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"Fostering Community Self-Reliance through Renewable Energy"

A New Approach to Community-based Biomass Energy:
Combining New Technology with Appropriate-scale Design To Create Viable Biomass Electricity Generation at Scales of 2-10 MWe

Overview
In the next 18-24 months, a combination of forces may converge that will have huge consequences for both forests and forest dependent communities in the Western US. The rapidly escalating risk of catastrophic wildfires and the dramatic increases in energy costs are creating an intense interest in the exploitation of forest biomass. Advocates in both the public and private sectors are promoting biomass energy development as a potential solution to both high forest fuel loads and dramatic energy price inflation.

Unfortunately, most solutions being proposed contain one or more of the following serious flaws:

Proposed designs rely on old technologies that may be inefficient, expensive, and in many cases substantial polluters. If successfully implemented, these projects will chain local communities and their surrounding forests to these deficiencies for the financial or mechanical lifetime of the proposed plants—often 20-30 years.

The scale of technologies being proposed are often far beyond the financial reach of local communities or entrepreneurs, impeding their progress toward energy self-reliance and security.

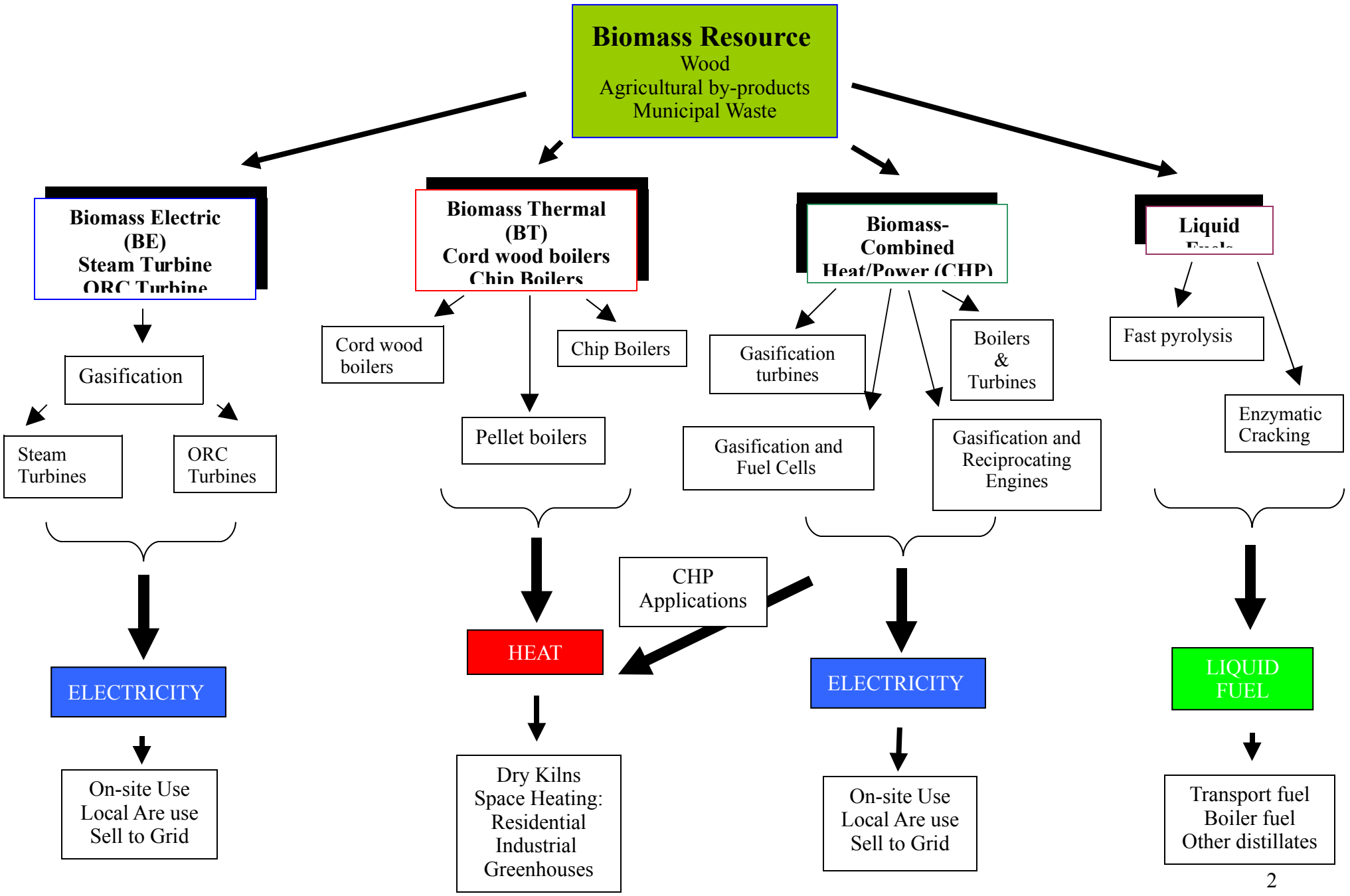
The financial structure of the development agreements frequently centralize economic benefits in a single location, displacing employment and enterprise opportunities in rural and tribal communities and transferring most of the financial returns to non-local shareholders.

