INL/EXT-07-12950

Center for Advanced Energy Studies (CAES) Strategic Plan

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July 2007

The INL is a U.S. Department of Energy National Laboratory
operated by Battelle Energy Alliance

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EXECUTIVE SUMMARY

Twenty-first century energy challenges include demand growth, national energy security, and global climate protection. The Center for Advanced Energy Studies (CAES) is a public/private partnership between the State of Idaho and its academic research institutions, the federal government through the U.S. Department of Energy (DOE) and the Idaho National Laboratory (INL) managed by the Battelle Energy Alliance (BEA).

CAES serves to advance energy security for our nation by expanding the educational opportunities at the Idaho universities in energy-related areas, creating new capabilities within its member institutions, and delivering technological innovations leading to technology-based economic development for the intermountain region.

CAES has developed this strategic plan based on the Balanced Scorecard approach. A Strategy Map (Section 7) summarizes the CAES vision, mission, customers, and strategic objectives. Identified strategic objectives encompass specific outcomes related to three main areas: Research, Education, and Policy. Technical capabilities and critical enablers needed to support these objectives are also identified.

This CAES strategic plan aligns with and supports the strategic objectives of the four CAES institutions. Implementation actions are also presented which will be used to monitor progress towards fulfilling these objectives.

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1. INTRODUCTION

1.1 Introduction

Twenty-first century energy challenges include demand growth, national energy security, and global climate protection. Multiple energy systems must be deployed to meet these challenges, although each presents scientific, technical and policy challenges. The Center for Advanced Energy Studies (CAES) responds to these challenges with programs that conduct energy research, that educate new energy professionals, that engage industry to ensure the nation's energy security, and that inform decision processes concerning an appropriate energy mix and policy options.

CAES is a public/private partnership between the State of Idaho through its academic research institutions, Boise State University (BSU), Idaho State University (ISU), the University of Idaho (UI), and the federal government through the Department of Energy and its Idaho National Laboratory (INL), which is managed by the private entity the Battelle Energy Alliance (BEA). Through its collaborative structure, CAES combines the efforts of these four research institutions to provide timely research support on both technical and policy issues.

1.2 This Plan

This Strategic Plan describes CAES strategy in alignment with the Balanced Scorecard approach. The balanced focus of CAES' strategy includes defining development and execution strategies in the areas of:

- Mission – strategic focal points within Research, Education, and Policy that provide and define the value for CAES constituents,
- Technical Capabilities – specific science and engineering capabilities that support the CAES mission, and
- Critical Enablers – certain systems, processes, and tools critical to deliver the mission and develop the technical capability.

Implementation actions are also presented which will be used to monitor and assess progress in executing these strategies.

2. STRATEGIC OBJECTIVES

CAES partners leverage their resources, capabilities, and expertise in collaboration with others to solve energy-related challenges through cutting-edge research, to prepare the future energy workforce through expanded educational opportunities, and to create a venue for the energy dialogue that shapes U.S. energy policy.

2.1 Research

Deliver innovative, cost-effective, credible research that meets the demands of a carbon-constrained world.

CAES is engaging in fundamental and applied research that contributes to the:

- Expansion of energy production from high-capacity, reduced-carbon sources, including support for a national renaissance in commercial nuclear power;
- Management of fossil fuel energy systems and emitted carbon through reuse, capture and storage, while responsibly expanding use of regionally abundant coal and unconventional hydrocarbon resources;
- Availability of carbon-neutral energy, such as biofuels, to support the expansion of renewable energy sources for transportation; and
- Stewardship of the environment during energy production, distribution and consumption to increase understanding of key issues (e.g., water resource quality and availability, impact on public and private land, and continued economic growth in the arid West).

CAES, through the Idaho Academic Center of Excellence (ACE) for Nuclear Fuel Cycle Research, is supporting the DOE Office of Nuclear Energy by engaging in advanced fuel cycle and material research and providing the next generation of nuclear scientists and engineers.

