SCHATZ ENERGY RESEARCH CENTER

Request for Qualifications: Torrefaction Research and Development Partner

Issued on June 23, 2014 by the Schatz Energy Research Center/Humboldt State University Sponsored Programs Foundation (SERC/HSUSPF).

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1. SUMMARY AND BACKGROUND

The Schatz Energy Research Center/Humboldt State University Sponsored Programs Foundation (SERC/HSUSPF) is seeking a torrefaction research and development (R&D) partner to participate in a biomass energy R&D project sponsored by the U.S. Department of Energy (DOE). The torrefaction partner will join a team of academic researchers, forestry professionals, equipment manufacturers, research engineers, and government agency staff in a research effort to quantify the environmental and economic benefits of near-forest or in-woods woody biomass utilization.

The "Waste to Wisdom" (W2W) project is a $7.45 million, three year project funded by the US DOE's Biomass Research and Development Initiative (BRDI). The W2W project includes Principal Investigators from twelve universities, companies, and government agencies across the western states, with expertise ranging from feedstock extraction, to energy conversion, to economic and life cycle assessments.

The project budget for the torrefaction partner is approximately $400,000 and there is a cost share requirement of $320,000 that the torrefaction partner must bring to the project. Further information regarding eligible cost share items can be found in Attachment 2 to this Request for Qualifications (RFQ).

2. SCOPE OF WORK

Over the course of the three year period (September 30, 2013 – September 29, 2016) of performance, the selected torrefaction partner will complete the following tasks and a detailed scope of work will be developed during the contracting phase of the selection process described in Section 3 below.

1. Provide a torrefaction unit for project use with a capacity of approximately one ton per hour, that is suitable for field operation and sufficiently durable so that it can be transported and protected from the elements during outdoor operation;
2. Transport and set up the torrefaction unit at a field site to be determined, preferably in northern California;

3. Work closely with SERC engineers to test the unit with multiple feedstocks and collect operational data that can be utilized to evaluate its utility for field operations;
4. Scale up torrefaction unit, preferably to a production rate of approximately 20 tons per day;
5. Operate the scaled up torrefaction unit at a forest operations site and provide performance data;
6. Collaborate with researchers and engineers to support the economic, market, and life cycle analyses that will be conducted under the project.

3. SELECTION PROCESS

The process under which a torrefaction partner will be selected is as follows:

1. This document comprises the RFQ seeking information from interested torrefaction partners;
2. Responses to this RFQ will be reviewed by an evaluation committee and a shortlist of interested torrefaction partners will be developed;
3. A Request for Proposals (RFP) will be sent to the shortlist of interested torrefaction partners;
4. Responses to the RFP will be evaluated by a selection committee;
5. The best fit for the torrefaction partner will be contacted and a site visit to their facility will be arranged. Other respondents will be provided a status update at this time.
6. Pending the results of the site visit, SERC, the HSUSPF, and the US DOE will finalize scope of work and contract documents.

4. QUALIFICATIONS

The qualifications being sought for the torrefaction partner are as follows:

1. Five years of experience in torrefaction R&D
    a. Demonstrated progress towards mobile operations and energy and water efficient process design;
    b. Qualifications of primary personnel that indicate expertise in torrefaction technology;
2. Currently able to demonstrate a working torrefaction unit;
3. Able to demonstrate a working torrefaction unit in a field setting by June 30, 2015;
4. Able to demonstrate a working scaled-up torrefaction unit in the field by June 30, 2016;
5. Able to comply with US DOE accounting and progress reporting requirements.

5. REQUIRED ELEMENTS IN RESPONSE TO THIS RFQ

In order for submissions to this RFQ to be considered responsive, the following items must be included:

- Letter of Interest (LOI)
    - Describe your company's interest in the project;
    - Describe how you see your company contributing to this project;

  - Include a statement commenting on your company' s intention and timeline with regards to commercializing your torrefaction technology
  - Summarize any questions or concerns you have or clarifications you would like addressed to provide a full proposal in response to the forthcoming RFP.
- Statement of qualifications
  - Provide an introduction to your company/institution;
  - Describe your company's experience in the field of torrefaction
    - Specifically comment on your companies abilities relative to Items 2, 3, and 4 listed in Section 4 above,
    - Describe any experience your company has with mobile operations and/or energy and water efficient process design if applicable;
  - Provide 1 page resumes for key personnel;
  - List any relevant publications your company has been involved in;
  - Provide a list of relevant projects your company has been involved in.

6. RFQ EVALUATION CRITERIA

Responses to this RFQ will be evaluated base on the following rubric:

Criterion	Weight
Responsiveness (items requested were provided)	20%
Qualifications	50%
Potential contribution to project as demonstrated in the Letter of Interest	30%

7. EVALUATION SCHEDULE

The Schedule associated with the RFQ is as follows:

Milestone	Date
RFQ issued	Monday June 23, 2014
Deadline for questions	Thursday July 3, 2014, 5:00 PM
Response to all questions received issued	Monday July 7, 2014, 5:00 PM
Deadline for responses to RFQ	Thursday July 10, 2014, 5:00 PM
Selection of shortlist announced**	Wednesday July 23, 2014
RFP Issued**	Friday July 25, 2014

** These dates are subject to change based on review time requirements. Respondents will be notified of schedule changes.

