Biosystems Engineering
2020-2025 STRATEGIC PLAN

BE's Purpose:
BE designs sustainable and data-informed solutions to generate food, bioenergy, and bioproducts; enhance human well-being; and optimize resources through innovative technologies and strategies.

BE's 2029 Vision:
BE will be a world leader known for developing technologies and systems for the safe production of food, bioenergy, bioproducts, and biological information for sustainable use of resources in arid and semi-arid environments. Students, constituents, and professionals will come from across the world to participate with our programs.

BE's Mission:
Our mission is to improve the quality of life through excellence in instruction, research, and extension. To achieve this, BE will provide safe and secure food, water, energy, and biological information systems to adapt to a changing world.

BE's Shared Values:

Innovation
We are innovative in our solutions and how we approach engineering, life science, and data science practices to solve challenges important to society.

Inclusiveness
We bring different people, ideas, backgrounds, and perspectives together to produce lasting solutions for all. We encourage and help all to be successful.

Interdisciplinary
We embrace multidisciplinary collaboration to develop better solutions that address the needs of all.

Cooperation
We forge partnerships with academic, government, and industry colleagues to solve society's complex problems and improve the quality of life.

Sustainability
We manage use of natural resources to maintain healthy ecosystems throughout the production cycle of food, bioenergy, and bioproducts.

Connectedness
We work with industry and communities to understand tomorrow's needs and open up opportunities for our students and alumni to help.

Ethics
High ethical standards and sound decision-making are at the heart of our research, discovery, business, and financial practices.

STRATEGIC GOAL ONE: Prepare marketable individuals for careers in the next generation of Biosystems Engineering, Science, and Technology

A. Current situation and gap between current situation and desired situation

The world has tremendous need for solutions to problems related to the environment, energy, health, food, water, and sustainability. Biological systems are related to or at the heart of all of these issues. A Biosystems Engineer learns to design and analyze biological systems to develop innovative and practical solutions.

Converting knowledge into action to solve real-world problems in the life sciences requires a merger of data science, biology and physics, and applied engineering (also known as the 4th Industrial Revolution). These efforts require innovative and integrated educational pathways in applied statistics, computer science, and engineering technology. The Biosystems Analytics & Technology (BAT) major trains students to take a true systems-level approach to understanding the relationships across food, water, and energy for a sustainable future by providing skills in sensors and remote sensing (data acquisition), statistics and bioinformatics (data management and analytics), and applying these tools to solve real-world problems.

B. Strategies to achieve goal

1. Continue to develop Biosystems Analytics & Technology major.
2. Provide educational and professional experiences for students and practicing professionals for workforce development.
3. Develop and strengthen communication channels with constituents, industry, and funding sources.
4. Engage under-served communities.
5. Secure more internship opportunities with funding, both intramural and extramural.
6. Require and encourage students to publish, make presentations, work on projects, develop intellectual property.
7. Secure industry-sponsored funding to support senior projects (both BE and BAT).
8. Foster soft skills for students (i.e., leadership, presentations in scientific meetings and conferences, team work, etc.).
9. Increase data literacy for all students.
10. Continue to investigate new degree programs in collaboration with other departments

C. Actions	**Time Period (Fiscal Years)**
1) Foster stronger collaboration with colleagues on campus (CHEE, PLS, SNRE, AREC, NSC, and School of Information) in research, instruction, and extension.	FY 20-25
2) Work closely with private sector to expand internship availability.	FY 20-25
3) Develop on-line courses for students and professionals.	FY 20-25
4) Provide hands-on experiences for HS students through college in biosystems engineering & technology.	FY 20-25

D. Inputs needed to achieve the goal (do not limit to financial inputs)

1. Wider collaboration of faculty, staff, students, industry
2. Graduate assistantships (RA/TA) 5 @ $25k each + ERE
3. Relationships with local HS, community colleges
4. Faculty lines for to replace faculty retiring
5. Collaboration w alumni

E. Objective metrics that will be used to track progress towards attaining goal

1. Number of students taking courses, students in the major, number of graduates, experiences on campus.
2. Number of internships offered.
3. Percentage of students offered jobs upon graduation.
4. *Will continue to develop at next retreat.*

STRATEGIC GOAL TWO: Have world-class infrastructure and resources to be the go-to place for education, research, and extension

A. Current situation and gap between current situation and desired situation

Will be articulating this goal at the next departmental retreat.

