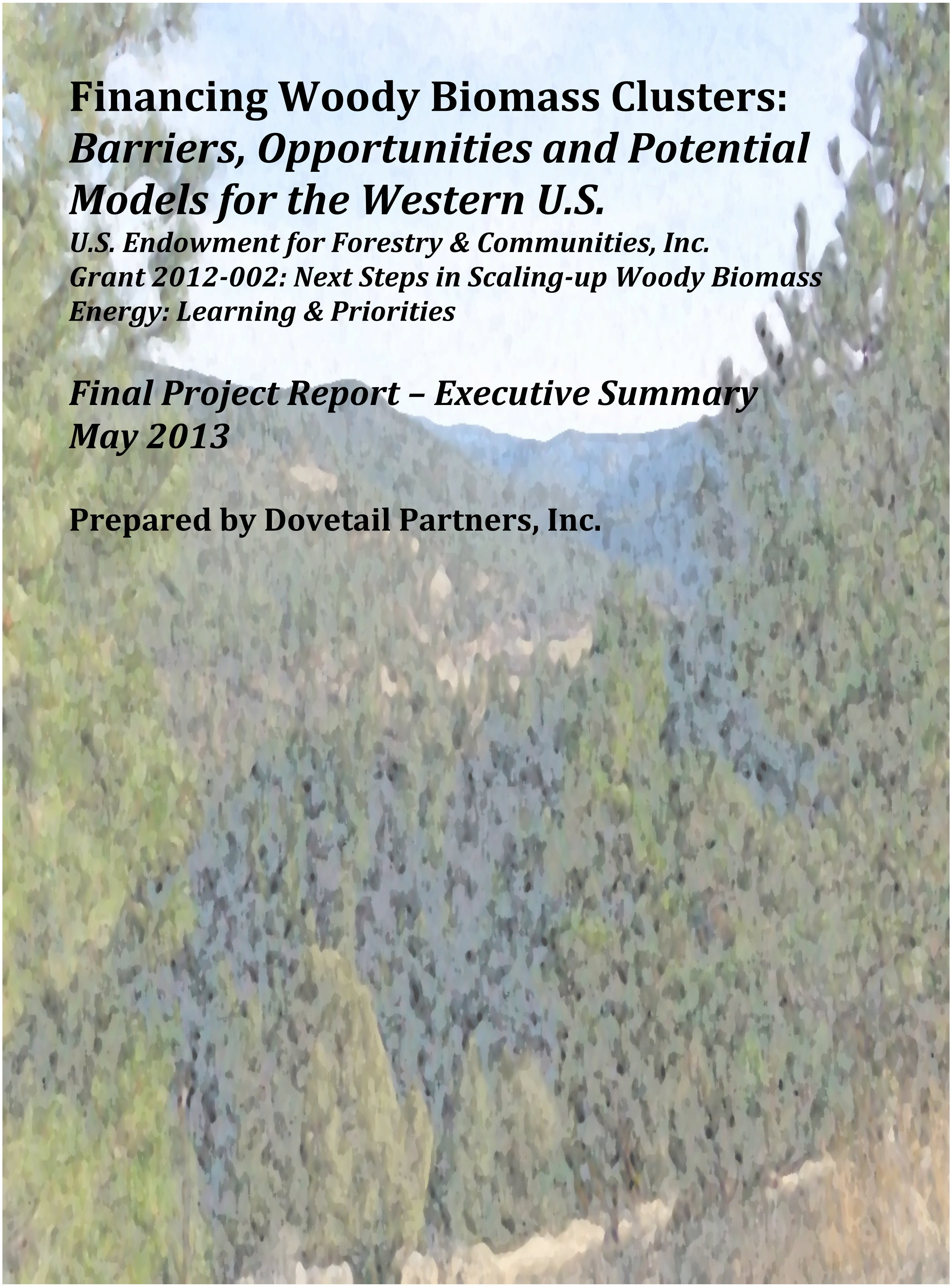
Financing Woody Biomass Clusters: *Barriers, Opportunities and Potential Models for the Western U.S.*

U.S. Endowment for Forestry & Communities, Inc.
Grant 2012-002: Next Steps in Scaling-up Woody Biomass Energy: Learning & Priorities

Final Project Report – Executive Summary
May 2013

Prepared by Dovetail Partners, Inc.



