

## REPORT OF THE CENTER FOR ENERGY RESEARCH (CER) SUNSET REVIEW COMMITTEE

Pursuant to University of California San Diego ORU policies and procedures a thorough review was conducted pertaining to the Center for Energy Research (CER). The committee reviewed documentation provided by the CER, and met with the CER Director Prof. Forman Williams, the CER Deputy Director Dr. Charles Baker, the Founding Director of the Center, Prof. Sanford S. Penner, the new MAE Chair Paul Linden, numerous Center faculty, researchers and staff. In addition the committee also met with various administrators including the Deans of the Jacobs School of Engineering and the Division of Social Sciences, chairs of some affiliated departments, and various faculty across campus whose interests and/or research extend into areas associated with energy. Based on the review the committee is unanimous about the need to *maintain and substantially strengthen* an Organized Research Unit on the UCSD campus related to Energy Research.

Issues related to energy production, usage, and distribution are extremely critical to the state of California and the nation. Today, we face the most serious energy shortages since the embargoes of the 1970s, and this affects our economy, standard of living, and even our national security. There are tremendous needs for fundamental and applied research in the areas of energy conservation, energy production, supply, distribution, security, and interaction with the environment. There is a critical need for the confluence of developments in science and technology with developments in national energy policy. This includes policies related to energy supply from countries such as Mexico. The University of California System, and due to its unique position, the University of California San Diego, has a responsibility to actively contribute to the resolution of challenges that the state and nation face vis-à-vis energy.

The review committee notes that “Since its origins, the center has focused on basic problems in finding new sources of energy and the social, environmental, economic and political consequences of energy consumption as well as scientific and technological aspects of improvement in energy availability, conservation and environmental friendliness”<sup>1</sup>. The focus, which was undoubtedly a timely one at the initiation of the center in 1972 by Prof. Sanford S. Penner, is no less critical today. In reviewing the past accomplishments of the CER the review committee acknowledges the outstanding leadership of both directors of the Center – Prof S.S. Penner (1972 – 1990) and Prof. F. Williams (1990-present), and notes with admiration the scientific and technical advances made over the last five years in the areas of combustion and fusion research.

The review committee notes that in its current form:

- The CER has tremendous strengths in two relatively narrow areas – combustion and fusion
- There are very few links to other research endeavors on the UCSD campus, and some potential synergies between the CER and the environmental engineering

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<sup>1</sup> The Center for Energy Research Proposal for Continuation, 2004.

thrust in the Department of Mechanical and Aerospace Engineering (which also serves as the defacto base for the CER)

- None of the current faculty or staff (with the exception of Professor Emeritus Penner) have expertise or interest in policy or economic issues

Given the above aspects of CER there are three mutually exclusive possibilities for the future of CER, namely

1. Continue functioning in its current form
2. Provide minor investment to encourage joint research activities between engineering and science faculty already at UCSD and already nominally listed as CER affiliates
3. Make a serious effort to develop a campus wide center that would have a broader vision, including aspects of policy, economics and environmental sciences.

While the first two options are possible, the review committee strongly recommends that the third option be considered as a means of growth and of providing focus for several ongoing, but discrete, efforts at UCSD.

While the committee endorses the “rationalization for continuation” elucidated in the CER Proposal for Continuation, it strongly urges that activities of CER be expanded to include aspects including those related to research in diverse energy sources, environmental effects, and energy policy. Further the committee strongly endorses the concept of a multi- and trans-disciplinary research endeavor, including not just faculty and researchers from the Jacobs School of Engineering, but also those from Divisions of Biological Sciences, Physical Sciences, Social Sciences, the Scripps Institute of Oceanography, and the Graduate School of International Relations and Pacific Studies (in many of which, faculty have interests and/or are conducting research in areas related to energy).

Comments of the review committee pertaining to specific aspects are provided below. It should be noted that some address the current structure of the CER, whereas others are aimed more at strengthening the ORU and maintaining UCSD’s premier position in an area that was highlighted by its founder in 1972, and which today may be even more critical to our future.

