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RECOMMENDATIONS for AIChE's ENERGY STRATEGY

AIChE®
Commission on Energy Challenges

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ABOUT AICHE

Founded in the United States in 1908, AIChE is a professional association of more than 40,000 chemical engineers in 92 countries. Its members work in corporations, universities and government using their knowledge of chemical processes to develop safe and useful products for the benefit of society. Through its varied programs, AIChE continues to be a focal point for information exchange on the frontier of chemical engineering research in such areas as nanotechnology, sustainability, hydrogen fuels, biological and environmental engineering, and chemical plant safety and security. More information about AIChE is available at www.aiche.org.

ABOUT THE COMMISSION ON ENERGY CHALLENGE

The Executive Committee of the AIChE Board of Directors formed the Commission on Energy Challenge (CEC) in July 2005. Their charge was to:

- Consider whether AIChE, as a professional engineering society, should undertake significant programs to address the complex technical, sociological, economic and sustainability issues of energy production, usage, and conservation.
- If affirmative, recommend the type of activities and projects that would most likely have beneficial impacts, taking into consideration the specific strengths, resources, and limitations of AIChE.
- Make recommendations on the most fruitful activities to AIChE Board of Directors by the 2006 AIChE Spring Meeting.

Recommendations for AIChEs Energy Strategy

While sustained high energy prices elevate energy issues in the public discourse, the passage of a sweeping national energy bill, importance of supply security, relevance of environment and sustainability, and concerns over energy economics will ensure that "Energy" will remain a major topic of interest in the foreseeable future. Energy will continue to impact the chemical enterprise, the chemical engineering profession, and the careers of current and future chemical engineers. As the world's leading organization for chemical engineering professionals, AIChE must take a proactive role in the debate and solutions to our energy challenges: supply, usage, conservation, and sustainability. In concert with our mission, AIChE can impact the chemical engineering profession, members, and society:

- **Service to the profession:** Develop tools and programs to evaluate energy systems comprehensively and objectively, utilizing the fundamental principles of chemical engineering.
- **Service to its members:** Assume a leadership role in technological innovation through better understanding of energy principles, education, and information dissemination. This can enhance the career opportunities of current chemical engineers and attract new members into the profession.
- **Service to Society:** Take a more proactive leadership role in the energy debate in order to elevate global energy issues to a higher level based on a sound, scientific evaluation of energy systems.

Following an intensive information gathering process that included AIChE members, volunteers, government officials, students, and subject-matter-experts, the Commission on Energy Challenge has developed and analyzed 15 specific proposals for consideration by the AIChE Board of Directors. We recommend these top priorities:

1. **Increase the energy focus throughout AIChE programs:**
   - Energy, Environment & Sustainability focus or theme at one or more AIChE national meetings
   - Energy Forums at AIChE Meetings
   - Critical Issues Forums in Chemical Engineering Progress (CEP)
2. **Motivate academic and industrial innovation in energy via:**
   - Energy Student Fellowships in Chemical Engineering to be funded by Industry
   - Energy Innovation Consortium
3. **Develop energy tools and outreach programs like:**
   - Energy Metrics
   - Energy R&D Website
   - Energy Resource ("Energy Toolkit")
   - Energy Information Data Center (Validated Domains of Knowledge)
   - Public Speakers Team on Energy and Sustainability
4. **Continue to evaluate opportunities to impact the energy challenge.**
   - Physical Properties for Real Fuel Systems
   - Educational television and radio programs
   - State-level outreach programs
   - Government outreach programs
   - Combustion Simulation Modeling

Though the proposed activities require further detail, valuation, and in-depth analyses before they may be cultivated from conceptual ideas to successfully executed initiatives, they illustrate ideas that would help AIChE and its members positively impact the energy challenge. As such, we believe this it the right time to raise funds from external sources in support of AIChE's energy programs.

Energy is undoubtedly one of the most important issues facing our society, and chemical engineers and AIChE should be poised to lead in their important role.