Financing Woody Biomass Clusters: ***Barriers, Opportunities and Potential Models for the Western U.S.***

Final Project Report – Executive Summary

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EXECUTIVE SUMMARY

Globally, wood and charcoal are the main energy sources for more than two billion people.[1] Production of energy using a renewable material such as wood can have positive impacts on the environment and the economy. It can also contribute to the nation's energy security in a significant way by reducing dependence on imported fossil fuels. Despite these positive impacts and abundant, in some cases overstocked, forest resources, woody biomass makes up only about 2% of primary energy production in the United States.[2]

To better understand how biomass energy could be more widely adopted in the U.S., this project focused on identification of factors contributing to success or failure of biomass energy projects. The findings were used to identify barriers to and opportunities for achieving more extensive use of such systems. This project focused on addressing four primary questions.

- What are the opportunities and barriers to wood-to-energy facilities?
- What are the lessons learned from existing projects?
- What are the potential impacts of non-traditional revenue sources (e.g., payments for environmental services)?
- What models could be economically viable for development of wood-to-energy facilities in a western public lands environment?

To address these questions, the project included a number of components that are summarized in this report and the appendices (see sidebar).

Project and Report Components

Appendix A: Interview Results
- Summary of interviews with 16 biomass experts representing various fields and located throughout the U.S.
- Identification of primary gaps and barriers to bioenergy growth
- Focus on economic factors, collaborative approaches, critical errors, and lessons learned

Appendix B: Survey Results
- Survey of 81 biomass operations, including 73 biomass energy facilities and 8 fuel producers/distributors
- Identification of key opportunities, barriers and lessons learned of current operations

Appendix C: Site Visit Report
- Visits to 15 biomass facilities located in New Hampshire, Maine, Vermont, and Oregon
- Collection of detailed information about specific operations to support case study development, financial analysis and model design

Appendix D: Non-Traditional Revenue Sources
- Summary of potential non-traditional revenues to support biomass energy development

Appendix E: Case Studies
- Case studies for 3 clusters located in Oregon and Maine
- Detailed information used to support financial analysis and model development

A first step of the project was to interview biomass experts representing various fields and located in different geographical regions of the U.S. Next, an extensive survey tool was developed to explore opportunities, barriers, and the financial conditions necessary to support wood-to-energy development. Survey data was gathered from 81 biomass energy

[1] Source: http://www.fao.org/sd/ruralradio/common/ecg/24516_en_factsheet3_1.pdf
[2] U.S. Department of Energy. 2012. Energy Information Administration. Energy Perspectives 1969-2011. (http://www.eia.gov/totalenergy/data/annual/perspectives.cfm)

operations (73 biomass energy facilities and 8 biomass fuel producers/distributors) across the northern region of the United States.

- Facilities surveyed represented over 2 Million tons of biomass fuel usage annually and ranged in size from 12 to 500,000 tons annually; the median consumption for the survey group was 367 tons annually
- Included were 5 Combined Heat and Power (CHP) facilities, 3 electricity-only facilities, and the balance were thermal facilities
- Fuel costs ranged from $140-189/ton for pellets and from $18/ton to $86/ton for non-pelletized biomass, depending on moisture content, size sort, and other factors
- Total project costs ranged from $36,000 to $80 million, with a median of $550,000

> **Primary Drivers of Wood Energy Investments**
>
> Heating cost savings
> - Savings versus heating oil, propane, electricity
> - Reduced fuel cost variability
> - Reduced disposal costs (e.g., utilization of waste wood for energy)
>
> Renewable and local
> - Reduced fossil-fuel dependence
> - Local economic development opportunities
> - Producing environmentally-preferable materials
>
> Productive use of woody biomass
> - Wildfire mitigation
> - Lower carbon and air emissions
> - Forest health improvements

The results of the interviews and surveys aided in the identification of key opportunities, barriers, and lessons learned from current operations as summarized on the following pages (also see Appendices A and B). The primary drivers in wood energy investments were also explored (see sidebar).