### ***Visibility***

The committee was pleased to learn from discussions with faculty, both on campus and at other Universities, that individual personnel at the Center are internationally recognized as leaders in areas of combustion and fusion science. However, the committee feels that there has been, over the years, erosion of the visibility of the center itself and urges that steps be taken to ensure that it is further recognized both, on campus and outside – at the state and national levels. It was found that a number of faculty on campus, who may have had interests in the area of energy were not aware of the presence of the ORU, and this decreases the potential for synergistic involvement of faculty from diverse disciplines. With the increasing importance of energy issues at the state, national, and international levels, it was felt that CER should have significantly greater visibility

outside UCSD as well, and the review committee looks to the Jacobs School of Engineering and the University administration to assist in facilitating this.

The committee recognizes that the lack of visibility outside narrow areas is probably due to a number of issues including narrowing of faculty interests over the years, lack of funding for seminars and workshops, reduction in interaction with industry outside narrow scientific confines, and perhaps the loss of a branch related to energy policy. Given the growing importance of energy to the future of both California and the nation, it would be a pity if potential opportunities for research leadership are lost due to lack of overall (rather than research area specific) visibility. The creation of an active corporate affiliates program and an advisory board with leaders from academia, government agencies and industry may assist in this.

### ***Identity and Scope***

The activities of the CER have over the past few years evolved into two primary thrusts – combustion and fusion processes. Each of these areas constitutes an important research focus at UCSD and the faculty and researchers are among the nation’s leaders in these fields. Discussions with personnel from both groups, as well as a review of the CER proposal, shows well developed and structured plans for growth and advancement in both areas. Thus the two primary foci of CER are well founded, established, and thriving.

While both areas are active and extremely well funded, they do not in themselves provide sufficient impetus for an ORU. CER leadership and personnel have also recognized this and have identified a number of growth areas. The review committee strongly urges that the breadth of focus be widened to include critical areas such as diverse energy sources, stockpile stewardship, impact on use and supply of energy, interaction with the environment, and energy policy. This would not only help to solidify its identity as a true ORU, but would also serve as a forum for wider faculty involvement.

There is a perception, at least among some faculty associated with the CER, and at the level of the Dean of the Jacobs School of Engineering, albeit from different perspectives, that the CER is essentially a research thrust within the Department of Mechanical and Aerospace Engineering. While the review committee acknowledges the administrative and financial challenges associated with the operation of an ORU, it strongly endorses the continuation of CER as a University-wide ORU. Dissolution of the CER, at any level, into a department would only further dilute its visibility and ability to conduct leading edge cross-cutting research. It is true that a majority of the current active faculty are from the Department of Mechanical and Aerospace Engineering, and thus the department may be bearing an unintended load as a consequence of contracts, space and reviews. However, the committee views these ~~are~~ as results of the unfortunate temporary narrowing of CER thrusts, rather than as a direct consequence of the maintenance of the ORU.

### ***Integration of Combustion and Fusion Groups***

The committee was pleased to see that the “fusion group” had found a home in CER. However, with a few notable exceptions, there still appears to be a lack of true integration

of these groups within the CER, leading to a perception of a “marriage of convenience.” This is perhaps more true of faculty who do not have primary appointments in the Department of Mechanical and Aerospace Engineering, and research personnel who may have found themselves “disenfranchised” when the fusion group was merged into CER. This is a matter of some concern, since the fusion group has an international reputation and lends significant stature and intellectual depth to CER and the University. In meeting with CER leadership, however, the review committee was pleased to find a strong commitment to the growth of both thrusts and a desire to see enhanced synergy and interaction. This however will require both continued commitment and resources as discussed later.

### ***Interaction Across Campus***

With the increasing importance of energy issues, the review committee would like to suggest that different ongoing efforts across campus be integrated using CER as the focus since almost all the efforts that the review committee members were aware of fall within the overall purview of CER. This would not only facilitate greater interaction between various constituencies (including the Scripps Institute of Oceanography, the Center for Environmental Research and Training, and the Graduate Program in School of International Relations and Pacific Studies), but would also provide much greater visibility and leverage. We believe that this is an opportune time for UCSD to provide leadership both at the State and National area vis-à-vis energy policy and research. Rather than achieve this through the initiation of a new effort, the review committee urges that CER be used as the base.