8. QUESTIONS AND COMMENTS ON THIS RFQ

Questions and comments on this RFQ are welcome and the deadline for questions is shown in Section 7 above. One document responding to all questions received will be issued by email to the distribution list for this RFQ. Please direct all questions and comments to the Schatz Energy Research Center **via email or by phone** at the contact information below.

David Carter, P.E.
Senior Research Engineer
Schatz Energy Research Center
Email: david.carter@humboldt.edu , Phone: (707) 826-4306

9. CONFIDENTIALITY

If your response contains confidential information please contact SERC well in advance of the response due date to discuss this and, if necessary, arrange for a non-disclosure agreement to be executed.

The following attachments are included for reference:

1. Statement of Project Objectives, Humboldt State Sponsored Programs Foundation, Waste to Wisdom: Utilizing forest residues for the production of bioenergy and biobased products
2. Cost Share Information

STATEMENT OF PROJECT OBJECTIVES

Humboldt State University Sponsored Programs Foundation

Proposal Title:
Waste to Wisdom: Utilizing forest residues for the production of bioenergy and biobased products

A. PROJECT OBJECTIVES

The research goal is to produce bioenergy and biobased products through effective utilization of forest residues using biomass conversion technologies (BCTs) and optimized biomass operations logistics. The outcomes from this project will make positive impacts on the forest and energy sectors by 1) reducing US dependence on imported energy, 2) improving the environment, and 3) promoting economic development in rural, forest-dependent communities in the Western United State (U.S.). Improving the utilization of forest residues through the use of BCTs will affect environmental, economic, and social policies throughout the U.S. The production of torrefied pellets and briquettes can strengthen our nation's economy by incorporating renewable fuels into current bioenergy and coal-fired energy facilities. In addition, converting forest residues into biochar is an effective strategy for carbon sequestration and improving the productivity of forest soils while reducing the incidence of catastrophic wildfires. This project will result in important changes in forest management and energy policy in the U.S.

B. PROJECT SCOPE

Our interdisciplinary research team, consisting of academics, business professionals and land managers, will work together to: 1) conduct field-based experiments to develop innovative tools and systems that improve the economics, accessibility, and production of quality feedstocks from forest residues, 2) develop and test field-deployable BCTs to evaluate the economic feasibility of commercialization of BCTs for the production of biochar, torrefied pellets, and briquettes, and 3) perform macro- and micro-economic and life cycle analyses to quantify the life cycle economic and environmental benefits of utilizing forest residues with BCTs for the production of bioenergy and bioproducts.

The expected outcomes of this project are (1) improved feedstock collection, processing, and transportation, (2) incorporation of baler technology for pre-processing forest residues, (3) improved production and mobility of biochar, torrefaction and briquette machines, (4) improved knowledge of the application of biochar to forest soils in terms of productivity and water holding capacity, (5) new knowledge quantifying the Life Cycle Assessment (LCA) of BCT products, (6) improved knowledge of economic and marketing potentials for BCT products, and (7) increased awareness and education of the production of bioenergy and biobased products. The study will directly affect the development of new policies and strategies in minimizing greenhouse gas emissions through the substitution of biomass for petroleum based fuels. This will improve overall economic development throughout the United States. The proposed research will also provide public outreach and technology transfer to relevant industries.

C. TASKS TO BE PERFORMED

Task 1.0 Project Management

Reports and other deliverables will be provided in accordance with the Federal Assistance Reporting Checklist following the instructions included therein. Additional deliverables will be submitted as required including attending Department of Energy (DOE) sponsored Peer Review meetings every other year, and occasional attendance as requested and reasonable at DOE sponsored seminars or workshops.

- **Organization completing task**: Han-Sup Han, P.I., Forest Operations Research Laboratory, HSU.
- **Deliverable:**
  Reports specified in the FS 4600.2 including but not limited to the quarterly Research Performance Progress Report (RPPR), the SF-425 Federal Financial Report, and any Conference papers/proceedings.

Task 2.0 Feedstock Development

Subtask 2.1. Sorting and arranging forest residues.

- **Organization completing task**:
  Forest Operations Research Laboratory, HSU
  Forest Concepts Inc.
  Peterson Pacific Corporation, Steve Morris Logging LLC, and Green Diamond Resource Company
- **Description of task:**
  Field-based experimental studies will be applied to develop strategies and methods of sorting and arranging forest residues resulting from timber harvesting and fuel reduction thinning operations. The goal is to develop a feedstock supply that 1) minimizes contamination, 2) facilitates comminution, 3) improves moisture content control, and 4) improves handling and transportation efficiency.
- **Milestones:**
  - Develop a strategy and methods for sorting and arranging forest residues
- **Deliverables**
  - Research article published in a peer reviewed journal
  - Presentation at professional workshops and conferences

Subtask 2.2 Densification of loose forest residues

- **Organization completing task**:
  Forest Concepts Inc.
  Forest Operations Research Laboratory, HSU.
  Steve Morris Logging LLC, Green Diamond Resource Company, and Oregon State University
- **Description of task:**
  The forest residue baler will be upgraded and operated by sub-recipient Forest Concepts on forest residues generated on a Green Diamond Resource Company harvest conducted

by sub-recipient Steve Morris Logging. The time-study and bale transport density data will be collected by Forest Concepts and Oregon State University, and subsequently incorporated into forest operations economic models by Oregon State University.

- **Milestone:**
  - An evaluation of the Forest Concepts forest residue baler.
- **Deliverables**
  - Research article published in a peer reviewed journal
  - Presentation at professional workshops and conferences
  - Preliminary specifications for logging slash balers

Subtask 2.3 Production of high quality feedstocks through comminution.