CAES will focus efforts on reducing carbon emissions resulting from the continuing utilization of fossil fuels through the development and demonstration of carbon management techniques such as carbon capture and storage. CAES will continue to support regional research and policy collaborations such as the Big Sky Carbon Sequestration Partnership.

CAES' focus on bio-energy will support efforts to expand the national availability and use of renewable energy and plays to the strengths of Idaho's agricultural and forestry products.

CAES will support the sustainable development of energy options by pursuing research opportunities defined by recent DOE efforts to quantify energy-water research and modeling needs in the Energy-Water Nexus Roadmap. The existing collaborations developed by Idaho Water Resources Research Institute strengthen CAES' position to expand its programs.

2.2 Education

Educate the next generation of energy scientists, policy makers and the public while accepting and leveraging the values of those groups.

As the United States enters a period of renewed energy focus, it is becoming more evident that an integrated and multidisciplinary education is needed to develop the next generation of energy professionals and policy makers to prepare the public to participate in complex energy decisions. To meet this need, CAES member institutions are working together to create unique educational opportunities that blend the talents and capabilities found at the Idaho Universities and the INL. This collaboration creates hands-on educational opportunities for students, scholars, and faculty. Working across institutional boundaries, CAES partners integrate curricula and share infrastructure to expand the number and preparation of energy professionals, to enhance technical capabilities, and to advance energy science.

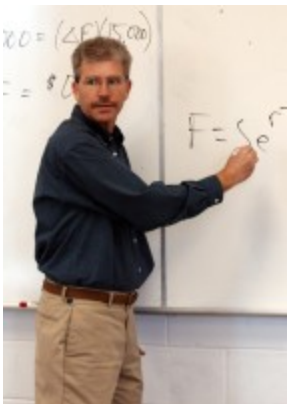


Photo courtesy Boise State University

2.3 Policy

Facilitate an informed dialogue involving the scientific community, the public, and government; leading to energy policy at a national, regional and State level.

Al Gore speaks at Frank Church Institute Conference
Photo courtesy Boise State University

Sound energy policy, coupled with scientific advancement, is needed to enhance energy self-reliance. Socio-political issues regarding energy production, transmission, and management of by-products are often overlooked at early stages of development only to be the limiting force at implementation.

CAES strives to support policy-makers in their decisions and analyses, as well as to understand the flow and impact of policy on science and engineering. The CAES Energy Policy Institute (EPI), a home for energy-related policy research, analysis, and education, seeks to combine the talents of the four institutions' policy personnel. Policy researchers and analysts examine proposed energy policy in the context of enabling the nation's transition to secure sustainable energy solutions. Public and private entities seek this skill base, and CAES intends to support these organizations to achieve their objectives.

3. TECHNICAL CAPABILITIES

Technical capabilities are required to accomplish strategic objectives. CAES partners are building upon their current technical expertise to enhance the key capabilities necessary to accomplish the strategic objectives.

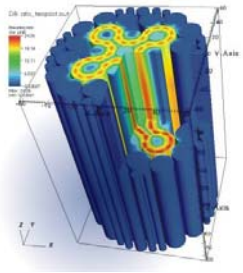
Photo courtesy Boise State University

Expand science and engineering education in Idaho

An energy renaissance is needed to progress towards sustainable energy self-reliance. Engineers and scientists in all energy production and utilization areas will need to have a better understanding of the multidisciplinary interactions associated with their work. Understanding and communicating research results in

ways that are beneficial, productive, and understandable to the public, policy-makers and those who influence energy decisions will be critical.

Solve challenging energy problems through applied advanced modeling and simulation



As fossil, renewable, and nuclear energy systems become more complex and costly to build and test, advanced modeling and simulation capability plays a larger role. CAES, in partnership with the INL's Center for Advanced Modeling and Simulation (CAMS), will coordinate resources of the INL, the Idaho universities, and other universities to build a world-class capability in modeling and simulation of advanced energy systems.

