Final Report

For the

Regulation 2-13 Committee on Chemistry and Chemical Engineering

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Saman Aryana
Tara Evans (Ex Officio)
Lars Kotthoff
Holly Krutka
Teresa Lehmann
Bruce Parkinson
Tom Peterson (Chair)
Ainsley Thrailkill (Staff Senate)

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Executive Summary

The original proposal described in the July 28, 2021 memo asked the committee to consider three structural elements:

1. Transfer of the Chemistry department reporting structure from the current College of Arts and Sciences to a newly established College of Engineering and Physical Sciences.
2. Discontinuation of the Chemical Engineering department.
3. Merger of all academic programs in chemical engineering and chemistry within a single department.

Following an Interim Report submitted by the committee to the Provost on September 1, the Provost and President modified their proposal by eliminating element #2, the discontinuation of the Chemical Engineering department. The committee applauds the administration for modifying the proposal with the removal of the discontinuation. The proposal now consists of a reorganization resulting in a combined department with chemistry and chemical engineering, housed in a reorganized College of Engineering and Physical Sciences.

Overall, there is no outright opposition to moving Chemistry to a newly established College of Engineering and Physical Sciences. There is a mix of support and opposition on the proposal of a merger of the departments.

There is general support for a merged department within the chemical engineering faculty while the chemistry faculty are more hesitant. There continue to be many questions and concerns that have been raised that fall into three categories:

- What are the perceived benefits to be accrued by some combination of chemistry and chemical engineering?
- What is the best organizational structure involving a combination of chemistry and chemical engineering?
- What current collaborations/synergisms exist between chemistry and chemical engineering and how do those efforts benefit or are enhanced by some combination of chemistry and chemical engineering?

The committee was unable to reach unanimity regarding a single overall recommendation, and the views of the committee members divided along departmental lines. The chemical engineering faculty were supportive of the merger as well as a plan to follow a process leading to fully integrated staff support of the entire merged department. The chemistry faculty preferred that each program remain as autonomous departments, but if the merger goes forward they strongly preferred to maintain the current staff support model involving shared staff between physics and chemistry.

One thing is abundantly clear: an Ad Hoc Committee to thoroughly study the details of the administrative structure of a new merged department must be stood up immediately. There are multiple issues relating to potential transfer of staff from the current College of Arts and Sciences to the new College of Engineering and Physical Sciences, the current staff sharing model in Chemistry and Physics, the culture of centralization in engineering and decentralization in the Physical Sciences, etc., that must be ironed out before any formal restructuring and/or merging can efficiently occur. In addition, the committee is concerned that there may be significant costs and need for additional support from UW services including the Office of Sponsored Programs, IT, Human Resources, etc. These additional costs and needed support should be understood before any actions are taken.

Organizational Structure and Rationale for the Proposal

A rather detailed ***Interim Report*** (found in Appendix I) dealt with numerous issues relating to the basic question immediately asked by the Chemical Engineering department: "why has the department been targeted for discontinuation?" The committee felt unanimously that the department was unfairly singled out for discontinuation. It was apparent to the committee that the decision was driven primarily by faulty data analysis, and the *Interim Report* presented the specifics of those faulty analyses. The "primary source" data the committee gathered (most of which are found in Appendices II through VI) included:

1. Enrollment data for chemistry and chemical engineering, and for all other engineering degree programs as well. These data also include gender-specific and URM-specific data;
2. Degrees granted by chemistry and chemical engineering;
3. Career and placement information for graduating students. We have focused primarily on BS degree recipients although data for MS/PHD grads exists as well
4. Faculty lines, by type, in chemistry and chemical engineering, as well as in all other engineering fields;
5. Direct financial support for research and creative scholarship;
6. Publications resulting from that research and creative scholarship;
7. Unrestricted budget numbers for programs in the current College of Engineering and Applied Science; and
8. Direct and identifiable contributions to the teaching mission of the department. The ABET self-study data compiled in Appendix VI refutes considerably an unfounded notion that the chemical engineering faculty have low teaching loads and teach to small class sizes.

