



SPONSORED RESEARCH AGREEMENT

between

MASADA RESOURCE GROUP, LLC

and

AUBURN UNIVERSITY

THIS AGREEMENT is made and entered into as of the 9th day of January, 2007 by and between **AUBURN UNIVERSITY** (hereinafter referred to as "AUBURN") and **MASADA RESOURCE GROUP, LLC**, 2170 Highland Avenue, Suite 100, Birmingham, Alabama 35205 (hereinafter referred to as "SPONSOR"):

WHEREAS, the research program contemplated by this Agreement is of mutual interest and benefit to AUBURN and to SPONSOR, and will further the instructional and research objectives of AUBURN in a manner consistent with its status as a non-profit, tax-exempt, educational institution;

NOW, THEREFORE, the parties hereto agree as follows:

1. Scope of Work

SPONSOR grants to AUBURN and AUBURN accepts support for research investigations under the direction of Harry Cullinan of the Alabama Center for Paper and Bioresource Engineering, as described in the attached Statement of Work (Attachment A). AUBURN undertakes this research in furtherance of its goal of seeking new knowledge.

2. Compensation

In consideration of AUBURN's exerting its good faith efforts to carry out the research described in Attachment A ("Research"), SPONSOR will pay AUBURN the firm fixed-price amount of \$1,000,000, subject to SPONSOR closing its pending equity financing transactions. Payment shall be made in two equal installments of \$500,000 with the first such installment due 30 days after the closing of SPONSOR's pending equity financing,

and the last to be due six months after the closing of SPONSOR's pending equity financing.

SPONSOR shall remit payment to:

AUBURN UNIVERSITY
Attention: Director, Contracts and Grants Accounting
303 Samford Hall
AUBURN University, AL 36849

AUBURN shall not be obligated to expend funds in excess of those provided under this Agreement to conduct the Research.

3. Period of Performance

Research under this Agreement will be performed during a one year period beginning on or after the closing date of SPONSOR'S pending equity financing. SPONSOR will provide a formal authorization to proceed in a format similar to that contained in Attachment B notifying AUBURN to start work. On or near one year from the date specified in the notice to proceed, SPONSOR may exercise the option to fund a second year for \$1,000,000 for continuation of current research or additional research to be determined at that time. The notice to proceed will become part of this agreement once accepted by AUBURN. This Agreement may be extended upon mutual written agreement of the parties.

4. Technical Representatives

SPONSOR's technical representatives shall be Timothy Judge and David Webster or such other representative as SPONSOR may subsequently designate in writing. AUBURN's Principal Investigator shall be Harry Cullinan who shall be responsible for the direction and conduct of the Research.

5. Consultation with SPONSOR's Representatives

During the period of this Agreement, SPONSOR's Technical/Scientific Representative and other representatives may have reasonable access to consult informally with AUBURN's Principal Investigator regarding the Research both personally and by telephone. Access to work carried on in AUBURN laboratories in the course of the Research shall be entirely under the control of AUBURN personnel; SPONSOR's representatives shall be permitted to visit such laboratories only during usual hours of operation as is mutually agreeable.

6. Technical Reports

The Principal Investigator shall make up to four written reports each year if requested by SPONSOR's Technical Representative. Within sixty (60) days after the expiration of this

Agreement or any option period, the Principal Investigator shall submit a comprehensive written final report to SPONSOR.

7. Publicity

SPONSOR will not use the name of AUBURN, nor of any member of AUBURN's Project staff, in any publicity, advertising, or news release without the prior written approval of an authorized representative of AUBURN. AUBURN will not use the name of SPONSOR nor of any employee of SPONSOR, nor any SPONSOR trademarks, in any publicity, publications, dissertations, or formal oral presentations without the prior written approval of SPONSOR, with the exception that AUBURN may publish standard award announcements, including the campus faculty/staff newsletters, the AU Report and AU Research News. The information to be published includes the name of the principal investigator(s), University department, award amount, SPONSOR name and project title

