent 80% of expenditures are exported and 20% remain local; / ton/cd indicates per ton of pellets or full cord of wood.
Thus, the North Country is ready for the expansion of the biomass energy market. Such high alignment of regional goals, the existence of strong, established supporting organizations, recent advances in appliance energy and emission performance, and the history and familiarity with the resource base are all contributing factors. Additionally, the struggling economy needs opportunities for job creation and proliferation of products that can be consumed within the region. An expanded biomass energy market can provide these, as well as help to buffer residents from the price volatility associated with reliance on fossil fuels. It is important to note that things are not so different in the North Country from other forested areas, and that this region could also serve as a model for biomass energy market expansion elsewhere in the State or the greater Northeast region.

Identifying Areas for Strategic Support

Although there is an established biomass energy value chain in the North Country region as well as a strong foundation of supporting organizations hosting relevant initiatives and research and development efforts to continuously advance this energy market forward, gaps do exist where strategic support by New York State programs could facilitate efficient, effective, and environmentally friendly stabilization and expansion of the biomass energy market in the North Country. Expanding this market will lead to economic, social and environmental benefits for the region, where business development and job creation opportunities will play to the strengths of the region, and more of the money spent on heating the built environment will circulate within the regional economy instead of being exported out of State. Supportive State policy would be an important foundation for State and local sustainability goals. It also would create the opportunity for significant returns on public-sector investment while advancing economic development and environmental stewardship.

This section presents a summary of observations on opportunities for biomass energy market expansion and current challenges or hurdles to such expansion as perceived by a voluntary group of participating regional stakeholder ranging across the biomass energy value chain. This information was gathered by the author through communication with stakeholders via submitted documents and reports, emails, and conference calls. Details of this correspondence, as well as a list of stakeholders contacted and those who participated are provided in Appendix E. No individual Statement made in this section is representative of any particular stakeholder, including the author or the contracting organization. The total list represents a

[28] Niebling, C., 2012. "Widespread Adoption of Pellet Heating in the NY's North Country: Overcoming the Challenges", Presented at the North Country Clean Energy Conference, Lake Placid, NY June 22, 2012.

summary of prevailing themes and ideas distilled from conference call notes, written submissions, and communications.

The solicitations for input sent by the author, as well as lists of specific contributors are available in Appendix E. Stakeholders were asked to contribute by providing their perspective on:

> (1) The "State of the North Country" with respect to the existing biomass energy market;
> (2) Opportunities for market expansion and/or stabilization that will contribute to social, economic, and environmental goals;
> (3) Areas where additional research will be critical to ensuring that market expansion and/or stabilization align with social, economic, and environmental goals).

Stakeholders were also informed that the timeline was very short and the focus would be to compile and summarize existing research and analysis. The author specifically framed the solicitation for input as seeking:

> "stakeholder perspectives on where financing support through the Green Bank [and/or other NYS initiatives] could result in regional economic benefit including job creation (direct and/or indirect) while meeting environmental goals/targets established by NYSERDA (for example, with respect to increasing efficiency and reduction in targeted atmospheric pollutants such as GHGs, PM, CO)…[and] identifying the 'who's who and what's what' of the existing biomass energy value chain."

The opportunities presented in this section are offered in an advisory capacity, as New York State expands its support of renewable energy projects and infrastructure through the establishment of the Green Bank and the Renewable Heat NY initiative, as well as the continuation of other established offices, programs and initiatives.

Potential for Expansion/Stabilization of the Biomass Energy Value Chain to Enhance Regional Economic Development and Job Creation

"People need work…organizations/institutions need thermal energy for space and water heating…lots of forests need thinning and potentially lots of land owners are interested in the benefits of thinning."

- J. Culpepper, Director of Facilities & Sustainability, North Country School/Camp Treetops

Near-term biomass energy market expansion opportunities

Growing existing market sectors provides obvious and near-term opportunities to expand and stabilize the biomass energy market in the North Country region:

- More residential and smaller-scale commercial/industrial space and water heating from biomass, especially in areas where natural gas service is not available, and for critical infrastructure such as firehouses, schools, municipal infrastructure, areas of refuge, etc.

- Further combined heat and power production from biomass at public schools, universities, municipal buildings and other commercial/small-scale industrial facilities, especially in areas where natural gas service is not available.

- Increased demand for woody biomass for power production at existing and newly renovated facilities.

- Increased demand for woody biomass for pellet fuel production at existing and potential new facilities.

Mid-term biomass energy market expansion opportunities

Diversifying the biomass energy market using proven technologies that have not yet been established in the North Country region will provide mid-term opportunities for market expansion and stabilization including:

- Farm or municipal-based anaerobic digestion to produce biogas for space and/or water heating or combined heat and power production.

- Torrefaction facilities that can produce feedstock for biomass-based fuels and/or materials.

- Gasification facilities that can produce feedstock for biomass-based fuels and/or materials.

- Regional biorefineries allowing both material/chemical and energy value to be extracted from regional biomass resources.

Longer-term biomass energy market expansion opportunities

Opportunities for biomass energy market expansion that would be a good fit for the North Country but will require more extensive efforts in infrastructure building, public planning, and community investments include:

- District systems for central heating/CHP generation in communities/neighborhoods that have the right configuration of homes and commercial properties.

Current Challenges/Barriers to Biomass Energy Market Expansion

Challenges for ALL biomass energy options:

- Upfront capital costs (in many cases higher than their fossil fuel-based system equivalents) can be prohibitive.

- Lack of awareness in the marketplace of the economic, environmental and job-creation benefits of biomass systems.

- Perceived risk of "new" technology by consumers, investors, financing entities, regulators, politicians, etc.

- Lack of available technical expertise for biomass project planning, development and installation.

Challenges specific to the biomass thermal market:

- Lack of program support/funding for biomass thermal compared with other renewable options.

- There are limited high-profile demonstration projects across the value chain that illustrate project planning considerations and that encompass enough data tracking to adequately showcase how different approaches and technology configurations work.

- Biomass thermal and CHP projects are competitive on a life-cycle cost basis with fossil energy but potential users (i.e. homeowners, business owners, municipalities, etc.) are often unaware of biomass options or are reluctant to pursue them due to market perceptions based on lack of knowledge or misinformation about biomass systems or because higher upfront costs are a barrier to some users.

- Lack of infrastructure for bulk biomass fuel delivery.

- Lack of experienced biomass thermal appliance installation and service personnel.

- Lack of in-house expertise at commercial-scale buildings for biomass boiler service, maintenance and fuel procurement.

Challenges specific to the biopower market:

- The current NYS Renewable Portfolio Standard program does not contemplate renewed participation by biopower facilities with existing contracts.

Challenges specific to other developing markets (torrefaction, gasification, anaerobic digestion, biorefineries):

- Acceptance of legitimacy by financing entities. Even though these processes are proven and well-established in other areas of the world, many financing entities in the US/NYS will not discuss financing options due to lack of knowledge and experience with these biomass market options.

- Off-take contract requirements. If a financing entity will discuss financing options, a requirement for letters of intent and/or off-take contracts for the total output of the project is often set.

Actions/Mechanisms That Could Support Biomass Energy Market Expansion and Stabilization

> *"If we could harness the capacity-building and resources of the Green Bank initiative to help with creative finance of capital cost of high profile demo projects, help with finance of trucks and fuel storage, and help with general public outreach and awareness - we could make huge progress. I am confident in time this opportunity will sell itself, but we are just not there yet."*
>
> - C. Niebling, Biomass Thermal Energy Council; Innovative Natural Resources, LLC, Consultant to New England Wood Pellet

For ALL biomass energy projects:

- **A loan program at zero % interest with repayment equal to or even less than current annual fossil energy expense** (similar to on-bill financing options currently offered for some measures).

- **Credit support or debt guarantees.**
  Such assistance could provide assurance to a private sector lender that debt service would be paid regardless of facility performance (fuel/product supply, market pricing, etc.), wherein the funding

agency would undertake rigorous due diligence review of the project to ensure that the risk exposure is well-defined and meets certain thresholds established by the agency. This would demonstrate the legitimacy of specific projects to financing entities and alleviate off-take requirements.

- **Low-interest mezzanine debt** issued by a funding agency could fill the gap between available market-based senior debt and sponsor equity.

Specific to biomass thermal projects:

- **A predictable source of funding for biomass thermal projects.**
  This would not only help improve individual project economics, but would also serve as a technical endorsement to potential customers that biomass thermal is an "approved" and desirable renewable energy option. The typical project development cycle for a commercial-scale biomass project is 2-3 years so the availability of a predictable financial support mechanism for pre-approved technologies would be a great benefit to help project developers invest the time and resources to nurture projects through to implementation. Over the long term, a predictable finance model should help shorten the project development cycle as biomass thermal achieves broader market penetration.

- **NYS Investment Tax Credit for high efficiency biomass heating technology.**
  Legislation will be debated in the 2014 session to enact an investment tax credit for residential and commercial/industrial projects that meet stringent efficiency and emissions requirements. This will help the owner overcome the high capital cost.
- **Rebate programs** have potential as a market stimulation tool for biomass energy. However, these programs require long-term, stable funding sources and setting the optimal level of rebate to effectively stimulate fuel switching without creating long-term market expectations of and dependency on subsidization is critical.

- **Sales tax exemptions** on purchase of biomass fuel and purchase and installation of biomass heating equipment that meet efficiency and emission standards would create parity with State tax credits for other renewables.

- **Adding thermal energy to the RPS.**
  Several other States in the Northern Forest region have added or are considering legislation to add thermal energy to an existing RPS. Broadening eligibility to include biomass thermal sources is one policy option NYS could pursue under this scenario.

Specific to biopower projects:

- **Policy mechanism to allow/facilitate continued monetization of renewable attributes** in order to maintain operations in the current wholesale energy market. NYS could engage this mechanism by providing continued policy support for existing biomass facilities that have historically participated in the RPS program. This would preferably be in the form of an extension of the current RPS program for biomass where the RPS "maintenance support" category becomes modified or abolished. Modification would encompass an extension for "maintenance support" subsidies where the extension could be tied to the economic impact of a facility. Abolishing the "maintenance support" category by changing the Main Tier requirements to allow participation by resources historically classified as "maintenance support" is a preferred solution.

- **Attribute contracts** for REC purchases at a contract rate that varies depending on energy pricing and the average cost of fuel utilized to produce qualifying renewable energy. This approach allows the price paid for REC purchases to decrease as energy prices increase over current low levels and as costs for fuel decrease through diversification initiatives, bringing the State's AA credit rating to the market as credit support for the REC off-take without exposing the State to various other risks associated with the operation of the project.

- **Energy contracts** where the State would purchase energy output from a biopower facility to fulfill a portion of the energy demand of State facilities. Under a long-term contract with a defined pricing structure, the State would enjoy price certainty and predictability, and contracts would bring the State's AA credit rating to the market as credit support for the energy off-take from the project but would not expose the State to the various other risks associated with the operation of the project.

Research Needs

- **Understanding job generation.**
  Research focusing on the job generation characteristics of expanding the biomass energy market across the value chain would be helpful to stakeholders and policy makers. Considering the complexity of the biomass energy value chain as compared to other renewable energy options, there are many nuanced research questions that are not currently answered with a degree of certainty, especially when considering the characteristics of a specific region like the North Country. For example, how many jobs will be created in what specific sectors of the value chain (feedstock supply, processing, delivery, appliance servicing, etc.) and where within the region? What types of jobs will they be (skilled labor vs. advanced degrees vs…) and what sort of wages would be typical? What would be the impact of large-scale conversion of different market sectors across the region: e.g. what if all North Country public schools, NYS facilities, local municipalities, X-Y-Z % of homes, etc., converted to biomass heating?

- **More rigorous, region-specific life cycle analysis for forest-based biomass.**

Life cycle analysis of forest-based biomass feedstock extraction in other parts of the country has been performed and some work is currently underway in New York State. However, more rigorous analysis, specifically addressing North Country forest conditions and harvesting systems, is needed to clearly demonstrate potential impacts and value-added opportunities for an expanded forest-based biomass market in the region. A properly conducted LCA of North Country forest biomass production, harvest and use for energy production would directly address the very different messages that are communicated about the greenhouse gas balance of these systems.

- **Investigation of "best uses" for biomass resources i.e. electricity vs. biomass thermal.**
  An evaluation of the current economic and job benefits/impacts of low-cost electric power vs. the benefits/impacts if this electricity was targeted for higher-value uses (i.e. other than resistance heating) would help illustrate how biomass thermal can be part of a demand-side management approach to reducing electricity consumption in certain sectors.

- **Development of small, integrated biomass CHP units.**
  Units in the kW size range would be ideal for on-site power production and provide reliability and security, especially in rural areas. However, there are no examples of these in the region and in order to develop this efficient use of biomass, a few systems need to be installed and operated in the region to expand this sector. The technology is still in the very early stage of development and market viability, but progress (especially in Europe) is being made.

- **Development of "clean" biomass gasification.**
  Development of a biomass gasification process that results in product "clean" enough to go directly in a combustion turbine or fuel cell without a separate gas cleaning stage would be a big step in the biomass energy field. Although believed to be a "solvable" problem, more research and development in this area is needed.

- **Development of biofuels and biochemicals production and torrefaction processes specifically suited for the North Country regional resource base and economic framework.**
  Biomass contains a mixture of complex compounds that have a high economic value. Deploying pilot scale systems that would extract a portion of these compounds (about 20 – 30% of the biomass weight) from each ton of biomass would increase the value of each ton of biomass and make the remaining 70-80% of the biomass a more cost effective feedstock for renewable energy. Recovering these higher value products before using the biomass for power, heat and power or heating will make all of these systems more cost effective.

- **Investigation of EU models and success stories applicable to the North Country region.**

Communication and Education Needs

Many stakeholders ranging across the North Country biomass energy value chain who provided input for this report (identified in Appendix E) expressed a critical need to communicate the values of biomass energy to the general public, financing entities, regulators and policy makers across the State at local, regional and State levels. Biomass is often poorly understood and misinformation about various aspects of the value chain has been propagated, hindering the growth of confidence and investment in this market. State-supported education and information dissemination is needed so residents and policy makers can understand the economic, social and environmental benefits of a stronger biomass energy market in the North Country region, including the benefits associated with a significant increase in energy dollars staying in the regional economy rather than being exported, and the creation of diversified job opportunities. Input from NYSERDA also specifically identified education and outreach to potential customers, installers, energy service companies, and deployment programs as a need (Appendix C).

Workforce Training

Additionally, a comprehensive platform of critical workforce training should be developed by the State to ensure that local/regional residents in any region will be qualified to support a stronger, more dynamic biomass energy market. The jobs that will be created by this market expansion will be long-term, and the ability for North Country residents to fill the positions that will be created in the North Country region is critically important to achieving the goals established by the North Country Regional Economic Development Plan and the North Country Sustainability Plan.

Recommendations

> *"Becoming self-sustaining here won't happen by growing the economy's top line, it will happen by growing the share of the economy that is localized. Biomass will do that."*
>
> - J. Herman, ADK Futures Project

This section presents a summary of recommendations for New York State administrators regarding biomass energy market expansion as perceived by a voluntary group of participating regional stakeholder ranging across the biomass energy value chain. This information was gathered by the author in concert with the information presented in the previous section, through direct communication with stakeholders via submitted documents and reports, emails, and conference calls. No individual statement made in this section is representative of any particular stakeholder, including the author or the contracting organization. The total list represents a summary of prevailing themes and ideas distilled from conference call notes, written submissions, and direct communications. The recommendations presented in this section are offered in an advisory capacity, as New York State expands its support of renewable energy projects and

infrastructure through the establishment of the Green Bank and the Renewable Heat NY initiative, as well as the continuation of other established offices, programs and initiatives.

Expansion and stabilization of the biomass energy market should be a priority for NYS.

Supporting a diversified biomass energy portfolio that extends beyond the traditional focus on liquid biofuels to encompass biopower, biomass thermal, anaerobic digestion, and the cascading use of biomass resources for material and energy products will be critical to the transition of New York State to a cleaner, greener, domestically-produced energy base. This renewable energy market has great potential for business development and long-term job creation within the State. There is also a strong alignment of biomass energy goals, with at least 3 of the 10 Economic Regional Development Council plans established in 2011 identifying biomass energy as a critical aspect of regional development.

NYS support for biomass energy projects should be available for those that address:

- Research to answer critical market-based questions;
- Research and development of new and maturing technologies;
- Deployment of new and maturing technologies;
- Proliferation of existing, high-efficiency, low-emitting technologies;
- Distribution of biomass energy resources across the value chain;
- Support services, including installation and maintenance;
- Education and communication of the benefits of biomass energy.

Biomass energy projects that stabilize, strengthen, and diversify forestry and agricultural market opportunities should be prioritized by NYS through appropriate programs.

These markets have a long history in the North Country region and are of critical importance to a strong regional economy.

Biomass energy projects supported by NYS should demonstrate sound forestry/agricultural practices associated with the feedstock supply chain.

When sustainable forestry practices are encouraged, over time land owners often see a reduction in forest fire risk, higher value timber for lumber products, and healthier forest ecosystems.

NYS strategies to expand the biomass energy market should consider the interconnectedness of the resource base.

The seven county North Country region of New York State encompasses a significant biomass resource base that can and should be carefully managed to produce meaningful social, economic and environmental goals for the communities within the region as well as the State overall. The dominant market areas, forestry and agricultural, are highly related to one another. Any long-term strategies should consider the interconnectedness of the resource base when deciding how to best to leverage

any specific aspects thereof. Any strategy must also consider human health and the quality of air, water and soil as well as economic impact.