From the committee's perspective, there were significant discrepancies in the data that were used by various committees and outside consulting firms to evaluate the Chemical Engineering department. Examples of those discrepancies were presented in the ***Interim Report*** and will not be reiterated here.

Following the removal of the proposal to discontinue the Chemical Engineering department, there remain two aspects of the structural reorganization.

The transfer of Chemistry from the College of Arts and Sciences to the new College of Engineering and Physical Sciences

Broadly speaking, while there are many details that need to be ironed out with respect to the impact of overall administrative structure, there is general support for the move of the chemistry program to the new College of Engineering and Physical Sciences. This report will touch on those details still requiring attention.

The Establishment of a new department of Chemistry and Chemical Engineering

There is a mix of support and opposition regarding creating a merged entity that includes the chemistry and chemical engineering programs. Questions remain about the objective and the benefit of such a merged entity, as well as what the best structure of that merged entity would be. Generally, the chemical engineering faculty are more amenable to this proposed merger than are the chemistry faculty.

As part of the Committee's work, we examined the administrative structures of other research universities where chemical engineering and chemistry are combined in some way. Historically, chemical engineering is an offshoot, in the early 1900s of "Applied Chemistry" foci within departments of chemistry, so there have indeed been departments housing both chemistry and chemical engineering. However, to our knowledge such departmental structures disappeared by about the 1960s. Currently, there are three well-respected universities that have *Divisions* or *Schools* of Chemistry and Chemical Engineering, but in all three cases separate and autonomous departments are maintained. Those schools are Caltech, UC Berkeley, and UIUC.

Also, as part of our work, the committee met with both Deans and both Department Heads, both groups of faculty, support staff from both departments as well as with a small group of chemical engineering students. It has also solicited individual input from faculty in both departments, from outside constituencies such as the ChE Industrial Advisory Committee and has undertaken a significant effort to collect data that represent each department's contributions to the overall mission of the institution. Parenthetically, unsolicited input from all those groups listed above has also been received, and industrial and business constituent input (found in Appendix (??)) has spoken directly about their concerns with the proposals.

Without explicitly recommending a merged department and focusing only on the question of organizational structure for a merged department, two potential models can be considered. One is proposed with the long-term intent of a truly integrated and merged department (supported by the ChE faculty) and one is proposed with the intent of a merged academic structure but with support provided to chemistry following the current shared chemistry/physics model. More will be said about this below, but it is fair to say that chemistry favors this latter approach because (a) it is working well for the chemistry and physics departments now and (b) a considerable amount of effort was

put into standing up this shared arrangement over the last few years and there is great reluctance in having to start over with that process. Chemical engineering is currently under-resourced, and is therefore more amenable to working towards establishing a shared structure within the new department.

Table 1.
Possible Organizational Structures for
A Merged Department

	Favored by ChE	**Favored by Chem**
Academic Leadership	Department Chair	Department Chair Assoc Head of Chem Assoc Head of ChE
Graduate Pgms	Grad Coordinator	Rely on chemistry graduate committee (faculty) Similar structure for ChE?
Undergrad Pgms	Undergrad Coordinator UG Curriculum Comm – 4 faculty members including ABET and ACS accreditation reps	Rely on faculty coordinator Similar structure for ChE?
Office Administration	Office Associate Senior Administrative Assistant Office Assoc/Bookkeeper Accountant	For Chemistry: continue to share 4 persons with Physics For ChE: own staff
Technical Staff	Research Scientist (1 Current Chemistry) Master Technician (1 Current Chemistry) Instrumentation Scientist (XPS, TEM) (Vacant) Unit Operations / Bioengineering Undergraduate Laboratory Technician (Vacant)	Research Scientist (1 Current Chemistry) Master Technician (1 Current Chemistry) Instrumentation Scientist (XPS, TEM) (Vacant) Unit Operations / Bioengineering Undergraduate Laboratory Technician (Vacant)

While admittedly a bit of an “apples and oranges” comparison (because there are no other research universities in the US with a combined chemistry and chemical engineering department) it is informative to look at an “idealized” support structure assembled from the information we have gathered from Caltech, Berkeley and Illinois for *their* combined chemistry and chemical engineering entities, found in Table 2.