8. Publication

AUBURN's Investigators shall have the right to publish or otherwise publicly disclose information gained in the course of the research provided that copies of all materials to be published will be submitted to SPONSOR for review sixty (60) days prior to being submitted for publication. Fair consideration shall be given to SPONSOR's comments; however, AUBURN shall have the right to the final decision. Proprietary information of SPONSOR not protected by patent(s) or patent application(s) will be excluded from publication. In order to permit SPONSOR an opportunity to determine if a patentable invention is disclosed, the Principal Investigator will provide SPONSOR with drafts of intended materials, whenever possible, as soon as they reach a stage suitable for distribution. SPONSOR shall notify AUBURN and the author(s) within ninety (90) days after receipt of proposed materials so as not to delay publication whether in its judgment the material contains information on which patent applications may or should be filed. If SPONSOR wishes to file a patent application, SPONSOR will have ninety (90) days to do so from such notification date.

9. Confidential Information

- a. The receiving party shall maintain for a period of three (3) years from the end-date of this Agreement the confidentiality of information disclosed to it or otherwise learned by it during or as a result of research, hereinafter "Confidential Information", provided such information is in writing or other tangible form and clearly marked as proprietary when disclosed, or is so designated in writing within thirty (30) days of such disclosure. This term for confidentiality shall survive any termination of this Agreement. The receiving party shall use the same level of care to prevent the use or disclosure of the Confidential Information as it exercises in protecting its own information of similar nature.

The receiving party's obligation shall not apply to information that:

- i. is not disclosed in writing or reduced to writing and marked with an appropriate confidentiality legend within thirty (30) days after disclosure;
 - ii. is already in the recipient party's possession at the time of disclosure;
 - iii. is or later becomes part of the public domain through no fault of the recipient party;
 - iv. is received from a third party having no obligations of confidentiality to the disclosing party;
 - v. is independently developed by the recipient party; or
 - vi. is required by law or regulation to be disclosed.
- b. In the event that information is required to be disclosed pursuant to subsection (vi), the party required to make disclosure shall notify the other to allow that party to assert whatever exclusions or exemptions may be available to it under such law or regulation.

10. Intellectual Property

All rights and title to intellectual property developed solely by AUBURN employees under this Agreement shall belong to AUBURN. All rights and title to intellectual property developed solely by SPONSOR employees under this Agreement shall belong to SPONSOR.

All rights and title to intellectual property developed jointly by one or more AUBURN employees and one or more SPONSOR employees under this Agreement shall be determined by good faith negotiations between the parties, and shall be agreed upon in writing. Such negotiations shall be concluded within sixty (60) days after the notification by either party to the other that an invention disclosure or other reported intellectual property development is considered to fall under the terms of this Section 10. If either party formally withdraws from the negotiations, all rights and property shall belong to the remaining party. It is understood by the parties that jointly developed Intellectual Property as contemplated in this Agreement includes any and all such intellectual property for which conception and/or reduction to practice have been accomplished by joint efforts of employees of both SPONSOR and AUBURN in the course of performance under this Agreement.

To the extent not prohibited by other obligations, AUBURN hereby grants SPONSOR an option to acquire an exclusive, worldwide, royalty-bearing license under AUBURN's intellectual property rights relating to inventions, discoveries, technologies or enhancements arising from this research which were made solely by AUBURN or jointly by AUBURN and SPONSOR ("Subject Invention"). SPONSOR's option shall extend for a period not to exceed six (6) months after the notification by either party to the other that an invention disclosure or other reported intellectual property development is considered to fall under the terms of this section 10. Patent preparation, filing, and prosecution during the option period, if any, shall be at SPONSOR's expense. If SPONSOR wishes to

exercise its option hereunder, it shall so notify AUBURN within the option period, and both parties shall negotiate in good faith the terms of the license within sixty (60) days following SPONSOR's exercise of its option, such period to be extended upon mutual written agreement of the parties. Such license agreement shall include at least the following provisions: license fees, royalty payments, the right to grant sublicenses, a commitment by OPTIONEE and any sublicensee to exert their best efforts to introduce the licensed material into public use as rapidly as practicable, the right of AUBURN to terminate the license should OPTIONEE not meet specified due-diligence milestones, a commitment by OPTIONEE to pay all past and future domestic and foreign patent costs, and indemnity and insurance provisions. If AUBURN and SPONSOR cannot agree upon the terms of the license within ninety (90) days thereafter ("License Negotiation Period"), either party is free to pursue formal dispute resolution proceedings (below).