- **Organization completing task:**
  Forest Operations Research Laboratory, HSU.
  College of Forestry, Oregon State University
  Peterson Pacific Corporation, Steve Morris Logging LLC, and Green Diamond Resource Company
- **Description of task:**
  Processing equipment and equipment configurations that produce high quality feedstock material, with low contamination, and suitable for use with BCTs will be identified. Additionally, the effects of different chipping knives and grinding bits on the size distribution of feedstock material, as well as fuel consumption and productivity of the different comminution (i.e. chipping and grinding) technologies will be examined.
- **Milestone:**
  - Analysis of the most efficient and highest quality equipment configuration suitable for use with BCTs
- **Deliverables:**
  - Research article published in a peer reviewed journal, including recommendations for effective comminution methods of forest residues
  - Presentation at professional workshops and conferences

Subtask 2.4 Controlling feedstock size with new screening technologies.

- **Organization completing task**:
  Forest Operations Research Laboratory, HSU
  Forest Concepts Inc.
  Peterson Pacific Corporation, Steve Morris Logging LLC, and Green Diamond Resource Company
- **Description of task:**
  This task will develop new screening technologies, such as on-site screener with grinders. It will focus on the effects of incorporating these innovations into biomass operations with the intention of improving product quality and meeting BCT particle size requirements.
- **Milestone:**
  - New screening technology analysis

- **Deliverables:**
    - Research article published in a peer reviewed journal, summarizing the information on new screening technologies to produce quality feedstocks from forest residues
    - Presentation at professional workshops and conferences

Subtask 2.5 Centralized biomass feedstock operations supporting BCTs.

- **Organization completing task:**
  Forest Operations Research Laboratory, HSU
  College of Forestry, Oregon State University
  Peterson Pacific Corporation, Steve Morris Logging LLC, and Green Diamond Resource Company
- **Description of task:**
  Various opportunities associated with the centralized biomass feedstock operation will be explored with an emphasis to attain a balanced system configuration that can be integrated with BCTs. This task will also examine pre-hauling forest residues from harvest sites to centralized processing areas using modified dump trucks or hook-lift trucks.
- **Milestones:**
    - Analysis of centralized biomass feedstock operation systems.
- **Deliverables:**
    - Research article published in a peer reviewed journal, suggesting methods and strategies for forest residue recovery operations linked to BCTs
    - Presentation at professional workshops and conferences

Subtask 2.6 Integration of BCTs with landscape level planning and transportation logistics.

- **Organization completing task**:
  College of Forestry, Oregon State University
  Forest Operations Research Laboratory, HSU.
  Forest Concepts Inc.
  College of Forestry, Oregon State University
- **Description of task:**
  Develop a landscape scale feedstock development scheduling model to optimize the selection of production pathways including collection, comminution, product upgrading (moisture control, densification, and in-woods biomass conversion), and transportation in order to identify pathway streams using BCTs that maximize net revenues while reducing adverse environmental impacts.
- **Milestone :**
    - A landscape scale feedstock development scheduling model knowledge.
- **Deliverables:**
    - Software for decision support
    - Research article published in a peer reviewed journal
    - Presentation at professional workshops and conferences

Task 3.0 Biofuels and Biobased Product Development

Subtask 3.1 Scale up and development of field ready unit.

- **Organization completing task**:
  Schatz Energy Research Center, HSU
  Biochar Solutions Inc.
- **Description of task:**
  This task will involve the adaptation and scale up of BSI's biochar production unit to be a field-ready, high production system. Activities will include: 1) Develop field applicable tooling and parts box, 2) add a laser-level based reactor loading control to reduce operator effort, 3) develop and add stack fire protection to improve fire safety in field operations, 4) double throughput capacity of the unit.
- **Milestone:**
  - Field-ready biochar production unit.
- **Deliverables:**
  - Documentation showing tooling and parts box, laser-level based reactor loading control, and fire protection improvements
  - Documentation of throughput capacity improvement

Subtask 3.2 Testing and field deployment.

- **Organization completing task**:
  Schatz Energy Research Center, HSU
  Biochar Solutions Inc.
- **Description of task:**
  BSI will work with SERC to collect operational performance data that can be used to evaluate opportunities for stand-alone energy operation. BSI will set up the biochar unit for operation and evaluation at a site in northern California. The unit will be tested with multiple feedstocks. BSI will provide input to TASK 4 team members to support the economic analysis, market analysis and life cycle assessment tasks.
- **Milestone:**
  - Analysis of field ready biochar unit performance.

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- **Deliverables:**
  - Performance data summary for multiple feedstocks.

Subtask 3.3 Adapt unit for field readiness and operation.

- **Organization completing task**:
  Schatz Energy Research Center, HSU
  Renewable Fuel Technologies
- **Description of task:**
  RFT will upgrade their one ton per day torrefaction unit to be suitable for field operation. This will include modifications to maintain operability and durability during unit transport and to provide protection from the elements during outdoor operation. RFT will work closely with SERC to collect operating data that can be used to evaluate opportunities for field operation.

- **Milestone:**
  - Upgraded RFT torrefaction unit suitable for field operation.
- **Deliverables:**
  - Documentation of field modifications.
  - Performance data summary.

Subtask 3.4 Scale up unit, and field deployment and testing.