Table 2.
“Typical” support for Division/School of Chem and ChE

	Typical at Division level for Caltech, UCB, UIUC
Academic Leadership	Unit Head ChemE Curriculum Head Chemistry Curriculum Head

Graduate Pgms	Grad Coordinator (one for each program)
Undergrad Pgms	Undergrad Coordinator (one for each program)
Office Administration and Technical Staff	Chief Administrative Officer Dept Head Admin Support Grad Coordinator Admin Support UG Coordinator Admin Support (2) Academic Personnel Analyst Financial Analyst Facilities Manager Facilities Technician(s)

During the interviews, concern was expressed that it would be problematic to have a division in the new college while all other units were department level. This is another issue that an ad hoc committee would need to consider with consultation at the college administration level.

Benefits, Efficiencies, Unintended Consequences and How to Deal With Them

For reasons that will become clear in this Report, one of the "efficiencies" in writing this report is in dealing with the "pros, cons and mitigations" all at once as a specific issue arises. We have therefore taken the liberty to slightly alter the report format while still maintaining the need to cover all the issues raised in the Report Template. An over-arching set of questions raised by *all affected faculty in both departments, the department heads, the Deans and the support staff and even the students* with whom we met now that the matter of discontinuation of chemical engineering has been set aside, continues to be

- What is the university leadership expectation regarding the benefits of a merged department of Chemistry and Chemical Engineering?
- What are the financial benefits, costs and risks?
- What are the overall educational benefits?
- What are the specific research, teaching and outreach benefits?

Following the proposed Report Template, we address five aspects of the proposed reorganization:

- Organizational Structure
- Staffing Efficiencies
- Research and Scholarly Synergisms
- Improvements in Educational Programs
- Community Engagement

Organizational Structure

With the exception of this specific paragraph, the committee's response to *all* the issues raised herein have been "itemized". But one over-arching issue in all these deliberations deserves description in paragraph form. Above all else, for this merger to go forward successfully, all aspects of it, down to the finest of details, need to be executed in a way that everything is **equalized** across both disciplines in a merged department. The numerous aspects of Chemistry TA allocation and their use, both to offer a rigorous undergraduate learning experience AND to support the graduate program, is one example. Chemistry has more TA slots (albeit underfunded) than they have grad students to fill them and so they use undergrads, some of which are Chem E students. These TAs could go to ChE grad students *if they had the additional funds* to do so. The staff issue relating to Physics, described in detail below is yet another example of the current asymmetry in support between the two programs. And of course, true equity in a merged department would require directly addressing the salary differential between chemical engineering and chemistry faculty, which is primarily market-driven.

- Benefits and Efficiencies
    - As with any merger/consolidation of organizational entities, be they in academia, industry or government, there always exists the possibility for efficiencies relating to areas such as
        - Functional overlaps,
        - providing complementary services,
        - realignment of job responsibilities and
        - providing higher levels of external visibility.
    - The committee found that for the most part, those benefits and efficiencies, if available at all, fell into one of the four categories that follow (staffing, research, teaching and outreach).
    - This was also true for discussions relating to Unintended Consequences and Strategies for Mitigation.
    - Therefore the discussions of "Organizational Structure" will be articulated in the *context of* those four areas, which follow immediately.
- Unintended Consequences
    - See comments above
- Mitigation Strategies
    - See comments above