To pursue such formal dispute resolution, the party raising such dispute shall advise the other party of such claim, dispute or controversy in a writing that describes in reasonable detail the nature of such dispute within ten (10) business days of the expiration of License Negotiation Period. By not later than five (5) business days after the recipient has received such notice of dispute, each party shall have selected for itself a representative who shall have the authority to bind such party, and shall additionally have advised the other party in writing of the name and title of such representative. By not later than ten (10) business days after the date of such notice of dispute, the party against whom the dispute shall be raised shall select a mediation firm in the Birmingham area and such representatives shall schedule a date with such firm for a mediation hearing. The parties shall enter into good faith mediation and shall share the costs equally. If the representatives of the parties have not been able to resolve the dispute within fifteen (15) business days after such mediation hearing, AUBURN shall be free to license the patent to third parties. However, AUBURN shall not offer the Subject Invention to a third party on terms less favorable to AUBURN than such terms of the least favorable terms offered by AUBURN to SPONSOR during the License Negotiation Period, without first offering such less favorable terms to SPONSOR.

Notwithstanding the dispute resolution proceedings above, SPONSOR shall have a right of first refusal to the same technology for no more than 6 months after failure to negotiate acceptable license terms.

11. Collaboration

Subject to the terms hereof concerning confidentiality and SPONSOR's exclusive rights, it is understood that the AUBURN investigators shall be free to discuss the Research with other investigators and to collaborate with them.

12. Indemnification

SPONSOR hereby waives, and agrees to indemnify, defend, and hold harmless AUBURN and its present and former officers, directors, governing board members, employees, agents, and students from, any claim, loss, cost, expense, or liability of any kind, including

reasonable attorney's fees and expenses, arising out of or connected with this Agreement or the Research, except to the extent such claim is due to the negligence or misconduct of AUBURN, and including, without limitation, product liability claims relating to products based on the Research. AUBURN shall promptly notify SPONSOR of any such claim and shall cooperate with SPONSOR and its insurance carrier in the defense of the claim. SPONSOR agrees to consult with AUBURN regarding the defense of such claim and to submit any proposed settlement to AUBURN in advance.

13. Warranties

AUBURN MAKES NO WARRANTIES, EXPRESS OR IMPLIED, AS TO ANY MATTER WHATSOEVER, INCLUDING, WITHOUT LIMITATION, THE CONDITION, ORIGINALITY, OR ACCURACY OF THE RESEARCH OR ANY INVENTION(S) OR PRODUCT(S), WHETHER TANGIBLE OR INTANGIBLE, CONCEIVED, DISCOVERED, OR DEVELOPED UNDER THIS AGREEMENT; OR THE OWNERSHIP, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE OF THE RESEARCH OR ANY SUCH INVENTION OR PRODUCT. AUBURN SHALL NOT BE LIABLE FOR ANY DIRECT, CONSEQUENTIAL, OR OTHER DAMAGES SUFFERED BY SPONSOR, ANY LICENSEE, OR ANY OTHERS RESULTING FROM THE USE OF THE RESEARCH OR ANY SUCH INVENTION OR PRODUCT.

14. Independent Contractor

For the purposes of this Agreement and all services to be provided hereunder, each party shall be, and shall be deemed to be, an independent contractor and not an agent or employee of the other party. Neither party shall have authority to make any statements, representations, or commitments of any kind, or to take any action, which shall be binding on the other party, except as may be explicitly provided for herein or authorized by the other party in writing.

15. Governing Law

The validity and interpretation of this Agreement and the legal relations of the parties to it shall be governed by the laws of the State of Alabama.

