

Baling to Improve Transport of Biomass from Urban Areas

Forest Concepts, LLC

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Our objective is to enable more woody biomass produced in urban and suburban areas to be diverted to value-added uses including energy, bio-refineries, and engineered wood products.



Our solution is to bale woody biomass and brush to enable handling and transport through existing recycling infrastructure and on long-haul trucks.

Woody biomass is a core element of our nation's strategy to replace imported oil and natural gas with renewable resources. The Western Governors' Association January 2006 task force report concludes that 35% of the biomass available for power generation in the West must come from urban areas. If they could be transported at a reasonable cost, low grade logs and wood fiber from urban centers could provide raw materials for composite lumber and panel products.



SBIR Phase II Program Results

Baling – At least four research organizations in the U.S. and Canada developed design information and tested baler concepts during the 1978-1982 timeframe. All projects were discontinued when public funding stopped due to the end of the energy crisis. The "Virginia square baler" demonstrated the most promise for our application. It produced high-density bales that could be handled and transported on flatbed trucks. We carefully evaluated all earlier research, then conducted science and engineering research to develop additional design parameters. In 2007, we built a prototype baler to validate the data.



More than 100 bales of woody biomass were produced in our research and prototype balers. Materials ranged from fine shredded wood to firewood size chunks and stumps. Bale integrity was correlated to ten biomass type classifications.

The challenge facing potential users who gaze longingly at urban biomass sources is how to economically recover and transport the material from residential neighborhoods, urban centers and suburban landscapes to distant users.



Transportation – Bales that fit into the same transport infrastructure as agricultural hay and straw or recycled paper products would be much easier to deliver from urban centers to rural producers than if transported in chip vans or dump trucks. We evaluated transportability and loads with local delivery on 1-ton trucks and long haul on commercial flatbed truck-trailers.

That is where we at Forest Concepts come in. We are systems, equipment, technology, and business development specialists with the expertise to create a biomass recovery and logistics system that works.



We delivered baled woody biomass to five processors in Washington and Oregon. Delivery distances ranged up to 450 miles. All loads were tarped. All shipments were successful.

Our part of the solution is to develop effective methods and equipment to bale woody biomass into easily transported units.



End-user/customer handling and processing – We expect the primary early markets for urban woody biomass to be energy facilities, technical mulches, and compost facilities. Over time, processing improvements should enable use in engineered wood products and other more valuable applications. Our research bales were processed by compost and bioenergy cogeneration facilities.

During 2005, we completed a Phase I study of the current situation in the western U.S. We conducted two surveys and a number of site visits with community wildfire protection organizations in Washington, Oregon and California. We gratefully acknowledge the time and consideration of our respondents and hosts. Key findings include:

Based on our Phase I findings, an improved biomass collection and handling system would have the following functional characteristics:

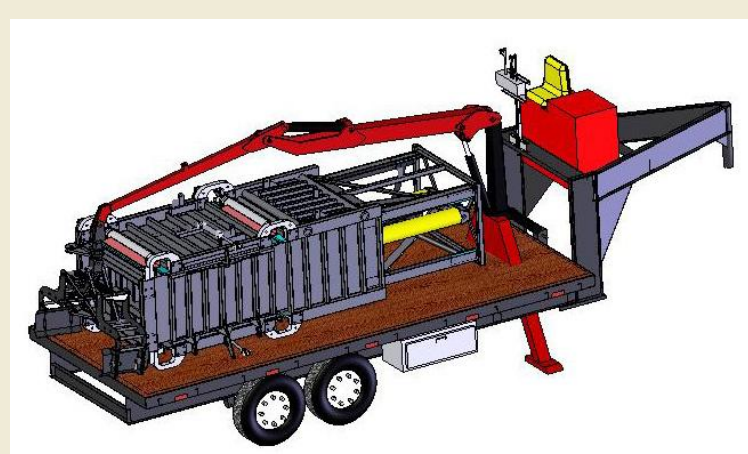
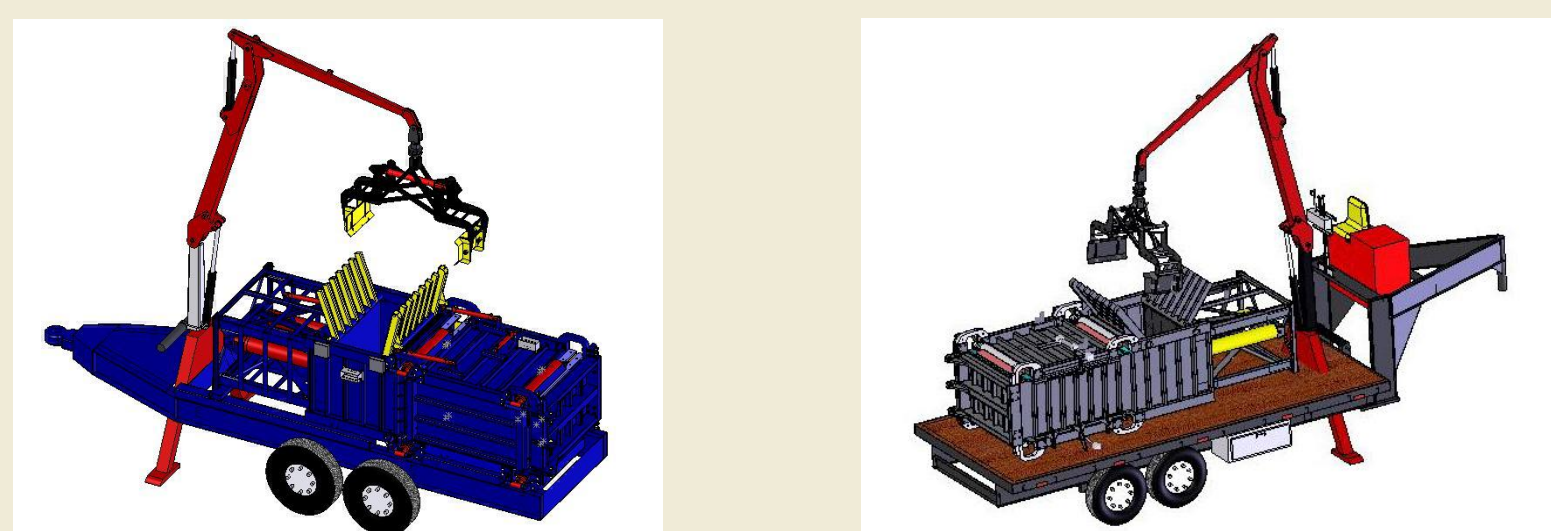
- Nearly all of the urban/suburban projects that we studied framed biomass handling as a disposal problem. Most of the volume is woody brush, branches and deadwood. Little of the volume is in roundwood poles and merchantable logs.
- Chipping with landscape/arborist chippers is currently the most cost-effective method to increase transport bulk-density. Piled biomass has a bulk density of approximately 2-3 lb/ft³ while chipped material has a bulk density of approximately 8-10 lb/ft³ (green weight).
- Chipping is noisy, dusty, and somewhat dangerous to accomplish in residential neighborhoods. The costs of chipper maintenance (knife sharpening /replacement) and fuel are higher than most users anticipated.
- Commingled chips have little or no market value, even to biomass energy facilities. Piece size must be preserved if there is to be any hope of value-added utilization.
- If the transport bulk density could be increased and shipping could be accomplished without specialized trucks or trailers, then more distant markets may be profitably reached.

- Minimize the noise, fossil fuel energy, maintenance and operating cost for equipment used in residential and suburban neighborhoods.
- Scale on-site equipment and operating simplicity to the needs of community FireSafe/FireWise organizations, public agencies, and small contractors.
- Preserve utilization opportunity by transporting larger piece sizes. The more intact the biomass is the more downstream opportunities are preserved.
- Shift size reduction to centralized locations to the extent practicable. Any size reduction should produce feedstock for particular value-added uses or customers.
- Package biomass into high-density form(s) that enable transport on standard flatbed trucks and trailers.

Baled woody biomass was processed through tub grinders, horizontal axis grinders and hybrid grinders by five cooperators. All reported that processing went well. In some cases the processing throughput is expected to increase significantly for baled versus bulk materials.

Project Outcomes:

- Specifications for logistics and equipment (i.e., a system or systems) that can efficiently and cost effectively deliver woody biomass from urban sites to distant users.
- Education and guidance to urban waste managers, recycling coordinators, local wildfire protection efforts and local communities about opportunities and methods for woody biomass utilization and value-added uses.
- Knowledge and data to equipment manufacturers that reduce the risk of designing woody biomass processing and baling equipment.



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