Staffing Efficiencies – faculty and support staff

- Benefits and Efficiencies
    - Any merged department offers the potential, but not gurantee, for efficiencies, not only in terms of reductions of duplication, but more likely in terms of provision of services to the entire group previously available only to a subset of the new group. Possible examples include technician support and research operational support, but both are clearly conditioned on continued proportionate financial support as the new department grows.
- Unintended Consequences
    - A merged department will have faculty and staff occupying five separate buildings. This may pose new logistical challenges. Currently the shared Physics/Chemistry Office runs well and is located in the same building with Physics and Chemistry. Considerable time/expense/disruption ensued when Physics and Chemistry offices were merged just a few years ago and to undo that and assemble yet a different structure would be highly counterproductive. Will this current arrangement be carried over, and if so, how will this decision impact the proposed merged department of Physics/Astronomy/Atmospheric Sciences?
    - Precisely how will new faculty positions be allocated? Will it be left to the department to decide where a new position will go, when available, or will there be clear directions at the college level about allocations to chemistry vs chemical engineering? If the former, how does one address the numerical imbalance if positions are only allocated by vote of the faculty?
    - Tenure and Promotion standards may need to be calibrated across both programs if a department-wide policy is to be implemented for the merged department.
    - Currently, there are significant differences between the two programs in
        - faculty salaries
        - teaching load expectations
        - TA allocations. Driven by service-course generated SCHs, chemistry can rely on first-year graduate student support via TA's. This is not possible in chemical engineering.
    - A single department head over these two merged programs will be expected to interact extensively with corporate and industry constituents, particularly in Wyoming, and oversee two very different degree programs with very different accreditation and course requirements.
- Mitigation Strategies
    - The most obvious solution is the appointment of Associate Heads over each of the two programs, and continuing to maintain separate policies for salaries, teaching loads, graduate student support, accreditation support,

etc. This bifurcated approach may work against the eventual seamless merging of both programs and could cause implementation challenges if it is a unique situation within the new college.
    - The latter suggests consideration of a Division of Chemistry and Chemical Engineering rather than a department, maintaining separate departmental structures for the two programs with considerable consultation at the dean level.
    - Both these strategies return us to the overarching question of "what's the point for Chemistry"? What do we gain, in any aspect of teaching, research, outreach or financial burden, by any form of consolidation? The Chemical Engineering faculty believe the overall staff support to be provided to the faculty will improve in a merged department. This position presupposes addition of staff personnel for those purposes. The Committee has struggled to clearly identify clear and unambiguous benefits in any of these areas in the absence of some future resource commitment.

Research and Scholarly Synergisms

- Benefits and Efficiencies
    - There is uniform and genuine interest among both faculty groups to find ways to enhance collaborative research opportunities and a merged department could facilitate those research collaborations, impacting primarily the graduate program, but also benefitting the individual undergraduate programs. These advantages for the undergraduate students manifest primarily through research experiences, often under the mentorship of graduate students, postdocs and faculty. It should be noted, however, that significant collaborations *already exist* between the two departments. There are numerous identifiable collaborative projects currently involving various chemistry faculty and chemical engineering faculty.
    - Sharing instrumentation facilities, technician support (those that are state-funded) and laboratory space may also be a benefit to the merger, although a merger does not immediately solve such issues, which may be better addressed at the college or even university level. Assuming no physical relocation will take place, sharing of lab space could be difficult, but once again a good portion of the chemical engineering faculty believe this issue can be surmounted, assuming some level of increased staff support.
- Unintended Consequences
    - While the merging programs have a potential for increased collaboration and facilities-sharing, a much larger issue, which can be dealt with only at