For many facilities, funding is a primary roadblock. Biomass energy systems may provide significant annual heating cost savings, but potential investors may desire a shorter payback than is realistic without low interest financing. Biomass energy systems may also be more capital intensive than alternatives. In many instances, there is broad recognition of the potential environmental and socio-economic benefits of adopting a biomass energy system, but the system still needs to make financial sense as an investment.

Following completion of the interviews and surveys, site visits were conducted at fifteen (15) biomass facilities located in New England and Oregon.

Site Visit Locations

- New Hampshire
  - Concord Steam
  - Crotched Mountain
  - New England Wood Pellet
  - Schiller Station
- Vermont
  - Camel's Hump School
  - McNeil Generating Station
  - A. Johnson Company
- Maine
  - Maine Energy Systems
  - Regional School Unit 74
  - Regional School Unit 18
- Oregon
  - Malheur Lumber Company
  - Grant County Regional Airport
  - Blue Mountain Hospital
  - Grant Union School
  - Oregon National Guard

A primary purpose of these visits was to gather additional and more detailed information about unique experiences related to project finance, clustered development, and best practices to inform the development of a model for wood-to-energy facilities and the writing of case studies (see Appendix C for the Site Visit Report). Case studies were developed for 3 clusters (15 facilities) located in Oregon and Maine. The case studies provide detailed information about four biomass projects in John Day, Oregon, seven sites that are part of the Oregon Army National Guard, and four retrofitted schools that are part of Maine's Regional School Unit 74. These case studies provide detailed examples and lessons learned that can be applied to other locations and used to assist in efforts to scale-up community-based biomass energy (see Appendix E for the case studies).

As a result of the interviews, surveys, site visits, case study development and other research, the following key barriers and opportunities related to the wider use of biomass energy systems were identified.

Barriers to widespread adoption of biomass energy systems:

- High upfront capital costs of biomass systems
- Lack of profitability among many biomass energy fuel producers
- Seasonality of heat demand
- Commodity nature of energy production (high competition/low margin)
- High biomass transportation costs
- End-user issues and customer concerns (e.g., Compared to fossil fuel systems, biomass energy systems are viewed as complex technology requiring large facility space, long lead times on supply, bulk delivery, and complex material handling.)
- Unreliable biomass fuel sources and variability in fuel quality
- Lack of harvesting/processing/transportation infrastructure and value-added industries in the Western U.S. compared to the Northeastern U.S.
- Risk averse operations in the forest products sector and/or interest in maintaining existing methods and technologies
- Uneven playing field in terms of energy policy incentives
- Underdeveloped non-traditional revenues to support biomass energy (e.g., payments for environmental services)

Opportunities for achieving wider use of biomass energy systems:

Address producer needs:

- Replicate models that combine biomass energy production with a sawmill or similar production facilities as a way to improve profitability (e.g., in regions with significant heating seasons, wood products demand in summer may be countercyclical to energy demand in winter)
- Foster further innovation in biomass energy fuel production within traditional lumber facilities, including the rethinking of how, why, and to what end wood products are produced. A new model of softwood lumber production may result that better addresses customer expectations of wood as a source of materials and "fuel" (e.g., modified handing and delivery systems, consistency, maintenance services, etc.).

- Support the continuation and expansion of collaborative planning processes, especially in regards to the western public lands setting, as an essential means of facilitating access to a sustainable biomass supply

Address customer and biomass facility needs:

- Improve how wood energy fuels are transported, delivered and stored. Current systems create significant costs to customers in terms of required storage space and material handling. Innovations in wood energy technologies, including advancements in wood torrefaction and liquid biofuels development, represent a long-term trend to create a more consistent primary combustion material that can be marketed for multiple uses.

Address environmental risks:

- Address regional wildfire risks and other forest health issues. The utilization of woody biomass can help in these efforts. Current approaches to forest fire mitigation and wildlife habitat enhancement activities on public lands in the Western U.S. are expensive. The woody biomass generated by restoration activities is often burned on site with significant environmental costs and without energy recovery. Diverting a portion of current dollars spent in forest fire mitigation and wildlife habitat restoration to biomass energy development could significantly reduce financial barriers to project development. Similar opportunities to connect forest health improvements with biomass energy investments also exist for other public lands as well as private land ownerships.