16. Assignment

This Agreement shall not be assignable by AUBURN without the prior written consent of the other party. SPONSOR shall have the right to assign its rights and obligations hereunder in connection with (i) any financing engaged in by SPONSOR or (ii) any sale of SPONSOR to or merger by SPONSOR with any other firm or entity, and any such successor to SPONSOR by purchase or merger shall have similar rights of assignment as are provided herein to SPONSOR.

17. Notices

Any notice or report required or permitted to be given under this Agreement shall be deemed to have been sufficiently given for all purposes if mailed by first class certified or registered mail, postage prepaid, to the following addresses of either party:

Ms. Martha M. Taylor, Assistant Vice President for Research
Office of Sponsored Programs
Auburn University
310 Samford Hall
AUBURN University, AL 36849

and

Donald V. Watkins, Manager
Masada Resource Group, LLC
2170 Highland Avenue, Suite 100
Birmingham, Alabama 35205

or to such other addresses as shall hereafter have been furnished by written notice to the other party.

18. Title to Equipment

AUBURN shall retain title to all equipment purchased and/or fabricated by it with funds provided by SPONSOR under this Agreement.

19. No Oral Modification

No change, modification, extension, termination, or waiver of this Agreement, or any of the provisions herein contained, shall be valid unless made in writing and signed by duly authorized representatives of the parties hereto.

20. Paragraph Headings

The section headings are provided for convenience and are not to be used in construing this Agreement.

21. Survivorship

The provisions of Sections 7, 9, 10, 12, 15,, 21, and 23 shall survive any expiration or termination of this Agreement.

22. Term and Termination

Either party may terminate this Agreement upon thirty (30) days written notice. Upon termination, AUBURN shall deliver work completed as of the date of termination and SPONSOR agrees to justly and equitably compensate AUBURN for all costs and noncancelable commitments incurred prior to the effective date of termination; however, the maximum liability to the SPONSOR shall not exceed the unpaid portion of the total firm fixed price of the Agreement as outlined in Article 2.

23. Entire Agreement

This instrument contains the entire Agreement between parties hereto. No verbal agreement, conversation or representation between any officers, agents, or employees of the parties hereto either before or after the execution of this Agreement, shall affect or modify any of the terms or obligations herein contained.

IN WITNESS WHEREOF, the parties have caused this Agreement to be executed below.

MASADA RESOURCE GROUP, LLC

AUBURN UNIVERSITY

By: Donald V. Watkins
Donald V. Watkins
Manager

By: E. R. Richardson
E. R. Richardson
President

ATTACHMENT A

Statement of Work

Conservative estimates predict the depletion of crude oil resources in 80-120 years. Thus, to prevent a drastic decline in living standards and availability of consumer goods, it is necessary and prudent to immediately start the strategic planning for how different industries can alleviate the dependence on crude oil derived raw materials. The bioprocessing industries, i.e. the forest-based, agricultural and municipal waste treatment industries, are facing a growing need to explore alternative avenues to increase profitability in an increasingly competitive market. The integrated biorefinery provides the opportunity for a strong, self-dependent, sustainable alternative for the production of chemicals and fuels, thus satisfying national needs while moving toward sustainable development.

The integrated biorefinery combines novel biomass/waste conversion processes with conventional production capabilities to include a wider range of products, e.g. fuels, chemicals and/or renewable energy along with traditional products such as pulp and paper. The number of process configurations and possible products than can be derived from biomass/waste is quite extensive. Figure 1 illustrates the complexity encountered, when attempting to identify the optimal process configuration. The colored diamonds denote possible products for sale while the remaining boxes correspond to processing steps. It is apparent, that identification of the optimum process structure can not be done based on heuristics or rules of thumb. Depending on market prices and trends, the optimum allocation of resources and production capacity may switch between the different products.

Specific Aims: The principle focus of this work involves the development and evaluation of promising alternative bioprocessing strategies capable of utilizing biomass/waste resources for fuels production, namely ethanol and aviation fuel. This statement of work covers three specific experimental research projects supporting Masada's interests along with an overarching optimization framework utilizing process integration principles.