It is clear that although there are a number of faculty and researchers across campus who have interests and/or ongoing research in energy related areas, there is very little interaction between them and even less incentive to form an integrated group. We urge that a combination of the activities listed below be considered as a means to achieve this

- (a) Initiation of colloquia with the express purpose of bringing together diverse researchers to develop a collective vision.
- (b) Focused hiring of new faculty, under specially allocated inter-division FTE lines, in the areas of energy policy and economics. These faculty would have joint appointments in engineering/science departments and IRPS, for example.
- (c) Provision of a modest amount of seed funding to encourage collaborative research in energy science and policy with the provision that at least one researcher be from a science/engineering department and the other be from an area of policy/economics social science.
- (d) Establishment of a campus wide multi-disciplinary program on energy research and education, which could lead to an integrated advanced degree incorporating aspects of engineering, environmental science, energy policy, and economics. This could be done in a manner similar to that used for the bioinformatics program. The steering committee, charged with development of this program could comprise of senior representatives of each of the potential constituents, and should be provided with a time-line for submission of the proposal.

*UCSD's tremendous strength on environmental issues is a particular opportunity. For example UCSD is a leader in global climate change science, and GCC policy and forecasts are very strongly linked to energy issues. This interaction is illustrated by Prof. Penner's research on hydrogen-based transportation economics and policy. We see an opportunity for UCSD to extend its reputation on environmental science to become a key player in state and national debates, for example on the proposal to regulate CO<sub>2</sub> emissions as a pollutant.*

### ***Space***

The functioning of an ORU, by definition, requires allocation of center specific space, which can be used for purposes of administration, meetings, joint/shared laboratories, and students. This aspect appears to be a growing challenge for CER. While CER does have space within EBU II, it is clear that there is a shortage of space, which is restricting an increase in collaborative research within CER. The review committee acknowledges and applauds the tremendous efforts that have been made by the current director of CER, Prof. Forman Williams, in obtaining additional space from the Department of Mechanical and Aerospace Engineering. However, this space can be termed temporary, at best, since the growth of the department, itself, will cause a need for the "loaned" space. The review committee notes that space in an academic setting is never sufficient, but it was disheartened to hear from some CER faculty/researchers that they did not have space for funded research and that graduate students were without desk space. The review committee is also concerned that there appears to be perception that it may be advantageous to negotiate proposals between CER and some departments to assess which one would provide space and resources. While there is nothing incorrect, *per se*, about such an approach, ~~the initiation of such processes would appear to their existence~~ highlights critical needs of CER. The review committee strongly urges the UCSD administration to work with CER leadership and faculty/researchers to resolve the space issue – perhaps through focused fund raising to develop dedicated space for the ORU.

### ***Budget and Resources***

The CER proposal documents in substantial detail funding brought in by the CER and the review committee applauds the CER for its strong external support – a clear mark of its scientific and technical leadership. Despite this level of external support CER itself may not have a sufficient budget and resources for its administration and various non-funded activities (such as budgets for visitors, seminars, and even sundry consumables). With changes in federal regulations related to charging of administrative time to contracts it appears that a previous source of some discretionary funding for administration has been lost. It does appear that a significant amount of contractual administration is also now done by the MAE Department and this does alleviate the situation to an extent. However, it does raise a concern as related to the campus wide openness of the ORU and has appeared to create some barriers for increase in faculty activity from other departments. The review committee strongly urges the UCSD administration to study this situation and find means to alleviate it, perhaps through UC wide initiatives related to energy and the environment, or through focused fund raising for CER in a manner similar to that used for CMRR.

The current situation on discretionary funding is so acute that it may be cutting into CER's ability to write proposals and undertake pre-proposal activities. We were told that this, together with the lack of space, has led to potential projects not being pursued. There is also a perception that the lack of central funding in conjunction with the overhead system amounts to a "tax" on CER activities that would not be incurred if research were channeled through departments. Again, this is undesirable if it leads to suboptimal decisions about where and how to do funded research.

