

# DRAFT

## Proposed Bioenergy Plan

September 3, 2008

### Bioenergy Task Force

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## **UTIA Bioenergy Program**

### **Vision:**

The University of Tennessee Institute of Agriculture will be the national and international leader in cellulosic bioenergy and bioproducts research, education and outreach within five years.

### **Mission:**

The mission of the UT Institute of Agriculture Bioenergy Program is to enhance economic and environmental sustainability and reduce dependence on imported fossil fuels and petroleum-based products through research, education, and outreach programs on bioenergy and biobased, non-food energy sources.

The mission will be accomplished through:

- Development and adoption of technology for sustainable and responsible cellulosic resources to become a strategic source of the nation's fuels.
- Excellence in scholarly reputation and visibility among higher education institutions, private sector companies and government entities through research accomplishments that produce:
  - Economically competitive biofuels and bioproducts;
  - Advanced science and technology that results in new products entering U.S. and world markets;
  - Publications in highly respected refereed journals; and
  - Intellectual property worthy of patenting and licensing.
- Programs that foster economic growth, rural community development and sustainable use of natural resources.
- Appropriate, targeted educational programs that will train the future bioenergy workforce.
- Partnerships that leverage resources and build relationships.

## **Preface**

*In January 2008, Vice President of Agriculture Dr. Joseph DiPietro presented a draft of a bioenergy vision and mission at the UT Institute of Agriculture Bioenergy Strategic Planning Workshop. He later formed a Bioenergy Task Force, naming 11 individuals from across the Institute to serve. The task force was charged with finalizing the vision and mission statements, conducting a strategic planning process to include a needs assessment and an implementation plan for the vision, and gaining UTIA-wide input. The group's findings and recommendations were to be outlined in a report that was to be completed by mid August 2008.*

*The Bioenergy Task Force began with an organizational meeting on April 14, 2008 and met biweekly until mid August 12, 2008. The task force presented a draft of its recommendations to the vice president and deans on September 3, 2008 and to the department heads on September 11, 2008. On April 7, 2009 the task force met for a final review of the draft and to discuss next steps. The group decided another meeting with Dr. DiPietro was needed to discuss next steps, and that meeting was held April 23, 2009. The task force is now prepared to present its recommendations, including input gathered so far:*

***The Bioenergy Task Force concurs that the draft plan would be enhanced with recommendations from those meetings. For ease of review, these recommendations have not been incorporated into the original document but will be noted at the beginning of each section. Changes to the original document will not be made until the draft is revisited with department heads and faculty have the opportunity to offer feedback.***

***Recommendations:*** *The task force's original model for center development suggested initial establishment of a cross-departmental bioenergy center, eventually evolving into a separate department. The rationale for this approach was that the desired functions of the center (curriculum development, degree granting capability and the need to locate all bioenergy scientists and staff in one place) were seen by the task force as best occurring within a departmental model. However, a primary concern of the department heads was that such a model could lead to the loss of FTEs, funding or other support from the existing departments, and clearly stressed that such losses, either perceived or real, should not occur. Rather, the program plan must benefit or enhance departments and the new center at the same time. Program development within the existing organizational structure would be ideal. The task force acknowledges these concerns and reiterates its openness to a plan that meets the needs of all stakeholders.*

*The department heads also expressed concern with the goal of developing an undergraduate curriculum in bioenergy. The task force acknowledges these concerns and will reconsider the original recommendation of establishing a separate undergraduate degree. The task force agrees that the educational components of the plan can be accomplished by establishing a cross disciplinary bioenergy minor and possibly a certificate program under existing academic programs.*

*Can a center model accomplish these goals? The task force believes this is possible, and points to the UT Gardens and Forest Products Center as two successful center models. For example, Master's and Ph. D. degrees are granted by the Forest Products Center under the college umbrella. Collaboration already exists. Ultimately, the task force realizes that the label is not as important as the ability to carry out a research, education and extension mission. Overall, the task force believes that the key features of a successful organizational structure for bioenergy development will be 1) the ability to carry out its coordinated research, education and extension goals and 2) co-exist with the current administrative structure without inducing losses in individual departments.*