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For much of the 20th Century, the need for reliable, economical, safe and environmentally responsible energy was central to society. With the growth of economies in the developing world, along with continued strong demand in the developed world, energy's importance is projected to continue to grow in the 21st century.

Energy supply and demand, alternative sources, usage and conservation involve both socio-economic and political criteria as well as the technology and application of sound principles of engineering.

Chemical engineers have long been involved in the development, design, and efficient use of energy and are arguably equipped by training and practice to provide important leaderships to develop solution to energy problems.

AIChE Launches Energy Initiative

INTRODUCTION

Against the backdrop of growing global demand for energy and new energy legislation, AIChE and its members launched a series of initiatives that apply chemical engineering expertise to help develop solutions to energy problems. In 2005 alone, the Annual and Spring Meeting attendees witnessed a surge in the number and variety of papers devoted to energy. CEP published a series of articles on the critical issues surrounding energy. Operating councils heightened their plans to focus on chemical engineers roles in energy. And, in his discussions with AIChE volunteer leaders and members, John Chen said that he could remember no previous topic that has generated such broad interest. It was clear that strategies are required to ensure that chemical engineers play a central, if not preeminent role in advancing energy research and technology.

COMMISSION ON ENERGY CHALLENGE

To help guide this endeavor, the AIChE Board of Directors organized its Commission on Energy Challenge as an assembly of industry and academic experts and consultants representing a broad portfolio of energy technologies as well as business and research interests. Chaired by Amos Avidan, the nine-person commission represented several decades of experience in energy production, exploration, usage, conservation, and research. CEC members are listed on the back cover.

The CECs inaugural meeting took place at AIChE Headquarters in September 2005. Members discussed subjects ranging from the Energy Policy Act of 2005 to the price of a barrel of oil to the decline in physical and chemical academes now needed for the energy challenge. They also talked about the AIChE Spring and Annual Meetings, whose programming was indicative of research and industry trends of the profession. A historical review of meeting topics revealed the breadth and quantity of energy-related papers at AIChE meetings had been in decline since the early 1980s, although there have been increases since the turn of the century, particularly in the area of sustainability. Much of the energy programming at the industrially oriented Spring National Meeting surrounded fuels and petrochemicals. At the Annual Meeting, which is primarily driven by research and development, biological engineering and nanotechnology have eclipsed energy. Though current efforts in LNG, fuel cell, and energy efficiency programming are strong, AIChEs overall strategy requires more cohesiveness and elevation. The CEC set a tone for a very open and candid dialogue about the future of energy and AIChEs role in it.

Over the next six moths, commission members held more than a dozen teleconferences, face-to-face meetings and electronic exchanges continuing their dialogue, gathering information, and developing recommendations. Amos Avidan expressed the hope that, whatever the outcome of the commission's recommendations, AIChE would adopt a more pro-active role in educating the public and providing sound technical opinion to energy policy discussions.

Information Gathering

As part of its charge, the CEC conducted an extensive information gathering process. Rather than only relying on their personal and professional opinions, the CEC recognized the importance of hearing from AIChE members, government officials, students, and subject-matter-experts. Opinions and suggestions on what new initiatives should AIChE undertake to meet energy challenges were actively sought through the following activities:

Activity	Date	Participants
CTOC meeting on AIChEs roles in energy research & technology	September 2005	Chemical Engineering Technology Operating Council (CTOC)
Meeting with Department of Energy	September 23, 2005	AIChE leaders and Dr. Raymond Orbach, Director, Office of Science, DOE
Solicitation of comments via email (energy@aiche.org)	September-December 2005	All
Student Contest	September-October 2005	Chemical engineering students
Energy Forum	October 30, 2005	AIChE Annual Meeting attendees
Various consultation	Ongoing	AIChE volunteers, subject-matter-experts

Table 1. Summary of Information Gathering Efforts

ENERGY FORUM

More than 200 chemical engineers shared their ideas for the ways their profession can address the world's energy challenges at the Energy Forum at the 2005 AIChE Annual Meeting in Cincinnati, OH. The open forum was co-hosted by the CEC and AIChEs Assembly of Fellows, chaired by John O'Connell of the University of Virginia. Following three short vignettes on a systems view of energy, challenges faced by the oil and gas industry, and sustainability issues related to energy production and usage, the audience was invited to share its thoughts.