- **Organization completing task**:
  Schatz Energy Research Center, HSU
  Renewable Fuel Technologies
- **Description of task:**
  RFT will set up their 1 ton per day torrefaction unit at a field site in northern California and will test it using multiple feedstocks. RFT will work to scale up their 1 ton per day unit to approximately 20 tons per day of torrefied product. RFT will test the larger unit at a forest operations site. RFT will provide input to TASK 4 team members to support the economic analysis, market analysis and life cycle assessment tasks.
- **Milestone (Yearly level):**
  - Analysis of the RFT torrefaction field unit
- **Deliverables:**
  - Performance data summary for 1 ton per day unit using multiple feedstocks.
  - Performance data summary for 20 ton per day unit.

Subtask 3.5 Assess suitability of commercial briquetting unit for field operation.

- **Organization completing task**:
  Schatz Energy Research Center, HSU
  Pellet Fuels Institute
- **Description of task:**
  PFI will assess the adaptability of existing commercial biomass briquetting equipment for use in or near woods to process a variety of forest residue types. Forest residues that have been comminuted in the woods will be processed into densified briquettes and torrefied wood will be tested as a feedstock for briquetting. Modifications needed for field operation will be evaluated and/or implemented. PFI will address issues inherent in creating a field deployable system, including the necessary support and material handling equipment.
- **Milestone :**
  - Analysis of field deployed briquetting system for forest residues.
- **Deliverables:**
  - Summary report documenting field readiness of briquetting equipment.

Subtask 3.6 Operate a briquetting unit.

- **Organization completing task**:
  Schatz Energy Research Center, HSU
  Pellet Fuels Institute
- **Description of task:**
  PFI will operate a briquetting unit at a site in Oregon during Year 1 to create sample outputs. During this period, PFI will work closely with SERC to characterize the

electricity and heat/fuel drying requirements of a briquetting unit. During Year 2, PFI will set up a briquetting unit for operation at a field site and/or will implement similar alternative densification strategies aimed at improving the economics of forest biomass utilization. PFI will provide input to TASK 4 team members to support the economic analysis, market analysis and life cycle assessment tasks.

- **Milestone :**
  - Operation of a briquetting unit at a field site.
- **Deliverables:**
  - Analysis results from briquetting samples.
  - Summary of energy requirements for briquetting unit.

Subtask 3.7 Assess potential to utilize waste heat for energy input needs.

- **Organization completing task**:
  Schatz Energy Research Center, HSU
- **Description of task:**
  SERC will evaluate the potential to recover waste heat in a usable format to provide energy input needs for BCTs. This will include generation of electrical power from available waste heat. Energy sources to be considered include waste heat from the BCTs and other onsite sources such as waste heat from diesel powered grinders used for biomass comminution. Once potential heat sources have been measured, the team will assess several heat-to-electricity generation technologies, including organic Rankine cycle generators. SERC will also assess the ability of respective biomass conversion devices to utilize power generated from the heat-to-power devices, in particular load-following performance and the need for thermal or electrical energy storage. As part of this assessment, SERC will identify, procure, and test under laboratory conditions a heat-to-electricity generation technology such as an organic Rankine cycle (ORC) generator. The objective of this testing will be to assess the potential for using ORC or a similar technology to produce electrical energy for the BCTs using the BCTs' own waste heat. SERC will also perform detailed measurements or estimations of electricity requirements for the three biomass conversion technologies.
- **Milestone:**
  - Analysis of waste heat recovery and use.
- **Deliverables:**
  - Summary of waste heat sources.
  - Performance data summary for heat-to-electricity generation technology.

Subtask 3.8 Test BCTs using a variety of residue types and tree species under field conditions.

- **Organization completing task**:
  Schatz Energy Research Center, HSU
- **Description of task:**
  Working in close collaboration with the TASK 3 technology partners, SERC will coordinate and lead activities associated with comparative testing of the BCTs at forest operations sites using target feedstocks. SERC's role will include instrumentation, in-field monitoring, and analysis of system performance. The measurements will include input fuel and output product characteristics, fuel and product mass flow rates, emissions,

and auxiliary energy use. Economic and operational parameters such as labor utilization, operation and maintenance needs, and startup and shutdown requirements will also be recorded.

- **Milestone:**
  - Forest operation data analysis.
- **Deliverables:**
  - Performance data summary of BCT operation at forest operations sites using various feedstocks.

Subtask 3.9 Perform data analysis and report on outcomes.

- **Organization completing task**:
  Schatz Energy Research Center, HSU
- **Description of task:**
  SERC will assemble, organize, and archive data collected from field operation of the BCTs. SERC will analyze the data and prepare internal reports comparing measured parameters for the different forest residue types and species studied. Analysis of the data, including modeling of hypothetical operating scenarios, will be used to draw conclusions about the ability to operate commercial scale BCTs independent of outside energy sources, feasibility of product scale-up, and potential for operating equipment jointly to make the best use of energy and material outputs. SERC will take primary responsibility for contributing material on TASK 3 outcomes for the final project report.
- **Milestone:**
  - Forest operation data analysis
- **Deliverables:**
  - Summary reports for TASK 3 project activities.
  - TASK 3 project outcomes for final project report.

Task 4.0 Biofuels and Biobased Product Development Analysis

Subtask 4.1 Construct a suite of economic models to evaluate the equipment being studied in Tasks 2 and 3.

