

# UNIVERSITY OF MINNESOTA

## DEPARTMENT OF BIOPRODUCTS & BIOSYSTEMS ENGINEERING

### STRATEGIC PLAN

#### INTRODUCTION

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A bio-based revolution is underway that will fundamentally change how we produce and consume food, feed, fiber, materials, chemicals, fuel and energy. Public awareness about global climate change, fiscal and ecological costs of agricultural and energy production, and environmental sustainability has increased dramatically. Through cutting edge science, engineering, technology and business solutions, the University of Minnesota's Department of Bioproducts and Biosystems Engineering (BBE) fulfills this social mandate for renewable, sustainable utilization of bioresources and environmental enhancement. A leader in the burgeoning bioeconomy for Minnesota and beyond and addressing environmental sustainability, BBE advances the forefront of science, management, and engineering knowledge in bioproducts and biosystems. With interdisciplinary expertise and a demonstrated track record in innovation and collaboration, the Department is poised for institutional and national leadership in bio-based economy and ecological health. The vibrant interdisciplinary character of our unit will be enriched by continuous infusion of basic science expertise that advances the theory and praxis of our faculty and programs.

Collegiate and departmental mergers have resulted in a vibrant new department, where as a result of efforts outlined in this strategic plan BBE will be recognized throughout the University and country as a renowned leader focused on the science, engineering, and management of bioproducts and biosystems. With demonstrated excellence in learning, discovery and engagement and world-class facilities, BBE will help elevate the University of Minnesota to Top 3 public research university status through its emphasis on 'solution-driven science' in bioproducts and biosystems. The Department has thus developed a strategic plan that outlines an ambitious agenda addressing scientific, technological and business needs in building a robust bioeconomy, environmental enhancement, and serving traditional and emerging stakeholders.

#### MISSION

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The Department of Bioproducts and Biosystems Engineering integrates engineering, science, technology and management for the sustainable use of renewable resources and enhancement of the environment.

#### VISION

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We will serve as global leaders in the discovery, development and application of renewable resources and sustainable technologies to meet society's needs while enhancing the environment in Minnesota and beyond.

### Program Priorities

As the University of Minnesota highlights renewable energy and the environment and the College of Food, Agricultural and Natural Resources Sciences emphasizes bioeconomy, climate change, healthy foods, and biodiversity as key priorities, BBE's distinctive programming is positioned to substantially contribute. Faculty have thus identified cross-cutting *Program Priorities* that define the scope and aims of our research, teaching, and outreach/Extension functions and achieve interdisciplinary leadership:

- Bioproducts and Renewable Energy
- Environment and Ecology
- Advanced Building Systems and Energy Efficiency
- Food Production, Processing, Safety and Security
- Undergraduate and Graduate Education
- Extension Education

These *Program Priorities* will distinguish BBE as a unique leader within the University and among peer institutions nationwide. The Department has established numerous goals, benchmarks, and activities that enhance excellence across teaching, research, outreach and Extension functions which are outlined in detail in this strategic plan.

### Organizational Priorities

Attaining goals associated with these *Program Priorities* requires a strong, cohesive organization. BBE has identified four categories for organizational development to generate adequate resources, support the professional advancement of faculty, staff and students, evaluate its progress toward achieving its programmatic goals, and strengthen its culture, which include:

- Departmental Culture
- Leadership Development and Recognition
- Physical and Fiscal Infrastructure Expansion
- Evaluation of Progress

This strategic plan delineates the goals, benchmarks and activities associated with each of these *Organizational Priorities*.

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## OVERARCHING GOALS

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BBE has identified key goals that will define this era of a newly merged, strengthened, and internationally prominent department. We will:

- Establish comprehensive, state of the art research and teaching facilities
- Increase undergraduate and graduate student enrollment
- Develop robust involvement of alumni and key stakeholders
- Provide institutional, award-winning leadership around biofuels, bioenergy and environmental sustainability

- Sustain strong departmental culture that rewards excellence
- Cultivate strong relationships with other key units

All departmental priorities, objectives and activities outlined in this strategic plan are in service to fulfilling these critical measures of our success and long-term vitality.