**UT Institute of Agriculture**  
**BIOENERGY TASK FORCE**  
**Proposed Bioenergy Program Plan**

*Executive summary*

*\*The task force agrees with department heads recommendations that transitioning into a new academic department will not be necessary if the tenets of the plan can be accomplished under a center model.*

The primary recommendation of the UT Institute of Agriculture Bioenergy Task Force is to establish a center for bioenergy and bioproducts research, education and Extension. This center will be critical to realizing the UTIA vision and mission in bioenergy. In the long term, the center will eventually transition into a full academic department, providing research, education and service necessary to develop a robust, internationally recognized bioenergy program for the state of Tennessee.

The center's strategic focus will be systems required to convert biomass into fuel and biobased chemical products, and associated feedstock production. The Task Force identified several features that characterize a robust bioenergy program, including sufficient resources to support the research goals of the center, and the hiring of a prominent individual to serve as director of the center and subsequent department. The new center director will have key responsibilities for attracting major funding, providing leadership, and coordinating activities in the bioenergy and bioproduct area. Fulfilling these responsibilities will require that the director have power and authority to make strategic new hires, control budgets, and work across departments. A successful center and bioenergy program will require significant faculty and staff support, which will be achieved by developing strong interdisciplinary research groups, improved opportunities to obtain grant funding and other support and greater opportunity for faculty outreach in all aspects of center operation. This entity must be positioned to benefit the entire Institute, enabling each of our programs to achieve increased recognition both nationally and internationally. Multiple entities within the Institute have invested significant resources in bioenergy and bioproducts. The formation of this center will propel these

efforts to a national and international platform and allow the Institute to fully realize its vision.

The Task Force has had extensive discussion concerning the center evolving into a department and recognizes that the center's success will require that existing departments and department heads must buy-in to the center being a partner as departments fulfill their missions in research, teaching, and extension. The discussion has included examination of transitioning the center into a school, a college or an institute. The Institute has experience with a successful center, the Forest Products Center, which has national prominence and is able to attract productive faculty. But regardless of the ultimate organizational model chosen, the keys to the center's success will be 1) hiring an outstanding director, 2) building a facility which will give the center an identity and 3) providing the center with its own budget to use to address emerging issues, and 4) working closely with department heads and deans, the center would coordinate departmental teaching programs and provide a comprehensive curricula to prepare students for success in various systems in the bioenergy industry and a comprehensive, multidisciplinary Extension program.

The task force identified four goals it envisioned necessary for the strategic plan to come to fruition. Each goal includes action items (critical success factors) to achieve these goals. Successful completion of a given goal is summarized as projected outcomes from these action items. These goals are:

**Create an integrated structure for bioenergy research:**

The *research* component of the center will coordinate all bioenergy and bioproducts programs across the Institute, and will include activities in growing and harvesting feedstocks, transportation logistics, conversion of feedstocks into fuel and co-products, ecological sustainability, and economic feasibility. The center director will be responsible for coordinating these various bioenergy and bioproducts programs from across the Institute.

*\* The task force agrees with the department head's recommendations that undergraduate educational programs in bioenergy can be accomplished under existing programs. The task force recommends that development of an appropriate class list be initiated to identify resources and gaps associated with an undergraduate concentration in bioenergy.*

**Create multidisciplinary graduate and undergraduate programs in bioenergy and bioproducts:**

The *education* component of the center will create a knowledgeable bioenergy workforce for the future. The ultimate result will be programs at both the undergraduate and graduate level, with initial focus being placed on the development of multidisciplinary graduate programs at both the master's and Ph.D. levels. This can be accomplished in the short term by utilizing the model for the multi-departmental Ph.D. program that is currently being used among Plant Science departments within the AgResearch and CASNR. Longer term, a new curriculum will be developed for these programs. This emerging field offers an opportunity for CASNR to increase its enrollment by attracting students who may otherwise choose science, chemistry, or engineering programs outside the College.