Financial Analysis, Model Development, and Non-Traditional Revenue Impacts

A key component of the project was to apply the lessons learned from the evaluation of existing facilities to develop a potential model for economically viable wood-to-energy facilities in a western public lands environment. The primary purpose was to gain an understanding of the financial performance of various systems and to identify opportunities to optimize investment potentials.

To support development of a model, a financial analysis was carried out focusing on the information provided by the fifteen facilities included in the case studies. Information about non-traditional revenue sources was included in the analysis to understand how they can impact wood energy investments.

Traditional financial analysis metrics were utilized to determine which sites represented favorable (or unfavorable) investments and to identify the factors that can make projects more (or less) financially attractive. The metrics in the analysis provide information that can be used by facility owners and potential wood energy investors to make biomass energy project decisions (see sidebar).

Financial Analysis Metrics

Facility owner perspective

- Internal rate of return
- Simple payback
- Cash flow analysis

Investor perspective

- Return on investment
- Annualized rate of return
- Sensitivity analysis of annualized rate of return

The results of the financial analysis led to development of an additional metric that can assist in an economic assessment of a bioenergy project's potential – the **Biomass Investment Multiplier (BIM).** Generally, the purchase of a biomass energy system involves a comparative analysis of forecast expenses to determine net benefit (savings). The BIM concept (see textbox) derives from the fact that there is an inherent relationship between the displaced energy in million Btu's (MMBTUs)[3] and the cost of investment (e.g., $). This relationship is fairly direct and inverse and is expressed as the Biomass Investment Multiplier (BIM). The lower the BIM ($/MMBTU), the better the investment. Through this analysis a suggested range for BIMs was developed that can act as a guide both to entities seeking to implement biomass energy systems and to investors attempting to define practical investment options. It should be noted that the BIM is just one tool to add to the financial evaluation toolbox, and one that can serve as a "rule of thumb" to guide discussion. A key value of the BIM lies in the fact that investors can develop a target BIM (or range of acceptable BIM values) based on their own expected returns. The BIM target(s) can be used to calculate capital budgets using displaced (replacement) or competing (new construction) fuel estimates.

The Biomass Investment Multiplier (BIM)

BIM = ($ Total project investment)/(Units of Displaced Fuel x Conversion Factor in Btu/unit) x 1 million)

BIM is expressed in $/MMBtu.

Example Calculation:
($1 million investment)/(44,000 gal of fuel oil x 138,000 Btu/gal) x 1,000,000 = $165/MMBtu

The BIM is calculated by dividing the actual Total Investment in dollars by the actual Current Cost for energy, normalized for energy source by converting to BTUs. The BIM ratio thus represents dollars invested per million BTUs displaced. By selecting a multiplier based on expected return, an investor (including operator) could calculate an acceptable investment amount for a project(s). This also allows an owner-operator to budget a project.

The graph on the next page (Figure 1) suggests that a BIM of $200 per MMBTU (hereafter BIM of 200) of displaced energy will likely provide a 10-year ARR of greater than 5 percent, assuming that inflation varies by source of energy. In this analysis, inflation rates of 1.5 percent for wood, 5.5 percent for oil, and 5.6 percent for propane and 2.0 percent for electricity were used to calculate long-term impacts on costs.[4]