Integrate energy policy formulations into science and engineering disciplines

Public policy is the result of how society and its institutions address a problem that affects the lives of its citizenry. This decision-making process is characterized as collaborative, iterative, value laden, and continuous. CAES-affiliated policy educators, working in partnership with EPI, will educate future scientists and engineers about the important impacts of energy policy on technological solutions.

Develop advanced materials to support innovative terrestrial and spaced-related energy systems

Photo courtesy INL

Future energy production will push known materials beyond their physical limitations. Additionally, the potential for space-related energy production requires novel, lightweight, and extremely durable components to be cost-effective. CAES, in partnership with the INL Center for Nuclear Space Research (CNSR), will promote collaborations that establish niches related to materials science research.

Advocate environmental stewardship and conduct research into mechanisms to minimize energy impacts to land, water, and air

Part of the recognition of societal impacts of energy production is the understanding of environmental impacts and stewardship concerns. From historic concerns over hazardous waste to more recent concerns regarding carbon emissions, climate change, and water resource use in energy production, CAES will promote environmental stewardship by assessing and communicating life-cycle environmental consequences of energy technologies and policies.

4. CRITICAL ENABLERS

Advanced capabilities in all of the aforementioned areas are required to meet the critical research, educational, and policy objectives that CAES has set. These capabilities, supported by other critical enablers, form the basis of successful execution and realization of the CAES vision. Critical enablers are the fundamental building blocks on which technical capabilities and mission execution will be accomplished. CAES has identified five enablers that are critical to success.

Photo courtesy University of Idaho

World class research requires state of the art laboratories with modern equipment and computing capabilities. Complimenting the existing facilities at the INL and Universities, CAES will have a facility, provided by the State of Idaho, which will house laboratories to further facilitate its research. The CAES building and associated laboratories will be linked through a high-speed

Lambda rail network to INL facilities to enable increased information transfer and computational capability.

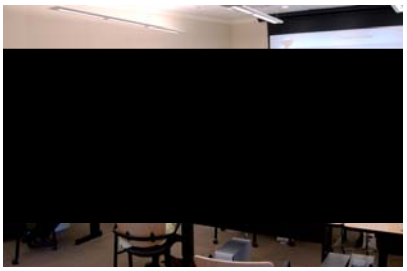


Photo courtesy University of Idaho

Collaboration among professors, professionals and students relies on modern computing and communication technology. CAES will provide opportunities and tools to increase the efficiency, benefit, and ease of networking. These, along with a facility for co-locating research teams, will increase the ability to attract and successfully execute research and policy analyses while providing high quality energy-related educational opportunities.

Often existing business systems of the CAES member institutions do not facilitate collaboration, networking, and sharing. CAES has the opportunity to bridge these gaps and break down barriers. CAES will work with the member institutions to optimize business processes to aid cross-organizational efforts while satisfying the requirements of the individual institutions.

All of the aforementioned systems, processes, networks, and infrastructure would be lacking without the strong, continuing support of the State of Idaho, the federal government, non-government organizations, private industry, and public stakeholders. This support ranges from the tangible (financial input) to the intangible (publicly supporting in communication and commitment of non-financial resources). CAES will focus on maintaining and building strong ties with these groups by focusing on the value that CAES brings to each of the groups.

5. VALUE PROPOSITION FOR CONSTITUENTS

CAES provides value to five main constituencies: CAES partners, researchers and students, industry, policy makers, and government.

5.1 CAES Partners

CAES will enhance the statures and business outcomes of both the Idaho academic community and the INL. It will do this by showcasing the institutions' leadership roles in energy science and technology critical for the future of the state and nation, expanding the research portfolios of the universities in these key areas, creating new capabilities, and working with national laboratories, industry, and other partners in technology and workforce development.