**Extension activities must be fully integrated with strategic directions in bioenergy:**

The *Extension* component of the center will transfer knowledge developed through integrated research activities into practical demonstration. Extension will expand the knowledge base of the staff, incorporating feedstock production, conversion and product utilization, engineering, sustainability and economic feasibility expertise, with a goal of achieving program integration from plants to products. This effort will involve hiring additional specialists, holding more in-service training in the bioenergy and bioproducts area and other methods of increasing the capacity of county staff to offer programs in this area.

**Establish permanent campus facilities in support of bioenergy research, education, and Extension:**

The *infrastructural* component of the center will build research, education, and Extension capabilities within state-of-the-art facilities to include office, lab and greenhouse space in existing and new buildings. Construction of new facilities will be

key to increasing the visibility of the Institute programs and establishing its identity. A building within the Cherokee Research Campus will help create synergy with private industry and research organizations.

Success in this effort will also require sufficient funding as the center establishes itself within the UTIA community. The center will be initially funded through new state government commitments. The task force also believes that strategic linkages with industrial partners as well as private donations to establish a bioenergy endowment and capital funds will help secure the center's future. The task force realizes that development of a budget is an iterative process, but estimates that establishing a bioenergy center will require at least \$100 million and perhaps as much as \$150 million over five years to cover hiring a new director and staff, providing infrastructure, and support of a much larger graduate student population in bioenergy.

**GOAL I: Create an integrated structure for bioenergy research**

The *research* component of the center will coordinate all bioenergy and bioproducts programs across the Institute, and will include activities in growing and harvesting feedstocks, transportation logistics, conversion of feedstocks into fuel and co-products, ecological sustainability and economic feasibility. The center director will be responsible for coordinating these various bioenergy and bioproducts programs from across the Institute.

Action Items:

- a. In the short term, an organizational structure and budget for the center, even if preliminary, must be in place to attract a nationally recognized center director. The structure will include a critical mass of researchers (the equivalent of 10 research faculty members from existing departments) and an approved multi-year budget. Expertise from both UTIA and UTK must be included in the organization. Interdisciplinary projects should be encouraged. At least one of these positions should be dedicated to sustainability-related research.
- b. Within 12 months of center organization, a nationally/internationally recognized bioenergy expert will be hired as center director.
- c. Longer term, center success will depend on establishing a diverse research program through hiring of new faculty. At least 20 new scientists with research/teaching appointments will be added to the original group of research faculty. The best candidates will become available as a result of the center developing competitive startup packages.
- d. The nature of bioenergy research offers natural partnership opportunities with industry as well as traditional funding agencies. The center will create an Industrial Advisory Board to review research programs and the center's strategic plan.

Outcomes:

- a. Cohesiveness among researchers within the Institute as well as UTK and ORNL will result in successful execution of the strategic plan in bioenergy.
- b. The Institute will be recognized as a national and international leader in cellulosic bioenergy and products.
- c. The Institute exhibits excellence in scholarly reputation and visibility among peer institutions through a solid track record of successful grantmanship, refereed publications, intellectual property development, and competitive products in the marketplace.

*\*Administrative comments from the department heads and deans, reflected concerns with an undergraduate major in bioenergy. For example, a major with an engineering component would be problematic due to requirements to become a licensed engineer. To address these concerns, we recommend that a bioenergy cross disciplinary minor within existing majors would be more successful than creating a new major. The minor would be based within the center. However, development of a graduate program (described in Goal II, part a) in bioenergy was supported at all levels. Therefore, we recommend proceeding with the development of graduate programs in bioenergy while we lay the foundation of an undergraduate program by investigating barriers, needs and solutions.*

**GOAL II: Create multidisciplinary graduate and undergraduate programs in bioenergy and bioproducts:**

The *educational* component of the center will create a knowledgeable bioenergy workforce for the future. Ultimately, programs at both the undergraduate and graduate level will result, with initial focus being placed on the development of multidisciplinary graduate programs at both the master's and Ph.D. levels. This can be accomplished in the short term by exchanging currently dormant programs for one that is focused on bioenergy and bioproducts. New curricula will be developed for these programs. As the center evolves into a department, the development of a new undergraduate curriculum and degree program should occur. This emerging field offers an opportunity for CASNR to increase its enrollment by attracting students who may otherwise choose science, chemistry, or engineering programs outside the college.