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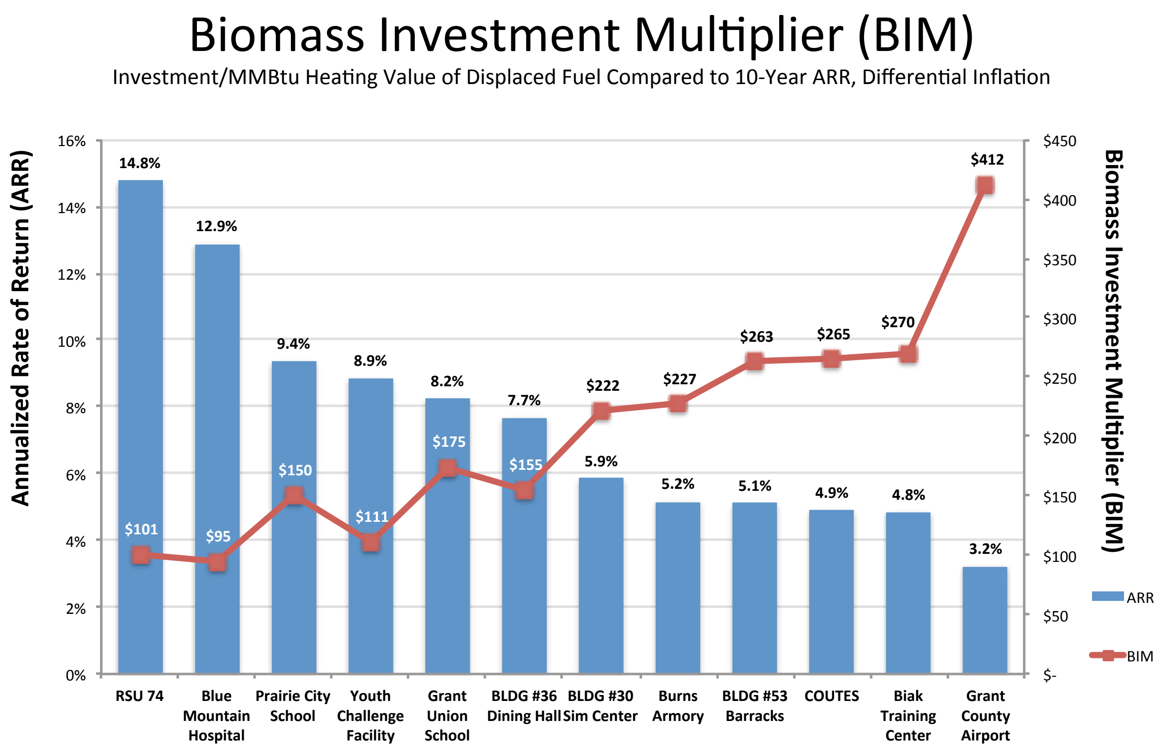
[3] Displaced energy is calculated using previous or recent year's actual volume of energy source used (e.g. oil or propane) converted to MMBTUs.

[4] U.S. Energy Information Administration for all inflation estimates except wood. Wood inflation estimate used for Oregon was provided by local expert Andrew Haden (www.Wisewood.US) and for Maine was provided by the Forest Service (D. Atkins).

Figure 1. Biomass Investment Multiplier (BIM)



Of the 15 facilities subjected to in-depth analysis, 9 were found to have a maximum BIM of 200 (Note: RSU 74 data in Figure 1 is for a cluster of 4 schools). In addition, our analysis suggests that five other facilities would likely meet this threshold with grants (or other forms of financial support) of about 20 percent of the investment costs.

Also evident in Figure 1 is that there are two major groupings based on investment potential. Tier one investments would be those with a BIM of 175 or less (anticipated return > 7%), and tier two would have a BIM of 275 or less (anticipated return > 4%).

In general, based on both this and previous studies, facilities seeking funds for the development of woody biomass energy systems with a BIM less than 100 need the least additional support in terms of grants and nontraditional revenues and are most likely to appeal to traditional financing methods (e.g., banks). Facilities with a BIM greater than 200 will likely need support in an amount greater than 10% of initial investment costs to be economically viable and attractive to funders. Facilities with BIMs between 100 and 200 likely represent the most attractive option for pooling (e.g., cluster development) and where additional relatively minor levels of support can make a big difference between success and failure.

The BIM metric was incorporated into the further development and evaluation of a potential model for wood-to-energy development. The base model of a potential wood-to-energy facility included the following assumptions:

- $25 million investment (for a single facility, group of sites, or bundled projects)
- 10% ($2.5 million) supporting grants, subsidies or other incentives, for a net cost of $22.5 million
- Wood pellets cost assumed at $165/ton current market
- Fuel oil costs were calculated at current cost of $3.36/gal and propane at $2.25/gal
- These alternative fuels (fuel oil and propane) were selected as the most common replacement or competitive option in rural areas of the Western U.S.

The financial performance of the model was evaluated using various BIM levels (see Table 1 below and additional tables in the report). An evaluation was also done that included a hypothetical scenario of a project receiving non-traditional sources of revenue (e.g., payments for environmental services).