- **Organization completing task**:
  USDAFS Forest Products Laboratory
- **Description of task:**
  Develop a suite of fully integrated economic models that will be used to evaluate the equipment. The models will calculate break-even costs including not only capital and operating costs, but also taxes, loans, and inflation. Where market prices do not exist, the break-even costs will be used as transfer prices for raw materials produced by the equipment in TASK 2 going to TASK 3.
- **Milestone:**
  - Develop, and test a costing model for the processing and pre-hauling equipment being developed in TASK 2 and for the biomass densification systems being developed in TASK 3.

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- **Deliverables**
  - Research article published in a peer reviewed journal
  - A suite of economic models that will be available on the project website for use by anyone with an interest in the technologies.
  - Presentation at two professional workshops and conferences

Subtask 4.2 Develop a tool to evaluate the value of biochar as a soil amendment for carbon sequestration.

- **Organization completing task**:
  USDAFS Rocky Mountain Research Station
  University of Washington (UW)
  University of Washington Forest Resources LCA

- **Description of task:**
  Determine the ecological sustainability of using biochar as a soil amendment, focusing on its impact on forest soils (including carbon storage and nutrient cycling), forest productivity, water quality and air quality. An investigation into the avoided costs and environmental benefits needed in the social and environmental analysis will also begin. Biochar application field studies will support estimation of carbon sequestration potential.
- **Milestone (Yearly level)**
  - Evaluation of soil amendment treatments and estimate carbon sequestration potential
- **Deliverables:**
  - Submit research article to peer reviewed publication
  - Present research results at scientific conference

Subtask 4.3 Identify an input/output modeling protocol to assess economic impacts of BCTs on local communities.

- **Organization completing task**:
  University of Washington

- **Description of task:**
  The goal of this research is to assess the economic impacts associated with the production of biochar using forest-based materials in communities within Northern California. We will do so by reviewing, developing and using economic models that consider the industries and institutions that make up the economic and social infrastructure in the region. We will examine existing input/output (I/O) models, construct preliminary social accounting matrices (SAM) that contain the intra-industry relationships as well as the capital and labor flows needed to assess the impact from biochar production and review and adapt computable general equilibrium models that utilize the SAMs to analyze taxes, subsidies and programs that may promote or constrain activities related to biochar. I/O analyses produce multipliers useful in impact analysis. The multipliers quantify how an external change in final demand will impact the various suppliers of production factors and producers of commodities in the economy. Several assumptions limit the applicability of I/O analysis results, including the inability of these models to capture internal investment activities funded by tax dollars from government accounts. SAM analysis expands the intra-industry transaction tables to include all monetary flows from

sources to recipients. A SAM analysis permits describing the economic activity in those areas where proposed biochar facilities may be constructed. A general equilibrium modeling framework may also be developed.

- **Milestone:**
  - An estimate community impacts of biochar production
- **Deliverables:**
  - Submit research article to peer reviewed publication
  - Present research results at scientific conference

Subtask 4.4 Develop air quality indicators.

- **Organization completing task**:
  Rick Bergman, P.I., USDAFS Forest Products Laboratory
- **Description of task:**
  The team will develop a series of location-specific macro-level indicators of changes to air quality as a result of adoption of the proposed technologies. Economic quantification of the effects of the changes to air quality will be conducted using region-specific indicators. The variables in this section will be populated using secondary regional data as well as primary data from experimental sites based on coordination with the work being done for the life cycle analysis.
- **Milestone:**
  - An LCA model for test technologies.
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- **Deliverables:**
  - Final results will be published in a peer-reviewed journal;
  - Results to be presented at scientific conference and via webinar

Subtask 4.5 Conduct a workshop to explore stakeholder perceptions.

- **Organization completing task**:
  University of Washington

- **Description of task:**
  The team will continue its analysis looking into market assessment and strategic marketing plans accompanied by the analysis of the avoided costs of producing biochar from forest residuals. The evaluation of social impacts will continue with stakeholder workshops to better understand perceptions and to help guide technology development.
- **Milestone:**
  - Market assessment and marketing recommendations.
- **Deliverables:**
  - Conduct workshop with stakeholders regarding use of forest residuals for biochar
  - Publish results of stakeholder analysis and strategic market analysis in peer reviewed publication
  - Present results in scientific conference/workshop

Subtask 4.6: Evaluate impacts on forest soils.

- **Organization completing task**:
  USDAFS Rocky Mountain Research Station

University of Washington

- **Description of task:**
  Evaluate if and where biochar applications are appropriate on forest soils. Determine if biochar can be used to remediate mine soils. Field trials will be established on either single tree or larger plots (depending on the availability of biochar) and pre- and post-biochar application soil and vegetation samples will be collected. In addition, lab and/or field trials on select mine land sites will be used to determine the feasibility of biochar being used to absorb heavy metals.
- **Milestone:**
  - Field tests the use of biochar to improve soil characteristics on (1) a thinning study and (2) a mine site.
- **Deliverables:**
  - Installation of field sites that can be used for long-term assessments of the application of biochar to forest sites.
  - Publication on forest responses to biochar vs. other treatments
  - Publication of lab leaching study from mine site
  - Publication of field mine restoration activities.

Subtask 4.7 Conduct life cycle analyses.

