APLU RESPONSE to DOE-QTR RFI

The Association of Public and Land-grant Universities (A·P·L·U) is a non-profit association of 221 members -- public research universities, land-grant institutions, and state university systems located in all 50 states, U.S. territories and the District of Columbia. A·P·L·U institutions enroll more than 3.5 million undergraduate students and 1.1 million graduate students, employ more than 645,000 faculty members, and conduct nearly two-thirds of all federally-funded academic research, totaling more than $34 billion annually. A·P·L·U institutions also have extensive relations with energy companies, high technology firms, and with other leading universities and research institutions around the world.

Energy is a focus of A·P·L·U. Our institutions train most of this country's energy professionals, keep them current through continuing education, and conduct research on all of the topics mentioned in DOE's QTR Framing Document. Our institutions house many energy institutes and many of our nation's top business, architecture, policy, arts and sciences, and engineering schools. The missions of many of our institutions including land-grant institutions in every state go well beyond education and research. As state institutions, we are actively involved in local and regional development. We run the Cooperative Extension Program which is housed in most counties in the United States. Additionally our schools are home to Manufacturing Extension Partnership Centers, Small Business Development Centers, and their state counterparts. We and our institutions wish to be supportive of the Quadrennial Technology Review in any way possible and are willing to help identify university participants for the various stages of the QTR.

We offer brief responses to some of the questions contained in your framing document. We agree that the six strategies you have laid out for the most part are sufficiently broad to cover most topics of importance to our energy future, provided that they do not focus on too narrow a group of energy sources. Ours is a diverse nation with great diversity in fuel needs. For instance, we feel the sixth strategy "*drive adoption and deployment of a clean electricity supply*" cannot be limited to renewable energy and energy conservation because large sections of our country will be highly dependent on fossil fuels for the foreseeable future. Without deployment of clean coal technologies and appropriate use of natural gas for electricity, green house gas emission levels will remain high. For instance, continued development and deployment of Integrated Gasification Combined Cycle (IGCC) is important if we are going to be able to replace many of the older coal-fired units now operating with new units that permit significant CO2 reductions because of the large improvements in overall efficiency. Coal is a huge domestic energy resource and it will be used at least for the next 40 years. If we walk away from development and deployment of the fossil technologies that will obviously be needed in the short and mid-term we will have no choice but to import them from China and other countries that are willing to continue their development. We much prefer that DOE adopt policies that encourages US industry, supported by our universities, to be the owners and marketers of these technologies.

Our members also have some concerns about Strategy #2 **"***promote progressive electrification of the vehicle fleet."* Transportation cannot be completely separated from stationary generationand electrification of the fleet certainly spills over into the stationary generation area. We would like to see the Department consider a broader look at transportation, e.g. how the transportation sector can reduce carbon emissions and contribute to energy security through domestic supplied energy and more efficiency. We encourage the program to include alternative fuels including algae and algae-culture development in states; university research in this area is not limited to the Southwest; states like Ohio are also convinced that they also are places where algae can grow abundantly. There is still a lot of potential in fuel cell technologies that generally depend on liquid fuels rather than electricity. The vehicle fleet should not just be automobiles but we should also look at long haul transportation both by rail and by air.

We also believe there should be a seventh strategy related to extractive technologies. We have a group of twenty schools of mining and mineral sciences that have joined together to encourage modernization and expansion of mining and extraction research programs. Since DOE's withdrawal from mining and coal preparation research and since the closing of the Bureau of Mines in 1995, the introduction of new mining technology in this country has slowed dramatically. This happens at a time when fossil energy is still needed for the foreseeable future and when nuclear and renewable technologies depend on a variety of metals and minerals including rare earths. The highest quality reserves of many of these raw materials have been used which requires more sophisticated mining, milling, and processing techniques. Improvements are needed in safety and related environmental areas as well. Extractive technologies related to energy should have the same degree of thought as the other topics you have proposed. We would be pleased to work with DOE and other appropriate agencies and partners in developing the mining and minerals research programs necessary to meet future energy goals. We and our members have expertise on each of the enumerated energy areas and stand ready to share that expertise in your upcoming workshops and otherwise as appropriate.

With regard to Clean Energy Leadership, we see the need for strong efforts in 1) basic and applied research, 2) technology transfer, and 3) understanding what it will take for the public to embrace new energy sources. If clean energy includes energy efficiency, we also should not overlook the huge savings possible from operating turbines at higher temperatures.

We support strong basic research across the board. We agree with the statement in the Executive Summary of the National Research Council 2005 report: <u>Assessment of Department of Defense Basic Research</u> that rather than being parts of a linear process from basic research, to applied research, to development and application, that basic research, applied research, and development should be viewed as continuing activities occurring in parallel, with numerous supporting connections throughout the process. Having separate Under Secretaries for Science and for Energy sometimes leads to a fire wall between the Office of Science and the programmatic offices. University experience is that since the track of research is not linear but has lots of loops back and forth, in which applied research suggests basic problems that, when answered, help further

applications, DOE would be greatly strengthened in its mission if reforms were made that guaranteed greater communication and access between basic research and the applied areas of DOE.

Rethinking DOE's overall approach to applied research also should be a high priority. We strongly advise for DOE to adopt the best practices of leading Federal agencies, private sector companies, and universities in this area. Our December 2010 Report, *Best Practices in Merit Review*, describes how representatives of each of these groups approach applied research and outlines necessary changes both in applied research programs and DOE support functions if these programs are to lead to market penetration by new conservation and renewable energy technologies within the timeframe they are needed. We hope these changes will enable universities to be even more important partners in the applied areas; our institutions stand ready to help.