the college level, involves the lack of sharing across *current engineering* programs.
    - It was pointed out that in many ways, existing collaborations and the sharing of research facilities have been smoother for chemistry and chemical engineering than it has been for departments *within* the College of Engineering and Applied Science, questioning whether the merger will have an impact on these areas. There seem to be significant barriers to equipment and facilities sharing. This level of "turf protection" will work very much against the smooth incorporation of the science colleagues into the combined college. Specific examples mentioned were related to equipment and facilities in Petroleum Engineering and Mechanical Engineering.
    - While some aspects of staff support are administered centrally on behalf of all departments, other aspects such as technician support are assigned directly to departments and not shared. Currently the Chemical Engineering department has zero technician support and must rely on the faculty to maintain and service equipment used for both teaching and research. This is also the case in Chemistry.
    - It is important to understand that the movement of Chemistry to a new college as well as a potential merger will require significant support across UW from units not staffed to provide this level of support. This is only a short-term concern, but the committee recommends any reorganization proceed with caution and with consultation with the Office of Sponsored Programs, IT, Human Resources, etc. Thus, there may be substantial costs from any reorganization steps without clear savings. This is not a reason not to proceed but must be understood and addressed prior to doing so.
- Mitigation Strategies
    - Pockets of culture with an unwillingness to share resources exists within the College of Engineering, both within some departments (not chemical engineering) and across departments and Colleges. This must be dealt with by College leadership and may require Provostial or Presidential intervention. As programs in the physical sciences, previously enjoying a culture of collaboration and sharing, join the college there will be significant dislocation if this attitude persists.

Improvements in Educational Programs – Teaching Efficiencies

- Benefits and Efficiencies
    - While chemical engineering students take many chemistry courses, chemistry majors take few or no chemical engineering courses.
    - Possible sharing of teaching responsibilities in courses like thermodynamics

    - A merged department could offer new and unique research internship possibilities to our undergraduate students.
    - A merged department could offer new and unique team-taught elective courses of interest to both chemistry and chemical engineering students at both the graduate and the undergraduate level.
- Unintended Consequences
    - The accreditation process under ABET (chemical engineering) and ACS (chemistry), differs in many aspects and will require specialized expertise that has very little “crossover” from Chem to ChE.
    - The current teaching load expectations are about 50% higher in chemical engineering than in chemistry.
- Mitigation Strategies
    - Appointment of individual and separate faculty to oversee respective accreditation processes, although it must be considered how this will relate to the college if no other units are set up in a similar manner.
    - Establishment of a uniform teaching load policy, or in the absence of such a policy, clear guidelines and explanations for why the teaching load expectations should differ.

Community Engagement

- Benefits and Efficiencies
    - The merger would provide chemistry faculty with much greater access to industrial partners across the state. ChE will in turn have the opportunity for greater participation in the local ACS chapter.
    - For many (most) high school students, there is poor understanding of the differences in true curricular content, high school preparation needed and employment opportunities for various university degree options. A merged department may give faculty and staff from both disciplines better opportunities for joint recruitment of undergraduate students and clearer articulation of the pros and cons to each degree pursuit.
- Unintended Consequences
    - There is significant business and industry resistance to the proposal to merge chemical engineering with chemistry, expressed primarily by constituents in Wyoming who hire chemical engineers. See Appendix VII. We also heard similar expressions of concern during a recent Trustees meeting, no doubt because they too were hearing from the same constituents. The perception, rightly or not, is that a merger could dilute the critical emphases on business and industry-related topics within the ChE curriculum (e.g., process control, engineering design, etc.). If true,

this translates directly to an adverse impact on each company's bottom line.
    - Notably, industry in Wyoming has positive sentiment toward the graduates from the chemical engineering program in particular, which is critical to industries important to Wyoming.
- Mitigation Strategies
    - Knowing that there really will not be any noticeable change in either curriculum as a result of the merger, these industry-related concerns are mostly due to perceptions, and could be addressed by a targeted communications campaign. However, when it comes to university/business interactions, these perceptions from engineering companies are deeply felt and often hard to neutralize.