- **Organization completing task**:
  University of Washington Forest Resources LCA
  Woodlife Consulting/ Biochar Processing LCA
  USDAFS Forest Products Laboratory

- **Description of task:**
  Forest Resources LCA:
  - Develop a cradle to gate life cycle inventory (LCI) for the forest collection processes and conduct a life cycle assessment (LCA) using the TRACI method (Bare 2002) to determine comparable environmental footprints from harvest to utilization.
  - Provide relative comparisons of fuels (torrefied wood and pellets) to fossil fuel sources and biochar to the alternative of prescribed burning and/or wildfire impacts as federal land management tools.

  Biochar Processing, Torrefied Wood, and Densified Briquettes LCAs:
  - Develop a cradle to gate life cycle inventory (LCI) for biochar processing, torrefied wood, and densified bruquettes and then conduct life cycle assessments (LCAs) using the TRACI method (Bare 2002) to determine comparable environmental footprints from harvest to utilization.
- **Milestone:**
  Forest Resources LCA:
  - LCA and spatial analysis for Biochar Processing Torrefied Wood, and Densified Briquettes LCAs
- **Deliverables:**
  - Life cycle inventory and assessment report for forest resources and biochar production including upload of data into the US LCI database.

- Comparative analysis of forest resource impacts from wildfire and biochar production processes including sensitivity analysis of predicted impacts on forest productivity of biochar application.
- Life cycle inventory and assessment report for torrefied wood products and densified briquettes production including a comparison with the impacts of fossil fuels and an upload of data into the US LCI database.

Subtask 4.8: Evaluate impacts on fire reduction and forest productivity gains.

- **Organization completing task**:
  University of Washington
  USDAFS Rocky Mountain Research Station
- **Description of task:**
  Use GIS spatial analysis linked to inventory data to evaluate the potential feedstock volumes available from selected forest types on federal lands in the western region under a range of sustainable management scenarios and relative to transportation distance, natural disturbance impacts and economic variables.
- **Milestone :**
  - Development of an integrate spatial database with inventory to support comparative forest resource LCA analysis
- **Deliverables:**
  Spatial database as underpinning of comparative LCA for forest resources that examines the tradeoffs between planned biochar production and wildfire impacts

Subtask 4.9: Conduct outreach.

- **Organization completing task**:
  Forest Business Network
  Forest Business Network
- **Description of task:**
  Conduct outreach and public relations efforts over the duration of the project through the creation of 1) online platforms (website, social media, press releases), 2) advertising inventory (banner ads, classified advertising, email marketing, event sponsorship), 3) stakeholder engagement opportunities (webinars, conference speaking engagements), and 4) annual team meetings in order to promote the free flow of information between team members. The goal is to increase awareness about bioproducts and the project's objectives, and to help influence positive perception of environmental products.
- **Milestone:**
  - Website and social media systems creation.
- **Deliverables:**
  - Professionally-built website and social media pages, marketing materials, blog posts on a popular forest products industry website, webinars, photo galleries, press releases.
  - Presentation at professional workshops and conferences.

PROPOSED PROJECT TIMELINE TABLE

	Technical Area/Milestone/Quarter	Year 1				Year 2				Year 3			
		1	2	3	4	1	2	3	4	1	2	3	4
	TASK 2: Feedstocks Development												
Biomass Collection & Processing	Sorting, arranging, comminution, and screening	■	■	■		■	■	■			■	■	
	Feedstock quality control experiments		■	■			■	■			■		
	Biomass operations integrated with MBCTs		■	■			■	■	■	■	■	■	
Baler Technology	Productivity & cost analysis for forest residue types		■	■	■		■	■					
	Development of baling system logistics				■		■	■	■	■	■	■	
Transportation Analysis & Feedstock Scheduling	Biomass feedstock pathway development & analysis	■	■	■	■								
	Landscape scale feedstock scheduling model		■	■	■	■	■	■					
	Model validation & modification						■	■	■	■	■	■	
	TASK 3: Biofuels and Biobased Products Development												
Biochar production	Scale up and develop field ready unit	■	■	■	■	■	■	■	■	■	■		
	Operate biochar unit at BSI headquarters in CO				■								
	Operate biochar unit at field site in CA					■	■	■	■				
Pyrolysis / Torrefaction	Adapt unit for field operation	■	■	■	■								
	Operate unit at field site in CA					■	■	■	■				
	Scale up unit									■	■	■	■
Briquetting	Assess suitability of briquetting unit for field use	■	■	■	■	■							
	Operate briquetter and assess energy requirements				■	■	■	■	■				
BCT analysis	Assess waste heat use, test heat-to-electric technology	■	■	■	■	■	■	■	■				
	Field test of BCTs with various feedstocks					■	■	■	■				
	Data analysis			■	■	■	■	■	■	■	■	■	
	TASK 4: Biofuels and Biobased Products Development Analysis												
Economics & Marketing	Integrated engineering/costing models	■	■	■	■	■	■	■	■	■	■		
	Market assessment & strategic marketing plans					■	■	■	■	■	■	■	
	Economic impacts of biochar carbon sequestration					■	■	■	■	■	■	■	■
Social Impacts	Social, environmental and economic evaluation				■	■	■	■	■	■	■	■	
	Avoided cost analysis		■	■	■	■	■	■	■	■	■		
Ecological sustainability	Site selection & field trial: Biochar application	■	■	■	■	■	■	■					
	Lab testing: Chemical analysis of soil samples					■		■	■	■	■		
	Greenhouse: Seed germination, biochar application				■	■		■	■	■	■	■	
Life Cycle Analysis	LCI/LCA development			■	■	■	■	■	■	■	■	■	■
	Spatial analysis and inventory assessment			■	■	■	■	■	■	■	■	■	
Outreach & Information Dissemination	Website development, technology transfer & marketing	■	■	■	■	■	■	■	■	■	■	■	■
	Organize webinars, workshops and conferences		■	■			■						■
	Periodic evaluation & submission progress report		■		■		■		■		■		
	Annual project meeting at HSU				■				■				■
	Submission of final report												■