5.2 Researchers / Students

CAES will expand opportunities to create, learn, and disseminate knowledge. Expanded energy research infrastructure will enhance the collaborative opportunities among INL researchers and university faculty and students, leading to increased international recognition and competitiveness.

Photo courtesy University of Idaho

5.3 Industry

CAES will provide industry with multiple benefits. Specifically, CAES will educate a technically and politically talented workforce, will complete sponsored research activities, and, as a result of membership in the CAES consortium, will deliver solutions for common areas of industry need.

5.4 Policy Makers

CAES will provide policy makers with vital technical and social information on the impact of specific energy options allowing more informed public discourse and policy formulation.

5.5 Government

CAES' focused research, analysis, and education supports delivery of state and federal agency missions through enhanced collaboration and more effective utilization of research infrastructure contributing to secure, sustainable energy systems.

6. IMPLEMENTATION PLAN

6.1 Near-term Actions

Near-term actions are being implemented and tracked to ensure adequate progress is made towards fulfillment of the CAES Strategy. Selected tactical efforts and actions include:

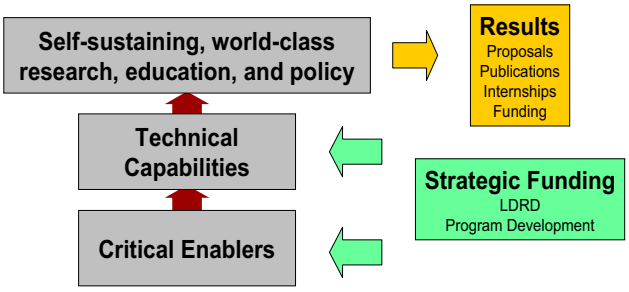
- **Sponsored Research** – INL supports CAES through its Laboratory Directed Research and Development (LDRD) investment program in both mission-related directed portions and more broadly defined energy-studies related requests. It is anticipated that $1 million will be distributed annually to CAES-affiliated researchers to conduct initial research and develop key capabilities in a collaborative manner.
    - **Strategic Program Development** – INL supports CAES through investments of its Program Development Funds (PDF). PDF are used by CAES for the preparation of key proposals, for collaborative team building and for tools that will streamline development of such proposals (e.g., CAES Capability Catalog).
    - **CAES Research Facility** – Ground was recently broken for the CAES research facility, which will house world-class laboratories and equipment needed to support the CAES missions. The State of Idaho is showing its support of CAES through funding the facility construction, with bond guarantees provided by the INL managing contractor, Battelle Energy Alliance, and its partners. Occupancy of the new facility is scheduled for August 2008.
- **Affiliated Centers/Institutes** – CAES will take advantage of existing Centers/Institutes among the partners to enhance technical and professional capabilities. Additionally, CAES is creating multi-institutional Centers/Institutes such as the Energy Policy Institute and the Idaho Nuclear Fuel Cycle Academic Center of Excellence to execute the CAES mission. These affiliations will expand as the program matures.
- **Research Network** – CAES is growing an Idaho energy research network by linking together expertise from the Idaho and National universities, the national laboratory and industry. Through focused workshops, conferences, seminars, joint appointments, and affiliate programs CAES is fostering collaborations and partnerships.
- **CAES Collaboration Portal** – CAES has focused resources on leveraging the INL's Collaboration Portal at a prototype level and will soon expand its use to include key representatives from the universities.