NYS should tie support to a continuous improvement process.

New York State should tie incentives to a continuous improvement process as opposed to establishing very difficult to achieve requirements that act as significant barriers to overcome in the near-term. Such requirements fundamentally hinder market expansion as well as maturation of critical aspects of developing value chains. Setting standards that require lower emissions and higher efficiency *over time* is optimal, while also assuring that the State does not reverse recent improvements in air quality or create new health risks associated with wood combustion. Supporting manufacturers who engage in technology-based research and continued performance improvements to meet incremental increases in standards has been a very successful model in the EU.

Opportunity to aggregate smaller projects across the region to achieve scale is critical.

NYS needs to conscientiously create a level playing field when establishing selection criteria for evaluating competing proposals from different types of renewable energy projects. For example, the existing NYSERDA RPS program selection criteria weighs the overall impact of a project on the State's economy (i.e. direct and indirect jobs, purchase of local goods and services, etc.) in comparison to the State's participation level over the term of the proposed contract or financing. This model has been proven, and could be applied to other areas of renewable energy development. However the opportunity to aggregate smaller projects for evaluation within such a framework is critical to rural regions like the North Country and should be central to NYS's support approach.

Strategic support on the demand-side will stimulate the entire value chain.

Stimulating/supporting the market to increase biomass equipment installation (in terms of equipment affordability and accessibility) will create economies of scale for bulk fuel delivery and a dedicated sales/service sector, creating job opportunities.

Sustained programs are more effective than one-time funding opportunities.

Sustained funding/financing programs developed by NYS will be the most effective to address market barriers because they encourage stable development of markets over time in a situation where public investment decreases as private investment increases.

Any subsidy-based programs should have sunsets that would be enacted once established levels of market saturation are realized.

Providing support for programmatic support services is critical.

Funding/financing for programmatic support services can catalyze the development of multiple projects simultaneously across the region and bring stability to areas where market uncertainties currently prevent further investment.

Biomass energy should be considered a critical aspect of the renewable thermal energy sector.

NYS should consider biomass energy a critical aspect of the future renewable thermal energy sector. Any incentives made available for solar thermal applications should also be made available for biomass thermal options. Biomass thermal creates comparable jobs to solar thermal during installation and for long-term maintenance of systems, yet biomass thermal also creates additional, long-term employment opportunities for fuel production and supply.

Incentives for biomass-based electricity generation should focus on applications other than space heating.

From sustainable development and energy efficiency perspectives, incentives for renewable, biomass-based electricity generation should focus on applications other than space heating. When electricity is used for resistance heating, the efficiency of the overall energy supply system is very low (25-30% efficient conversion of biomass-to-electricity-to-heat) and there are many higher-value uses for electricity, including information technology, transportation, etc. Additionally, high-efficiency, renewable, thermal technologies (i.e. biomass and solar) are readily available and more appropriate for space and hot water heating applications. Direct biomass-to-heat systems average ~80% efficient conversion with recent, improved technologies.

NYS should look to European models and success stories for guidance and inspiration.

Like Northern Europe, the North Country region is a patchwork of public and private lands. However, Europe is well ahead of the US in the biomass energy arena. NYS should look to European models and success stories in areas such as sustainable forestry practices, technological development and deployment, and market strategies and innovation to help guide the support structure and overall development of the biomass energy market in NYS. European countries such as Austria and Germany provide examples of a successful, multi-faceted approach that combines incentives, regulations, and programmatic support.

Short-term exportation of biomass energy products can expand/stabilize the regional market.

Although the overall desire is to produce local energy products for local consumption, opportunities to leverage the St. Lawrence Seaway to export biomass energy products such as pellets and/or torrefied wood should not be ignored. There is a growing market for biomass energy products in Europe and leveraging this existing demand could hasten regional production market expansion, stabilization and maturity. Once the supply side of the value chain is better established, the regional demand will naturally grow where eventually the regional market will substantially supplant the export market.

The scope of biomass initiatives should be widened to include advanced materials and chemicals.

To increase opportunities for job creation and economic growth, the emphasis of biomass energy initiatives should be widened/strengthened by focusing support toward "clean technology

manufacturing chains" that including the production of biomass-based materials, chemicals and energy products. Supporting the development of multiple products from each ton of biomass that is produced and harvested will make these systems economically more valuable and viable.

Implications

Expansion and stabilization of the biomass energy value chain in the North Country (and other regions of NYS) through implementation of State-level programs and initiatives like the Green Bank and Renewable Heat NY will significantly advance individual regions and the State as a whole toward its economic and energy-related goals. Outreach and education efforts as well as programs that incentivize phase-out and replacement of outdated, inefficient, low-quality combustion appliances while increasing access to the new generation of combustion technologies will be critical. There remain biases in the marketplace that were created by older combustion appliances, and these need to be addressed with successful demonstrations of new generation appliances.. Recent advances in the biomass energy market, from the residential to the commercial scale, based on decades of research and development in Europe and more recently in the US, have resulted in increased thermal efficiencies and reduced emissions. Leveraging a locally abundant, renewable resource will contribute to job creation, business development, and the displacement of imported, unsustainable fossil fuels. The North Country is an ideal region to pilot these State-level efforts: an historic connection to and familiarity with the biomass resource base coupled with the high priority placed on biomass energy embedded within regional sustainable development plans and established regionally-focused organizations like ANCA provide a strong foundation of support for biomass-based renewable energy initiatives and a regional identity that will welcome their implementation.

Appendix A: Defining the "Biomass Energy Value Chain"

An energy "supply chain" is the complex network of producers and consumers, buyers and sellers associated with the movement of raw energy resources through the production of energy forms that are of use/value to end users. The biomass energy supply chain is quite complex and encompasses multiple biomass sources (or feedstocks), conversion technologies and processes, energy products, resulting energy forms, and a very stratified and broad reaching range of utilization sectors and system/appliance scales (Table A1). Unlike many other renewable energy options, biomass fuels can be solids, liquids, or gasses and therefore can sometimes be more easily integrated into the existing supply infrastructure established for certain fossil energy sources than other renewables that only create electricity. Biomass is also unique in the renewable energy resource spectrum in that it can be used to displace/replace many highly valuable and essential materials currently derived from petroleum.

An energy "value chain" adds to the complexity of the supply chain model and includes any processes and activities undertaken within a sector that add value to a product or products, considering primary and secondary scopes. The value chain, for example, would consider jobs created due to energy expenditures becoming more local. The value chain places any particular energy supply chain within the regional economy.

Table A1: The complexity of the biomass energy supply chain.

Biomass Resources	Conversion Processes	Product States	Useful Results	Use Sectors
Forestry Residues/slash Fuel wood *Agricultural* Crops Grains Oil Grass Woody Residues *"Waste"* Manure Food processing Municipal Solid Waste (MSW)	Direct combustion Gasification Pyrolysis (torrefaction) Anaerobic digestion Fermentation Trans-esterification	*Solids* Cord wood Chips/chop Bales Briquettes Pellets Torrefied solids (biochar/charcoal) *Liquids* Alcohols (ethanol/methanol) Biodiesel Pyrolysis liquids (synthetic fuel oil) *Gasses* Biogas Synthesis gas Producer gas	Heat Electricity Mobility Materials	Residential Commercial Industrial Transportation Electricity

Appendix B: North Country Biomass Energy Value Chain Baseline

There is already a complex value/supply chain for biomass energy established in the North Country, with regionally-located businesses participating in all steps across the energy supply system from resource extraction to fuel utilization. Some areas of the biomass energy market in the North Country are well-established, successful and stable while others are immature, where greater uncertainty in longevity and long-term success hinders additional investment critical to future expansion. Although the preliminary inventory of the biomass value chain summarized below is incomplete at this time, and is provided to indicate where there is existing strength in the value chain, as well as where there might be weaknesses that could be remedied by strategic support. This preliminary list can act as a foundation for the development of a more comprehensive, continuously updated value chain inventory that would help guide support for the expansion and stabilization of the biomass energy market (Figure B1).

As indicated earlier, extensive work has been done to assess the potential for production of liquid biofuels in New York State in the *Roadmap* project. Therefore, liquid biofuels have not been included in this baseline assessment (although there are currently no facilities producing liquid biofuels in the North Country region). Also, even though the existing biomass energy value chain in the North Country does encompass a significant use of cord wood by individual households, this aspect is also excluded from this advisory report.

Preliminary/Partial Inventory of North Country Biomass Energy Value Chain

Feedstock suppliers: wood (rounds, chips) and raw agricultural crops (chips, bales)

- Seaway Timber Harvest (wood)
- Curran Renewable Energy (wood),
- Second Chance Ranch (grasses),
- Cornell Cooperative Extension (grasses),
- SUNY ESF (hybrid willow),
- Private foresters

Feedstock processors/Fuel producers: pellets, syngas, torrefied wood, biobased materials, etc.

- Adirondack Harvest (wood pellets),
- Curran Renewable Energy (wood pellets),
- New England Wood Pellet (wood pellets),
- Second Chance Ranch (grass pellets)

Fuel distributors:

- Curran Renewable Energy (bulk pellets)
- New England Wood Pellet (bulk pellets)

Energy Producers:

- *Bioenergy producers*
    - ReEnergy Holdings: Black River; Chateaugay; Lyons Falls/Lyonsdale

Appliance manufacturers:
- ACT Bioenergy (biomass boilers)
- Zero Point Clean Tech (modular multi-feedstock gasification technology)

Appliance distributors: (This category not yet addressed)

Appliance installers/servicers: (This category not yet addressed)

End Users
- *Biomass boiler systems*
    - Ausable Valley Central School (2 sites)
    - Clarkson University
    - Edwards Knox Central School
    - Malone Central School
    - North Country School
    - Saranac Lake Central School
    - SUNY Ranger School
    - Wild Center

Consultants:
- Cato Analytics
- Bioenergy Project Partners
- Handley and Associates
- Renewable Energy Resources
- Richmond Energy Associates
- Yellow Wood Associates

Supporting organizations:
- North Country
    - Adirondack North Country Association (ANCA)
    - St. Lawrence & Drum County Grass Energy Working Groups (SLCGEWG/DCGEWG)
- New York
    - New York Bioenergy Alliance (NYBEA)
    - New York Wood Products Association
    - NYSERDA
- Northeast regional
    - Biomass Energy Resource Center (BERC)
    - Northern Forest Center (NFC)
- National
    - Biomass Thermal Energy Council (BTEC)

Regional Initiatives:

- ADK Futures Project
- Adirondack Climate and Energy Action Plan
- Cleaner Green Communities: North Country Sustainability Plan
- North Country Clean Energy Conference
- Northeast Biomass Heating Expo

It is anticipated that this preliminary list will act as a foundation for the development of a more comprehensive, continuously-updated value chain inventory that would help guide support for the expansion and stabilization of the biomass energy market in the North Country. Regional supporting organizations, including ANCA and the Northern Forest Center, have identified the establishment and maintenance of such an inventory as desirable and beneficial to regional initiatives.

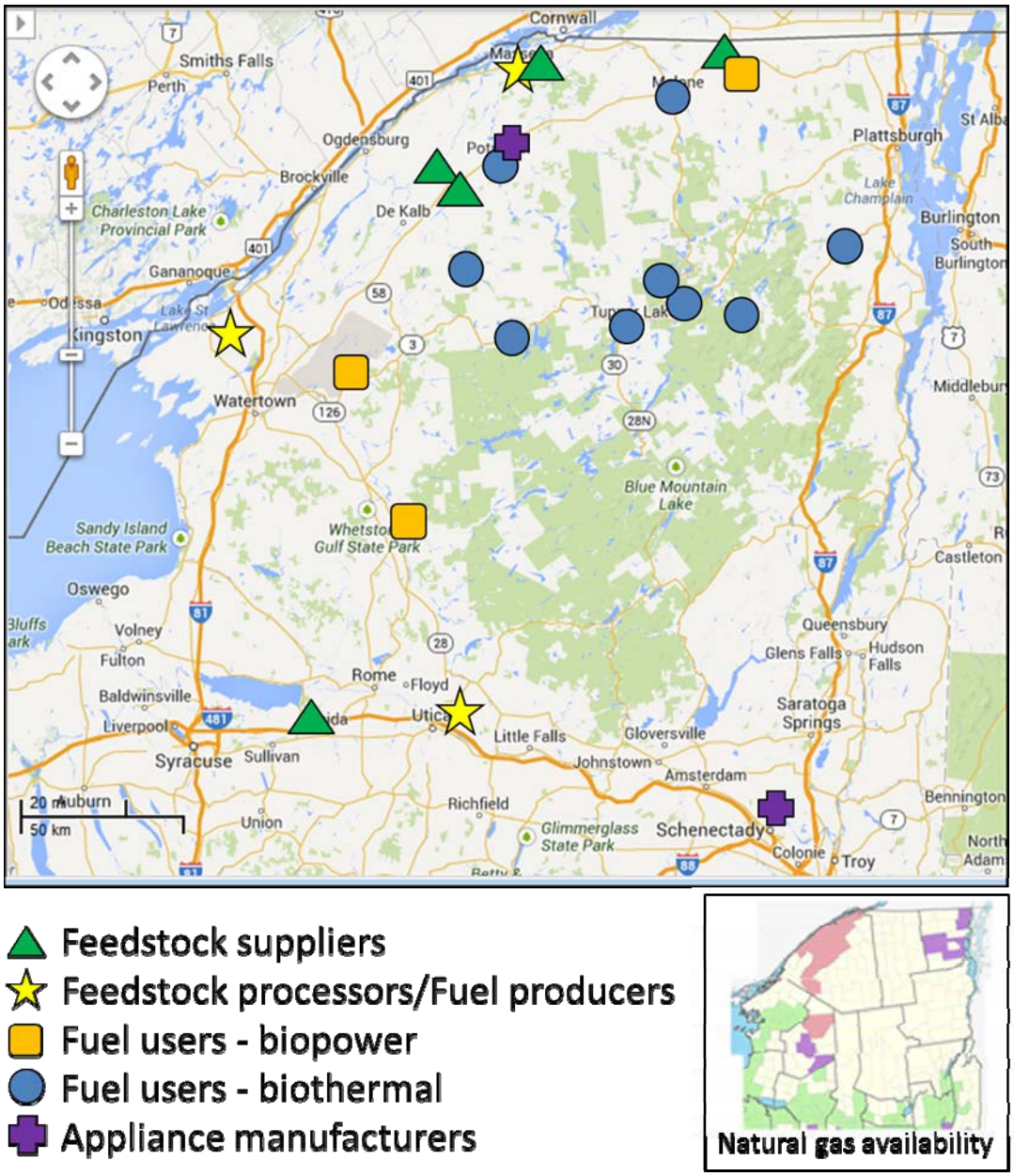

Figure B1: Map of Preliminary North Country Biomass Energy Value Chain Inventory

Organizational Support in the North Country Region

An extraordinary amount of good, critical work focused on understanding the strengths and addressing the weaknesses of the current biomass energy value chain in the North Country region is already being carried out by many regional stakeholders, encompassing expert teams from New York State's own Energy Research and Development Authority (NYSERDA) as well as other research-based universities and non-profit institutions across the State and the greater Northern Forest region of the Northeast. The efforts of these groups range in scope from regionally-focused to those that act on a national level and provide critical support in the form of research platforms and programs that contribute to research and development, public policy formation, and implementation of projects. These organizations will be important partners in the expansion and stabilization of the biomass energy market in the North Country. This section provides information on some of the most visible members of this group and a few of their relevant, ongoing efforts. Research and project/platform focus areas are emphasized rather than specific results or outcomes. The information provided here was sourced directly from the organizational website indicated, and represents the organization's own perspective on their mission, goals, and programs.

North Country Based Organizations

Adirondack North Country Association (ANCA) http://www.adirondack.org/

The Adirondack North Country Association (ANCA) is the longest running not-for-profit rural development organization in Northern New York. Formed in 1955 by a group of intrepid business and government leaders, ANCA has leveraged investment of tens of millions of dollars into the region. The partnerships with local government, non-profits, small businesses, and universities across the region are long standing, broad and deep.

ANCA is the only economic development organization that reaches across the entire 14 county North Country. ANCA's largely rural region encompasses 38% of the State's geographic area including 14 cities and 255 towns.

Energy Efficiency Program

ANCA helps homeowners take advantage of the major investments New York State has made in helping residents and small businesses save money on energy bills, specifically through cash incentives and affordable financing options for making energy efficiency upgrades. ANCA facilitates the application for a 10% cash-back incentive and low-interest financing for up to $25,000 in energy efficiency improvements for individual homeowners. The program begins with a home energy assessment.

Cleaner Greener Communities

ANCA (in cooperation with Ecology and Environment) shepherded the development of the North Country Sustainability Plan, produced as part of the Statewide "Cleaner Green Communities" initiative created by New York Gov. Andrew Cuomo and administered by NYSERDA. The North Country's plan,

titled "Our Economy," features the combined efforts of leadership from a seven-county consortium and hundreds of participants across the region. The plan outlines the region's vision, goals and objectives for a sustainable future, identifies a number of regional assets and makes recommendations for building on those assets to enhance the quality of rural communities, and promote sustainable management of its natural resources. This plan specifies "the greenest and most self-reliant energy economy in the State" as a development goal and is the winner of the Planning Excellence Award for Innovation in Sustaining Places for its success in addressing such issues as energy use and efficiency, disaster recovery, green infrastructure, resource conservation, transportation choices and impacts, compact development, density, diversity, revitalization, employment opportunities, and population impacts.