APPENDIX B – Cost Share Information

Cost Sharing or Cost Matching

The terms "cost sharing" and "cost matching" are often used synonymously. Even the DOE Financial Assistance Regulations, 10 CFR Part 600, use both of the terms in the titles specific to regulations applicable to cost sharing. DOE almost always uses the term "cost sharing," as it conveys the concept that **non-federal share is calculated as a percentage of the Total Project Cost.** An exception is the State Energy Program Regulation, 10 CFR 420.12, State Matching Contribution. Here "cost matching" for the non-federal share is calculated as a percentage of the federal funds only, rather than the Total Project Cost.

How Cost Sharing Is Calculated

As stated above, cost sharing is calculated as a percentage of the Total Project Cost. Following is an example of how to calculate cost sharing amounts for a project with $1,000,000 in federal funds with a minimum 20% non-federal cost sharing requirement:

Formula: Federal share ($) divided by Federal share (%) = Total Project Cost
Example: $1,000,000 divided by 80% = $1,250,000

Formula: Total Project Cost ($) minus Federal share ($) = Non-federal share ($)
Example: $1,250,000 minus $1,000,000 = $250,000

Formula: Non-federal share ($) divided by Total Project Cost ($) = Non-federal share (%)
Example: $250,000 divided by $1,250,000 = 20%

See the sample cost share calculation for a blended cost share percentage below. **Keep in mind that FFRDC funding is DOE funding.**

What Qualifies For Cost Sharing

While it is not possible to explain what specifically qualifies for cost sharing in one or even a couple of sentences, in general, if a cost is allowable under the cost principles applicable to the organization incurring the cost and is eligible for reimbursement under a DOE grant or cooperative agreement, then it is allowable as cost share. Conversely, if the cost is not allowable under the cost principles and not eligible for reimbursement, then it is not allowable as cost share. In addition, costs may not be counted as cost share if they are paid by the Federal Government under another award unless authorized by Federal statute to be used for cost sharing.

The rules associated with what is allowable as cost share are specific to the type of organization that is receiving funds under the grant or cooperative agreement, though are generally the same for all types of entities. The specific rules applicable to:

- Institutions of Higher Education, Hospitals, and Other Nonprofit Organizations are found at 10 CFR 600.123;
- State and Local Governments are found at 10 CFR 600.224;
- For-profit Organizations are found at 10 CFR 600.313.

In addition to the regulations referenced above, other factors may also come into play such as timing of donations and length of the project period. For example, the value of ten years of donated maintenance on a project that has a project period of five years would not be fully allowable as cost share. Only the value for the five years of donated maintenance that corresponds to the project period is allowable and may be counted as cost share.

Additionally, DOE generally does not allow pre-award costs for either cost share or reimbursement when these costs precede the signing of the appropriation bill that funds the award. In the case of a competitive award, DOE generally does not allow pre-award costs prior to the signing of the Selection Statement by the DOE Selection Official.

Following is a link to the DOE Financial Assistance Regulations. You can click on the specific section for each Code of Federal Regulations reference mentioned above.

USDA Cost Sharing

The non-Federal share of the cost of a research or development project under BRDI shall be not less than 20 percent of the total allowable cost. The non-Federal share of the cost of a demonstration project under BRDI shall be not less than 50 percent of the total allowable cost. The total project cost is equal to the sum of Federal funds requested and non-Federal matching funds. Cost share should be calculated as illustrated above. Applicant cost share must come from non-Federal sources unless otherwise allowed by law. Refer to Section VI.B.2 for costs allowable on NIFA grants. **USDA-NIFA DOES NOT PERMIT BLENDING OF RESEARCH AND DEVELOPMENT WITH DEMONSTRATION COST SHARE.**

DOE Financial Assistance Regulations:
http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=98a996164312e8dcf0df9c22912852b0&rgn=div5&view=text&node=10:4.0.1.3.9&idno=10

As stated above, the rules associated with what is allowable cost share are generally the same for all types of organizations. Following are the rules found to be common, but again, the specifics are contained in the regulations and cost principles specific to the type of entity:

(A) *Acceptable contributions.* All contributions, including cash contributions and third party in-kind contributions, must be accepted as part of the recipient's cost sharing if such contributions meet all of the following criteria:

(1) They are verifiable from the recipient's records.

(2) They are not included as contributions for any other federally-assisted project or program.

(3) They are necessary and reasonable for proper and efficient accomplishment of project or program objectives.

(4) They are allowable under the cost principles applicable to the type of entity incurring the cost as follows:

(a) *For-profit organizations.* Allowability of costs incurred by for-profit organizations and those nonprofit organizations listed in Attachment C to OMB Circular A–122 is determined in accordance with the for-profit costs principles in 48 CFR Part 31 in the Federal Acquisition Regulation, except that patent prosecution costs are not allowable unless specifically authorized in the award document.