B. Strategies to achieve goal

1. Update and modernize BE facilities for research and education
2. Provide research experiences for students
3. Increase the number of online courses to reach a broader student base
4. Increase research expenditures for equipment and facilities, and diversify sources of funding
5. Increase collaborative efforts within UA, other institutions, and industry both nationally and internationally
6. Monetize services provided by the BE Fabrication Laboratory & Shop
7. Increase development activities (endowments, gifts, etc.) to support infrastructure
8. Promote research and teaching activities in off-campus centers (i.e., MAC, YAC)
9. Establish learning centers for workforce training in the use of digital tools for agricultural production
10. Explore monetizing innovative research outcomes/products with patents and licensing to generate revenue

C. Actions **Time Period (Fiscal Years)**

1. Obtain funding to renovate Shantz 440	FY 19
2. Conduct a Rate Study for the BE Fabrication Lab & Shop to be able to charge for services	FY 20-21
3. Display current research posters in hallways, Shantz 440, 425, and on BE foyer monitor	

D. Inputs needed to achieve the goal (do not limit to financial inputs)

1. Willingness and participation of industrial partners with funding investments
2. Enhanced research and teaching facilities
3. Diversified funding and financial support for increased RA/TA's and technical staff FTE
4. Collaboration and support of UA OTT, Az Center for Innovation

E. Objective metrics that will be used to track progress towards attaining goal

1. *Will develop at next retreat*

Notes (if any)

STRATEGIC GOAL THREE: Conduct and deliver strategically-critical, regionally-important, and globally-relevant research to promote positive economic and social impacts in Arizona and the southwest region

A. Current situation and gap between current situation and desired situation

Currently, resources are strained to provide safe, secure, nutritious, and plentiful food, feed, and fiber supply to the world. This is particularly true in arid and semi-arid environments where resources needed for agricultural production (water, energy, infrastructure, labor) tend to be scarce. As world population increases and resources become increasingly limited, production systems that are more efficient, productive, environmentally sound, ensured safe, and economically viable will be increasingly important. Development and dissemination of new technologies and information systems that provide solutions to problems facing field and controlled environment agriculture (CEA) in arid and semi-arid environments is important today and critical for the future.

The BE department has long dealt with the problems associated with high temperatures and solar radiation loads, water scarcity, low soil fertility, and an increasing population. Many solutions include intensive crop production, specialized animal and crop breeding and germplasm evaluation programs, and an extensive dairy and meat production program, all of which are focused on climate-responsive sustainability. BE will continue to be the crucial interface between the laboratories and the field/controlled environment agriculture-based producers. In short, we are well positioned as a global leader in efforts to enhance agricultural production in increasingly harsh environments.

We live in an information-¬-rich age in which measurements can be made on a tremendous number of aspects of living systems. It is becoming clear that having more information is not necessarily beneficial but requires thoughtful design and analysis. The BE department is unique in having faculty that span a wide range of areas in information-¬rich topics: fundamental biology, sensor development and deployment, biological statistics (biometry), and utilization of information for better decision making for optimal crop and animal production, human nutrition and health, and environmental protection. The BE department can play a leadership role in addressing issues that arise in application based information management and to bridge the gap between knowledge and insight especially in support of the private sector. Current thrusts include biosensors, plant health and growth monitoring, biometry, and remote sensing. Opportunities include genomics, bioenergy, biomedical, pharmaceuticals & nutraceuticals, monitoring & control of crop nutritional &phytochemical content, and natural products.