North Country Clean Energy Conference http://www.ncenergyconference.org

Now entering its third year, the North Country Clean Energy Conference is a forum designed for educators, practitioners, community leaders, industry professionals and others to share information about clean energy opportunities in the North Country. This year, ANCA has identified the conference as an event that is central to its overall mission and has adopted a more prominent role in conference planning. The conference objectives are:

- Share techniques, technology and lessons learned as related to clean energy projects in the North Country;
- Assist participants in identifying potential projects and lead organizations submitting projects in the next round of proposals in the NY State development process;
- Share technical staffing and regulatory issues as related to clean energy projects;
- Share funding sources and opportunities for clean energy projects;
- Connect participants with the businesses, educational institutions, and not-for-profit organizations on the cutting edge of the clean energy transition through the all new exhibitor showcase and business-focused round tables.

New York State Based Organizations

New York Biomass Energy Alliance (NYBEA) http://www.newyorkbiomass.org/

NYBEA is a coalition of individuals, businesses and organizations demonstrating that material derived from plants and animals can be used to meet local energy needs while creating local, long-term jobs, reducing greenhouse gas emissions and contributing to State, regional and national energy goals. The Alliance seeks to build public understanding of the full range of biomass-to-energy technologies, and the contribution that they can make towards meeting the State and region's energy needs, while creating in-State jobs and reducing carbon emissions. NYBEA does not promote one feedstock or technology over another, believing that almost every form of biomass can be used in an efficient and sustainable manner, utilizing the proper technology at an appropriate scale.

NYBEA serves as a sounding board for public officials who are considering various policy options, helping them understand how alternative regulatory strategies appear from the point of view of people who are building and managing businesses in the biomass energy sphere. Although biomass is one of the oldest energy sources, it is also one of the newest in terms of evolving production and conversion technologies. NYBEA strives to help policy makers distinguish measures that guide the growth of the biomass energy industry from measures that are likely to choke off development entirely, or allow biomass to play only a minimal role, even in situations where it is most economically advantageous.

NYBEA near-term objectives:

- Rebranding: There is a need to reposition the biomass energy market/industry front and center in the larger discussion of how NYS is going to meet its demand for energy, with a consistent message, highlighting job creation, affordability and sustainability.
- NY State Energy Plan 2013 (SEP): working to make sure biomass is not overlooked as an important in-State energy source within the draft SEP.
- NY Biomass Thermal Roadmap: NYBEA will work with the selected team to assure that work is undertaken in a manner likely to produce policy recommendations favorable to the near-term and long-term growth of the NY biomass energy industry.
- Renewable Portfolio Standard (RPS): There are a number of alterations to the current RPS that would make biomass energy more economically sustainable. NYBEA is working closely with members in the biomass power sector to address these issues within the RPS program.
- NY State Tax Parity, Legislative Monitoring & Biomass Definitions: NYBEA is seeking comparable tax treatment for solid biofuels in laws granting tax credit for biodiesel used in heating applications, comparable treatment of biomass as a source of renewable energy in laws that will incentivize the use of renewable energy and practical definitions of "biomass" by State agencies.
- State Procurement Policy: Unfortunately NYS procurement policy makes it very challenging for State institutions to finance biomass energy systems. NYBEA is working with the State to encourage rather than discourage the use of biomass heat in State buildings, including schools and correctional facilities.
- Engagement with Regional Development Councils: NYBEA membership is dispersed all over the State. This gives NYBEA the opportunity to engage with many of the regional development councils on biomass energy projects.
- Farmland Restoration Tax Credit: To encourage the establishment of energy crops on idle farmland, NYBEA is supporting a tax credit for capital costs of land improvement.
- Property Assessed Clean Energy (PACE): NYBEA is working to include efficient biomass heating and CHP in the PACE program in NYS, similar to PACE programs in Maine and New Hampshire.

Technical Assistance for Customer-Sited Rural Biomass Energy Projects in New York State

This program is a collaborative effort of the NYBEA, the New York Farm Viability Institute, and SUNY/Cobleskill with funding provided by a U.S.D.A. Rural Development Rural Business Enterprise Grant program. SUNY Cobleskill and the New York Farm Viability Institute are providing in-kind contributions to the project, including staff and faculty time, space, testing and engineering equipment and supplies, to supplement grant funding. The program supports private biomass projects in the State that have already moved past the "concept" phase, but have not been developed to the point that they can attract investment capital and finance. Selected projects receive engineering and economic feasibility technical assistance focusing on engineering and economic issues in project design. In most cases, both an engineering and a financial consultant will be assigned to provide technical assistance and expertise. As examples, assistance may be provided for evaluating the economics of energy production and consumption, insight into crop handling, logistics at a scale larger than a single farm enterprise, or understanding of fuel combustion and heat transfer technology.

New York State Energy Research and Development Authority (NYSERDA)
http://www.nyserda.ny.gov

Biomass Heating Program

NYSERDA hosts the largest biomass heating research program in the United States. Similar to the oil-heat research undertaken in past years, NYSERDA has been placed in a leading R&D position due to the size of the heating market in NYS and lack of federal funding to advance the development these technologies. This program was developed through a joint effort of NYSERDA's Environmental Research program and the Buildings R&D program to develop high efficiency, low emission biomass heating technologies in New York State. The program also supports air quality studies to characterize impacts from the production of electricity, mobile sources, and transport into NYS from regions upwind. All technology evaluations are compared to the energy and emissions performance of oil heat, the primary technology being displaced.

Program activities and objectives include:

- Evaluate energy-efficiency and emissions and compare to oil-fired systems;
- Develop advanced commercial and residential technologies;
- Demonstrate advanced technologies in representative applications;
- Evaluate feedstocks (energy, ash, moisture, trace elements);
- Evaluate the net effect of emissions on local air quality;
- Evaluate emission control technologies;
- Provide updated information for the NEI;
- Provide objective scientific information for the development of high-efficiency and low-emission biomass heating initiatives in NYS.

As this R&D has occurred, NYSERDA has funded more than $3 million in installations for end-users of commercial pellet boilers through ARRA and the Regional Economic Development Greenhouse Gas Reduction Program. Biomass heating is also an eligible technology in the Cleaner Greener Communities (CGC) program, a competitive deployment program for the economic development regions funded at $90 million over three years. The CGC program requirements for biomass heating systems include:

- Only high-efficiency pellet boilers at either the commercial or residential scale. Systems must have >85% thermal efficiency using the higher heating value of the wood pellet fuel.
- Boilers must have low emissions for CO and $PM_{2.5}$ with more stringent requirements at locations with susceptible populations such as schools, hospitals, and nursing homes.
- Only premium wood pellets with low ash and low moisture content may be used. Pellets are to be free of heavy metal contaminants from construction and demolition or other waste streams.
- Stack height and placement is to be selected carefully to avoid increased on-site concentration of air pollutants.
- Projects at schools and hospitals are required to perform an air quality impact analysis.
- Boilers are to be properly sized based on the actual building heating load using a model recognized by NYSERDA's residential or commercial deployment programs.
- Thermal storage is required to be incorporated into the heating system design to achieve high efficiency on an annual basis.
- Pellet storage must be outside of the building envelope to reduce hazards from CO off-gassing.
- An energy management system is required to optimize the heating system performance on both a diurnal and seasonal basis.
- Installations must be cost-effective, potentially incorporate a plug-and-play system to avoiding high boiler room construction costs. Systems should have paybacks of approximately 12 years or less.
- All commercial projects must be commissioned and have measurement and verification of system performance for the first year of operation.

Additionally, NYSERDA is currently providing financial support to four NYS manufacturers of biomass-fired boilers: Advanced Climate Technologies (Schenectady); Econoburn (Dunkirk); ThermoControl (Cobleskill); and Hydronic Specialty Supply/Lopper (Cassadaga). In addition, EvoWorld of Troy will be producing high efficiency wood pellet and wood chips boilers for domestic and export markets and is in regular communication with NYSERDA technical staff.

One NYSERDA Biomass Heating R & D Program project currently close to completion is the ***"Developing a Biomass Heating Roadmap for New York State"*** study being performed by principle investigator Northeast States for Coordinated Air Use Management (NESCAUM) in cooperation with Bioenergy 2020+, Brookhaven National Laboratory, and Innovative Natural Resource Solutions. This project will result in

the development of a "Roadmap" for biomass heating opportunities, similar to the *Roadmap* for biofuels developed by researchers at Pace University for NYSERDA in 2010.[29]

According to the project description, the Biomass Heating Roadmap will evaluate critical technical, environmental, public health, forest health, economic, and policy issues; assess potential biomass fuel feedstocks and their availability; assess biomass combustion technologies and the implications of employing them; and identify critical actions to create a pathway that can: (1) stimulate the necessary research, investments and policies to build appropriate capacity; (2) maintain feedstock supplies; and (3) ensure public health and environmental protection.[30] This will be critical in the development of a strategic plan to guide New York State as it considers expanding the use of biomass in clean and efficient heating applications. The project is scheduled to be completed in December, 2013.

Biomass Resources Program

NYSERDA's Biomass Resources Program funds research on transportation biofuels and other bioproducts, as well as biomass feedstock supply issues. This list summarizes the focal areas for this research platform:

- Agricultural biotechnology
- Environmental biotechnology
- Bioremediation
- Fermentation
- Enzymes
- Improving woody crops for the agricultural sector
- Scale-up of fast-growing willow plantations

Northeast Regional Organizations

Biomass Energy Resource Center (BERC) http://www.biomasscenter.org/

The Biomass Energy Resource Center (BERC) is a program of Vermont Energy Investment Corporation (VEIC), an international non-profit headquartered in Burlington Vermont. BERC assists communities, colleges and universities, State and local governments, businesses, utilities, schools, and others in making the most of their local biomass energy resources. BERC is a project-focused organization

[29] Wojnar, Z., (2010). Renewable Fuels Roadmap and Sustainable Biomass Feedstock Supply for New York: Final Report. Prepared for NYSERDA, the New York State Department of Conservation, and New York State Department of Agriculture and Markets by Pace University Energy and Climate Center and Cornell University, NYSERDA Report 10-05. April. http://www.nyserda.org/publications/renewablefuelsroadmap/default.asp.

[30] Northeast States for Coordinated Air Use Management (NESCAUM), http://www.nescaum.org/documents/developing-a-biomass-heating-roadmap-for-new-york-State /

whose mission is to achieve a healthier environment, strengthen local economies, and increase energy security across the United States through the development of sustainable biomass energy systems at the community level. BERC's particular focus is on the use of woody biomass and other pelletizable biomass fuels. With years of staff expertise in the field, and extensive relationships with other experts, manufacturers, suppliers, public agencies, and consultants, BERC is one of the nation's leading organization involved in the assessment, development, and management of community-scale biomass energy projects. BERC offers a wide range of technical assistance in the use of biomass for energy projects of various types, including heating and combined heat and power (CHP) for schools, hospitals, institutions, industries, and other public buildings, community district energy systems, campus energy systems, industrial cogeneration, and distributed electric generation.

BERC's work and services include:

- providing information and education on biomass energy to communities and the general public;
- designing and implementing programs for State and federal agencies;
- performing pre-feasibility and feasibility studies;
- assessing biomass fuel availability and developing the supply market;
- analyzing site considerations for biomass system potential;
- advising on project structuring and development;
- conducting third-party technical review;
- assessing and developing biomass public policy at the State, regional, and national levels.

Northeast Biomass Thermal Working Group http://www.nebioheat.org/

The Northeast Biomass Thermal Working Group (NEBTWG) is a coalition of biomass thermal advocates committed to working together to advance the use of biomass for heating and CHP (combined heat and power) in the northeastern United States. This group developed the "Heating the Northeast with Renewable Biomass: A bold Vision for 2025" report, which calls for an American Revolution to domestically produce the thermal energy consumed in the six New England States and New York. The primary objective of this "bold vision" is that 25% of all thermal energy requirements in the Northeast are met with renewable energy resources by the year 2025.

Northern Forest Center (NFC) http://www.northernforest.org/

The Northern Forest Center (NFC) advocates for the Northern Forest region and helps its communities benefit from forest-based economic and conservation initiatives, working to build a shared vision for the region based on three essential ingredients: thriving communities, healthy forests and innovative and resilient local economies that can support both. The Center works within three scopes:

- Resource programs, helping communities, businesses and landowners generate income from the sustainable use of the forest through promotion of renewable energy from biomass, wood products, ecosystem services, tourism, and community forests;
- Regional capacity and networking, building capacity across the region through financing & investment and collaborative networks & projects, and;
- Regional strategy and leadership, using place-based projects to integrate multiple strategies to demonstrate how they can benefit their host communities through coordinated public policy and regional strategies.

NFC Model Neighborhood Project

The goal of the NFC's Model Neighborhood Project is to help the Northern Forest region move away from dependence on imported oil toward a local energy source that will create jobs and strengthen the forest economy. The NFC feels high-efficiency, fully automated, centralized wood pellet boilers are a means to achieving this goal. The technology is well established in Europe but its market penetration in the U.S. is minimal. To increase its adoption in the U.S., wood pellet heating needs to be understood as convenient, safe, dependable and economical. The Model Neighborhood Project creates real world examples that illustrate the benefits of advanced wood pellet heating and generate demand for emerging businesses serving this market. The NFC States that the community benefits of the Model Neighborhood Project include:

- 40% annual savings on fuel costs for an average home and for participating affordable housing buildings (based on March 2013 oil prices).
- 14 ton per house reduction in greenhouse gas emissions for every home that replaces 1,000 gallons of heating oil with wood pellets.
- Financial incentive for forestland owners to keep forests intact through stronger markets for low-grade wood.
- Stabilized and increased employment in forest-related businesses, such as 4 existing Maine pellet producers that could support 500 additional direct and indirect jobs if operating at full capacity.

NFC New Markets Tax Credit Financing

The NFC facilitates the use of the federal New Markets Tax Credit (NMTC) Program as a subsidized financing tool for projects involving the forest based economy, including projects involving working forestland, renewable energy, tourism, and forest products manufacturing. The direct subsidy is typically 20% or more of the amount of the financing. This savings can be a critical factor in making projects viable and achieving mission-related benefits. The Center facilitates projects in Maine, New Hampshire, Vermont, New York and Massachusetts.

Northern Forest Biomass Energy Initiative

The Biomass Energy Resource Center, the Northern Forest Center, and the Carsey Institute at the University of New Hampshire convened this initiative in 2006. The purpose is to explore the potential for woody biomass from the Northern Forest to provide an increased source of renewable, sustainable energy for the region, and to determine what needs to happen in the region for that potential to be realized. A multi-stakeholder Steering Committee was formed and a Working Session Conference and two Steering Committee meetings were held to engage the expertise and insights of a diverse cross-section of experts from throughout the region in the areas of forest resources, wood products, conservation and recreation, economic development, biomass energy, financing, and environmental impacts.

National Organizations

Biomass Thermal Energy Council (BTEC) http://www.biomassthermal.org/

The Biomass Thermal Energy Council (BTEC) is a nonprofit association dedicated to advancing the use of biomass for heat and other thermal energy applications. BTEC is an association of biomass fuel producers, appliance manufacturers and distributors, supply chain companies and non-profit organizations that view biomass thermal energy as a renewable, responsible, clean and energy-efficient pathway to meeting America's energy needs and engages in research, education, and public advocacy for the fast growing biomass thermal energy industry. BTEC focuses its efforts in three main areas:

- Advocacy and Government Affairs**,** advocating for public policies that recognize the energy savings and efficiencies that can be provided through the use of biomass in direct heat and combined heat and power (CHP) applications. BTEC develops strategic guidance for industry and policy makers that articulates the benefits and promotes the use of biomass thermal energy. A member-led Government Affairs Committee guides the organization's efforts in this area.

- Education and Outreach, improving awareness and broadens understanding among government and industry leaders, media, the general public, and other stakeholders regarding the benefits of biomass thermal energy and of the technologies that will lead to its wider use. A member-led Education and Outreach Committee guides the organization's efforts in this area.

- Research and Analysis**,** engaging in developing peer-reviewed, authoritative research in areas where little is currently available for the biomass thermal industry. These studies will provide the needed data for policymakers, investors, and consumers to make informed decisions related to the use of biomass for thermal energy. A member-led Research and Analysis Committee guides the organization's efforts in this area.

Leveling the Playing Field

Biomass resources will not be directed to their most efficient uses without technology-neutral energy policy. And the current reality is that less-efficient electricity and transportation end-uses for biomass are heavily incentivized at both the State and federal levels, in addition to the continuing subsidization of fossil fuels and other renewable energy technologies like wind, solar, and geothermal. Incentives in one sector impact the price of raw biomass materials in all other sectors. A level playing field is needed, where biomass thermal can compete on its merits with biomass power and transportation fuels.

Legislative Accomplishments

Commercial/Industrial Biomass Heating Systems

- Introduction of S. 3352 – Expanding Industrial Energy and Water Efficiency Incentives Act of 2012 (Sens. Bingaman, Feinstein, Snowe) – Worked with Senate offices to craft a two-tiered Investment Tax Credit of 15 or 30% based on operating efficiencies for commercial and industrial biomass systems.

- Introduction of S. 1294 – Oil Independence for a Stronger America Act of 2011 (Sen. Merkley). Would establish a renewable biomass thermal energy loan program for non-federal, commercial and commercial and multi-family residential buildings.