Questions, comments and suggestions covered topics from biomass to nuclear to hydrogen to photovoltaics as well as education to advocacy to research. One over-riding theme that emerged was that AIChE, with its technical expertise, should provide a neutral ground for methodically exploring energy options, and for sifting through the conflicting analyses that sometimes characterize the energy debate. Another idea was for AIChE to adapt its model of the Center for Chemical Process Safety or Design Institute for Physical Properties and launch a research effort on behalf of a consortium of companies. The focus of such research could be optimizing the companies' energy usage and identifying potential feedstock alternatives.

There was a great deal of sentiment that AIChE should do more to educate the public about energy issues. Speakers pointed to nuclear and waste-to-energy options as ones that face public perception obstacles, instead of technical ones. One student attendee said that AIChE should also educate engineers about policy, as well as policy-makers about technology. The CEC pledged to look at supply and demand equally, use a systems approach, address global issues, and look at unconventional energy sources and renewables, including biofuels and nuclear.

STUDENT CONTRIBUTIONS

As future technologists, policy makers, and leaders, chemical engineering students were asked to share their opinions about chemical engineers' roles in energy production, usage, and conservation. Dozens attended the Energy Forum to hear the results of a contest held prior to the event. The CEC reviewed all of the responses and chose one that they felt articulated and reflected the sincere concerns of young chemical engineers. Contest winner Nastassja Lewinski, a student at Rice University, expressed her concerns about diminishing energy supplies and the US's increasing dependence on foreign oil. She noted the need for research into alternative fuels as well as optimizing existing processes to balance energy demands with environmental concerns.

Proposed Activities

EMERGING THEMES

As a result of the information gathering activities, over a hundred ideas were submitted, and five overriding themes emerged from which the CEC would develop proposals for AIChEs energy strategy. Chemical engineers would expect that AIChEs energy initiatives to address the following areas:

1. AIChE, with its technical expertise, should provide a neutral ground for methodically exploring energy options, and for sifting through conflicting analyses.

2. AIChE should do more to educate the public about energy issues.

3. AIChE should facilitate technology and education that is required to move forward on the energy front and chemical engineering curricula.

4. AIChE should address energy management, conservation, and environmental issues.

5. AIChE, adapting its current consortia or division and forum models, should promote dialogue about technological advances and consider collaborative research efforts on behalf of companies, academia, and government.

THEME 1: ENERGY INFORMATION ANALYSES

There is no shortage of energy-related information in the public domain available to investigators. However, access to this information is often hampered by a number of complications including: (1) broadly distributed sources, which require experience to navigate, (2) varied reliability, (3) timeliness, and (4) consistency. Moreover, the analysis and comparison of energy options is often developed within a framework that is at the discretion of individual or their organization. This inherently introduces subjectivity, complicates like-to-like comparisons, and can neglect critical considerations. Greater objectivity in analysis can lead to improved clarity of the key issues and improved focus and application of resources to the key challenges facing the energy sector.