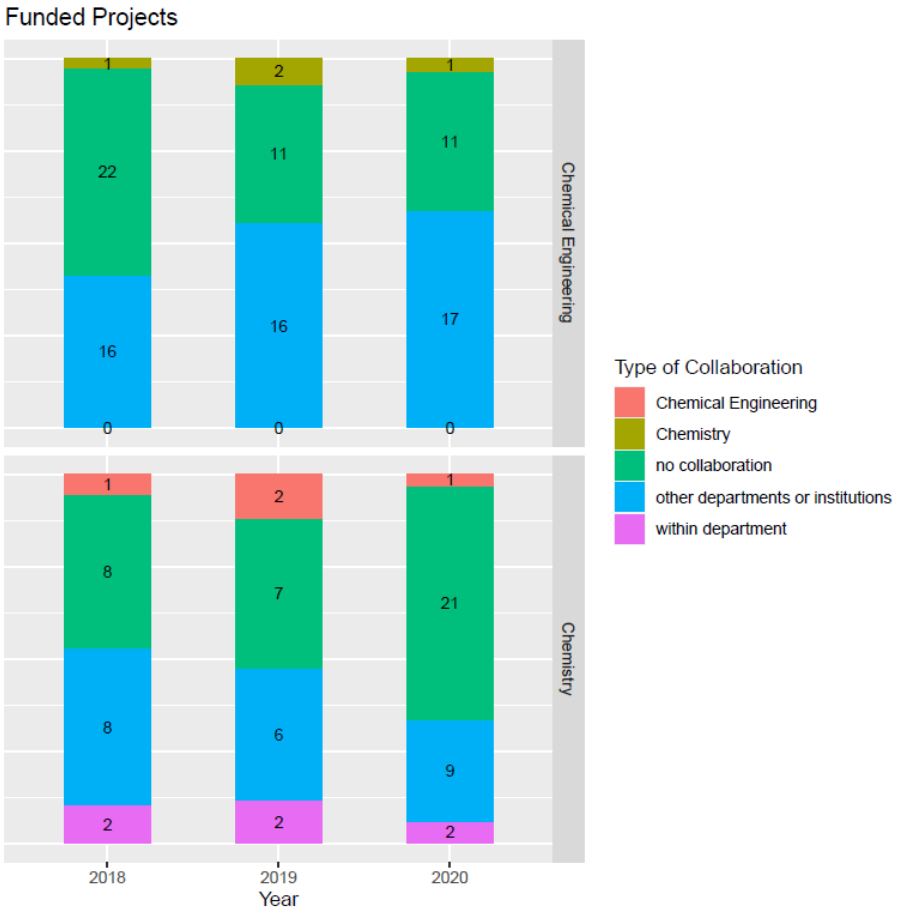
Academic/Discipline-Specific Expertise

It is quite apparent that while many of the research areas of interest to the faculty are pursued individually (i.e., without other faculty collaborations) there are also many funded projects in which both chemistry and chemical engineering faculty participate. A quantitative analysis of all funded research projects in chemistry and chemical engineering in the period 2018-2020 illustrates this point.

The graph in Figure 1 shows the types of funded projects that have been active 2018-2020 for the Chemical Engineering (top) and Chemistry (bottom) departments.

Figure 1

Current State of Collaborative Work in Chemistry and Chemical Engineering



For chemical engineering, there has been a steady increase in the total number (and fraction) of collaborative funded projects with chemistry (olive green) and others (blue) over that three-year period.

For chemistry, collaborative funded projects with chemical engineering (orange), other departments/institutions (blue) and other chemistry faculty (purple) has increased numerically, but at a rate slower than the rate of increase in single-PI projects.

These data only consider currently funded projects, and the majority of those projects are collaborative and interdisciplinary. Furthermore, projects funded by Wyoming resources such as through SER are not listed included here and therefore is an under-representation of total collaborations. The Chemical Engineering department conducts significant research under the auspices of SER, and at least two of those projects involve partnership with the Chemistry Department.