- Introduction of S. 1000 – Energy Savings and Industrial Competitiveness Act of 2011 (Sen. Shaheen) - The bill would provide a suite of industrial energy efficiency tax incentives and revise federal energy purchase mandates to include thermal energy from biomass.

Residential Biomass Heating Systems

- Introduction of S. 1914 – Cut Energy Bills at Home Act (Sen. Snowe) – Bill to amend existing Internal Revenue Code Section 25 tax credit to provide a credit ($5,000 maximum) for performance based residential energy improvements, including improvements from biomass heating appliances.

- Introduction of H.R. 4230 – HOMES Act (Rep. McKinley) – The Bill would provide tax credits of up to $8,000 for whole home energy efficiency improvements, including eligible biomass thermal appliances.

Combined Heat and Power/Renewable Energy Credits

- Introduction of S. 2146 – Clean Energy Standard Act of 2012 (Sen. Bingaman) – The bill would create a national clean energy mandate and also authorize a study on mechanisms to incorporate energy pathways that do not generate electric energy, including biomass converted to thermal energy.

- Insertion of amendment to S. 1462 – American Clean Energy Leadership Act – Amendment would establish telescoping renewable energy credits for the useful electric and thermal output of biomass facilities. Credits awarded based on energy efficiency. If passed, this bill would for the first time establish renewable energy credits for thermal energy.

Education and Outreach

- Began research and industry outreach efforts with support from the New York State Energy Research and Development Authority (NYSERDA) on the potential off-gassing of Carbon Monoxide from the bulk storage of wood pellets

- Received a $70,000 grant from the U.S. Forest Service to conduct workshops to educate HVAC engineers and architects on commercial class biomass heating systems.

- Received a $60,000 grant from the U.S. Forest Service for education and outreach projects on biomass thermal energy, addressing biomass topics like air quality, commercial/industrial/residential applications, rural impacts, policy outlook, environmental commodities, and much more.

- Co-host of the Heating the Northeast with Renewable Biomass Conference, first conference in the northeast focused on biomass thermal energy (www.heatne.com).

North Country Regional College and University Research Platforms

Many regional colleges and universities have research platforms and/or individual faculty members who are actively engaged in research addressing various aspects/phases of the biomass energy value chain. A few of the most visible examples from the North Country region are:

Clarkson University, Potsdam, NY

> Atmospheric pollution from biomass combustion, biomass boiler efficiency, life cycle assessment of biofuels, anaerobic digestion.

Cornell University/Cornell Cooperative Extensions, offices in all North Country counties

> Cellulosic crops including woody biomass and grasses, biorefining.

SUNY Canton, Canton, NY

Performance of biomass combustion appliances, Atmospheric pollution from biomass combustion, biomass boiler efficiency.

SUNY Cobleskill, Cobleskill, NY

Biomass and biowaste energy.

SUNY College of Environmental Science and Forestry (ESF)

Woody biomass, willow biomass, biorefineries, impact of biomass resource removal on watersheds.

Paul Smiths College, Paul Smiths, NY

Forestry practices, impacts of forestry practices on forest ecology.

Relevant Supporting Policy/Initiatives

Biomass resources are becoming increasingly valuable as the climate impacts of using fossil fuels become more evident and the search for renewable energy alternatives becomes more critical. Biomass resources hold a particular place of import in this transition, as biomass and biomass-based fuels are flexible and functional in displacing/replacing fossil fuels as both critical energy *and* material resources. The ability of biomass to take the place of various fossil fuel resources in form and function makes this renewable resource category a critical component of a smooth transition strategy to replace our existing fossil fuel energy supply infrastructure. Biomass energy thereby warrants critical attention in the policy arena at all levels. Below is a summary of some of the relevant federal, regional and State level policies that specifically point to the significance of biomass energy in the transition away from fossil fuels.

Federal Policy

Most biomass-related renewable energy policies at the federal level focus on the transportation sector and the production of liquid fuels including ethanol, cellulosic ethanol, and biodiesel. A summary of relevant, federal-level legislation addressing biomass-based alternative fuels is provided:

- 1992: Energy Policy Act of 1992 established regulations requiring federal, State, and alternative fuel provider fleets to build an inventory of alternative fuel vehicles.
- 2002: Farm Security and Rural Investment Act of 2002 was the first farm bill to contain an energy title and include significant incentives for biomass production and use. The Act requires federal

agencies to buy officially designated, bio-based products whenever possible for purchases of $10,000 or more.

- 2005: Energy Policy Act in 2005 emphasized the use of alternative fuels and the development of supporting infrastructure and created the nation's first Renewable Fuels Standard, setting new reporting, registration, and compliance requirements for major refiners, fuel blenders, and fuel importers. This legislation also mandated that electricity generated from biomass under a closed loop biomass system (which uses dedicated energy crops) is eligible to receive a 1.9 cents/kWh credit.
- 2007: Energy Independence and Security Act introduced provisions to increase the supply of renewable fuel sources and raise CAFE standards to reach 35 miles per gallon by 2020.
- 2008: Emergency Economic Stabilization Act enacted the Energy Improvement and Extension Act of 2008, amending and extending existing biodiesel blending and production tax credits, extending existing alternative fuel excise tax credit, and extending the alternative fueling infrastructure tax credit.
- 2008: Food, Conservation, and Energy Act accelerated the commercialization of advanced biofuels and encouraged the production of biomass crops through grants and tax credits, providing for grants covering up to 30% of the cost of developing and building demonstration-scale biorefineries for producing "advanced biofuels," and allowing for loan guarantees of up to $250 million for building commercial-scale biorefineries to produce advanced biofuels.
- 2009: American Recovery and Reinvestment Act (ARRA) directed nearly $800 billion into various programs designed to stimulate the economy, of which the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy received $16.8 billion to invest in energy independence and renewable energy technologies. The $16.8 billion supported a variety of alternative fuel and advanced vehicle technology grant programs, research and development initiatives, and fleet improvement efforts. In NYS, American Recovery and Reinvestment Act -funded biomass heating projects included 6 commercial pellet boilers manufacturer by Advanced Climate Technologies (Schenectady, NY) and cost approximate $2.1 million.
- EPA is currently developing the New Source Performance Standard for all Residential Wood Heaters. This will include new purchases for all wood stoves, pellet stoves, outdoor wood boilers, indoor wood boilers and wood furnaces. EPA has recently been sued by several States, including NY because they have not updated this regulation in 25 years and it is supposed to be done every eight years.

The United States Department of Energy Office of Energy Efficiency and Renewable Energy does mention biomass-based electricity generation and biomass heating applications, although program emphasis and support of biomass energy lies predominantly within the transportation fuels sector (https://www1.eere.energy.gov/bioenergy/).

Biomass Thermal Utilization Act of 2013 (H.R. 2715)

This bill proposes to amend the Internal Revenue Code of 1986 to include biomass heating appliances for tax credits available for energy-efficient building property and energy property. It was introduced July 17, 2013 (113th Congress, 2013–2015, Sponsor: Rep. Michael Michaud [D-ME2]) and immediately referred to committee.

Regional Policy & Initiatives

Referred to as "The Bold Vision," the Northeast Biomass Thermal Working Group released a vision Statement in 2010 calling for policies to support domestic production of the thermal energy consumed in the six New England States and New York, proposing that 25% of all thermal energy requirements in the Northeast could be met with renewable energy resources by the year 2025. Many northeastern US States have recently established aggressive targets for renewable energy as a way to expedite the transition away from fossil fuels, although most of the targets are focused on the use of renewable energy for electricity generation rather than for thermal energy or transportation. A report recently prepared for the Northern Forest Center by the Biomass Energy Resource Center indicates the New York State is significantly lagging behind other Northeastern States in the development of policies to support the expansion of a biomass thermal market (Figure B2).[31] However, New York State has excelled in supporting biomass thermal research and development efforts that focus on product development, technology performance evaluations, demonstrations in replicable installations, test method development, air quality and health effects studies, and health and safety studies and training. The energy efficiency approach to biomass thermal R & D efforts by NYSERDA is similar to those applied to oil-heat R & D, and provide consumers with a realistic expectation of performance with an emphasis on consumer protection and public health. So, although NYS does not currently rank at the top in the policy support categories identified in the BERC study (Figure B2), it does 'lead the pack' in terms of R & D efforts that can support future policy implementation. In fact, the State of Massachusetts has benefitted from NY's research and initiatives and has recently adopted similar performance requirements for its renewable heating program.[32]

[31] Biomass Energy Resource Center (BERC), 2013. An Overview of Biomass Thermal Energy Policy Opportunities in the Northern Forest Region. Prepared for the Northern Forest Center, August 30.

[32] NYSERDA (Ellen Burkhard, Judy Jarnefeld, Mark Watson) personal communication (2013).

mmary of broad categories of policies that could be used to support biomass thermal

	NY	VT	NH	ME	MA
Flexible Boiler Regulations		√	√		
Sales Tax Exemption on Biomass Appliances		√	√	Partial	Partial
Sales Tax Exemption on Biomass Fuel		√	√	Residential only	Residential only
State Income Tax Exemption					
Pellet Boiler incentives		√	√		√
PACE Financing		√			
Thermal RPS			√		Almost
State Grants for Biomass Thermal Projects	√	√		√	√
Government "Lead by Example" for Biomass Thermal		√			√
System Benefits Charge		For weatherization only			

Figure B2: Comparison of New York State to other Northeastern States in policy support of biomass thermal.[33]

New York State Policy & Initiatives

In the last decade, New York State has established significant State-level support for the transition to a more renewable energy supply. The importance of biomass in the renewable energy portfolio is clearly indicated in these efforts.

New York State Renewable Portfolio Standard

In 2004, the Public Service Commission of New York adopted regulations that first enacted its Renewable Portfolio Standard (RPS). The goal of the RPS was to increase the amount of renewable electricity used by consumers (produced from a variety of sources, including biomass) to 25% by 2013. In 2010, following a mid-course review, the Commission expanded the target from 25% to 30% and extended the timeline from 2013 to 2015. The PSC is currently undertaking another comprehensive review of performance and reform of the NY RPS. The NY Biomass Energy Alliance has called for the inclusion of a thermal component in the Customer-Sited Tier that would recognize and incentivize high efficiency biomass thermal projects.

New York State Energy Plan

[33] BERC, 2013.

The New York State Energy Planning Board was established in 2009 and given the charge of developing a State energy plan. The resulting *2009 New York State Energy Plan,* based in part on preliminary analysis of biomass supply from the *Roadmap,* called for a least 30% of renewable electricity by 2015 (sometimes referred to as '30 x 15') and an 80% reduction in greenhouse gas emissions by 2050.[34] Resource-specific targets are not set for any renewable including biomass and very little attention is given to space and water heating. An update to the Plan prepared by the State Energy Planning Board was released for public comment in January, 2014.

New York State Climate Action Plan

Executive Order 24 (2009) required preparation of a plan to reduce the State's greenhouse gas emissions 80% by 2050 (known as '80 x 50'). The New York State Interim Climate Action Plan (CAP) was released in November 2010. Biomass energy is very much a part of the strategy the CAP offers to achieve the 80% reductions. Five working groups considered possible approaches to increase energy efficiency, reduce greenhouse gas emissions, and adapt to the changing climate within the State. While the *Roadmap* defined the biomass feedstock available in New York, it did not conclude any one use should be given priority over others. Rather, it created scenarios to illustrate potential impacts from a biofuel industry. It also discussed how the quality and type of biomass needed by various users differs, making overall biomass usage not simply competitive but sometimes complementary among sectors. Absent data to form a more specific prediction of future trends to allocate feedstock among industries, but wishing to create a scenario that encompassed all of bioenergy, researchers performing the CAP analysis allocated available biomass feedstock equally to three sectors: 1/3 to transportation; 1/3 to the residential, commercial and industrial heating sector; and 1/3 to the power supply and delivery sector. Recommendations relevant to biomass energy include::

- *Agriculture, Forestry, and Waste*: Called for the creation of a State-level Biomass Energy Program to support policies to increase the sustainable production of agricultural and forest biomass within the State by providing coordination of research efforts and public/private partnerships, track sustainability criteria, and monitor the flow of biomass.
- *Power Supply and Delivery*: Emphasized policies encouraging development of low-carbon renewable energy sources including biomass/biofuels, calling for studies to determine potential climate protection benefits from renewable energy sources, as well as to foster market introduction of these technologies.
- *Residential, Commercial/Institutional and Industrial*: Assumed that by 2030, 90 TBtus of sustainable biomass energy would displace fossil fuel-based heating fuel. This could include direct combustion of biomass or the use of liquid biofuels derived from biomass feedstocks.

[34] New York State Energy Planning Board (NYSEPB), (2009). 2009 State Energy Plan Volume 1, Office of Governor David A. Paterson, December.

- *Transportation and Land Use*: Emphasized shifting the vehicle fleet away from conventional internal combustion engines and petroleum-based fuels towards a mix of vehicles powered by electricity, hydrogen, and sustainably derived biofuels.
- *Adaptation*: Indicated that future changes in climate could alter New York's ability to produce certain biomass feedstocks and recommended strategies to adapt to changes in climate, such as raising different biomass crops or adopting alternative agricultural management practices, to be conducted in concert with other strategic planning efforts.

Renewable Heat NY

The Renewable Heat NY program is a long-term commitment to help the high-efficiency and low-emission biomass heating industry reach scale. The aims of this program, laid out in the State of the State address in January are to:

- raise consumer awareness and develop larger-scale anchor customers energy firms need to begin transitioning heating oil delivery fleet to bulk biomass;
- lay a foundation for upstream support (i.e. workforce training, manufacturer support for field testing, equipment certification, early stage product development, etc.);
- issue a policy roadmap for accelerating use of biomass for heating using the most efficient, low-emission technologies, identifying pilot projects ideally suited for biomass conversion;
- challenge communities to develop clustered approaches for sustainable biomass heating markets and support those efforts using a competitive grant program;
- leverage funds of the BuildSmart NY initiative through NYPA, financing up-front costs for advanced biomass heating systems in State and municipal buildings and coordinate with NYSERDA to ensure that biomass heating projects can take advantage of all available financing and technical assistance from the State;
- develop long-term, reasonably-priced private sector financing to cover the up-front cost of qualified biomass heating systems for buildings outside of the municipal sector;
- provide support so that sustainable forestry practices are available for small and large landowners and are utilized to maintain and enhance the long-term health and productivity of New York's forests.

Regional Economic Development Plans

In 2011, Governor Cuomo created ten Regional Councils to develop long-term strategic plans for economic growth for their regions. These councils are public-private partnerships made up of local experts and stakeholders from business, academia, local government, and non-governmental

organizations. Three out of ten regions identified the development of biomass energy as a critical component of their regional plans: the North Country, Central New York, and the Southern Tier. Several significant biomass proposals submitted under the Consolidated Funding Application, Cleaner/Greener Communities program administered by NYSERDA were funded in a grant round announced in December, 2013. These projects, in the North Country and Southern Tier, will go a long way to developing infrastructure for broader adoption of advanced biomass heating.

Appendix C: Overcoming the Challenges of Biomass Energy

For all of its advantages as a locally-sourced, potentially renewable and sustainable energy source, biomass is not without its drawbacks. Fortunately, decades of research and development in the European Union and more recently in the US are addressing these challenges and making significant progress in reducing the adverse impacts of increasing the utilization of this energy source.

Unlike other forms of renewable energy such as wind and solar, biomass requires harvesting resources grown on the land, which can have adverse impacts on the environment if not done in a conscientious and sustainable manner. Although not uniquely attributable to the energy resources derived therefrom, improper biomass/timber harvest practices in general can lead to loss of habitat and biodiversity, degradation of soils, increased erosion, sedimentation of surface waters, reduction in primary productivity, and loss of carbon sequestration capacity. Additionally, biomass energy is a form of potential energy stored in the chemical bonds of the plant material and therefore some action is required to release that energy to make it available for use. Typically, combustion is utilized to achieve this purpose, which also has the potential to create harmful impacts on the environment, particularly in the form of atmospheric pollutants. Particulate matter, black carbon, acidification precursors (sulfur and nitrogen oxides), carbon monoxide, and greenhouse gasses including carbon dioxide, nitrous oxides and methane are just a few of the air pollutants that can result from biomass use. Therefore, the largest challenges to the expansion of the biomass heating industry include responsible stewardship of the resource base/forest ecosystem and increasing appliance efficiency thereby reducing combustion emissions to protect environmental and public health.

In New York State, especially in the North Country region, stewardship of critical ecosystems has a long history and significant legislative support through the existence of the Adirondack Park. Although there are still challenges to be faced in this area, as an expanding biomass energy market increases demand for feedstocks harvested from these ecosystems, a majority of the R & D being undertaken to overcome the challenges described above is being focused on the feedstock utilization side of the equation: increasing efficiency of combustion appliances to reduce impacts associated with atmospheric emissions.