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## **PROGRAM PRIORITIES**

Our priorities for research, teaching, and outreach will offer economic, environmental, and social benefits to stakeholders in Minnesota and beyond. We will achieve global research prominence and international excellence in education and Extension. BBE will make strategic investments to increase faculty research, innovation, and productivity; refine and invest in future areas of new knowledge creation; enhance amount of interdisciplinary research; and strengthen BBE resource base for research. Investments in the below *BBE Program Priorities* will fulfill these research goals and augment by relevant research-based education including Extension, undergraduate, graduate and continuing education, outlined in detail in subsequent sections of the document.

### **BIOPRODUCTS AND RENEWABLE ENERGY**

BBE serves as a prominent leader in sustainable biomass conversion for materials, chemicals, fuels, and energy and offers accompanying strength in related marketing, management, and business applications. In coming years, we will invest in initiatives that include:

#### **Biomass conversion and biorefining**

- Development of novel biocatalytic approaches for biomass conversion
- Transgenic plants and algae as energy crops
- Gasification processes and second generation biofuels
- Safe and efficient machinery systems for bioproducts and renewable energy systems
- Comprehensive environmental and techno-economic analysis for the advancement of bioeconomy

#### **Bio-based materials, bio-composites and applications**

- Marketing, management, and business applications of bio-based materials
- Advanced building materials and their application to efficient buildings
- Bio-nano composites and their applications
- Improved utilization of bio-based materials and products

### **ENVIRONMENT AND ECOLOGY**

Departmental efforts in this priority focus on designing and developing systems and practices that create solutions for problems affecting soil, water, and air quality and advances in industrial ecology and corporate environmental management. BBE will support two strategic objectives: *Land, Water and Air Quality of Human-Impacted Systems* and *Sustainable Enterprise Development*. These objectives have associated initiatives that include:

#### **Land, Water and Air Quality of Human-Impacted Systems**

- Ecological engineering (develop minor, coursework)
- Environmental impacts of animal agriculture

- Reduce the ecological footprint of livestock systems and animal housing

### **Sustainable Enterprise Development**

- Strengthen and build Corporate Environmental Management expertise through a focus on sustainable organizations, management systems, and strategy
- Provide product stewardship, standards, and information disclosure
- Explore policy, management, and social/economic development
- Systematically identify and develop frameworks for improved environmental and social performance assessment

## **ADVANCED BUILDING SYSTEMS AND ENERGY EFFICIENCY**

There is strong public and commercial interest in energy efficient, durable, healthy and affordable buildings as we provide housing for the 21st century. BBE faculty will focus on three strategic objectives and related activities to create green and efficient buildings, including:

### **Advanced materials, components and systems for highly efficient buildings**

- Improve energy efficiency of existing and new buildings (residential and livestock)
- Integrate efforts with life cycle analysis, renewable energy systems, marketing and economics
- Provide high quality Extension programs for relevant stakeholders

### **Enhanced long-term durability of building materials, components and systems**

- Convene departmental members and relevant colleagues to formulate new initiatives and seek significant new sources of revenue (e.g. grant support) for these efforts

### **Improve air quality in buildings**

- Advance an integrated research and teaching initiative, based on current expertise

## **FOOD PRODUCTION, PROCESSING, SAFETY AND SECURITY**

Faculty affiliated with this *Program Priority* conduct critical research, development and education associated with agricultural and food production, processing, and consumption concerns. Strategic objectives and initiatives include:

### **Environmentally sustainable food production technology systems**

- Design, develop, and/or model processes and systems that support agricultural and food industry supply chains within changing global food system.
- Focus on unique, non-commodity applications within food production -- organic and specialty product production (plant or animal)
- Improve sustainable agricultural production via Extension education for agricultural enterprises

### **Food system safety and risk control**

- Investigate and design within risk-filled systems, processes, and specific technologies in agricultural, food, and bioenergy industries.
- Apply engineering design and technology principles to address food safety/protection issues; worker safety/health; public health; and homeland security.
- Interface with faculty with bioenergy and environmental/ecological expertise

- Develop alternative food processes particularly non-thermal processes for production of safe and high quality food products.
- Improve post-harvest handling of crops

### **Healthy and High Quality Food Processing and Storage Systems**

- Develop innovative engineering processes to improve nutritional and healthy benefits and sensory quality of whole food products
- Develop advanced sensing and analytical techniques to improve process and product design and control

These efforts are designed to fit within the University's *Healthy Foods, Healthy Lives* initiative and position BBE faculty to contribute to new institutional efforts around biofuels.