B. Strategies to achieve goal

1. Build agricultural production capacity that will, in time, sustain our collaborative efforts in arid land agriculture; combine the efforts of multi-disciplinary researchers and Extension agents working at existing centers within the college, in USDA, and with local farmers and growers. These include CEAC, MAC, YAC, ARC, Meat Science Laboratory, Water and Environmental Technology Center, WRRC, and Food Safety Consortium; USDA facilities (ALARC, SWRC) and others; industries of cotton, leafy greens, greenhouse production, animal products, and others.
2. Develop and promote sensing, automation, and alternative energy systems for agricultural operations to reduce inputs (labor, water, fertilizer), while improving food quality, safety, and production primarily for semi-arid environments.
3. Support the growth and public perception of locally grown food and community agriculture through research, Extension, and instruction.
4. Develop internationally recognized education programs in arid land agriculture including CEA production, sensing and automation, and irrigation using marginal water and reclaimed water onsite wastewater treatment).
5. Assist growers, farmers, and the community through dynamic, timely, and unique extension programs.
6. Promote and facilitate international collaboration.
7. Develop tools for the detection of pathogens in the environment and in patient care.
8. Facilitate the ability to acquire and visualize, process, analyze, model and simulate complex data to close the data-to-knowledge gap

C. Actions	Time Period (Fiscal Years)
1) Formalize partnerships with colleagues to foster growth of arid land agriculture; jointly host visitors, local conferences, and coordinate research and teaching with the goal of solving high impact problems. Possibly create a Center for Translational Agriculture for Arid and Semi-Arid Climates (BE, PLS, AREC, ARC, ALARC, Nut Sci).	FY 20-25
2) Seek new sources of funding for research, extension, and instruction especially to promote utilization of new technology in arid land agriculture that utilizes integrated, strategic teams.	FY 20-25
3) Develop sensing, mechanization, and automation technologies for crop production in the field and in CEA environments to reduce labor requirements; decrease production cost; improve food safety, traceability, and nutrition; increase yields and improve resource use efficiencies with current production practices and with increasing use of marginal quality water for irrigation.	FY 20-25
4) Develop and evaluate information-rich methods (remote and near sensing, modeling and simulation, genomic and phenotypic data) using decision-support systems to improve agricultural production practice economics and environmental impact.	FY 20-25
5) Evaluate the "hard problems" in use of reclaimed water for irrigation.	FY 20-25
6) Translate new technologies and systems developed into viable commercial products with IP protection where appropriate.	FY 20-25
7) Facilitate community agriculture and education through Master Gardner programs, hosting externs, and community presentations.	FY 20-25
8) Develop educational tracks which partner with other CALS programs to foster incorporation of new technology into other majors (PLS, AnSci, AREC, AgEd, NS). Track with USAID initiatives.	FY 20-25
9) *Will continue to develop this section at next departmental retreat*	

D. Inputs needed to achieve the goal (do not limit to financial inputs)

1. Collaboration from diverse disciplines and organizations
2. Faculty-level planning and administration-coordinated efforts
3. Resources to perform technology translation
4. Financial support of unique facilities (CEAC, field capabilities)
5. Increase state and federally funded research and extension activities

E. Objective metrics that will be used to track progress towards attaining goal

1. Number of technologies (IP protected and non-protected) developed that are commercialized.
2. Number of UA and non UA faculty, growers, and industry personnel participating in activities.
3. Number of graduates (BS, MS, PhD) who gain jobs in this field, especially in AZ.
4. External funds raised (sponsored research and Extension, industrial contracts, gifts).

Notes (if any)

Notes:

The strength of our activities is in developing and implementing technologies and systems for application with living systems. Our activities uniquely connect *across* areas, as demonstrated in the Venn diagram below in which our emphasis areas intersect. For example, we are developing sensors and devices to monitor safety of food; this clearly connects two of our topical areas. Many of our programs unite three or four of our goals. The connection of sensors, systems (and systems approaches), and devices is consistent across our activities and this technology-driven approach underlies all that we do.