Residential-scale wood heating using outdated, inefficient combustion appliances (mostly non-compliant wood stoves, pre-1988 EPA certification standard models) is now a larger source of primary particulate in NYS than either the power sector or the mobile sector.[35] Wood is a fuel that has been used for a long time but many wood heating appliances are relatively basic combustion designs that have not had market pressure to undergo performance improvements due to historically low fuel costs. As a result, a very wide range of energy efficiency and emissions performance exists in both the residential and commercial

[35] National Emissions Inventory, accessible at http://www.epa.gov/ttnchie1/net/2008inventory.html

biomass heating market. Particles from wood smoke dominate rural fine particulate matter ($PM_{2.5}$) and reach high levels during temperature inversions – a time when air is trapped at low levels and more wood is burned due to the cold temperatures. In Rochester, NY, Clarkson University found 30% of the wintertime $PM_{2.5}$ was due to residential wood smoke.[36] This finding was surprising given that in Monroe County housing units are heated primarily by natural gas (82.5%), electricity (11.9%), heating oil (2.9%), propane (1.5%), and just 0.5% heat primarily with wood[37] (yet it should be noted that some question the accuracy of the wood heating statistics due to the frequent use of wood as a secondary source of heating fuel for many household, a factor not accurately accounted for by the survey mechanism). However, regardless of the actual percentages, efforts to expand the biomass heating market will have to address $PM_{2.5}$ concerns caused by the use of outdated residential-scale wood burning appliances in order for regions of NYS to remain in attainment of the National Ambient Air Quality Standard (NAAQS) for $PM_{2.5}$. Strategies for other rural regions in the US that have faced the same challenges and been designated as non-attainment areas due to wood smoke issues (including Libby, MT, Fairbanks, AK, and possibly Keene, NH), have included large-scale wood stove change-out programs.

Biomass heating technologies can also create localized increases in combustion-related pollutants that are public health concerns but do not necessarily constitute a regional air quality violation. Both indoor wood stove and outdoor wood boiler use can contribute to these other concerns, where problems can arise due to the outdated design of the combustion system, quality of the fuel used, and/or how the operator loads and burns the fuel. These concerns include the entrainment of combustion products into homes, particularly carbon monoxide (CO). CO concentration in the exhaust stack of oil- and gas-fired heating appliances must not exceed the 400 ppm limit set by the American National Standards Institute, however many outdated or improperly used biomass heating technologies operate with emissions in excess of this amount. Wood stoves, and wood boilers with unsophisticated designs can emit as much as 20,000 ppm CO, although advanced wood pellet boilers with an oxygen sensor typically operate between 50 and 250 ppm. However, as noted above, these issues can be mitigated by implementing/utilizing better combustion technologies that are becoming readily available.

Additionally, when sensitive sectors of the population are involved in locations such as schools, hospitals, and nursing homes, for example, some public health concerns remain even when the most advanced/efficient biomass combustion technologies are implemented. The NYS High Performance Schools Guidelines States:

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[36] Wang, Y.,Hopke, P.K., Xia, X., Rattigan, O.V., Chalupa, D.C., & Utell, M.J. (August 2012). "Source apportionment of airborne particulate matter using inorganic and organic species as tracers." Atmospheric Environment, 55, pp. 525-532. doi:10.1016/j.atmosenv.2012.03.073

[37] New York State Energy Research and Development Authority (NYSERDA), (2012). Patterns and Trends: New York State Energy Profiles 1996-2010, April.

> "*While the use of renewable resources is important in New York State, schools must also evaluate potential environmental effects from the use of renewable resources. Combustion of biomass for example could cause circumstances where the products of combustion are not properly dispersed (as a result of equipment technology or localized climatic conditions), thereby creating a potential health impact for students, staff and community members.*"

In addition, the New York State Education Department Manual of Planning and Standards (Part V, S501(b)) States:

> "*A school building must provide for the health, comfort, and safety of children, teachers, and other occupants. No mechanical equipment or construction materials shall be used, nor any type of construction permitted, which will endanger the health, safety, or comfort of all occupants in the school building.*"[38]

Lastly, concerns surrounding dust and off-gassing of CO in wood pellet storage areas has prompted research in Europe, Canada and NYS.

Making Progress

By increasing energy efficiency, large reductions in emissions are realized. Like fossil fuel-fired heating systems that have improved over the past few decades (with some condensing technologies showing efficiencies > 93% annual fuel use efficiency for oil and gas-fired heating appliances), wood fueled appliances are also improving in efficiency as market pressures grow. These developments put a spotlight on strategies that promote technology change-out programs as possible solutions.

Although there is no Energy Star rating methodology for wood heating appliances (mainly because Energy Star is based on greenhouse gas emissions and the EPA thus far considers biomass a carbon-neutral energy source), the development of performance standards for biomass-fueled appliances is desirable. Unfortunately, to date, EPA certification tests for emissions have not adequately assessed AFUE ratings used by States to promote energy efficient technologies. For example, the test results from the EPA Phase II (White Tag) Voluntary Program for Outdoor Wood Hydronic Heaters, when review by Brookhaven National Laboratory, were found to have numerous complications that resulted in unreliable values[39] and EPA has removed all efficiency values from their website and instructed manufacturers of outdoor wood boilers (OWBs) not to advertise their products using those values. As a result, new tests with greater quality control are now being developed, including work in NYS being funded by NYSERDA. Additionally, the Biomass Thermal Energy Council (BTEC) is working to develop a

[38] Neibling, C., personal communication: "NYSERDA funded projects must conform to $PM_{2.5}$ guideline of 0.03 lbs/mmbtu which is lower than #6 oil." January, 2014.

[39] Gibbs, R., T. Butcher, (2010). STAGED COMBUSTION BIOMASS BOILERS: LINKING HIGH-EFFICIENCY COMBUSTION TECHNOLOGY TO REGULATORY TEST METHODS, NYSERDA report 10-19, August.

consensus industry standard for biomass solid fuel efficiency testing, with timeline for anticipated completion in 2016.[40]

Considering that one of the main drivers to reduce the utilization of fossil fuels is the adverse impacts these fuels have on the environment, the biomass energy industry must be very careful to avoid or mitigate those same impacts. However, it is also important to keep the "bigger picture" perspective in mind. From some very narrow perspectives, the increase in efficiency of fossil fuel combustion technologies can make these fuels seem advantageous and even preferred over the use of other renewable energy options. However, addressing the transition of the energy sector by slicing up the whole into narrow issues addressed independently will not result in significant progress toward a more sustainable energy future. Fossil fuels will always be non-renewable and unsustainable for countless reasons, while biomass energy, although it does have its challenges, has the potential to get "better" and improve over time as knowledge and technologies advance. The challenges in this energy sector are surmountable with strategic market support, and research and development initiatives.

NYSERDA Biomass Energy Research Findings and Anticipated Needs[41]

NYSERDA Research Findings

OWB emissions

One model tested by the original Method 28 Outdoor Wood Hydronic Heater test method was rated to have an annual efficiency of 64%. This model was also tested by EPA in a NYSERDA co-funded evaluation of several technologies on a test simulating the heat demand for an average home on a cold day in upState NY. This scenario is considered optimistic because the cold day has a higher heat demand and boilers operate with better performance at high loads. The boiler sizing was within the manufacturer's recommendations but oversized in comparison to NYSERDA's Home Performance with Energy Star methodologies (Manual J of the Air Conditioner Contractors of America (ACCA) Handbook). The results showed that the same "White Tag" advanced outdoor wood boiler had thermal efficiency of just 30%. A pellet boiler without thermal storage with a large oversizing factor had just 44% thermal efficiency for the same conditions, a loss of 31% compared to how this boiler operates under high load, steady State conditions.

[40] Charlie Neibling, personal communication, January (2014).
[41] Ellen Burkhard, Judy Jarnefeld, and Mark Watson of NYSERDA, personal communication, October, 2013.

Brookhaven National Laboratory with funding from NYSERDA and letters of support of State and federal regulators, the Biomass Thermal Energy Council and manufacturers and importers of advanced cord wood boilers, recently developed a test method for advanced 2-stage boilers with partial thermal storage. This test method was developed using a Frohling boiler and 400 gallon thermal storage tank. This test method is rigorous in that it includes cold start, steady-State, and burn out phases and measures thermal efficiency and emissions. This test method was designed to be much closer to in-use conditions than previous test methods and provide consumers with a more representative estimate of the performance they will experience with the heating system. Development of this test method also removes a market barrier for these technologies in States that have regulated outdoor wood boilers. Despite exemptions for indoor wood boilers in some States, such as New York, consumers are looking for positive verification that the unit they purchase is allowed under current regulations. Testing at BNL showed that on a seasonal basis, this unit can achieve 69% AFUE, and by increasing storage to 800 gallons this system can achieve 80% AFUE, placing it close to the performance of Energy Star oil-fired boilers (85% AFUE).

Figure C1 below illustrates the wide range of PM emissions for whole house heating boilers by technology type. The thermal efficiencies of these systems are also given and range from only 22% on a cold day (optimistic test) to > 85%. The $PM_{2.5}$ emissions vary by a factor of 250,000 for these same technologies with those from an oil-fired boiler burning ultra-low sulfur home heating oil being the lowest and those from a conventional outdoor wood boiler being the highest. Also seen in the figure is the encouraging performance of smart down-draft cord wood burning technologies (0.22 lbs/day) and pellet-fired boilers (0.08 lb/day).

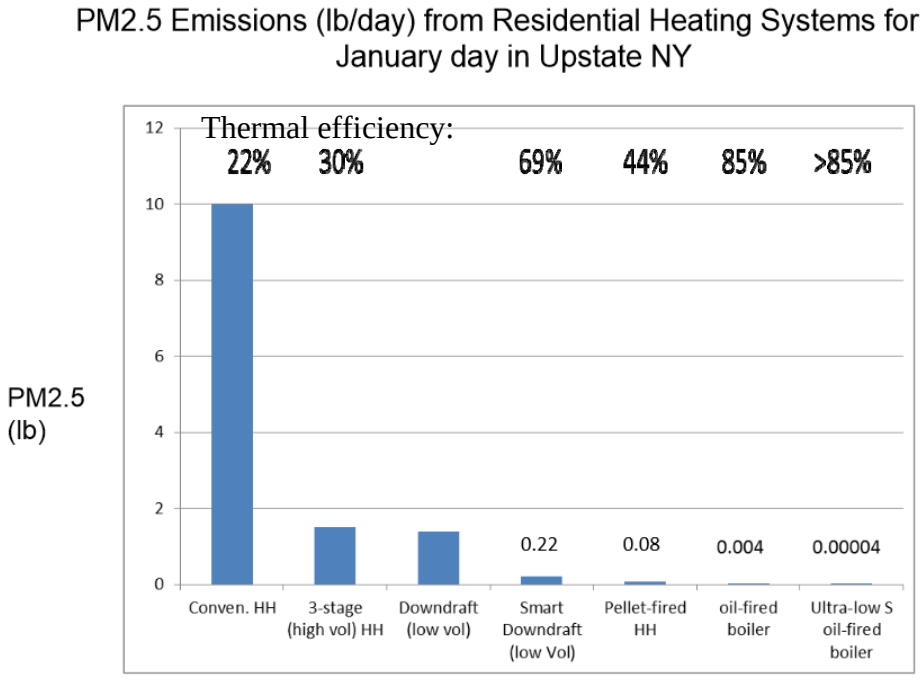

Figure C1: $PM_{2.5}$ Emissions (lb/day) and thermal efficiency Residential Heating Systems for January day in UpState NY.[42]

At the commercial scale, there is also a wide range of emissions performance ranging 5,000-fold. As more efficient biomass heating technologies such as Advanced Climate Technologies (Schenectady, NY) have entered the market, regulatory changes have continued to improve oil-fired technology performance. NYC is phasing out number 6 oil and all of NYS has now changed to ultra-low sulfur heating oil for home heating oil (number 2 oil).

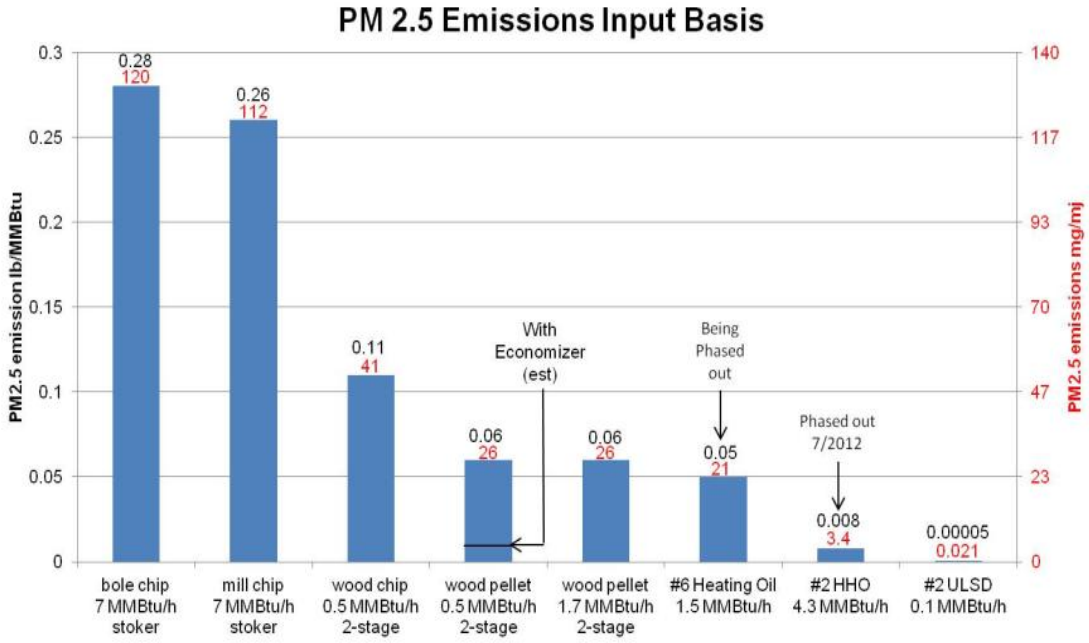

Figure C2: $PM_{2.5}$ emissions on an energy input basis from commercial heating technologies[43]

CO off-gassing

NYSERDA has provided funding to the scientific community and industry to address this emerging issue. The Biomass Thermal Energy Council has been providing outreach and education to industry members

[42] Butcher, T., Trojanowski, R., Brown, C., Wei, G., and Wong, J. (2013). Wood Boilers with Thermal Storage.Presented at The northeast Biomass Heating Expo., Saratoga Spring, NY.

[43] McDonald, R. (2009). "Evaluation of Gas, Oil and Wood Pellet Fueled Residential Heating System Emissions Characteristics." Brookhaven National Laboratories Energy Sciences and Technology Department/Energy Resources Division (BNL-91286-2009-IR).

and others through a series of webinars on the CO off-gassing topic, review of the Canadian and European literature, and engagement in the European Pellet Project. Clarkson University is monitoring for CO in commercial pellet storage facilities in NYS as well as one residential basement with large pellet storage in a mesh container. Clarkson University has also begun laboratory experiments to try to identify the chemical mechanism that is creating CO. Preliminary results demonstrate that the reaction is occurring with pellets made in NYS and values above 9 ppm (8-hour average) have been observed in a residential location. The University of New Hampshire, the NH Public Utilities Commission and NH Department of Environmental Services also have NYSERDA support to survey residential basements with bulk pellet storage for CO.

Pellet Boiler Efficiency

Clarkson University has evaluated both the 500,000 Btu/h and 1.7 MMBtu/h ACT pellet boilers. While the ACT boiler can achieve high efficiency (>85%) at high-load, steady State, the efficiency is lower at lower loads. On an annual basis the boiler at The Wild Center in Tupper Lake had only 65% thermal efficiency. Clarkson University has recommended recapturing this lost efficiency by adding thermal storage which will allow the boiler to operate under its optimum performance and avoid losses due to low load and cycling. Thermal storage will be installed at both Clarkson University and at The Wild Center to improve and document annual fuel use efficiency. Clarkson University has also evaluated the effectiveness of electrostatic precipitator technology on particle emission removal and found it to have a potential of >95 % reduction, but at a high cost. Clarkson University will also evaluate the performance of a condensing economizer on both improved energy efficiency and particle removal in the 2013-2014 heating season. Clarkson will also be evaluating the EvoWorld residential scale boilers being made in Troy, NY. These boilers have very high advertised efficiencies (>93%) and include thermal storage as part of the system. Two units will be installed in the Potsdam area in 2014.

Fuel evaluations have found that most of the pellet supply for sale in NYS (produced both in-State and out-of-State) had low ash and moisture content. However, some pellets had clear chemical signatures for pressure treated and painted wood. These heavy metals (As, Cr, Cu, Pb, Hg, and Zn) are not measured in the Pellet Fuels Institute voluntary standard and EPA and the States have not developed fuel composition standards for wood pellets.

Grass Pellets

Grass fuel has a much higher ash content than wood fuel making it a more challenging fuel to manage within the combustion appliance. Grasses also have much higher chlorine content which can corrode traditional combustion chambers unless corrosion-resistant materials are used in manufacturing. Research conducted by SUNY Canton and Clarkson University burned grass and wood pellets in six commercially available wood pellet boilers. They found exceptionally high CO emissions: as much as 5 times higher with grass pellets than when the same appliance burned wood pellets under the same load conditions and

10-fold higher than ANSI safety limits for oil and gas appliances. PM emissions were roughly two to four times higher than the same technologies burning wood pellets (Chandrasekaran, et al., 2013).[44]

Wood Smoke

With respect to local air quality, areas of NYS, especially rural valley communities experience occasional thermal inversions. The Northeast States for Coordinated Air Use Management performed a study of wood smoke in the Adirondacks and found wood smoke to be the primary source of $PM_{2.5}$ in the study. They also found wood smoke to vary spatially and with time of day, with the highest concentrations occurring around midnight within towns and the lowest occurring at noontime and at high elevations between towns. Very high spikes in PM were observed at nighttime during cold periods. Wood smoke is also an important component of urban air pollution. Clarkson University observed wood smoke to account for 30% of $PM_{2.5}$ in Rochester in the winter and about 7% of the annual emissions of $PM_{2.5}$ in Rochester.

