Name of the Proposed Unit: Chemical and Environmental Engineering to function within whatever colleges or related organizational structures (e.g. schools) emerge.

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Units to be Consolidated:

This proposal is that a previously consolidated unit, viz. the Department of Chemical and Environmental Engineering (CHEE), should be preserved and placed into the appropriate administrative structures that may emerge at the University level, such as a College of Science and Technology or a re-structured College of Engineering. Our choice is a College of Engineering since the majority of the land grant institutions have strong Colleges of Engineering.
Departmental Synopsis in Relationship to Academic Program Prioritization Guidelines:

- History: Chemical and Environmental Engineering merged in AY93-94. Previous to that time, the programs operated independently, with environmental engineering housed in civil engineering. The bases for the merger included administrative cost savings, commonality of research and teaching interests, increasing need to tackle environmental problem through prevention, viz. the design and implementation of environmentally friendly processes, as opposed to environmental remediation.

- Demand/Enrollment: 180 to 200 undergraduates (B.S. ChE); 60 to 75 graduate students (15 to 25 M.S.; 40 to 50 Ph.D.) Teach core undergraduate civil engineering courses as well as ChE.

- Productivity: Degrees granted per annum: 25 to 30 B.S. ChE; 5 to 15 M.S.; 5 to 10 Ph.D. Graduate BS starting salaries range from $60 to 80K. Approximately 95% are employed immediately upon graduation. Companies in Arizona that employee are graduates include: Proctor and Gamble, Frito Lay, CH2MHill, Intel, Freescale, and Raytheon as well as many government agencies (state, county and federal) and small start-up companies.

- Faculty: 13 instructional + 1 department head. Approximately, 75% of our state funds are for faculty lines.

- Departmental rank: 17th within the University and 2nd within the College of Engineering (Hydrology and Water Resources, HWR, is ranked 1st); CHEE is the highest ranked engineering department. We are currently at critical mass in terms of faculty.

- Research Centers: CHEE is home to the SRC/SEMATECH Engineering Research Center (ERC) for Environmentally Benign Semiconductor Manufacturing. The ERC was established in 1996 with $2M/yr from the NSF and SRC; in 2006, the center graduated off of NSF support and is now funded almost entirely through extramural industrial support (approx. $2.5M for AY08-09 to date). Member of the CHEE faculty also participate in other major research centers on campus, including the WQC, the NIEHS Superfund Program and the WRRC.

Justification for CHEE going forward

The ‘green’ transformation of engineering design and practice is driven by the convergence of a multitude of issues including: (a) widespread recognition of the impact of environmental pollution on human health, the rapid pace of resource depletion, (b) unrestrained commercial and residential development of land in environmentally fragile areas, (c) explosive economic growth of China and other Pacific Rim countries, (d) instability of energy prices and sources, and (e) accelerating threats posed by climate change.

In Arizona, the issues of environmental sustainability and economic development are especially intertwined. During the last decade, semiconductor and electronics companies have led statewide industrial growth and the creation of high-level employment. High technology manufacturing uses large quantities of natural resources and produces waste requiring treatment and disposal. The waste generated is a serious concern considering the proximity of the industries to urban and environmentally sensitive areas. Retention and growth of high-technology manufacturing plays a key and vital role in the economy and future prosperity of the second-fastest growing State in the Nation and the quality of life of all Arizonans.

The Chemical and Environmental Engineering Department has a leadership role in strategically addressing the above issues and the prospects for the Department to play a leading role in engineering for the environment are very high within the University of Arizona and on a State or regional basis. Semiconductor manufacturing, which has been a major focus for the Department for many years, primarily through the Center for Environmentally Benign Semiconductor Manufacturing, exemplifies
these challenges. A critical factor in sustaining the semiconductor industry and attracting the high-tech industries of the future is the availability of water and energy. Arizona is particularly disadvantaged in competition when it comes to the availability of water and our most abundant source of energy—solar—remains largely untapped. The nexus of these two infrastructures, water supply and energy production is barely understood from the standpoint of long-term resilience. Assuring a vigorous semiconductor manufacturing industry in Arizona, as well as attracting future high tech industries involving nano- or biotechnology, will be severely challenged by these environmental realities.

The Department continues to attract high quality faculty and students interested in the convergence of chemical processing and the environment and who are dedicated to advancing the technical aspects of environmental issues. The learning generated by all of this activity demonstrates that the most successful innovations for the environment connect a molecular scale understanding of processes with a macroscopic systems-design orientation. The Department has shown that it can build on these successes while also connecting with the increased societal awareness of environmental challenges.

The Department is poised for growth in several areas of graduate research and teaching. High priority research areas include water, sustainable nano-manufacturing, biologically-inspired processing and energy. The strengths in the department in water research include water reuse, biotechnology for environmental applications, groundwater treatment, desalination, management of trace organics and emerging contaminants. Classroom instruction of both undergraduates and graduate students in these areas is also on a firm foundation.

There are substantial collaborations by faculty members in the Department with other University of Arizona organizations in water-related research. There are several major centers on campus that do research on water resources including the four centers in the Department of Hydrology and Water Resources and the Water Quality Center supported by the NSF. There are also strong water science and water engineering collaborators in the Department of Soil, Water, and Environmental Science. These activities have successfully led to cutting-edge environmental water science and technology research by the Department which is nationally and internationally-recognized.

Environmentally sustainable nano-manufacturing of components and devices is a technology area that is vital to Arizona's current and future economy. Recent work in the Center for Environmentally Benign Semiconductor Manufacturing substantiates that the water required for electronic device fabrication increases dramatically as manufacturing moves to nano-scale feature sizes. Resource sensitive areas such as Arizona will find it increasingly difficult to attract industry unless a significant part of our research efforts are devoted to issues related to developing and applying new science to high-volume manufacturing in a manner that emphasizes sustainability. The Center is the administrative hub of the successful NSF-SRC (Semiconductor Research Center) which conducts about $3M/year of research on seven university campuses: this highly recognized Center is likely the optimum springboard to launch a new initiative on sustainable high-tech nano-manufacturing. The center has now expanded its research to include development of biologically-inspired processing techniques to high-volume manufacturing of both conventional and hybrid nano-electronics.

Water and energy resources and their use are inextricably linked to the high tech industry and the economic well being of the State. The research performed in the department is an essential part of the priority research fields for the university. In particular, we strive to solve environmental problems in Arizona. We have a strong outreach component to our department. We offer industrial short courses to the semiconductor industry as well as courses to water professionals on emerging contaminants and desalination. We also have a NSF sponsored Research Experience for Teachers program in which we have had over 300 teachers do research in our laboratories to enrich their math and science curriculum.
Consultation

The proposal originated from a regular meeting of the CHEE faculty, with a substantial majority of the faculty present.

Budget Impact

As noted, the CHEE unit is a productive result of consolidation measures that were taken more than a decade ago; the separate chemical and environmental engineering programs were merged in the mid-1990s. Because the unit has a successful track record—we are the highest ranked engineering department in the University—the proposal is to preserve the unit’s integrity and properly place it within whatever academic structure (e.g. College or School) results from the University-wide re-structuring. Budget saving would have to come from the efficiency of the new academic structures; CHEE was previously conceived and structured so as to administer separate but complementary academic programs within a single unit and thereby gain administrative cost savings. Owing to the unit’s track record of success, CHEE would ideally be allocated a larger, not smaller budget.