## **UNDERGRADUATE AND GRADUATE EDUCATION**

Education is a key feature of the Department. We will produce *well-educated citizens who are leaders in their chosen field* and offer *excellent educational programs that achieve global prominence*. BBE attracts a diverse population of students through an array of opportunities that offer many bioproducts and biosystems-related career options. To further strengthen our educational component, the Department has identified primary goals, including:

- Build and strengthen BBE undergraduate and graduate educational programs
- Increase undergraduate scholarship and graduate fellowship support

These efforts provide a conceptual framework, curricular content, while expanding and improving the effectiveness and reputation of our undergraduate programs and standards of excellence for the graduate program. Both of these areas reinforce our efforts to develop excellent teaching faculty while strengthening our connections to alumni and key stakeholders.

### **Build and Strengthen BBE Educational Programs**

To enhance our educational programs, we will support numerous initiatives to raise the profile and prestige of BBE degree programs. We will focus on student recruitment, enrollment, retention, advising, career development, curriculum, alumni and stakeholder involvement, faculty development, and continuous improvement practices.

Strategic *student recruitment* plays a critical role in enhancing *student enrollment* and the quality and prestige of BBE's undergraduate and graduate programs. The Department will undertake numerous initiatives to attract *high quality students* with a primary aim of *increasing total undergraduate enrollment to 200 students by 2010* and *doubling graduate enrollment by 2017*, including:

- Developing effective on-line and print communications strategies
- Exploring effective means to attract high quality students, including merit-based scholarships
- Publicizing cutting edge research and internationally recognized faculty to attract strong domestic and international graduate student candidates from high quality undergraduate programs
- Refining and streamlining graduate application and admissions process enabling timely, competitive assistantship offers

High quality *student enrollment in our classes* will also raise our visibility and prestige. We will strive to increase overall teaching productivity and efficiency. We will:

- Cross-list courses to expand student enrollment base
- Broaden and adapt course offerings to attract students from other majors and minors
- Develop interdisciplinary minors in Ecological Engineering and Building Science
- Explore feasibility of obtaining CLE approval for relevant courses
- Seek and expand the instructional contributions by adjunct faculty
- Promote and communicate our attractive course offerings using on-line tools

BBE will also develop effective *student retention* and *student advising* strategies. We will:

- Deliver excellent educational experiences in four undergraduate programs (Bioproducts & Biosystems Engineering; Bioproducts Marketing & Management; Building Science & Technology; Corporate Environmental Management)
- Provide high quality lower and upper division advising for undergraduates working closely with the Institute of Technology and CFANS
- Encourage faculty participation in advising of graduate students in programs across the campus in addition to our departmental graduate program
- Promote active faculty participation in departmental student seminars and presentations

As students end their academic careers, their attention turns to professional opportunities. By working with IT and CFANS Career Services, BBE Advisory Council members, and alumni, BBE will provide strong *career development* support to its students by:

- Facilitating a diverse array of internship, co-op, international travel and employment opportunities
- Creating opportunities for alumni and Advisory Council members to participate in academic advising, student recruitment, job placement, and mentoring
- Encouraging the Advisory Council to participate and conceptualize many dimensions of building and strengthening the Department's educational programs

Curriculum is a critical part of a high quality education. With respect to undergraduate curriculum, the recent departmental merger resulted in the creation of a revamped, merged engineering curriculum, recent accreditation of departmental programs. We are also seeking approval for a broad based, newly renamed Bioproducts and Biosystems Science, Engineering, and Management (BBSEM) graduate program, involving all BBE faculty in one graduate program. To ensure *continuous improvement of the curriculum and its implementation*, we will:

- Review and adapt undergraduate and graduate curricula to new needs in curriculum, advising, student experience, specialization or areas of emphases, graduate research experiences, relevant offerings, and faculty mentoring
- Continue and improve use of assessment methods for educational objectives and program outcomes for undergraduate education involving alumni, Advisory Council members, employers and other stakeholders
- Cultivate robust involvement of faculty, students and Advisory Council

Using continuous improvement processes enables BBE to rapidly and constructively respond to shifting circumstances, developing a culture of consistent innovation and responsiveness.