Additional studies of local air quality will be performed by NESCAUM, DEC, and the Atmospheric Sciences Research Center with funding from the US EPA and NYSERDA. These studies will further characterize the dynamics of wood smoke with meteorology and topography and may serve as the basis of a wood stove change-out program and track changes as more efficient and lower emitting biomass heating technologies displace older ones.

Economic comparison of fuel switching from oil heat to high efficiency biomass for a residential application.

In the past decade the price of natural gas has decreased while that of home heating oil has continued to increase. Some biomass heating technologies can compete economically depending on their thermal efficiency and the cost of the fuel selected. For example, if one has forested land, the fuel costs may be limited to the cost of operating chainsaws, a splitter, and the value of their time. Conversely, the cost of wood pellets may vary from $250 for a ton of bagged pellets at a retail outlet and between $225 and $247 delivered in bulk to a residence. Table C1 is an example of the range of costs for several biomass heating technology-fuel combinations and home heating oil.

[44] Author's note: The atmospheric emissions of any combustion appliance are related to the proper operation of that appliance, including the choice of fuel used. Utilization of a fuel source that the appliance was not designed to use will certainly affect the efficiency of the appliance and therefore the emissions associated with the use of that fuel.

A total cost of ownership analysis is performed below for a pellet boiler meeting NYSERDA's Cleaner Greener Communities requirements rated at 85% thermal efficiency at high-load steady-State with thermal storage; a 69% AFUE smart downdraft cord-wood boiler with partial thermal storage; an 80% AFUE smart down-draft technology with full storage and full fueling of the combustion chamber; an Energy Star-rated oil-fired boiler with 85% AFUE; and an Energy Star-rated condensing oil-fired boiler rated at 93% AFUE. All efficiencies are given for the higher heating value of the fuel and a 25 year lifetime of the heating equipment is assumed.

It is worth noting here that some pellet boiler manufacturers will void warrantees if the boilers are not installed with thermal storage due to impacts on system performance and longevity. Given the lack of experience of this emerging technology in US housing stock and heat distribution systems common to the US, annual maintenance costs are unknown and were not included for any of the heating systems. In addition, the cost of each fuel was held constant for the 25 year period.

A bin-hour analysis indicated a loss of approximately 17 percent for a properly sized pellet boiler if thermal storage was not included over the heating season. This is in good agreement with the evaluation of The Wild Center by Clarkson University that found annual heating performance without thermal storage to be just 65% rather than the anticipated 85%. This is significantly less than the 30% loss observed in the oversized pellet boiler without storage in the testing conducted EPA's Office of R&D. This analysis does not include pellet heating systems without thermal storage due to these large losses and the requirements in the CGC program to use thermal storage.

Table C1. Fuel Cost and Normalized Cost per MMBtu

	OIL	WOOD PELLETS	Cord Wood(high)	Cord Wood (low)
$ DOLLARS/UNIT	$3.99/gallon	$237/ton	$200/cord	$90/cord
BTU/UNIT	139,000/gallon	16,000,000/ton	22,000,000/cord	22,000,000/cord
$/MMBTU	$28.71	$15.44	$9.09	$4.09

- The Statewide cost of home heating oil is $4.00/gallon for the week of October 28, 2013 (NYSERDA.ny.gov).
- Bulk pellet prices in the Northeast range from $225 to $247 with delivery charges.

Table C2 shows the installed cost of each heating technology, the fuel cost, the fuel cost over 25 years, and the total cost of ownership over 25 years. The installed costs of the heating systems vary by a factor of 2.7 with a low of $8,000 to a high of $ 21,500. For the pellet-fired heating system, the cost of pellet storage and fuel conveyance is included as well.

The total cost of ownership (TOC) is given in Table 2. The heating system with the lowest TOC is the 80% 2-stage downdraft cord-wood boiler with full thermal storage and full loading of the primary

combustion chamber with a fuel price of $90/cord. The highest TCO is for the 85% AFUE oil-fired boiler. The simple payback on the 80% AFUE 2-stage down-draft with full storage is system is between five and six years assuming the 85% AFUE oil-fired system is the base case. For the high efficiency pellet system the simple payback is approximately 12 years.

Table C2: Estimated Total Cost of Ownership Over 25 Years

	Installed Cost	Fuel cost	Fuel Costs (25 years)	Total Cost of Ownership (25 years)
85% Pellet Boiler with Thermal Storage	$21,500	$237/ton pellets	$53,600	$75,100
69% 2-Stage Downdraft with Partial Thermal Storage (400 gal)	$16,000	$200/cord	$32,900	$48,900
80% 2-Stage Downdraft with Full Thermal Storage (800 gal)	$19,000	$200/cord	$28,400	$47,400
80% 2-Stage Downdraft with Full Thermal Storage (800 gal)	$19,000	$90/cord	$14,800	$33,800
85% AFUE OIL-FIRED Boiler	$8,000	$3.99 gal of oil	$100,000	$108,000
93% AFUE OIL-FIRED Boiler	$9,500	$3.99 gal of oil	$91,400	$100,900

*Heating system efficiency dropped from 85% efficiency to 68% AFUE but in practice, losses may be greater due to transient loads.

NYSERDA Research Needs

NYSERDA's biomass heating R & D program benchmarks performance of the emerging technology to oil heat, the technology most frequently displaced by biomass heating. In addition, this performance evaluation includes efficiency at full and part loads, multiple pollutants (ex. CO, $PM_{2.5}$, NO_x, CO_2) and human exposure considerations. In order for program administrators to effectively promote biomass systems in their programs, several data gaps must be addressed, including:

- **Robust performance evaluations for commercial biomass heating systems.** Advancement of the ASHRAE 155 provisional or other full-duty cycle test method that includes part loads and idle losses should be pursued. The emissions evaluations should be multi-pollutant and include CO, CO_2, $PM_{2.5}$, and NO_x at a minimum.
- **Pilot projects with in-situ measurements of system performance**. Such projects are needed to verify the predicted savings associated with full and partial conventional fuel displacement. The compatibility of different heat distribution systems for pellet boiler heating systems with and without

thermal storage or other efficiency measures is also needed. Component failure and warrantee details should also be tracked.

- **Identification of health and safety considerations for in-stack CO from biomass fuels**. These should be made in a similar manner as oil- and gas- fired systems that are covered by ANSI (400 ppm) and shared with the Codes community.
- **Establishment of Energy Star rating methodology for residential biomass heating systems.** A rigorous performance test method developing an annual fuel-use efficiency and emissions rating for biomass boilers is needed so full end-use comparisons can be made with oil-heat, propane, and electric heating systems and provide the consumer with more accurate fuel cost estimates. The emissions evaluations should be multi-pollutant and include CO, CO_2, $PM_{2.5}$, and NO_x at a minimum. Test protocols should include all phases of operation i.e. cold start/steady State/idle modes/burn-out.
- **Establishment of safety features for system installations** such as an automatic heat dumps for batch-loaded units should be explored and shared with the Codes community.
- **Establishment of more rigorous methods for proper sizing of boilers and integration with thermal storage.** Preventing installation of units that are oversized for a dwelling or commercial application is critical. This will have a major influence on diurnal and seasonal boiler cycling, in-use efficiency, CO and $PM_{2.5}$ emissions, fuel use, and fuel cost savings calculated. Simple methodologies for siting of the exhaust stack and its height are also needed to reduce human exposure to combustion products. This is especially important at schools, hospitals, and nursing homes where susceptible populations are located.
- **Development of recommendations for added efficiency measures.** These could include thermal storage, solar-thermal integration, or other strategies to prevent cycling and provide optimized performance. Many pellet boilers have an onboard computer that records the frequency of cycling and duration of idle modes that could be useful.
- **Establishment of pellet fuel quality standards.** Current pellet testing methodologies are voluntary and focus on ash and moisture content. Heavy metals analysis is needed given the findings that contaminated wood (i.e. pressure treated and painted) has been detected in a limited number of commercial wood pellet products. Economic circumstances could develop in which this would increase and go undetected. In addition there is interest in mixing grass feedstock to woody biomass or including binders. These fuels will also need an evaluation methodology and standardization.
- **Characterization of off-gassing of CO from stored wood pellets and other biomass fuels**. Health and safety for the storage and delivery wood pellets including the potential for explosive dust and off-gassing of CO must be a priority and is critical to the expansion of the biomass heating industry.
- **Development of <30% moisture content wood chip supply for use in high-efficiency chip boilers**. Currently green chips are most easily available but high-efficiency wood-chip boilers burning green chips suffer an approximately 15% energy penalty.

- **Development of methodologies for kiln-drying cord wood**. Some cord wood suppliers are providing this now but more science is needed to prevent over-drying the outer shell of the wood while collapsing the capillaries and maintaining green wood in the core. For the cord wood market to expand it is also necessary to kill invasive species to allow for shipping of the fuel beyond 50 miles. Currently fire wood originating in Europe that has been heat treated is being sold in retail convenience stores in NYS.
- **Characterization of user habits with respect to home heating systems and fuel use.** Understanding overall fuel usage percentages where multiple heating systems are present would assist in establishing program benefits. Conventional electric, gas, or fuel oil systems are rarely removed when biomass systems are installed. These systems can also be used to develop strategies for optimizing overall seasonal efficiency of the heating system such as heating with oil during shoulder seasons and switching to pellets once the weather is cold so the boiler does not cycle as frequently.
- **Quantification of electricity requirements for biomass heating systems.** The amount of time that the ignition, distribution fan, feeder, and exhaust fan operate, as well as their electrical consumption should be quantified by a third party. Research into the electric energy consumption per MMBtu of energy output produced by different biomass heating appliances is recommended.
- **Product development of well-designed and optimized biomass combustion appliances and emissions control technologies.**
- **Development of technology transfer tools for biomass heating system commissioning and measurement and verification protocols for use by customers, installers, energy service companies, and deployment programs.**

Appendix D: Biomass Market Expansion Snapshot Analysis

Understanding where potential areas of stabilization and/or expansion can lead to broader regional economic development and job creation is important to the efficient and effective allocation of funds for market stimulation and research. Table D1 summarizes a very high-level market "snapshot analysis" for selected sectors of the North Country biomass energy value chain. The analysis was based on the estimate of North Country forest resources derived from the *Roadmap* data values (1 million tons) and in each case simply assumes that all available forest biomass is accessible and gets converted within each possible supply chain. No allocation between supply chains, meaning no combination of options, has been addressed. These estimates are modeled after the approach taken by Booz & Co. in estimating the viability of the Green Bank to accelerate the deployment of clean energy in NY [45] and are based on data, case studies and conversion factors made available by stakeholders within each bioenergy pathway, as well as supplemental literature sources where required. Therefore different assumptions regarding job creation percentages, methodologies for calculating direct vs. indirect jobs, and methodologies for estimating economic impacts are unique to each scenario. Additional details for each scenario are provided in subsections following Table D1. This broad-stroke analysis in included in this white paper to illustrate that there is significant potential for biomass energy market expansion in the North Country region and that supporting more in-depth, rigorous analysis of these scenarios to understand this potential more accurately would be worthwhile.

Job Creation Estimates

The North Country region of New York has the potential to sustainably produce an abundant supply of biomass year after year from a multitude of different sources including forests, marginal and underutilized agricultural land, and residue streams from existing industries. The jobs that are created when biomass systems are developed and used to produce renewable heat, power, biofuels, and/or bioproducts, singly or in combinations with one another, are jobs that will be in place for many years to come. There is an initial increase in jobs as facilities are built or components are manufactured, but with biomass systems many of the jobs are long term jobs based on the rural development. The majority of jobs (generally >75%) created in biomass systems are associated with the production, harvesting and transportation of the biomass from forests and marginal agricultural land.[46] Because the biomass energy supply chains need to stay within a limited geographic region due to energy density and transportation considerations, a large number of jobs will be created and maintained within the North Country region. The *Roadmap* indicated that between 3,900 and 14,600 jobs could be created in the State if biomass was used for the production of biofuels, with the majority of jobs (~70%) in the feedstock supply arena. The figures above imply that in the North Country different biomass energy supply chains could create significant numbers of jobs at different levels of the supply chain. The potential to keep energy expenditures within the regional economy also creates a huge value proposition that, when combined with lower heating costs and job creation potential,

[45] New York State Green Bank Business Development Plan, (2013). NYSERDA report by Booz & Co., Sept. 3.
[46] New York Wood Products Development Council (WPDC) (2011). New York Wood Product Development Council Annual Report, 2010-2011.

simultaneously grows the regional wealth-base while maintaining a greater proportion of that base within the region overall.

Selected Forestry-Based Supply Chains (Plus Anaerobic Digestion)

Table D1: Market Analysis of Selected Biomass Energy Supply Chains Scenarios*
(*Based on *Roadmap* estimates indicating ~1-1.5 million t/yr forest biomass available in seven county North Country region.)

Bioenergy Scenario	Bioenergy Conversion Assumptions	Additional Jobs Created	Regional Expenditures	Other Considerations
Wood Pellet Manufacturing	1 ton pellets = ~2 tons forest biomass[47] *Possible production = ~500,000 tons pellets/year*[48] ~5 tons pellets per household/year[49] *Therefore ~100,000 homes heated*	~~*3.5 homes converted = 1 job (0.2 in supply of wood and pellets, 0.2 increase in disposable income, 0.6 no longer sending money out of area)*~~[50] ~~*Therefore ~28,500 jobs created*~~[51]	$40-$70 expenditure in local economy per ton of pellets produced[52] *Therefore ~$20-35 M added to local/ regional economy*	Reduce dependence on imported oil Reduce greenhouse gas emissions Keep fuel expenditures in local economy Create strong markets for low-grade wood Reduce certain air pollutants (e.g. SO_2, Hg)
Bioenergy Scenario	**Bioenergy Conversion Assumptions**	**Jobs Created**	**Expenditures locally/ regionally**	**Other considerations**
Chips for Commercial	Conservative production =	342 direct jobs created per 200,000 tons/yr biomass for commercial use[53]	Payroll contribution (@$37k/job) =	180 MW installed generating capacity = ~165,000 homes

[47] Biomass Thermal Energy Council, et al, 2010. "Heating the Northeast with Renewable Biomass: A Vision for 2025," April.
[48] Stakeholder input indicates this estimate, based on Roadmap biomass numbers and BTEC conversion factor, is high, and not really indicative of production from the North Country region alone, but possibly indicative of State-wide production.
[49] Katers, J. and A. Snippen, 2011. Life Cycle Assessment of Wood Pellet Manufacturing in Wisconsin, Final report for Public Service Commission of Wisconsin and the Statewide Energy Efficiency and Renewables Administration, Environmental Research and Development Program, March. http://www.focusonenergy.com/sites/default/files/research/katerswoodpelletmfg_report.pdf
[50] Strauss, W. 2013. An Analysis of the Effects of a 30% Credit on the Expected Demand for High Efficiency Wood Pellet, Wood Chip, and Agricultural Residue Fueled Boilers: The Cost/Benefit to the Treasury, and the Jobs Created, FutureMetrics, LLC, for the Biomass Thermal Energy Council http://biomassthermal.org/pdf/Strauss_BTU_Act.pdf
[51] Stakeholder comment on these estimates indicate that the job impact numbers as sources are inflated by the source (Strauss) and would not stand up to peer review.
[52] Cornell Cooperative Extension, Tompkins County, Associated Harvest, Last updated August, 2011. http://ccetompkins.org/energy/biomass-energy/associated-harvest

Boilers	~1 M tons chips/year	Therefore direct jobs created= 855 Jobs estimates are for new jobs created by regional biofuel production replacing non-regional oil production and increased disposable income creating new commerce/investment & assume no new jobs created at delivery end of supply chain. Estimates assume as transition from heating oil to biofuels takes place jobs that already exist for heating oil delivery and administration of that infrastructure will migrate to very similar activities for biofuels.[54] Indirect job multiplier for NY = 23.82/$1 M[55] Therefore Indirect jobs created = ~760	~$32 M[56] Indirect payroll contribution = ~$28.5 million Total contribution = ~$60 million	
Bioenergy Scenario	**Bioenergy Conversion Assumptions**	**Jobs Created**	**Expenditures locally/ regionally**	**Other considerations**
Biopower	450,000 tons = ~60MW[57] NC could support ~3	Each 1 MW of biopower supports approximately five full-time jobs: one job in the facility and the remainder in the surrounding forests and communities[58]	Input to local economy[59]: ~$33 million in fuel	Enhances forest health with sustainable harvesting practices: higher value wood to sawmills (for production of dimensional

[53] Biomass Thermal Energy Council, et al, 2010. "Heating the Northeast with Renewable Biomass: A Vision for 2025," April.
[54] ibid
[55] ibid
[56] ibid
[57] ReEnergy Holdings LLC, NY Portfolio Fact Sheet, supplemented by personal communication with Sarah Boggess, Director of Communications & Government Affairs, ReEnergy Holdings, LLC, Latham , NY, Sept. 4, 2013.ReEnergy, personal communication
[58] ibid

	facilities similar in size or about ~180 MW of installed generating capacity.	Therefore ~900 jobs created (~180 in plants + ~320 in woods)	purchases ($11 million * 3) ~$69 million in GDP annually during plant operations ($22.9 million *3) ~$42 million annually in new payrolls Statewide ($14 million * 3) ~$3.5 million in State tax revenues annually ($1.18 million * 3)	lumber), paper mills (paper production) and/or pellet mills and 'left-overs' or residues, comprised of tree tops, bark and slash, normally left on the forest floor have an end market. With the planting of energy crops such as shrub willow, potential to make use of underutilized farmland. Strengthens the reliability of the electricity grid with continuous, baseload energy.
Bioenergy Scenario	**Bioenergy Conversion Assumptions**	**Jobs Created**	**Expenditures locally/ regionally**	**Other considerations**
Biorefineries[60]	700 dry tons/day per refinery Therefore ~ 4 refineries in NC	~100 permanent, non-exportable jobs per biorefinery complex Therefore ~400 direct jobs created	~$15 M annual local/ regional expenditures Therefore ~$60 M annual expenditures	A range of bioenergy/material products produced: Ethanol 1.7k gal/d = ~$3500/day Methanol 1k gal/d = ~$1500/day Lignin 19.5 t/d = ~$23.3k/day Animal feed = ~$2000/day Other bio chemicals = ~$63k/d H-T™ 420 t/d = ~$31 k-~$1

[59] Economic Impact of The Black River Generation Facility; A Project of ReEnergy Holdings, LLC, Latham, NY, Prepared by Richard W. Heaps, Northern Economic Consulting, Westford, VT, October 17, 2011.