Action Items:

- a. In the short term, the task force believes that a graduate program should be the first focus area for educational development in the center. The program will create a Bioenergy Graduate Committee and develop a graduate program.
- b. Longer-term, an undergraduate major in bioenergy will need to be created. This curriculum can result from close coordination of existing classes within relevant UTIA departments, expansion of the new Bioenergy concentration within Plant Science, and the creation of required additional classes over time.
- c. Because of the strategic nature of the bioenergy effort within the state, the UTIA bioenergy program must ensure opportunities for increased involvement of UTK and other UT system campuses in bioenergy-related academic programs.
- d. Close alignment with UTK admissions will be necessary to improve the admissions process to enable CASNR to attract more undergraduate science and engineering majors, and provide the needed population of students to carry out the center's R&D program.

- e. A broad range of enrichment opportunities in bioenergy must be available for faculty, staff and student, for example, focused faculty sabbaticals in bioenergy (i.e. with DDCE), holistic internships with industry nationally and internationally, yearly retreats for students, faculty, and stakeholders involved with the graduate program, or international academic collaborations.

Outcomes:

- a. UTIA will realize its vision of becoming a national and international leader in bioenergy through its well recognized undergraduate and graduate programs in bioenergy and bioproducts.
- b. Significantly increased enrollment in both undergraduate and graduate programs at UTIA will result.
- c. UTIA will place graduates of its nationally recognized program in positions in private industry, academia, and government agencies.

**Goal III: Fully integrate Extension with strategic directions in bioenergy:**

The *Extension* component of the center will transfer knowledge developed through integrated research activities into practical demonstration. Extension will expand the knowledge base of staff, incorporating feedstock production, conversion and product utilization, engineering, sustainability and economic feasibility expertise, with a goal of achieving program integration from plants to products. This effort will involve hiring additional specialists, holding more in-service training in the bioenergy and bioproducts area and other methods of increasing the capacity of county staff to offer programs in this area.

**Action Items:**

- a. To achieve the desired integration of Extension with bioenergy development, initial staff additions should include specialists in feedstock production and utilization to target areas such as weed control, plant pathology, entomology, ecological sustainability, logistics, and co-product market development. One Extension specialist should be based at or near the new biorefinery.
- b. Extension will conduct programs in local communities to foster rural economic development opportunities.
- c. Engaging stakeholders in local communities to build relationships and support for Institute bioenergy and bioproduct efforts.
- d. The bioenergy program will provide in-services and workshops for county Extension agents and specialists covering bioenergy and bioproducts in cooperation with the new center.

**Outcomes:**

- a. By increasing the bioenergy program capacity, the UTIA programs will realize increased public support for the Institute's bioenergy and bioproducts activities.
- b. Expansion of bioenergy and bioproducts development activities, both private and public, statewide, and increased economic opportunities for rural and semi-rural communities.

**GOAL IV: Establish permanent campus facilities in support of bioenergy research, education, and Extension:**

The *infrastructural* component of the center will build research, education, and Extension capabilities within state-of-the-art facilities to include additional office, lab and greenhouse space in existing and new buildings. Construction of new facilities will increase the visibility of the Institute programs. A building within the Cherokee Research Campus will help create synergy with private industry and research organizations.

*Action Items:*

- a. In the short term, adjoining lab and office space in the Plant Biotechnology Building will be provided for the new center director and initial group of scientists associated with the center.
- b. Longer term, a green facility on Cherokee Research Campus with research labs, dedicated greenhouse space for bioenergy research, administrative offices, classrooms, and state-of-the-art conference rooms dedicated to bioenergy courses, seminars and long-distance communications to facilitate off-campus collaborations.

*Outcomes:*

- a. New facilities will define an identity and establish a recognizable presence for the UTIA bioenergy program.
- b. Infrastructural improvements will increase research capacity and productivity, improve visibility and the ability to collaborate with external partners, and markedly improve scientific recruitment capability and a demonstrated commitment by UTIA to bioenergy and bioproducts programs.

## RESOURCES

### **Sustained financial commitment**

Realizing the vision of becoming an international leader in bioenergy and bioproducts will require a sustained commitment of new funding (not diverted from existing programs) to provide seed money to lay the foundation for the center. These funds should occur on an annual basis for continuity. Funds would provide for increased research, teaching and Extension leadership in bioenergy and bioproducts.