(b) *Other types of organizations.* Allowability of costs incurred by other types of organizations that may be subrecipients under a prime award is determined as follows:

(i) *Institutions of higher education.* Allowability is determined in accordance with OMB Circular No. A-21 -- Cost Principles for Educational Institutions

(ii) *Other nonprofit organizations.* Allowability is determined in accordance with OMB Circular A-122, Cost Principles for Non-Profit Organizations

(iii) *Hospitals.* Allowability is determined in accordance with the provisions of 45 CFR Part 74, Appendix E, Principles for Determining Costs Applicable to Research and Development Under Grants and Contracts with Hospitals

(iv) *Governmental organizations.* Allowability for State, local, or federally recognized Indian tribal government is determined in accordance with OMB Circular No. A-87, Cost Principles for State, Local, and Indian Tribal Governments

(5) They are not paid by the Federal Government under another award unless authorized by Federal statute to be used for cost sharing or matching.

(6) They are provided for in the approved budget.

(B) *Valuing and documenting contributions*

(1) *Valuing recipient's property or services of recipient's employees.* Values are established in accordance with the applicable cost principles, which mean that amounts chargeable to the project are determined on the basis of costs incurred. For real property or equipment used on the project, the cost principles authorize

depreciation or use charges. The full value of the item may be applied when the item will be consumed in the performance of the award or fully depreciated by the end of the award. In cases where the full value of a donated capital asset is to be applied as cost sharing or matching, that full value must be the lesser or the following:

(a) The certified value of the remaining life of the property recorded in the recipient's accounting records at the time of donation; or
(b) The current fair market value. If there is sufficient justification, the Contracting Officer may approve the use of the current fair market value of the donated property, even if it exceeds the certified value at the time of donation to the project. The Contracting Officer may accept the use of any reasonable basis for determining the fair market value of the property.

(2) *Valuing services of others' employees.* If an employer other than the recipient furnishes the services of an employee, those services are valued at the employee's regular rate of pay, provided these services are for the same skill level for which the employee is normally paid.

(3) *Valuing volunteer services.* Volunteer services furnished by professional and technical personnel, consultants, and other skilled and unskilled labor may be counted as cost sharing or matching if the service is an integral and necessary part of an approved project or program. Rates for volunteer services must be consistent with those paid for similar work in the recipient's organization. In those markets in which the required skills are not found in the recipient organization, rates must be consistent with those paid for similar work in the labor market in which the recipient competes for the kind of services involved. In either case, paid fringe benefits that are reasonable, allowable, and allocable may be included in the valuation.

(4) *Valuing property donated by third parties.*

(a) Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the cost sharing or matching share must be reasonable and must not exceed the fair market value of the property at the time of the donation.

(b) Normally only depreciation or use charges for equipment and buildings may be applied. However, the fair rental charges for land and the full value of equipment or other capital assets may be allowed, when they will be consumed in the performance of the award or fully depreciated by the end of the award, provided that the Contracting Officer has approved the charges. When use charges are applied, values must be determined in accordance with the usual accounting policies of the recipient, with the following qualifications:

(i) The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of comparable space and facilities in a privately-owned building in the same locality.

(ii) The value of loaned equipment must not exceed its fair rental value.

(5) *Documentation.* The following requirements pertain to the recipient's supporting records for in-kind contributions from third parties:

(a) Volunteer services must be documented and, to the extent feasible, supported by the same methods used by the recipient for its own employees.

(b) The basis for determining the valuation for personal services and property must be documented.

SAMPLE COST SHARE CALCULATION
FOR BLENDED COST SHARE PERCENTAGE (*FOR DOE PROJECTS ONLY*)

The following example shows the math for calculating required cost share for a project with $2,000,000 in Federal funds with four tasks requiring different Non-federal cost share percentages:

Task	Proposed Federal Share	Required Federal Share %	Required Cost Share %	Non-federal
Task 1 (R&D)	$1,000,000	80%		20%
Task 2 (R&D)	500,000	80%		20%
Task 3 (Demonstration)	400,000	50%		50%
Task 4 (Outreach)	100,000	100%		0%
	$2,000,000			

Federal share ($) divided by Federal share (%) = Task Cost

Each task must be calculated individually as follows:

Task 1
$1,000,000 divided by 80% = $1,250,000 (Task 1 Cost)
Task 1 Cost minus federal share = Non-federal share
$1,250,000 - $1,000,000 = **$250,000 (Non-federal share)**

Task 2
$500,000 divided 80% = $625,000 (Task 2 Cost)
Task 2 Cost minus federal share = Non-federal share
$625,000 - $500,000 = **$125,000 (Non-federal share)**

Task 3
$400,000 / 50% = $800,000 (Task 3 Cost)
Task 3 Cost minus federal share = Non-federal share
$800,000 - $400,000 = **$400,000 (Non-federal share)**

Task 4
Federal share = $100,000
Non-federal cost share is not mandated for outreach = **$0 (Non-federal share)**

The calculation may then be completed as follows:

Task	Proposed Federal Share	Federal Share %	Required Non-federal Cost Share $	Required Non-federal Cost Share %	Total Project Cost
Task 1	$1,000,000	80%	$250,000	20%	$1,250,000
Task 2	500,000	80%	125,000	20%	625,000
Task 3	400,000	50%	400,000	50%	800,000
Task 4	100,000	100%	0	0%	100,000
	$2,000,000		$775,000		$2,775,000

Blended Cost Share %
Non-federal share ($775,000) divided by Total Project Cost ($2,775,000) = 27.9% (Non-federal)
Federal share ($2,000,000) divided by Total Project Cost ($2,775,000) = 72.1% (Federal)