## Increase Undergraduate Scholarship and Graduate Fellowship Support

Recruiting and retaining the best and brightest students requires the ability to offer competitive scholarships and fellowships. BBE has therefore committed to increasing its pool of undergraduate scholarships and graduate fellowships, by:

- Building a combined undergraduate scholarship endowment to \$2 million by 2010 and secure at least six new graduate fellowships by 2013
- Expanding the Department's donor base via contributions from alumni, Advisory Council members, individuals, philanthropic organizations and private sector partners

## EXTENSION EDUCATION/OUTREACH

Faculty and staff in BBE understand that research results are most valuable when they can be applied in the field to generate change. As such, we are committed to making a public impact through community engagement and Extension efforts. We will seek to develop and deliver high quality, regionally and nationally-recognized research-based programs to meet current and emerging needs of industry and communities. To best serve our industrial and community audiences in Minnesota and beyond, we will fulfill the following key goals:

- Provide leadership to Extension education and directly-related applied research activities across the UMN Extension system and facilitate/lead educational partnerships with other states to leverage resources
- Develop and use innovative education strategies, technologies, and partnerships with faculty in BBE, CFANS, IT, AHC and beyond to create and deliver educational offerings
- Improve public visibility of BBE Extension offerings
- Increase overall BBE Extension revenue

To fulfill these goals, we will implement our Extension and community engagement programming affiliated with the Program Priorities outlined in the strategic plan. We will implement numerous activities to fulfill these key goals:

### Provide Leadership to Extension Education and Related Applied Research

In addition to Extension education responsibilities, BBE faculty also conduct relevant applied research. To sustain a leadership role in both capacities, we will:

- Publish extensively in peer reviewed journal publications in high quality, high impact journals
- Publish extensively in non-refereed Bulletins, papers, proceedings, etc.
- Consistently receive invitations for presentations in national and international symposia and conferences
- Offer leadership to Extension program teams
- Receive institutional and national Extension-related awards and recognition

### Innovative Strategies for Education

While many stakeholders require ongoing Extension education, new opportunities to redesign delivery of BBE Extension programs abound. BBE Extension educators will use the latest

technologies to develop and deliver distance-based and technology-enhanced learning. Responding to increased demand for new models of education that make use of technology, BBE Extension education will:

- Build capacity in and develop new models of technology-enhanced Extension education

#### Increase Public Visibility of Extension Offerings

BBE Extension programs provide an important public face for the Department to numerous sectors and communities. To further burnish our public image and enhance our public profile, our Extension programs and personnel will seek to:

- Increase citizen contact hours
- Gain regular media coverage
- Provide ongoing outreach to prospective students, teachers and public

Our efforts in Extension Education are intended to improve the impact of our programs with citizens statewide and key stakeholders, elevate our reputation for excellence within the institution and among peers nationwide.

#### Increase Departmental Extension Revenue

Extension efforts will be successful in part if they generate additional revenue for the Department. BBE will seek to increase Extension-related funding for its programs and will:

- Increase funds awarded for Extension-based and/or technology transfer grants.
- Increase Extension revenue through product sales, workshop fees, etc.

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## **ORGANIZATIONAL PRIORITIES**

A department is only as strong as the organizational foundation upon which research, teaching, and outreach programs are based. A robust departmental culture, world-class facilities, recognized leadership, and continuous improvement are hallmarks of a healthy and progressive Department. To ensure our strength in these four Organizational Priorities, we will support initiatives and activities that range from professional development and recognition, new facilities, enhanced endowments, and ongoing planning and evaluation. We will undertake these efforts in service to developing highly regarded research, teaching, and outreach programs.