- **Education Programs** – CAES is working to provide enhanced educational opportunities for Idaho students, including internships at the INL and access to equipment and capabilities; courses specific to the needs of the INL and its employees; and support for implementation of the strategic directions of the universities. For example, BSU has been leading the efforts to integrate policy into the energy sciences working towards a PhD program for Public Policy; ISU is doubling its nuclear engineering faculty and moving the program to the Idaho Falls campus; and UI is expanding its research faculty and facilities at the Idaho Falls, University Place Campus.
- **ATR National Scientific User Facility** – CAES is working with the DOE in support of the transition of the Advanced Test Reactor (ATR) to a National Scientific User Facility (NSUF). ATR will continue to support its current national missions. As a NSUF, access to ATR will be expanded to include academia, commercial nuclear power industry and other federal government users.
- **CAES Industry Consortium** – CAES is forming an industry consortium to deliver research and policy solutions and products for common areas of industry need. By collaborating with industry members, CAES will provide opportunities for graduate students to participate in targeted high impact energy research that meets industry needs while educating the next generation of energy professionals who will implement the results of this research. The CAES-Industry consortium may be modeled after the NSF Industry/University Cooperative Research Centers program and will utilize subscription industry members to serve as an advisory board to help refine the research agenda for CAES.

6.2 Desired Results

As a result of the CAES partnership and the successful execution of the near-term implementation actions, the following results will be realized:

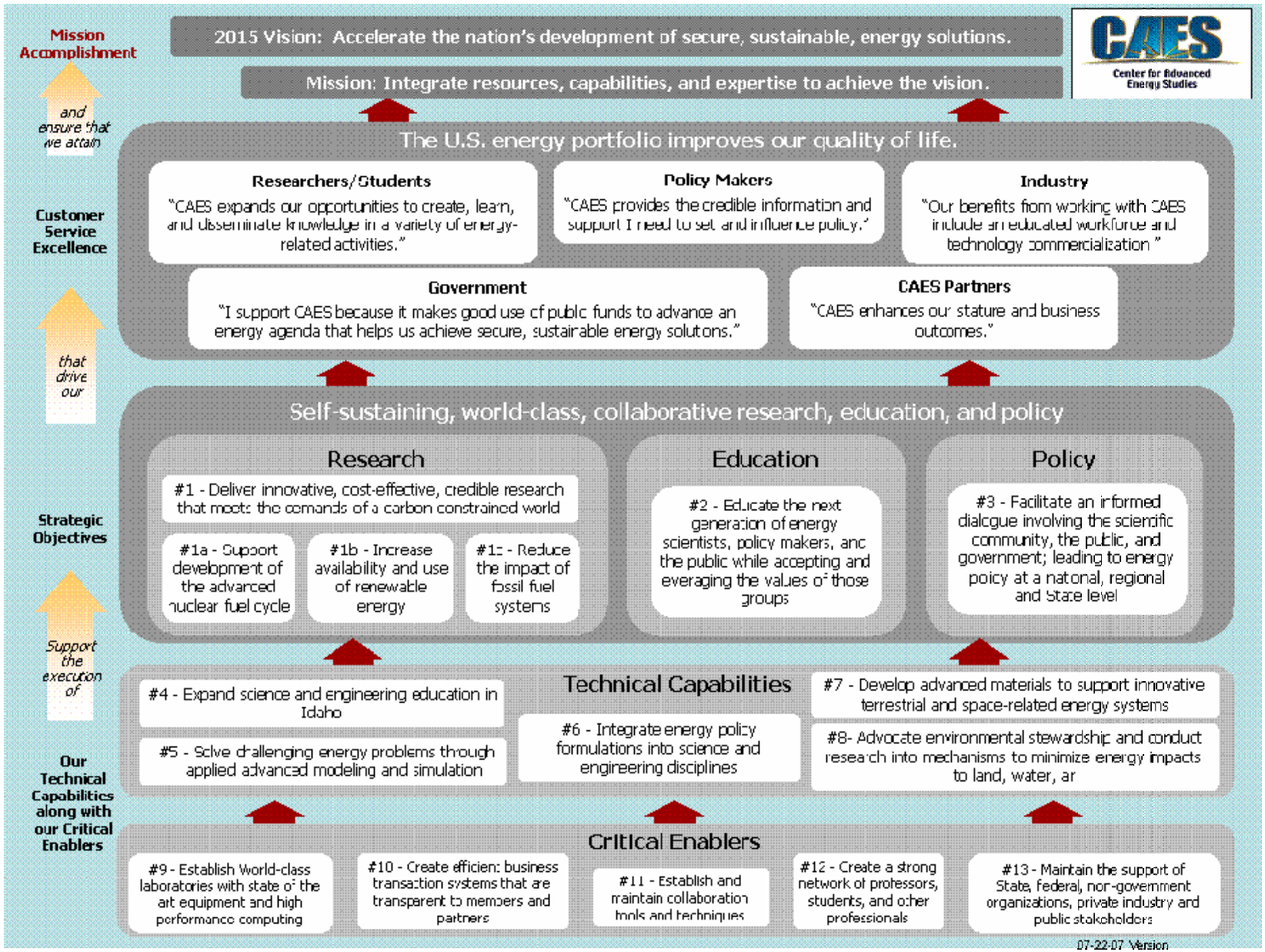
- **Increased Joint Research Proposals**
- **Increased Joint Peer-reviewed Publications**
- **Increased Student Internships at INL**
- **Increased Energy Research Funding**