Optimization Framework: Complex processing systems involving many different steps inherently possess tremendous integration potential, not just limited to recycling unused material, but also in terms of energy recovery. Process integration techniques can be employed to realize this potential by providing global process insights and identifying overall process performance targets. A mathematical optimization based framework will be developed, to enable the inclusion of profitability measures and other techno-economic metrics along with process insights and performance characteristics. An inherent benefit of this optimization framework is the ability to adapt to new developments within any of the subprocesses and also to incorporate novel innovative production processes in the decision-making framework. By incorporating the concepts of design under uncertainty, the framework will serve as the overarching

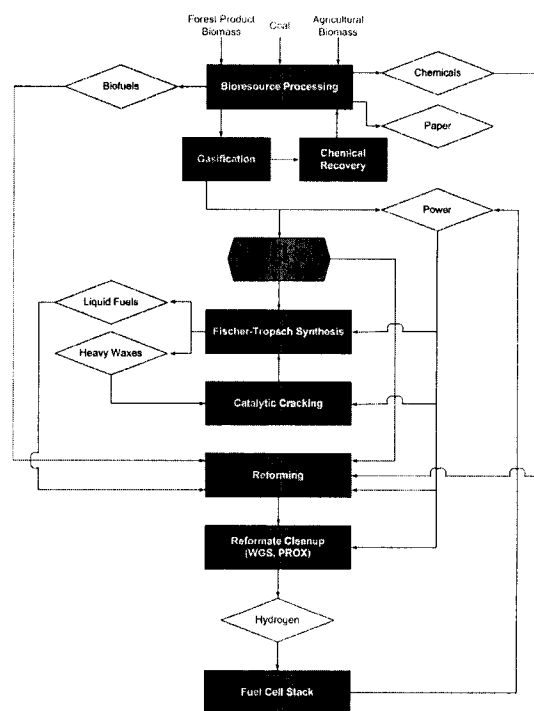


Figure 1. Biorefining production complexity

theme for directing research in the field, as it enables ruling out certain products and/or production routes for either economic or environmental reasons. This optimization framework enables seamless interfacing between the modeling and experimental studies in this work.

Feedstock Pretreatment and Biological Conversion to Ethanol: A comprehensive composition analysis of the municipal waste resources provided by Masada Resources LLC will be performed to establish a solid foundation from which targeted biological conversion strategies can be developed. The components to be analyzed include: carbohydrates, individual sugar components, Klason lignin, acid soluble lignin, acetyl components, alcohol extractives, Kjeldahl protein and ash. Based on this analysis the optimal pretreatment method of the municipal waste can be identified. This will be achieved through a rigorous study of various methods including: steam/hot water treatment, acid treatment, and alkaline treatment (aqueous ammonia and NaOH). Once the optimal pretreatment strategy has been identified and validated, the pretreated feedstock will be used for ethanol production via the simultaneous saccharification and co-fermentation (SSCF) process. Ethanol production through enzymatic as well as microbial conversion will be studied. The enzymes to be investigated are Cellulase (Genencor Spezyme-CP or equivalent), Xylanase (Genencor Multifect or equivalent) and Cellobiase (Novozyme 188 or equivalent), while the microorganism of interest is recombinant *E. coli* (KO-11). This project specifically includes the completion of the unfinished tasks associated with Masada's contract with the US DOE. These tasks will be completed in the first year of this Sponsored Research Agreement.