Current areas of research expertise in **Chemical Engineering** are:

- NMR, rheology, enhanced oil recovery, transport in porous media, interfacial phenomena and materials
- Transport in hierarchical permeable media, complex fluids and CCUS
- Sustainable wastewater treatment
- Coal conversion technology, emphasizing non-fuel products derived from coal
- Heterogeneous catalysis, materials characterization, renewable fuels
- Material science, bio-interfaces, biomaterials and biosensors
- Machine learning, fluid dynamics, soft matter, energy storage systems, complex materials
- Liquid filtration in energy exploration related activities, catalytic, functional membrane, thin film and coating material development, Fuel cell catalysts and membrane materials
- Microscale transport phenomena, microfluidic processes and applications, novel material synthesis and self-assembly, tissue engineering and regenerative medicine
- Biomaterials, drug delivery, biosensing, bioprocess engineering (*this expertise will be lost this AY due to resignation*)
- Process engineering and design – this has been identified as important to industry and will be lost with an expected retirement
- Process control and automation (this is led by a Professor of Practice (instructional faculty))
- Synthetic biology and genetic engineering of non-model bacteria for the production of fuels and chemicals

Current areas of research expertise in **Chemistry** are:

- Design, synthesis and testing of new functional membrane materials for applications such as desalinization and gas separations
- Nanoscale electrochemical and spectroscopic measurements
- Solar energy conversion into both fuels and electricity

- Photochemical processes on the surface of Mars
- Solid state chemistry for designing and synthesis of new structures and their applications in catalysis.
- Chemical reactions that take place in quantum solvents.
- Mass Spectrometry to analyze a variety of biological and environmental samples.
- Design of novel micro- and nanofluidic instrumentation to probe chemical and biological samples
- Rational design of multifunctional metal/ligand platforms that exploit ligand hemilability and/or secondary-coordination sphere interactions for control of substrate binding and transformation.
- New methods for the chemical modification of biomolecules for *in situ* generation of therapeutic compounds, and new organocatalytic strategies for the synthesis of high value chemicals.
- Fundamental understanding of structure-reactivity relationships of nano-catalysts using both ultrahigh vacuum techniques and conventional flow reactors.
- Using computational tools and strategies to investigate fundamental chemical and physical processes to advance scientific knowledge, improve existing technologies, and design the next generation of (smart) materials.

And finally, proposed **Organizing Themes** for the merged department include:

i. Life
ii. Energy
iii. Advanced materials
iv. Scientific computing

These organizing themes map onto research interests from funding agencies, such as the areas of research focus in the newly reintroduced Endless Frontier Act, (Latest Proposal for Major Reorganization of the National Science Foundation):

i. artificial intelligence, machine learning, and other software advances **(All Themes)**
ii. high performance computing, semiconductors, and advanced computer hardware **(Theme ii)**
iii. quantum computing and information systems
iv. robotics, automation, and advanced manufacturing **(Theme iii)**
v. natural and anthropogenic disaster prevention or mitigation **(Themes i and ii)**
vi. advanced communications technology
vii. biotechnology, genomics, and synthetic biology **(Theme i)**
viii. cybersecurity, data storage, and data management technologies
ix. advanced energy, batteries, and industrial efficiency **(Theme ii, iii)**
x. advanced materials science, engineering, and exploration relevant to the other key technology focus areas **(Theme iii)**

xi. State of Wyoming: Economic Diversification / Trona Industry / Carbon Capture, Utilization and Storage / BioHub / TerraPower **(All Themes)**

Furthermore, the chemical engineering faculty have gone so far as to postulate potential new areas of faculty hiring, in both chemistry and chemical engineering, that could build strengths in areas where both disciplines could contribute, both in research and in teaching. Table 3. presents the results of their analyses.