7. STRATEGY MAP

The CAES Strategy Map summarizes the vision, mission, customers, mission areas, capabilities, and critical enablers. This map highlights CAES' the focus in the areas of Energy Research (nuclear, renewable, fossil), Education, and Policy; the key capabilities (science and engineering, modeling and simulation, policy integration, materials science, and environmental stewardship); and the critical enablers (world-class infrastructure, business systems, collaboration, resource networks, and stakeholder support).

As illustrated in the Strategy Map from bottom to top, the Critical Enablers along with the Technical Capabilities support the execution of Strategic Actions that drive CAES customer services ensuring Mission Accomplishment.


Mission Accomplishment
2015 Vision: Accelerate the nation's development of secure, sustainable, energy solutions.
Mission: Integrate resources, capabilities, and expertise to achieve the vision.
CAES
Center for Advanced Energy Studies
and ensure that we attain
The U.S. energy portfolio improves our quality of life.
Customer Service Excellence
Researchers/Students
"CAES expands our opportunities to create, learn, and disseminate knowledge in a variety of energy-related activities."
Policy Makers
"CAES provides the credible information and support I need to set and influence policy."
Industry
"Our benefits from working with CAES include an educated workforce and technology commercialization."
Government
"I support CAES because it makes good use of public funds to advance an energy agenda that helps us achieve secure, sustainable energy solutions."
CAES Partners
"CAES enhances our stature and business outcomes."
that drive our
Self-sustaining, world-class, collaborative research, education, and policy
Strategic Objectives
Research
#1 - Deliver innovative, cost-effective, credible research that meets the demands of a carbon constrained world
#1a - Support development of the advanced nuclear fuel cycle
#1b - Increase availability and use of renewable energy
#1c - Reduce the impact of fossil fuel systems
Education
#2 - Educate the next generation of energy scientists, policy makers, and the public while accepting and leveraging the values of those groups
Policy
#3 - Facilitate an informed dialogue involving the scientific community, the public, and government; leading to energy policy at a national, regional and State level
Support the execution of
Our Technical Capabilities along with our Critical Enablers
#4 - Expand science and engineering education in Idaho
#5 - Solve challenging energy problems through applied advanced modeling and simulation
Technical Capabilities
#6 - Integrate energy policy formulations into science and engineering disciplines
#7 - Develop advanced materials to support innovative terrestrial and space-related energy systems
#8- Advocate environmental stewardship and conduct research into mechanisms to minimize energy impacts to land, water, ar
Critical Enablers
#9 - Establish World-class laboratories with state of the art equipment and high performance computing
#10 - Create efficient business transaction systems that are transparent to members and partners
#11 - Establish and maintain collaboration tools and techniques
#12 - Create a strong network of professors, students, and other professionals
#13 - Maintain the support of State, federal, non-government organizations, private industry and public stakeholders
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