The scale of most proposed biomass projects will likely create demands for forest resources that are not sustainable over the long-term.

In response to these serious deficiencies and potential threats to the well-being of rural and tribal forests and communities, Community Energy Systems was founded to develop and implement community-based biomass projects that work for the benefit of such places. Community Energy Systems development team has some of the leading experts in engineering, plant design, power sales agreements, community directed project financing, and community-based enterprise development who have collectively developed a new approach to community-based biomass project development.

The Three Branches of Biomass Opportunity
The broad use of the term "biomass" in recent months has resulted in both confusion and misunderstanding about the types of biomass opportunities that exist and the very different strengths and challenges associated with each. Figure 1 provides a graphic depiction of the three major branches of biomass energy opportunities—biomass to heat (thermal—BT), biomass to electricity (BE), a hybrid of these two approaches called Combined Heat/Power (CHP) facilities, and biomass to liquid fuels (BF).

Biomass Technology/Output Options



Strengths and Challenges of Each Approach

Biomass Thermal—The combustion of wood to create heat is obviously a form of biomass utilization that has been common for millennia. A major development in wood heating over the past several decades has been the development of wood boilers that can burn cord wood, pellets or chips a efficiencies approaching 80%. Each of these three different types of wood boilers has applications for which it is well suited, and conversely situations in which it is not an appropriate option. While many earlier approaches to wood boiler heating utilized high pressure steam, most current applications focus on the much more efficient and cost effective use of liquid as the heat delivery medium.

Biomass Electric—Recently there have been presentations and discussions in many forestry venues discussing the combustion of wood to create electricity. Most of the proposals for this type of application rely on conventional steam turbine technology that typically operates at efficiencies of 20% or less. For this reason, the use of wood exclusively for electricity has rarely been viable at scales of less than 20-30MWe. Plants of this size can require annual biomass harvests from as much as 30,000-40,000 and upfront investments of $40-$70 million. For this reason, only a few areas have developed significant stand-alone biomass to electricity plants, and these were generally only viable in situations in which developers could negotiate long-term above-market power purchase agreements.

Combined Heat/Power—A much more common approach to biomass utilization has been the development of "cogeneration" or "combined heat/power plants in which conventional steam turbine technology was augmented by capturing the otherwise lost heat and use of this heat in industrial applications, most commonly dry kiln's at sawmills. Even with these ancillary heat load uses, these plants generally do not attain efficiencies of greater than 30-35%. However, this is a substantial improvement of stand-alone plant efficiency and is currently the only potential approach to smaller-scale biomass-to-electric facilities.

Biomass to Liquid Fuels—Although not widely demonstrated in commercial settings as of now, it appears that there will soon be substantial technical breakthroughs in the development of wood-to-liquid fuels. Unlike conventional ethanol production which is primarily produced from sugar rich sources such as corn, wood fuel extraction requires a much more aggressive processing that can breakdown cellulosic materials. The development of fast-pyrolises shows substantial progress for coming on line within the next 2-3 years.

Community Energy Systems Unique Approach

Community Energy Systems has expertise in both biomass thermal and the development of biomass combined heat/power facilities. Given the enormous inefficiencies of stand-alone biomass electric plants and the requirements for large, often unsustainable fuel requirements, CES does not recommend this approach in most rural and tribal community settings.

Biomass Thermal

CES works in partnership with the Biomass Energy Resource Center (BERC) in Montpelier, Vermont in the assessment and development of biomass thermal projects. BERC was one of the first organizations in the country to develop a broad-based program to work with public schools and other institutional facilities to develop and install wood boiler heating systems. BERC has coordinated the design and installation of over 20 such systems in its 15 year history. BERC was also a part of the national steering committee that helped establish the "Fuels-for-Schools" program. This program has

assisted nearly two dozen public schools in assessing or installing wood boiler systems. These systems have generally had a 6-8 year payback.

CES can work with either public or private entities to do initial feasibility assessments, system specifications, and project management or system installation and operations. CES has preferred technologies that can work at scales of as small as 30-50,000 sq ft facilities up to large district heating systems with heating loads serving several hundred thousand sq ft of heating area.

Biomass Combined Heat/Power Plants

One of the areas in which CES is truly unique is its approach to biomass combined heat/power facilities. CES's approach includes the following characteristics.