Technology transfer is a specialty of our schools. The land-grant universities in particular were launched 150 years ago to create academic support for businesses including those in the agricultural sector. Most of our institutions have strong programs for working with industry and many of the new energy companies in these fields are conceived and nurtured in academic environments. The Cooperative Extension Service stands ready to extend its outreach activities further into energy. More cooperation between the Departments of Agriculture and Energy in extension and outreach could allow for the broad reach of Cooperative Extension to positively impact energy efforts across the country.

Human factors are huge in energy decisions and the social sciences are underutilized in this regard. It is frequently estimated that there is variation of as much as 25 percent in energy use between those who consciously try to save energy and those who are less inclined to do so. To meet carbon reduction goals, we need to learn why people are often acting against their economic self-interest when it comes to energy conservation and to address this problem. The academic community has strong capabilities in this area.

With regard to Program Definition and Management, we believe that it is important to continue to have strong research programs across the spectrum in energy. This is not possible at the levels that DOE has proposed for FY 2012. For instance, fossil fuels will be with us for some time and either the public or private sector or some combination thereof needs to step up to ensure that fossil energy technologies from mining through utilization are as efficient and as environmentally benign as possible. We strongly support the Department's advocacy of carbon capture and sequestration research, but also feel that it would be short-sighted to prematurely end research in areas such as solid oxide fuel cells. Likewise, nuclear energy is an important element of a clean energy portfolio and we applaud DOE's efforts to launch the next generation of these technologies. This is a field where substantial training is necessary both to replace the retiring generation and to prepare the workforce for nuclear plants that are significantly different than those which have come before. We refer once again to our December 2010 report regarding your program management questions. It is clear that applied research at all times needs to be conducted with the private sector which will commercialize the

technology in mind and with a government exit strategy which fairly quickly terminates efforts which do not live up to their potential and smoothly transitions important new technologies to companies that will create American jobs.

Regarding private sector partnerships, we point out that most US universities are in the public sector and should be treated equally with private sector universities. We stand ready to work with the Department in basic and applied research, in training present and future energy workforces, and in technology transfer and outreach activities. Because of the scale of the energy sector, technology development often involves pilot demonstrations and scale-up. Universities should be partners with industry and government in such efforts, as there will surely be surprises in technology requiring further research and also the social sciences can contribute to effective acceptance and penetration of new technologies and efficiencies. Timing is very important in deployment; failures usually come from entering this phase too early or by not having sufficient access to the research necessary to solve problems that arise in this stage. Once demonstration starts, the technology needs to be well along on its transfer to the private sector and the company receiving the technology needs to have enough at risk to give the project top level attention.

We feel that there are major lessons to be learned from overseas. For instance, we are just starting to think about how to get to commercially viable zero energy buildings at a time when Switzerland has launched Minergie A, its zero energy building standard. This is made possible by being ahead of the US both in building components and in looking at a building from a holistic, performance based, life cycle basis. Universities can be a major factor in knowledge exchange given the large number of US campuses overseas and the even larger number of international collaborations that occur between academic institutions and researchers. We also recommend looking at the Manufacturing Research Centers of Excellence in Britain and their new Centers of Excellence in Manufacturing Technologies and the A-STAR research institutes in Singapore as fascinating examples of how to use national labs to further the advancement of the economy and for examples as to how other nations set their priorities in technology development and deployment.

Regarding non-technical barriers, the Department of Energy has a role when their solutions lead to societal rather than individual gains. At a time of fiscal limitations, it is very important to look at structural impediments to adoption of new technologies and to work with affected parties to overcome these barriers. Export control policies are a very important barrier since it can delay US entry into a market and limit the size of the market available to US companies.

In addition to the questions you have posed, we would like to endorse three of the suggestions of the PCAST Report "Report to the President on Accelerating the Pace of Change in Energy Technologies through an Integrated Federal Energy Policy" that did not make it into your document. PCAST recommended that annual expenditures of $12 billion for energy R&D and $4 billion for demonstration and deployment, mostly from regulatory sources. APLU and its member institutions were very supportive of this suggestion when it first was proposed by the President early in his term and when the

American Energy Innovation Council issued its report concluding that 2050 carbon reduction goals would not be reached without this level of research effort. We also do not see how the massive changes that must occur across the board are going to occur unless investment of this magnitude is made. Universities stand ready to carry out much of this research if funding mechanisms can be developed. The report called for establishing a training grant program at universities to address critical energy workforce needs. This is very important both because of the volume of new energy technologies which are under development and because of the generational change in the energy industry that is already beginning as the baby boom members retire. In fact, we stand ready to educate, train, and conduct continuing education for the workforce of energy experts across the spectrum that are able to grasp the full range of technical, economic and social issues that pertain.

We would support elimination of the 20 percent matching requirement for applied energy research programs for universities and non-profit agencies. While we understand in the case of applied research to identify industrial partners fairly early on, universities do not have the independent financing to cost-share and their finances are already stressed in these days of declining state support for universities Furthermore, it is not uncommon for the companies who are willing to devote themselves to new technologies to be start-ups who also are not in a position to contribute. We feel that it is much better to have a flexible policy that keeps its eye on market penetration by new technologies. Cost sharing is appropriate when it is necessary to assure top management attention for commercialization of technologies in the case of larger companies, but it actually can impede the commercialization and deployment of other technologies when the businesses and universities are fully engaged but low on cash and have strong incentive to move the technology forward.

Individual university members of our Association have provided comments separately. We ask that each of these submissions be given full consideration.

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