[60] Personal communication, Dr. Joel Howard, CEO, Applied Biorefinery Sciences LLC., Sept. 6, 2013

				M/d Value of Hydro Torrefied™ fiber ("H-T™") for products other than heat energy is variable. When used as material = >800% output product value increase over burning wood feedstock for heat energy alone. Feedstock does not need to be bark free = raw material price advantage & market for small diameter/crooked trees, un-merchantable as raw material for traditional wood products like furniture/fine paper.
Bioenergy Scenario	**Bioenergy Conversion Assumptions**	**Jobs Created**	**Expenditures locally/ regionally**	**Other considerations**
Anaerobic Digestion[61]	1 facility = 330,000 t/yr animal & com. food waste = 650,000 mmbtu/yr = ~ 9MW = 9,000 homes +5 mmbtu/hr thermal energy +60,000 t/yr carbon credits + > 180k t/yr fertilizer & compost products Annual manure in NC	Construction phase employment = 100 jobs/facility Sustaining operational support = 20 jobs/facility Therefore temporary construction phase jobs = ~ 1900 Sustaining operational jobs = ~ 380	Local support services dollars spent annually in community = ~$300,000/ facility Therefore ~ $5.7 M annual expenditures in local support dollars	Each facility = 90,000 t/yr of wastes removed from landfill and/or land application = ~1.7 M t/yr across region More than 70% reduction in organic load of waters released to irrigation. Reduction of odors ~170 MW = ~170,000 homes

[61] Personal communication, Christine McKiernan, VP Engineering, BIOFerm™ Energy Systems, Sept. 13, 2013.

	= ~250,000 cows * ~140 lb/d manure/cow = ~6.4 million tons of manure/yr, Therefore enough for ~19 of the anaerobic digester scenarios presented above.			~1.14 M t/yr carbon credits ~3.4 M t/yr of fertilizer/ compost products with > 50% increase in plant available nutrients for fertilizer application compared to feedstocks.

Residential Wood Pellet Manufacturing

Market Analysis

Biogenic material	*Roadmap* estimates indicate ~1-1.5 million tons/yr forest biomass available in seven county North Country region. 1 ton pellets = ~2 tons forest biomass[62] Possible production = ~500,000 tons pellets/year
Energy production	~5 tons pellets per household/year[63] Therefore ~100,000 homes heated
Community Benefits	1,580 Jobs Created if 5,500 Homes and Businesses on Heating Oil are Converted to High Efficiency Pellet Boilers: Supply of Wood and Pellets, 310 Jobs Increase in Disposable Income, 310 Jobs No Longer Sending Money Away, 959 Jobs = 3.5 homes converted = 1 job (0.2 in supply of wood and pellets, 0.2 increase in disposable income, 0.6 no longer sending money out of area)[64] Therefore ~28,500 jobs will be created $40-$70 expenditure in local economy per ton of pellets produced[65] Therefore ~$20-35 million added to local/regional economy
Other benefits	Reduce dependence on imported oil; Reduce greenhouse gas emissions; Keep fuel expenditures in local economy; Create strong markets for low-grade wood; Reduce certain air pollutants (e.g. SO_2, Hg).

Wood Chip Supply for Commercial-Scale Boilers

Market Analysis

[62] Biomass Thermal Energy Council, et al, 2010. "Heating the Northeast with Renewable Biomass: A Vision for 2025," April.

[63] Katers, J. and A. Snippen, 2011. Life Cycle Assessment of Wood Pellet Manufacturing in Wisconsin, Final report for Public Service Commission of Wisconsin and the Statewide Energy Efficiency and Renewables Administration, Environmental Research and Development Program, March. http://www.focusonenergy.com/sites/default/files/research/katerswoodpelletmfg_report.pdf

[64] Strauss, W. 2013. An Analysis of the Effects of a 30% Credit on the Expected Demand for High Efficiency Wood Pellet, Wood Chip, and Agricultural Residue Fueled Boilers: The Cost/Benefit to the Treasury, and the Jobs Created, FutureMetrics, LLC, for the Biomass Thermal Energy Council http://biomassthermal.org/pdf/Strauss_BTU_Act.pdf

[65] Cornell Cooperative Extension, Tompkins County, Associated Harvest, Last updated August, 2011. http://ccetompkins.org/energy/biomass-energy/associated-harvest

Biogenic material	*Roadmap* estimates indicate ~1-1.5 million tons/yr forest biomass available in seven county North Country region Conservative production = ~1,000,000 tons chips/year
Community Benefits	342 direct jobs created per 200,000 tons/yr biomass commercial use[66] Therefore = 855 direct jobs created "The jobs estimates are for new jobs that will be created both by regional biofuel production replacing non-regional oil production, and by the increased disposable income that will create new commerce and investment. However, the jobs estimates assume that no new jobs will be created at the delivery end of the supply chain. The estimates assume that as the transition from heating oil to biofuels takes place, those jobs that already exist for heating oil delivery and the administration of that infrastructure will migrate to doing very similar activities with the biofuels."[67] Payroll contribution (@$37,000/job) = ~$32 million[68] Indirect job multiplier for NY = 23.82/$1 million[69] Indirect jobs = ~760 Indirect payroll contribution = ~$28.5 million

[66] Biomass Thermal Energy Council, et al, 2010. "Heating the Northeast with Renewable Biomass: A Vision for 2025," April.
[67] ibid
[68] ibid
[69] ibid

Biopower

CASE STUDY: Biopower generation from forest biomass (ReEnergy Holdings)[70]

ReEnergy Holdings LLC, a portfolio company of Riverstone Holdings LLC, owns and operates facilities that use forest-derived woody biomass and other wood waste residues to produce homegrown, renewable energy. It also owns facilities that recycle construction and demolition debris. ReEnergy was formed in 2008 by affiliates of Riverstone Holdings LLC and a senior management/co-investor team comprised of experienced industry professionals. ReEnergy operates in six States, employs approximately 290 people and owns and/or operates nine energy production facilities with the combined capacity to generate 325 megawatts of renewable energy.

Biogenic material	ReEnergy Black River: 450,000 tons ReEnergy Lyonsdale: 225,000 tons *ReEnergy Chateaugay (when operating): 225,000 tons* When all 3 facilities are operating (one is idled at this time), more than $24 million of sustainably harvested fuel is purchased from local suppliers.
Energy production	ReEnergy Black River: ~60MW ReEnergy Lyonsdale: ~20MW *ReEnergy Chateaugay (when operating): ~20MW* The three biopower facilities have the installed capacity of ~103 MW, producing ~738,000 MWh – enough electricity to serve 96,000 homes.
Community Benefits	At the present time, ReEnergy employs approximately 80 individuals in New York State and supports well over 300 indirect jobs in northern and central New York. = ~4.75 jobs/MW (Each 1 MW of biopower supports approximately five full-time jobs: one job in the facility and the remainder in the surrounding forests and communities). With direct payroll, purchases of fuel, goods and services, annual capital and maintenance expenses, and payments in lieu of taxes, ReEnergy creates an overall economic impact of well over $100 million per year in New York State. Specific for Black River[71]: • the creation of 307 new jobs • fuel purchases of ~$11 million annually • new payrolls of over $14 million annually Statewide

[70] ReEnergy Holdings LLC, NY Portfolio Fact Sheet, supplemented by personal communication with Sarah Boggess, Director of Communications & Government Affairs, ReEnergy Holdings, LLC, Latham , NY, Sept. 4, 2013.

[71] Economic Impact of The Black River Generation Facility; A Project of ReEnergy Holdings, LLC, Latham, NY, Prepared by Richard W. Heaps, Northern Economic Consulting, Westford, VT, October 17, 2011.

- State tax revenues $1.18 million annually
- $22.9 million in GDP annually during the plant operations.

Other benefits

Biopower facilities' demand for forest residue fuels is an important link in the forest products industry value chain, wherein:

- creates new jobs and retains existing ones, particularly in rural areas where biomass is produced and used;
- enhances forest health with sustainable harvesting practices: higher value wood goes to sawmills (for the production of dimensional lumber), paper mills (paper production) and/or pellet mills and the 'left-overs' or residues, comprised of tree tops, bark and slash, normally left on the forest floor have an end market;
- helps to reduce greenhouse gas emissions.

Additionally:

- With the planting of energy crops such as shrub willow, underutilized farmland adds additional potential for this sector.
- meets highest environmental standards w/ State-of-the-art tech;
- advances the State's energy independence;
- strengthens reliability of grid with continuous, baseload energy.

Market Analysis

The estimate of available forest biomass for the seven county North Country region (based on Roadmap data) indicates there are ~1-1.5 million dry tons/year that could be used for biomass energy projects.
This quantity could support ~3 facilities similar in size to the Black River Facility, or about ~180 MW of installed generating capacity.

Using Black River numbers as a multiplier, this would result in an additional:

~ 900 permanent jobs, ~180 in plants, ~320 in woods
Input to local economy =
~$33 million in fuel purchases ($11 million * 3)
~$69 million in GDP annually during plant operations ($22.9 million *3)
~$42 million annually in new payrolls Statewide ($14 million * 3)
~$3.5 million in State tax revenues annually ($1.18 million * 3)

Biorefineries

Deriving more value from wood than just burning it for energy will help restore a long-term, economically viable wood based industry to the North Country. Wood contains a wide variety of commercially valuable chemicals and materials that humans cannot "make" (e.g., cellulose, lignin, and 5- and 6-carbon sugars). For example, lignin historically has been burned in boilers for its heat value estimated at ~$0.07 per pound however, if lignin is isolated, using non-contaminative processes, it may have a market value far in excess of $2.00 per pound.[72] Biorefineries produce a multi-product portfolio utilizing currently unmarketable, low quality wood to extract valuable chemicals and, at the same time produce improved fiber for manufacturing traditional or "new technology" wood products.

[72] Personal communication, Dr. Joel Howard, CEO, Applied Biorefinery Sciences LLC., Sept. 6, 2013.

CASE STUDY: Forest biomass biorefinery (Applied Biorefinery Sciences, LLC)[73]

Applied Biorefinery Sciences (ABS) is a private, for-profit company commercializing technology that, compared to historical uses of wood in NYS, will capture significantly greater total economic value from the same amount of wood (Figure 1).

Revenue							
	Product	Price	Unit			Daily	Annual
	Butanol	0.81	$/Lb.	21.6	tons/day	$34,983	$12,244,023
	Acetone	0.35	$/Lb.	10.5	tons/day	$7,319	$2,561,777
	Ethanol	2.00	$/Gal	1733	gallons/day	$3,467	$1,213,307
	Furfural	0.80	$/Lb.	7	tons/day	$11,320	$3,962,112
	Acetic Acid	0.30	$/Lb.	16	tons/day	$9,675	$3,386,117
	Methanol	1.50	$/Gal	1065	gallons/day	$1,597	$558,896
	Lignin	0.60	$/Lb.	19.5	tons/day	$23,356	$8,174,497
	Formic Acid	0.30	$/Lb.	1	tons/day	$607	$212,544
	Animal Feed	0.10	$/Lb.	10.5	tons/day	$2,104	$736,463
	H - T ™ Fiber	75.00	$/ton	420.0	tons/day	$31,500	$11,025,000
Total Gross Revenue							$44,074,736
Expense							
Total Product Cost							$26,999,548
Net Income							$17,075,188

Figure 1: Estimated annual net income from a single, 700 dry ton/day, Applied Biorefinery Sciences manufacturing complex that is processing woody biomass in an integrated biorefinery.

Biogenic material	700 dry tons/day
Energy production	Ethanol 1733 gal/day = ~$3500/day Methanol 1065 gal/day = ~$1500/day Lignin 19.5 tons/day = ~$23300/day ***H-T***™ fiber 420 tons/day* = ~$31500/day-~$1 million/day The value of ***Hydro Torrefied***™ ("***H-T***™") fiber for products other than heat energy is not included in Table 1. Toward that end, assuming that one ton of ***H-T***™ fiber is used as feedstock for wood fuel pellets, the wholesale value of that manufactured ***H-T***™ fiber is ~$180 from one dry ton of input wood. In contrast, one ton of ***H-T***™ fiber manufactured into lignin, nano-crystalline cellulose, and glucose has a total wholesale value of over $1500 from one dry ton of input wood; that constitutes more than 800% increase in output product value over burning wood for heat energy alone. This would raise the daily monetary gain from ***H-T***™ fiber

[73] ibid.

from $31,500 to ~$1 million, thereby raising the annual net income by $353 million.

Other revenue sources	Other biobased chemicals = ~$63000/day Animal feed = ~$2000/day
Community Benefits	~100 permanent, non-exportable jobs per biorefinery complex ~$15 million in expenditures spent locally/regionally Increased net profits for sustainable forest & chemical industries Petroleum displacement products (e.g., fuels / biodegradable plastic) The feedstock serving as raw material for ***ABS Process***™ manufacturing does not need to be bark free, thus creating a raw material price advantage and a market for small diameter, crooked trees that are un-merchantable as raw material for traditional wood products such as furniture or fine paper.
Market Analysis	ABS estimates that at least two biorefinery manufacturing facilities (similar in product outputs and values shown in Table 1) can be supported by the wood resources located in the North Country Region. However, the forestry biomass estimates derived from the *Roadmap* data for the seven counties indicates that ~ 4 ABS facilities could be supported. This would result in: ~400 jobs created in region ~$60 million in annual expenditures spent in the local/regional economy

Anaerobic Digestion

Anaerobic digestion of mixed feed-stocks typically encompasses manure and food grade organic wastes from processors, retailers and institutions.

Project benefits:

Biogas is used for combined heat and power generation.
Digested biomass used as animal bedding and fertilizer.

Environmental benefits:

- base load renewable energy
- reduced greenhouse gas emissions
- diversion of organic waste from landfills
- reduced manure odors
- Improved nutrient management

Potential project scopes:

Food processor based – biogas facilities at food processor site providing waste management and renewable energy to the host site.

Regional – biogas facilities at wastewater treatment plants or industrial parks serving mixed waste generators – renewable energy sold to the host site and the utility grid.
Farm based – biogas facilities on large livestock farms processing host manure and off-site food waste – renewable energy sold to the farm and the utility grid.

CASE STUDY: Estimating Anaerobic Digestion Impacts (BIO Ferm Energy Systems)[74]

Biomass technologies are specifically applicable to the North County area, and can bring much needed localized energy production, waste reduction, job creation and preservation of the environment. The case study below demonstrates the scale of positive impact potential from biomass projects.

Biogenic material	330,000 tons/year of animal manures and commercial food wastes converted to energy
Energy production	650,000 mmbtu/yr (approximately equivalent to 9MW), or enough electricity to power approximately 9,000 US homes; also 5 mmbtu/hr of thermal energy
Other revenue sources	Generation of 60,000 ton/year carbon credits reflecting reduced GHGs; > 180,000 ton/year of fertilizer and compost products
Community Benefits	Construction phase employment in excess of 100 jobs; sustaining operational support of 20 jobs; local support services dollars spent in the community of $300,000/ year
Reduction of waste products	90,000 ton/year wastes removed from landfill and land application
Water quality improvements	More than 70% reduction in organic load of waters released to irrigation, reduction of odors, greater than 50% increase in plant available nutrients for fertilizer application compared to feedstocks.
Market Analysis	Based on estimates of annual manure production from all cattle in the seven county North Country region: Assuming ~140 lbs/day of manure produced for the average cow[75] and an average of ~250,000 cows in the seven county region[76], results in ~6.4 million tons of manure produced annually, or enough to supply ~19 of the anaerobic digester scenarios presented above.

[74] Personal communication, Christine McKiernan, VP Engineering, BIOFerm™ Energy Systems, Sept. 13, 2013.