#### *Financial Resource Action Items:*

- a.** The program will require that UTIA secure new funding from state government.  
Required funding includes an estimated directed research budget of at least \$10-20 million over five years, and seed money of \$2 million for the center director's research program above and beyond salary.
- b.** Although the bioenergy program must retain a strong component of fundamental research, there are natural linkages with industry that must be developed to support all components of the bioenergy supply chain. Potential industrial partners include (Ceres, Deere, Eastman, DuPont, Volkswagen, oil companies, etc. Bioenergy-related start-up companies to occupy the Business Incubator Building should be attracted.)
- c.** The potential for significant impact on the UTIA and the state of Tennessee will attract private donations. A working relationship with alumni to create a bioenergy endowment and capital funds should be developed.
- d.** Tools that support submitting grants and contracts must be developed, and will include providing necessary staff and administrative help to assist with budgets, interfacing with grants and contracts and personnel at UTK and ORNL searching for grant opportunities.
- e.** Increasing the awareness of state and federal politicians of our abilities and providing incentives for researchers to attend national bioenergy planning meetings.
- f.** Budgets must be sufficient to make faculty salaries and startup packages more attractive and competitive.
- g.** Offer more graduate assistantships.

*Faculty Resource Action Items:*

- a. Assist investigators with developing access to JIBS and other joint institutes.
- b. Encourage and provide incentives to take short- and long-term sabbaticals.
- c. Continue seminar series in the bioenergy area and provide honorariums to attract individuals to visit the University and share their work with scientists and graduate students.
- d. Provide travel monies to individuals to go overseas and interact with scientists and other bioenergy institutions.
- e. Use Distinguished Professor title for those who have achieved national and/or international recognition and developed noteworthy research programs.
- f. Create a mechanism to allow (more) joint UTIA-UTK and UTIA-ORNL faculty positions within new center/department.
- g. Facilitate joint research with ORNL (and other DOE labs: e.g., negotiate for a lower indirect cost percentage for ORNL/DOE-related research in joint proposals)
- h. Make the preparation of joint UTK-UTIA proposals more seamless.

*\*While the task force acknowledges the current economic crisis that will present even greater challenges in accomplishing the goals of this plan, particularly in funding, it believes that work on the plan must continue. The vision of being the national and international leader in cellulosic bioenergy and bioproducts research, education and outreach must be pursued so that when the economy recovers, UTIA will be ready to assume its leadership role.*

**Projected Total Cost of Plan:**

Center Director and related: \$4 million  
 New Facility on Cherokee Campus: \$60 million  
 Directed Research Funding: \$20 million  
 Research Equipment: \$5 million  
 Existing Faculty (total 10 FTEs): \$7.5 million  
 (10-20 FTEs): \$15 million  
 Twenty to 30 graduate assistantships (30K/student): \$4.5 million  
 Operating: \$25 million over 5 years

**Total budget approximately \$141 million over five years**

**Short-term Timeline with Major Tasks (tasks may continue beyond initial appearance into other years). Numbers presented represent ranges discussed by the task force:**

<b>Year 1</b>				
Establish dedicated budget and allocate space for center.	Bioenergy steering committee formed and search committees formed.  Promote interdisciplinary research groups.	Hire one or two new scientists and create competitive startup packages.	Create critical mass of researchers with internal appointments.  Promote faculty development: distinguished professorships, sabbaticals, ORNL/joint appointments, international cooperation.	Create graduate degree program and add new graduate assistantships (30/yr).
<b>Year 2</b>				
Hire bioenergy director.	Hire two to five new scientists.	Create industrial advisory board.	Hire two state Extension specialists.	Begin development of private funding partnerships.
<b>Year 3</b>				
Begin series of in-services for county Extension professionals.	Hire two to five new scientists.			
<b>Year 4</b>				
Begin creation of undergraduate program.	Hire two to five new scientists.	Begin construction of new green facility.		
<b>Year 5</b>				
Begin transition into department.	Hire two to five new scientists.	Move into new facility.		