Table 1. Summary of Financial Performance of Western U.S Biomass Energy Production with $25 Million Initial Investment Under Three Scenarios of Fuel Displacement (Oil, Propane, Hybrid) Using a BIM of 175 or 200 ($/MMBTU)

Summary Table 1 Wood Pellets	Oil-200	Prop-200	Hybrid-200	Oil-175	Prop-175	Hybrid-175
Displaced energy MMBTU	112,500	112,500	112,500	128,571	128,571	128,571
BIM ($/MMBTU)	200	200	200	175	175	175
Payback (Years)	11	11	11	10	10	10
Years to Positive Cash Flow	4	4	4	3	2	3
IRR 25 yrs. (%)	12.4%	12.6%	12.5%	13.8%	14.1%	14.0%
IRR 15 yrs. (%)	7.9%	8.2%	8.1%	9.8%	10.1%	10.0%
IRR 10 yrs. (%)	0.9%	1.1%	1.0%	3.2%	3.5%	3.4%
ARR 10 yrs. (%)	7.5%	7.5%	7.5%	8.2%	8.3%	8.3%
ARR 15 yrs. (%)	7.4%	7.5%	7.5%	8.1%	8.2%	8.2%
ARR 10 yr. 5% Disc rate	-2.3%	-2.2%	-2.2%	-1.0%	-0.8%	-0.9%
ARR 15 yr. 5% Disc rate	1.5%	1.6%	1.6%	2.4%	2.6%	2.5%

Overall, the results illustrate the potential to design biomass energy systems to fit desired financial performance targets. For example, calculated values in Table 1 show that, biomass energy is likely a good investment for owner/operators as compared against both propane and oil, assuming a BIM of less than 200. These projects can become an attractive investment for a broader pool of investors by combining nontraditional income sources (e.g., payments for environmental services) and cost reduction activities (e.g., forest restoration or wildfire risk reduction) to enhance the financial performance. In addition, clusters of projects can be identified that address the specific risk/reward parameters of funders or investors.

Findings and Recommendations

There are critical strategic, organizational, and financial issues that need to be addressed in order to realize the considerable potential of biomass energy. First and foremost, biomass energy needs to become an attractive and financially viable investment alternative. The following list of recommendations should be considered when seeking to optimize the investment value of a biomass energy project.

1. **Finance -** The era of biomass energy needing incentives via grants is waning and there is an opportunity to move toward market-based tools. Creative, non-grant financing methods such as long-term, low interest loans covering the upfront capital cost of projects can help take the risk out of biomass conversions and increase adoption.
   - For example, *Qualified Zone Academy Bonds* and *Qualified School Construction Bonds* have been effective in helping finance public school conversion projects.
2. **Project Development -** There are a number of best practices among the sample group that may increase efficiencies and minimize the costs of biomass projects in other locations.[5] They include:
   - Minimize capital costs and demand load by implementing energy efficiency improvements
   - Apply the 90/50 Rule for boiler sizing[6]
   - Utilize a modular design
   - Implement a collaborative, multi-site approach that includes standardized design and material reuse
   - Coordinate engineering and integrate work flow between multiple projects
3. **Aggregated and Clustered Development Practices -** There are advantages to utilizing a geographically clustered model *(where biomass fuel manufacturers and markets to utilize biomass are in close proximity to one another)* or a project aggregation approach *(where multiple biomass projects are carried out under the same financial bundle).*
   - Geographic and regional biomass clusters can improve delivery efficiencies by minimizing fuel transportation distances.
   - Project aggregation of multiple smaller biomass projects under the same financial bundle can lead to lower transaction costs associated with financing, achieve economies of scale, and increase attractiveness of biomass projects to lenders when compared to financing individual projects.
4. **Biomass Technology -** Investment to facilitate development of new, lower-cost, standardized biomass energy systems should be a priority, as the current capital costs can be very high as compared to competing systems. There is a need to provide lower costs along with the convenience of traditional fuel heating systems.