Aviation Fuels from Biomass-derived Synthesis Gas: Recent research at Auburn University has demonstrated an innovative approach to Fischer-Tropsch Synthesis (FTS) that allows enhanced production of fuel range products and value-added chemicals. This new approach uses customized reactor configurations and catalyst architectures to provide tight control over hydrocarbon composition, with focus on production of middle distillate components suitable for aviation fuel while also reducing the yield of light products such as methane. FTS involves surface catalyzed polymerization reactions of dissociatively adsorbed C1 monomers (from CO adsorption on the catalyst) in the presence of H₂ over common cobalt and iron catalysts. FTS is typically performed in either gas phase (packed bed) or liquid phase (slurry) reactors and produces hydrocarbon products ranging from C₁ to C₄₀₊ compounds. Auburn University researchers have recently demonstrated that increased middle distillate hydrocarbon production can be achieved by implementing a supercritical recycle stream of light products that enhances both heat and mass transfer compared to conventional FTS systems. Operating the FTS reaction under these supercritical conditions allows for vapor like transport properties while maintaining liquid like heat transfer and solubilities. The result is a reduction in undesired methane production, enhanced middle distillate (aviation fuel range products) yield, and better catalyst activity maintenance due to in-situ extraction of heavy products from the catalyst pores with the supercritical fluid solvent. Furthermore, these conditions can be achieved by simply recycling light products into the FTS feed thereby providing simultaneous product upgrade (longer chain length products) and improved reaction media. Systematic experimental investigations will be performed to identify and validate a suitable processing scheme specific to biomass and municipal waste enabling synthesis gas production and subsequent gas-to-liquids (GTL) production of aviation fuels. An analysis of the economies of scale will be performed in concert with the optimization efforts described above. In addition to FTS, other catalytic C1 chemistry routes will be examined including synthesis gas to methanol, methanol to olefins and alcohols, and dimethyl ether production.

Fractionation of Lignin and Cellulose: The traditional separation of cellulose from lignin is performed using the kraft pulping process. In this work, it is proposed to use a novel, environmentally benign means of separation using a mixture of NaOH supersaturated with O₂ and ethanol (generated as part of item 1 above). Although conceptually similar to a combination of soda/O₂ pulping and solvent pulping, the uniqueness of the process is the use of AU technology for in-situ production of supersaturated O₂ in

solution. This can potentially enhance kinetics by several orders of magnitude, allowing the soda/oxygen process to be implemented at much lower pressure (and lower cost reactors) than normal. The technology involves microfibrinous porous electrodes placed in the digester's circulating liquor stream that produce supersaturated O₂ in solution, which would be in an active state thereby enhancing the kinetics of lignin dissolution. It is also proposed to install an ultrafiltration membrane in a split stream of the cooking liquor, which will allow the separation of high molecular weight dissolved lignin allowing the sodium hydroxide to be circulated back to the process, enhancing the utilization of chemicals. The performance of the NaOH/O₂/EtOH separation technique will be compared to the proprietary reactive fractionation technology of PureVision Technology and other commercially available technologies along with traditional kraft pulping process. The comparison will be based on economic as well environmental metrics. The cellulose, with a small amount of lignin, present in the product can be converted to highly reactive cellulose by a process developed at AU. This new form of non-crystalline cellulose has physical properties drastically different from α -cellulose or micro-crystalline cellulose. Lignin and other unutilized carbon sources are available for pyrolysis or feedstock for chemical production.

Technical & Management Capabilities: The Alabama Center for Paper and Bioresource Engineering (AC-PABE) is uniquely suited to lead the proposed research program in collaboration with Auburn University's Department of Chemical Engineering (AU-CHEN). The principal investigator is Dr. Harry Cullinan. The Co-PI's are Drs. Mario Eden, Gopal Krishnagopalan, Y.Y. Lee, and Christopher Roberts. Expertise in additional crucial areas of biorefining research, e.g. characterization of biomass resources along with gasification of biomass and spent liquors, can be provided by a number of AU-CHEN and AC-PABE collaborators. AC-PABE enables contact to all major players in biorefining research as well as the industries where these technologies would be implemented.

Attachment B

Sample Authorization to Proceed

Office of Sponsored Programs
310 Samford Hall
Auburn University, AL 36849-5131

Re: Authorization to proceed on Masada/Auburn Research Agreement dated _____
Titled, “ _____ ”.

To whom it may concern:

This is your “authorization to proceed” with work on the above referenced project beginning on _____, 200_. The project period will begin on this date and continue through _____, 200_. This authorization shall become part of the referenced research agreement immediately upon acceptance by Auburn University’s authorized representative.

Sincerely,

Masada Resources Group, LLC

ACCEPTED BY:

E.R. Richardson
President\
AUBURN UNIVERSITY
Date: _____