Table 3

Potential Synergistic Areas for Future Faculty Growth
(Chemical Engineering and Chemistry)

Polymers	natural sources	biomass coal	Theme III: Adv. Materials
	biomedical		
	recylable		
Bio	Synthetic biologist		Theme I: Life
	metabolic modeling		
	new technologies		
Computational Catalysis	School of computing		Theme II, III & IV: Energy, Adv. Materials & Scientific Computing
	Electrochemistry - hydrogen		
Process engineer	commercialization		All Themes
	state priorities		
	carbon engineering		
	process intensification		
Materials	processing of nanomaterial		Theme III: Adv. Materials
	advanced chemical manufacturing		

Overarching Issues that must be addressed

- There is both a clear philosophical difference and a marked difference in the financial level of support provided to the faculty when comparing the current College of Engineering and Applied Sciences and the College of Arts and Sciences. Use and availability of instructional faculty, technical and staff support, access to shared equipment (particularly those purchased on state or university funds) or lack thereof, centralized vs decentralized support structures, etc., are but a few examples where “the devil is in the details” as to whether this merger can be carried out successfully.
- There is concern, particularly in Chemical Engineering but also in Chemistry, that research conducted under support from “state-supported” entities like SER is undervalued. The perception is that research for agencies like NSF, DOE, DOD, EPA, NIH, etc. have higher cache with University leadership, perhaps because they come with indirect cost reimbursement. If this is the case, then University

leadership need to clearly articulate this position to those who provide that state support and therefore have an attendant expectation for deliverables. It is unfair to Chemical Engineering and Chemistry faculty who are SER-supported to be simultaneously viewed as having "easy support" and at the same time responsible for meeting deliverables important to Wyoming government and industry. The expectation for those deliverables should be clearly recognized as value added to the mission, and a responsibility of faculty at a land-grant university.

- We have tried to outline numerous structural and operational issues within the current College of Engineering and Applied Sciences that need to be addressed and ***not*** carried over as part of the culture of the new College of Engineering and Physical Sciences. Those issues include
    - General lack of underlying support within CEAS for the research enterprise
    - College policies for teaching small classes utilizing scarce instructional faculty resources controlled by the college.
    - A recurring sentiment that within the College, the "Walls between departments are too high," implying a difficulty in efficient collaborations, equipment sharing, laboratory space sharing, etc., among engineering faculty in different departments.
- Considerable skepticism exists around the prudent and productive investment of funds relating to "The Science Initiative" and the "Tier 1 Engineering Initiative". There has been a lack of transparency, and the two programs within this 2-13 discussion have questions about how they have benefitted from these investments. Who, in the end, is accountable for identifying "deliverables" from those investments? There at least needs to be an explanation for why the physical sciences seemed not to have benefited as much as the biological sciences from the so-called "Science Initiative", and what specific chemical engineering advancements in reputation, research or teaching have resulted from Tier 1 Engineering investments?
- Everyone realizes the primary driver in this entire 2-13 exercise is the development of means to deal with draconian budget cuts, both now and in the future. Both departments have lost faculty (chemistry over a period of a few years, and chemical engineering rather drastically this year). ChE lost two faculty (and counting) in this year's process, including one faculty member critical to core chemical engineering undergraduate courses. Since those positions are being used to meet university budget cuts, is there a long-term plan to restore those positions? If so, what is that plan?

If the significant organizational changes proposed are to be realized by July 2022, it is imperative that an ad-hoc committee be immediately established to begin looking into all the details outlined in this report. It is difficult to see how these significant

structure changes can be completed in such a short period of time unless this ad-hoc committee begins its tasks immediately.

Appendices

I. Interim Report
II. Enrollment Data for Chemistry and Chemical Engineering
III. Degrees granted for Chemistry and Chemical Engineering
IV. Research Support and Publications for Chemical Engineering
V. Research Support and Publications for Chemistry
VI. 2021 ABET Self-Study Summary of Teaching Responsibilities for Chemical Engineering
VII. Chemical Engineering Constituent Input