1. Plants is designed to maximize earnings while substantially reducing fuel supply risk

By designing biomass plants to fall under the 10MWe threshold, CES can frequently generate comparable revenues with a significantly smaller plant. In Oregon for example, by making use of existing pre-negotiated PURPA rates, a 9.8 MWe plant, for example, could generate as much revenue as the larger 14 MWe plant but require less capital expenditure and far less wood resource. However, it may be possible and preferable to reduce plant size even further to build initial operations around known local loads while building in the capacity for expansion as both fuel supplies and ancillary thermal demands are secured.

2. Fuel needs are reduced and the value of purchased material increased

By reducing the size of the plant while maintaining comparable revenues, the plant operators can afford to pay more for the fuel resource if necessary to support forest restoration and stewardship operations. This substantially reduces the uncertainties associated with fuel supply as outlined above. The type of gasification system the CES design employs efficiently converts a wide range of materials including municipal solid waste and agricultural residues. This fuel flexibility reduces dependency on any particular source of supply and its market fluctuations.

3. Proved technologies with higher efficiencies are used

CES's plant will incorporate reliable technologies including biomass gasification which provide both substantially higher operating efficiencies and are compatible with emerging technologies that can be added into the plant system as they prove economically viable (see below). We expect to achieve plant efficiencies of at least 35%.

4. Emissions are reduced

Given the urgent requirement to reduce pollutant emissions, we believe it is essential to incorporate technology that will anticipate increasingly stringent emissions standards. The gasification technology mentioned above produces significantly less pollution than conventional boiler technology. CES is also working with the Oregon Department of Energy and the Climate Trust to engage Greenfuel Technologies Corporation to integrate a new system for carbon and nitrogen oxides removal from power plant stack emissions. If this technology is incorporated, the Lake County facility would immediately qualify for carbon credits (the current proposal would require a five year monitoring period prior to qualification). Please refer to the attached diagram, "gasification.pdf".

5. Expansion and technology upgrades are accommodated

A valuable feature of the gasification technology CES intends to incorporate into the plant design is its compatibility with promising new technologies that are approaching market readiness and will

substantially improve fuel conversion efficiency. Examples of these emerging technologies we expect to be market ready within 2-3 years include fuel cells, fast pyrolysis biofuel conversions and several low temperature boiler technologies. With the addition of some of these emerging systems—and integration of related thermal load users--later plant efficiencies could be substantially higher that the 30% currently projected. This once again reduces fuel supply uncertainty while increasing net operational revenues.

6. The CES project enhances community capacities

An important distinction in CES's proposal is the option of creating an ownership structure that provides for enhanced community participation. CES will develop a program that could gradually transfers ownership of the wood energy facility to a local community or tribe should it be interested in more direct control. CES is currently working with the National Biomass Energy Resource Center to create an Energy Services Company (ESCO). This entity can assume initial ownership and management of facilities while building capacity for eventual local ownership of community-based power facilities.

The Community Energy Systems Team

Plant Design—Power Engineering

Power Engineering is an employee owned design firm with offices in the US, Europe, and South America, and 30 years experience in power systems development. Their combustion power plants average 92-94% up time, while their geothermal plants achieve 98-99% availability. At its specified 80% availability, the previously proposed plant would have nearly three times as much down town time as the comparable PE combustion plants. The superior PE availability represents an 18% increase in power sales revenue.

Plant Siting and Permitting

CES will work closely with Lakeview Resource Initiative and Stoel Rives in completing all of the necessary plant siting and clearances. CES President Brett KenCairn was a part of the initial organizing group for Lakeview Resources Initiative and has worked extensively with public agencies and private interest groups in Oregon and throughout the West on forestry and economic development projects.

Project Financing

Stoel Rives has been retained to develop each project phase's financing package and recruit suitable investment partners. Stoel Rive's Ted Bernhard has extensive experience in the development and successful project financing of renewable energy projects throughout the Northwest.

Project Construction

The construction partner will be selected through competitive bids. CES has established relationships with several industrial construction firms with extensive experience in turn-key biomass plant construction.

Facility Ownership and Operations

As noted above, CES is working with the National Biomass Energy Resource Center in the development of an energy services company (ESCO) ownership/management structure for a number of community-based power projects currently under development. To the extent that additional operational services are required, vendors will be selected by competitive bid

Conclusion
Significant opportunities do exist for rural and tribal communities to utilize biomass energy as both an economic development and ecological stewardship tool. Successfully using this tool will require new approaches that are based less on the interests and demands of large non-local corporate interests and more on the coordination of local resources, expertise and strategically placed technical and financial assistance. Community Energy Systems is dedicated to providing these services in a way which can build both the economic and ecological assets of rural and tribal communities through biomass facilities that support long-term stewardship of local resources.

For additional information, please contact Community Energy Systems through either of the following individuals:

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Gasification of Biomass Yields Fuel Sourcing Agility and Maximizes Power Production Efficiency