[75] http://www.progressivedairy.com/anm/features/2009/0109/0109_ketterings.html

[76] National Agricultural Statistics Service, CATTLE: Number on Farms, by County, New York, January 1, 2011-2012. http://www.nass.usda.gov/Statistics_by_State/New_York/Publications/Annual_Statistical_Bulletin/2012/2012%20page73%20cattle%20county%20estimates.pdf

This would result in:

- ~95 million mmBTU/hr of thermal energy, 12.4 million mmBTU/yr or ~170 MW, enough power for ~171,000 homes
- Generation of 1.14 million tons/year of carbon credits and 3.4 million tons/year of fertilizer and compost products
- Construction phase employment of ~1900+ jobs
- Sustaining operational jobs = 380 jobs
- $5.7 million in local support dollars spent within the host communities

Grass Pellets

Locally-produced and consumed grass pellets could support the local economy by keeping more of the money currently spent on imported fossil fuels used for space and water heating within the region. Such local/domestic production of heating fuel could also allow a sense of ownership to be associated with a critical resource that now predominantly comes from foreign countries and increased energy independence for the North Country is an attractive prospect for many. A grass pellet market would encourage the conservation of grassland in the North Country region. All North Country counties, and the State as a whole, have been losing farm acres at an alarming rate.[77] With the loss of grasslands, discernable decreases in populations of grassland species including many birds and insects critical for pollination have been documented, sparking an increased effort to conserve and maintain open spaces.

Currently, combustion of non-woody biomass is extremely challenging. Heating technologies with acceptable safety and basic performance characteristics have not entered the NY market. European observations of challenging ash management, corrosive properties, and higher emissions suggests that this feedstock will be most useful at an industrial scale with control technology and skilled facilities staff.

Estimates for the impact of grass feedstock for fuel pellet production from available marginal and idle crop land in the seven county North Country region[78]:

Total homes heated 33,000-95,000

[77] United States Department of Agriculture National Agricultural Statistics Service (NASS), (2009). Census of Agriculture, 2007 Census Volume 1, Chapter 2: County Level Data, Table 8: Farms, Land in Farms, Value of Land and Buildings, and Land Use: 2007 and 2002. Available at http://www.agcensus.usda.govaccessed March 10, 2013.

[78] Estimates from unpublished study performed by Dr. Amanda Lavigne (St. Lawrence University) and Jon Montan, (Director, St. Lawrence Country Grass Energy Working Group, "Estimating the Potential to Produce Grass Energy Feedstock in the North Country", under review Adirondack Journal of Environmental Studies.

Total % of homes	20-57%
Total fuel oil disp.	26.5-76.0 Mgal
Total $ kept local	$79.9 – 304.3 m

Table D2: Summary table for grass pellet estimates for all North Country counties

	Clinton	Essex	Franklin	Hamilton	Jefferson	Lewis	St. Law	North Country
Occupied homes[1]	31,700	16,000	19,000	2300	45,200	10,600	43,100	167,900
Marginal land acres	**6300**	**2100**	**5500**	**5**	**11000**	**7000**	**14600**	**46600**
Homes heated[2]	2075 - 5974	702 - 2020	1824 - 5252	1.5 - 4.4	3642 - 10483	2322 - 6685	4812 - 13852	**15378 - 44271**
% homes heated[3]	7 - 19%	4 - 13%	10 - 28%	0 - 0%	8 - 23%	22 - 63%	11 - 32%	**9 - 26%**
Fuel oil disp. (Mgal)	1.7 - 4.8	0.6 - 1.6	1.5 - 4.2	0.002 - 0.004	2.9 - 8.4	1.9 - 5.3	3.9 - 11.1	**12.3 - 35.4**
$ kept local[4] (M)	5.0 - 19.1	1.7 - 6.5	4.4 - 16.8	0.003 - 0.014	8.8 - 33.6	5.6 - 21.4	11.7 - 44.4	**37.3 - 142**
Ag land acres	**2600**	**3400**	**3600**	**100**	**21300**	**7200**	**15000**	**53300**
Homes heated	857 - 2466	1134 - 3265	1187 - 3418	26 - 74	7031 - 20240	2388 - 6875	4965 - 14292	**17587 - 50630**
% homes heated	3 - 8%	7 - 20%	6 - 18%	1 - 3%	16 - 45%	23 - 65%	12 - 33%	**10 - 30%**
Fuel oil disp. (Mgal)	0.7 - 2.0	0.9 - 2.6	1.0 - 2.7	0.02 - 0.06	5.6 - 16.2	1.9 - 5.5	4.0 - 11.4	**14.1 40.5**
$ kept local (Million)	2.1 - 7.9	2.7 - 10.5	2.9 - 11.0	0.06 - 0.23	17.0 - 64.9	5.8 - 22.0	12.0 - 45.8	**42.6 - 162.3**

Marginal + Ag Acres Grass Energy Potential for the North Country Region

Total homes heated	33,000-95,000
Total % of homes	20-57%
Total fuel oil disp.	26.5-76.0 Mgal
Total $ kept local	$79.9 – 304.3 m

[1]From NYSERDA Patterns and Trends

[2]From St. Lawrence County estimate, range of homes heated/acre of land available for grass production. Estimate based on range of grass yield per acre, range of pellet yield per mass of grass feedstock, range of heating value for pellets, and range of energy use for heating per home) = 0.33-0.95 homes heated per acre.

[3]From SLC estimate, range of fuel oil displaced/acre of land. Estimate applies homes heated factor to average fuel oil use per home = 265 – 760 gal. fuel oil displaced per acre of grass.

[4]From SLC estimate, range of heating $ kept local/ acre of land. Estimate applies average cost of fuel oil in 2012 to gal. displaced per acre = $800 - $3,045

Appendix E: Solicitation of Input and Identification of Stakeholders

Approach

From the formal work Statement for this project:

"Dr. Lavigne will consult with a reference and resources group comprised of stakeholders/leaders in the biomass value chain of the North Country region, including but not limited to:

Ellen Burkhard and Judy Jarnefeld (NYSERDA),
Dr. Phil Hopke and Dr. Steven Bird (Clarkson University),
Pat Curran (Curran Renewables),
Tom Beck (ReEnergy),
Rob Riley and Joe Short (The Northern Forest Center),
Dan Mason (Director of the North Country Clean Energy Conference),
Dr. Ross Whaley, (Adirondack Landowners Association and former President SUNY ESF),
Greg Hale (Senior Advisor to the Chairman, Energy & Finance, Office of the Governor, St. of NY)
Sloane Crawford (Department of Environmental Conservation)
Joe Visalli
Phil Giltner (Deputy Commission NYS Ag and Markets)

… Project lead: Dr. Amanda Lavigne…..shall consult/collaborate with members of the reference and resource group on issues within their individual purviews."

The general approach to this report was to gather input, relevant data, and existing research and information from regional stakeholders in the biomass energy value chain. Very little original analysis and assessment is presented in this white paper. An iterative approach was taken, where solicitation of input and feedback from experts and stakeholders was followed by writing or revision, then further solicitation of input and feedback was made. This approach was taken to safeguard against the perspective of any one particular stakeholder from dominating the project. The information presented in this white paper is representative of a broader, regional, perspective, and not the individual perspective of the author or contract organization.

The work Statement for this project identifies a preliminary Reference Group of relevant stakeholders and experts for the author to consult and collaborate with. Throughout the course of the project, the author made contact with all members of the Reference Group except for Phil Giltner, Deputy Commissioner of NYS Ag and Markets.

The initial impetus for the project was provided by Greg Hale, senior advisor, Governor Cuomo's Chamber Energy Team. State-level market assessments for all renewable energy sectors were being performed by consulting firm Booz & Co.[79], and there was a desire to more specifically understand how the biomass energy market could be expanded in the North Country region. As funding would be channeled through NYSERDA, preliminary input was sought from NYSERDA representatives Ellen Burkhard and Judy Jarnefeld, with the addition of Mark Watson.

As per the allowance to expand the reference group specified in the work Statement, a more extensive list of regional experts and stakeholders was then solicited for input by the author via email (this list of stakeholders and the specific language of the solicitation are appended below). Based on the input and feedback received through the email solicitation, a series of conference calls was scheduled. These calls fell into three distinct categories: private calls requested by individuals, private calls requested by small groups from a single organization, and open-invitation conference calls with multiple stakeholders participating. Lists of all participants on all types of calls are below.

Following this period of collecting input from experts and stakeholders via email and conference call, a draft white paper was developed. As per the allowance to "consult/collaborate with members of the Reference Group on issues within their purview", sections of the draft white paper were sent to targeted individuals for further input and feedback. This feedback was then addressed by the author, and a final draft was prepared for submission to Reference Group members from NYSERDA for review. Input and feedback from NYSERDA was then addressed, and another round of input and feedback from targeted members of the Reference Group was sought. Final discussion and collaboration with NYSERDA then completed the project.

List of stakeholders initially contacted for input via email

This list was compiled from the ANCA biomass energy contact list, the North Country Clean Energy Conference Biomass energy attendee list, the personal biomass energy contact list of author Dr. Amanda Lavigne, and the proposed project Reference List (members highlighted):

[79] New York State Green Bank Business Development Plan (2013). NYSERDA report by Booz & Co., Sept. 3.

ADK Futures Project:
Jim Herman
Dave Mason

Barton & Loguidice Eng:
C. Manello

BioFERM:
Christine McKiernan
Biomass Thermal Energy Council (BTEC):
Ray Albrecht
David Dungate (BPP)
Charlie Neibling (NYBEA)
Casella Organics:
Jeff Brinck

CH4Biogas:
L. Toretta

Clarkson University:
Stephen Bird
Stephan Grimberg
Phil Hopke
Susan Powers

Comm. Power Network:
Sue Montgomery-Corey

Cornell Cooperative Extension Energy Outreach & Education:
Peter Hagar (Clinton Cty)
Richard Gast (Franklin Cty)
Jerry Loch (Jefferson Cty)
Joe Alm (Lewis Cty)

Cornerstone:
Jim Britell

Curran Renewables:
Kelli Curran
Pat Curran

Dept. of Env. Conservation:
Sloane Crawford

Essex Co. Planning Office:
Garrett Dague (Deputy Dir.)

Farm Credit East:
Tonya Egan
Howard Pope

International Paper:
P. Castonguay

Kraft Foods:
Bill Blunden

Larsen Engineers:
Ram Larsen

North Country School:
John Culpepper

Northern BioFuels:
John Dowd

Northern Forest Center:
Maura Adams
Rob Riley
Joe Short

NY Biomass Energy Alliance:
Alice Brumbach
Dan Conable (Cato Anltcs)
Rick Handley (Handley Asts)
Matt McArdle (Mesa Redct)
Charlie Neibling (BTEC)
Joe Visalli

North Country Clean Energy Conference:
Dan Mason
Ann Heidenreich
Melissa Hart (ANCA)
Jennifer Perry (ANCA, PSC)
Jon Montan (NYBEA)

ReEnergy:
Tom Beck
Sarah Boggess

Renewable Energy Resources:
John Bootle
Chris Flinn

St. Lawrence University:
Jon Rosales
Louise Gava

SUNY Canton:
Mike Newtown

SUNY Cobleskill:
Phil Hofmeyer

SUNY Environmental Science and Forestry:
Colin Beier
Tim Volk
Ross Whaley (ADK Landowners Assn.)

Tug Hill Commission:
John Bartow
Katie Malinowski
Arnie Talgo

University of Vermont:
William Keeton

The Wild Center:
Stephanie Ratcliffe
Kara Page

Yellow Wood Associates:
Jeff Forward
Samantha Dunn

ZeroPoint Clean Tech:
John Gaus

Stakeholders who provided direct input:

Maura Adams	Director, Northern Forest Center
John Bartow	Tug Hill Commission
Tom Beck	ReEnergy Holdings, LLC
Stephen Bird	Clarkson University
Sarah Boggess	Director of Communications and Governmental Affairs, ReEnergy Holdings LLC
John Bootle	Renewable Energy Resources
Alice Brumbach	NYBEA
Ellen Burkhard	NYSERDA
Eric Carlson	President and CEO, Empire State Forest Products Association
John Culpepper	Director of Facilities and Sustainability, North Country School/Camp Treetops
Sloane Crawford	NYS DEC
Kelli Curran	Curran Renewable Energy
John Dowd	Northern BioFuels
David Dungate	President, Bioenergy Project Partners; Biomass Thermal Energy Council
John Gaus	Zero Point Clean Tech
Jeff Forward	Richmond Energy Assts.; Senior Associate/Consultant, Yellow Wood Associates
Rick Handley	NYBEA, Handley and Associates
Jim Herman	ADK Futures
Joel Howard	Applied Biorefinery Sciences
Judy Jarnefeld	NYSERDA
Dave Mason	ADK Futures
Katie Malinowski	Tug Hill Commission
Matt McArdle	NYBEA, President, Mesa Reduction Engineering & Processing, LLC, Auburn NY
Christine McKiernan	BIO Ferm
Jon Montan	Director, North Country Clean Energy Conference, Retired St. Law. Cty Planner
Charlie Niebling	NYBEA, BTEC, Innovative Natural Resource Solutions LLC
Stephanie Ratcliffe	Executive Director, Wild Center
Rob Riley	Northern Forest Center
Joe Short	Northern Forest Center
Timothy Volk	Co-Director, SUNY Center for Sustainable and Renewable Energy
Mark Watson	NYSERDA

Stakeholders identified within proposed project Reference Group who indirectly contributed or contacted the author and were unable to contribute at the time:

Dr. Phil Hopke	Clarkson University
Dan Mason	North Country Clean Energy Conference
Greg Hale	New York State Energy office
Dr. Ross Whaley	Adirondack Landowners Association and former President SUNY ESF

Stakeholders Engaged Through Individual/Organizational Private Phone Calls:

Individual private calls:

John Dowd	Northern BioFuels
David Dungate	Bioenergy Project Partners

Organizational private calls:

NC Clean Energy Conference	Jon Montan, Dan Mason
Northern Forest Center	Maura Adams, Joe Short, Rob Riley
NY Biomass Energy Alliance	Alice Brumbach, Rick Handley, Matt McArdle, Charlie Neibling, Tim Volk
NYSERDA	Ellen Burkhard; Judy Jarnefeld; Mark Watson
ReEnergy	Sarah Boggess, Tom Beck

Stakeholders Engaged Through Participation in Group Conference Calls:

Maura Adams	Program Director, Northern Forest Center
John Bartow	Tug Hill Commission
Tom Beck	ReEnergy Holdings, LLC
Sarah Boggess	Director of Communications and Governmental Affairs, ReEnergy Holdings LLC
Alice Brumbach	NYBEA
Eric Carlson	President and CEO, Empire State Forest Products Association
Sloane Crawford	NYS DEC
Kelli Curran	Curran Renewable Energy
David Dungate	President, Bioenergy Project Partners; Biomass Thermal Energy Council
Jim Herman	ADK Futures
Dave Mason	ADK Futures
Jon Montan	Co-Director NCCEC, Retired St. Lawrence County Planner III
Charlie Niebling	Biomass Thermal Energy Council; Innovative Natural Resource Solutions LLC
Joe Short	Northern Forest Center
Timothy Volk	Co-Director, SUNY Center for Sustainable and Renewable Energy

Email sent by author on 8/21 soliciting stakeholder input:

Hello colleagues and friends –

I am writing to you as familiar names and faces in the biomass energy arena of the North Country.

Those of us with an interest in the biomass energy market of the region have a great opportunity before us:

Greg Hale (Senior Advisor to Richard Kauffman, the Chairman of NYSERDA and NYS Energy & Finance) who is working on the New York State Green Bank (Gov. Cuomo's proposal to support investment in clean energy projects in the State http://breakingenergy.com/2013/01/29/1-billion-green-bank-to-advance-new-yorks-clean-energy-economy/) has engaged the Adirondack North Country Association (ANCA) to develop a broad stroke report on the biomass energy market in the 7 county North Country region. I'm working with ANCA to develop this report.

The goals of this report are to:
1) Communicate the "State of the North Country" with respect to the existing biomass energy market;
2) Identify opportunities for market expansion and/or stabilization that will contribute to social, economic, and environmental goals;
3) Identify areas where addition research will be critical to ensuring that market expansion and/or stabilization align with social, economic, and environmental goals.

The turn-around time is very short, so the focus of my efforts has been to compile and summarize existing research and analysis.

This is a solicitation for input for the report.

Specifically, I am looking for stakeholder perspectives on where financing support through the Green Bank could result in regional economic benefit including job creation (direct and/or indirect) while meeting environmental goals/targets established by NYSERDA (for example, with respect to increasing efficiency and reduction in targeted atmospheric pollutants such as GHGs, PM, CO).

I am also interested in identifying the "who's who and what's what" of the existing biomass energy value chain.

If you would like to provide me with information to consider, please feel free to send web links, documents, summaries, personal Statements, etc. I would also be happy to schedule a phone call with you to discuss your thoughts/input on this report in more detail.

Thank you for your time and your effort.

Sincerely,
Amanda Lavigne

Amanda Lavigne, Ph.D.
Environmental Studies
St. Lawrence University
Canton, NY 13617
Office: 315-229-5890
Cell: 518-593-7200

Email sent by author on 8/29 inviting stakeholders to participate in discussion via conference call:

Hello colleagues -

Thank you to all who have provided input to the ANCA report on the North Country biomass energy market being prepared for the NYS Green Bank. Many of you expressed a desire to attend a meeting with multiple stakeholders to discuss this report. In response to those requests, I will be hosting 2 conference calls next week to facilitate this discussion.

This meeting invitation is for the second available call time 9/6 FRIDAY 10-11:30 am.

Call information = 916-558-7514 Passcode 2199414#

Please indicate your interest/availability for one or both times by responding to the meeting requests. If many cannot accommodate either time, I can work to open another opportunity for discussion.

Thank you for your time and help on this exciting project.

Amanda

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Environmental Studies
St. Lawrence University
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