### ***Current Personnel and Future Faculty Recruitment***

Based on interviews with faculty, researchers and staff it is clear that CER has a collegial atmosphere, and in the main most of the faculty, researchers and staff acknowledge the value and resources provided by the CER. The CER proposal provides documentation of intended growth in a variety of areas and resources for this growth have been carefully enumerated. In general the review committee applauds the choices of areas of growth especially those related to environmental aspects, and policy. The concern, however, is that faculty lines are not directly linked to CER, but exist with departments, leading to a gap between well laid plans and potential reality. It should be noted, in this context, that the Department of Mechanical and Aerospace Engineering has recently hired in the general thrust area of the CER. However, given needs of each of the departments that could be involved with CER it is almost certain that the departmental priorities in general will naturally, and correctly, over-ride those of the CER.

In speaking with Deans, and Chairs of other departments it was clear that while a number expressed support for CER and a genuine openness about hiring in areas relevant to CER, all expressed the opinion that they did not have the luxury of providing specific FTEs focused on CER needs. Given the increasing importance of energy related research, and the role that the CER plays in this area, the review committee feels that there needs to be a campus wide strategy for strategic hirings in this general area, spread across the campus.

### ***Leadership***

From discussions with administrators, faculty, researchers, and personnel it is clear that the current director of the CER, Prof. Forman Williams, has done an exemplary job in maintaining and building the reputation of the CER. His stewardship and mentorship was widely praised and the review committee was pleased to see this acknowledgement of leadership.

It is also clear that both Prof. Williams and Dr. Baker, the Associate Director of CER, have worked well together in the overall administration of the CER and in attempting to combine the previously distinct groups. The review committee is, however, a bit concerned that Dr. Baker is only an adjunct faculty member, and could thus be recruited away from UCSD.

The review committee notes that while Prof. Williams will undoubtedly continue to ably lead the CER, there is ~~over the short term the~~ presently a lack of a ~~potential-visible~~ successor of the same stature as Prof. Williams (and the previous director, Prof. Penner).

This aspect was discussed with Prof. Williams and other senior faculty/researchers and their opinions were sought by the review committee. It appears that there is near consensus that although some of the faculty have significant potential of developing the same level of stature, it may be advisable for CER to recruit a leading scientist from outside. The review committee understands that an effort in this direction was made a few years ago but the targeted faculty member decided that he was unable to move. The review committee believes, that it may be extremely advantageous for the CER, and UCSD, to recruit a leading scientist in the mold of the founding director. While the review committee did not attempt to search for candidates, discussions with CER faculty and researchers revealed four names of scientists having both technical and policy backgrounds - Robert Williams (Princeton University, Environmental Institute), Robert Socolow (Princeton University Environmental Institute), and John Holdren (Kennedy School of Government, Harvard University). We urge the administration to work with the CER in identifying and recruiting a leading academic who could continue to shepherd both the tremendous scientific developments made to date, and who could strengthen the area of energy policy. In the interim period we recommend that the current CER Director be re-appointed for a period of 2-3 years to provide continued leadership while a new Director is recruited. The review committee recommends that a search committee that includes Prof. Williams and Prof. Penner be formed to initiate this process and that the committee membership reflect not just the present focus areas, but also the critical areas of policy, economics, and environmental sciences.

### *Summary*

The review committee was impressed with the continued achievements of the CER and was pleased to see the high quality of research being conducted. It is clear that the area of emphasis is such that a campus wide ORU is essential and that dissolution of the CER into a department based activity would have significant negative consequences, including an inability to pursue potential funding opportunities, and a tendency for UCSD to be viewed as irrelevant to most state and national energy policy issues. While the CER can probably continue to function in its current state there are areas of concern related to space, resources, and future faculty recruitment. The review committee strongly urges that the administration support the CER's efforts in resolving these issues.

The CER has substantial potential to serve as a focus for increased activity at the campus wide level through inclusion of a large number of constituencies and we urge, not only that the CER be provided support to continue its excellent research in its current thrust areas, but that means be found to enhance and enlarge-expand these activities. Through this, UCSD could potentially serve as a state and national leader in an area that is today, and will continue to be, critical to the nation's economic development and national security.