### DEPARTMENTAL CULTURE

Investing in a strong, vibrant and collaborative department produces the highest quality research, teaching and outreach programs. BBE will work to increase *faculty satisfaction and retention*, support *professional development* of its staff and faculty, and ensure a *fair, respectful and collegial work environment*. Moreover, BBE will serve as a collegiate leader in service to creating a culturally integrated and collaborative unit. To build a strong, cohesive departmental culture, we will:

- Identify and support opportunities for faculty and staff development on an ongoing basis
- Promote a culture of active faculty participation in internal and external invited seminars
- Conduct faculty-led monthly departmental seminars and information sessions

- Contribute service that enhances the well-being of the Department, administrative units, university, disciplinary societies and other relevant entities
- Continue regularly scheduled social events in Department to sustain and enhance strong social capital
- Collaborate with the CFANS Director of Diversity to develop a comprehensive diversity plan
- Explore ways to enhance international presence and involvement by members of department

Strategic and supportive investments in the human resources of the Department will provide the good will and technical and intellectual expertise with an international reputation of excellence. These efforts will facilitate a vital departmental community.

## **LEADERSHIP DEVELOPMENT AND RECOGNITION**

Achieving our aim of becoming a world-class bioproducts and biosystems department that focuses on innovation and development of the bioeconomy and environmental sustainability requires a multifaceted strategy to recruit, reward, and retain top notch faculty, staff, students, alumni and friends. We will strategically reinvest in the *recruitment and retention* of new, world-class faculty. Our aims include:

- Increasing total number of tenured/tenure-track faculty to 30 by 2012
- Pursuing expansion of the number of endowed professorships

*Recognition and reward* are a key part of successful retention strategies for faculty. BBE has developed a comprehensive strategy for rewarding and recognizing professional excellence and leadership by faculty, staff, students, alumni and friends, including:

- Increased number of internal and external faculty awards (e.g. McKnight Professorship, Regents Professorship)
- Greater number of faculty fellows in professional societies and leadership in national academies
- Recognition for teaching and advising excellence (e.g. Morse Alumni Award, Richard C. Newman Award, Taylor Award, etc.)
- Higher number of student awards and wins of national and international competitions
- Improved external relations and effective communications to increase visibility of faculty accomplishments
- Institute a BBE Awards and Recognition standing committee to:
  - Disseminate information and nominate worthy faculty, staff, students, alumni, and friends of BBE for collegiate, institutional, national and international awards
  - Create awareness and appreciation for significant contributions by key BBE stakeholders

Our focus on recognition of significant contributions by the departmental community will encompass institutional, national and international awards and opportunities in keeping with our aim of global prominence.

*Professional development* of faculty and staff also contributes significantly to departmental excellence. Exemplary education is built on excellent teachers with a strong curriculum, cutting

edge instructional technologies, and effective pedagogy. BBE will encourage innovation and distinction in teaching work to develop excellence in teaching through:

- Funding opportunities and incentives for faculty investments in and use of technology-enhanced learning including software and computational support

These efforts to develop award-winning teaching faculty are aimed at increasing overall teaching output and productivity significantly beyond the average metrics within the College.

## **PHYSICAL AND FISCAL INFRASTRUCTURE EXPANSION**

Internationally recognized, cutting edge research and education in the 21<sup>st</sup> century requires top notch facilities and equipment. The BBE Department will require substantial investments to augment and upgrade existing facilities and equipment to fulfill the aims of this strategic plan and to most effectively serve the state and institution in advancing the forefront of a renewable bioeconomy and environmental sustainability, including:

- Ensuring modern facilities and equipment by securing a UMN legislative capital request for new buildings in 2010
- Increasing endowment through support from alumni, advisory council members and key stakeholders
- Ongoing upgrade of equipment via faculty-led grants procurement
- Obtain additional monies for administrative and technical support staff positions

## **EVALUATION OF PROGRESS**

The Department has carefully considered how best to assess and monitor our progress in fulfilling the objectives and activities outlined in this strategic plan. Continuous review of numerous dimensions of our programs will serve as a key part of our ongoing evaluation strategy, including measurement against specific metrics and involvement of student, faculty, and key stakeholders in ensuring high quality and successful fulfillment of our goals. The Department has deliberately infused this entire strategic plan with assessment approaches and clearly defined goals and activities that we will track and measure on a regular basis.