[5] For more detailed information about each of these strategies, see the RSU 74 case study, Appendix E.
[6] This guideline suggests that by designing the system to only meet 50% of peak load the system will likely be sufficient to address 90% of annual demand. The 90/50 rule is most applicable to retro-fit conversions where an old system can serve as the back-up for meeting peak load. Thermal storage systems can also be installed as an alternative to having to maintain two systems and may be more appropriate for new construction.

- Investment in biomass system development could be guided by following best practices used in the design of European biomass system technology and examining why customers choose to import European systems (e.g., identify the weaknesses and examine how they could be cost effectively addressed to better meet consumer needs). Improvements to automation, efficiency, and user-friendliness are key.

5. **Fuel Competitiveness -** Biomass project investments should focus on regions and locations that are dependent on propane, electricity, and heating oil.
6. **Fuel Supply -** Collaborations centered on National Forest restoration activities represent a best practice most relevant to public lands in the Western U.S. and can help provide access to a sustainable biomass fuel supply for users. One of the major benefits of National Forest collaborations, like the one centered on the Malheur National Forest, is that they can help prevent litigation that can hinder forest management activities.
   - There is a need to sufficiently fund and build the capacity of collaborative groups in the West so that they can continue their work and help make bioenergy fuel access self-sustaining. There also may be opportunities for biomass projects to benefit from collaborations that address other public and private lands.
7. **Fuel Delivery -** There is a need for new fuel distribution methods/models that are more customer-oriented (e.g., selling convenience) while also being profitable for distributors.
   - For example, biomass fuel distributors could learn from the experience of U.S. heating oil and propane distributors and/or from the European/Austrian model of delivery for successful best practices and models that could be emulated.
8. **Co-Benefits and Non-Traditional Revenue Sources -** There are significant co-benefits associated with biomass beyond simply using it to produce energy.
   - Creating value and demand for biomass products can lead to economic benefits in timber-reliant communities (job creation and local spending) in addition to diverse environmental benefits (reductions in wildfire threat, watershed improvements, air pollution reductions, improvements in forest health, and utilization of harvested forest residuals that would otherwise be left unused or burned in piles).
   - Some of the environmental co-benefits have existing or emerging markets associated with them (e.g., carbon offset markets) and incorporating these non-traditional revenue sources into project design can positively impact the financial performance of a biomass investment.
9. **Policy –** Policymakers in the U.S. should investigate and consider the biomass policies and incentives that have been adopted in several European nations.
10. **Regional Differences -** The regional issues associated with private land prominence in the Northeast versus public land dominance in the Western U.S. are very important (especially in regards to access to long-term, sustainable biomass supply).
    - Harvesting activities on private forestlands tend to shift according to markets. When markets drop off, private landowners are more reluctant to sell and activity declines. Whereas, activity on National Forests (and other public lands) tends to be more consistent from year to year. However, public lands management can be contested, which can significantly hinder harvesting activities.

SUMMARY

Based on interviews, survey results, site visits, case study development, and a financial analysis that involved biomass energy facilities across the United States, a number of barriers to wider adoption of biomass energy production in the U.S. were identified. Recognition that economic factors and financial concerns on the part of potential purchasers and investors are critical elements in biomass energy adoption and long-term success led to close examination of the economics of biomass energy production. The result was the development of the Biomass Investment Multiplier (BIM) as an additional tool for use in economic assessment of bioenergy project potential. This, in turn, was used to evaluate a number of model scenarios in which biomass energy was compared with more traditional energy sources. This evaluation illustrated how biomass energy investments compare with alternatives and opportunities to design financially competitive biomass energy systems. The availability of payments for environmental services can contribute to improving the financial performance of associated biomass energy systems. Applying biomass energy development as a more economically efficient wildfire risk reduction activity could provide opportunities to access non-traditional revenue sources.

The production of energy using a renewable material such as wood can have positive impacts on all three legs of the sustainability stool - society, the economy, and the environment. Biomass energy development has the potential to foster economic development, address wildfires and associated risks and costs, and reduce dependence on fossil fuels. There are critical strategic, organizational, and financial issues that need to be addressed in order to realize the considerable potential of biomass energy. First and foremost, biomass energy needs to become an attractive and financially viable investment alternative. This can be aided by strategically applying a wide array of market-based, as well as incentive and grant-based financial tools.

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