As an objective professional society, AIChE should promote constructive dialogue and investigation of emerging and current energy options through improved access to existing knowledge resources. AIChE should also work to provide greater confidence in the conclusions drawn from these analyses to help engineers make better decisions. In order to provide engineers with a comprehensive resource for framing and conducting their analyses of energy processes and alternatives, the following initiatives are proposed:

1-1 Energy Information Data Center (Validated Domains of Knowledge)
1-2 Energy Evaluation Resource (“Energy Toolkit”)

THEME 2: ENERGY OUTREACH

Chemical engineering is recognized as a valued profession whose expertise is required to meet the nation’s energy needs. Among members and chemical engineers, AIChE is also recognized as a valued resource on energy. However, outreach is largely the result of energy-related information disseminated at AIChE conferences. Additionally, the Government Relations Committee has been active in co-sponsoring the Critical Issues Series: Energy, joint policy statements with ACS, critical issues forum in CEP, and a position paper being developed on energy storage. Other AIChE entities also perform valuable outreach activities. They include the Fuel and Petrochemicals Division, the Nuclear Engineering Division, the Environmental Division, the Sustainability Engineering Forum, and the Institute for Sustainability. A revived Transport and Energy Processes Division might also play a part. These efforts may be enhanced to broaden their reach.

Though partnership with other technical societies and NGOs or as the premier chemical engineering professional organization, AIChE has opportunities to inform government, NGO's and the public about energy issues. The following initiatives are proposed as outreach efforts at a local, national, or international level:

2-1 Energy Forums at AIChE Meetings
2-2 State-level Outreach Program
2-3 Energy R&D Website
2-4 Educational Television and Radio Programs on Energy
2-5 Government Outreach (including Advocacy of Relevant Energy Issues)

THEME 3: ENERGY EDUCATION

Societal priorities and governmental policies are often influenced by public opinion; though informed public opinion occurs only with the understanding of the complex, interactive, and often competing issues involving energy sources, production, usage, conservation, and sustainability. As an objective professional association, AIChE can speak to the public with credibility and can spread the messages broadly through its 40,000 volunteer organization.

Additionally, the emphasis on life sciences in the recent decade in research and graduate schools has reduced the numbers pursuing advanced studies in physical and chemical sciences and technologies, and more are needed to meet the energy challenges of the future. Many young chemical engineering faculty recruited by universities is focused on biological and medical issues, as evidenced by the many chemical engineering departments that have converted to departments of chemical and bio- engineering. Consequently, only a very small fraction of the current graduate students are being trained in the energy field. It is important for the profession, and for the nation, that the energy intellectual capital be supplemented through the following activities:

3-1 Energy Research Fellowship in Chemical Engineering
3-2 Public Speakers Team on Energy and Sustainability
3-3 CEP Critical Issues Forum

THEME 4: ENERGY, ENVIRONMENT, AND SUSTAINABILITY

A traditional role for AIChE has been the publication and diffusion of knowledge. During the energy crises of the 1970s and early 1980s, AIChE national meetings devoted a substantial fraction of presentation time to energy related papers. At that time, up to one third of the papers related to energy. In the last few years, that has declined to approximately 10%. Recent increases in energy papers and activities by the Institute for Sustainability are promising, but AIChE can do more to raise their prominence.

The impact of energy extraction and consumption on the environment differs widely depending on the source of the energy. Engineers need to account for and address this impact through the following proposed activities:

4-1 Energy Systems Metrics
4-2 Energy, Environment & Sustainability focus at an AIChE Meeting

THEME 5: ENERGY COOPERATIVES

The academic, industry and government communities benefit from AIChE as an important source of information and action in the energy area. Through diverse membership, access to high-level executives, and the credibility of its Industry Technology Alliances (ITAs), AIChE can lead efforts to facilitate collaborative research on behalf of companies, academia, and government. AIChE has already taken steps to establish a leadership role in energy technology issues through: (1) 2005 LNG Conference Vancouver, sponsored by AIChE, along with its Center for Chemical Process Safety and the Canadian Society of Chemical Engineers, (2) participation as a founding member of the Department of Energy's Vision 2020, and (3) hosting the physical properties of fuels and combustion workshop in Boulder, CO. It has also developed key relationships with the

American Chemical Society, the American Society of Mechanical Engineers, DOE, NIST, and other organizations that also serve to advance energy-related efforts.

ITA-type of activities centered on energy would yield opportunities for income producing ventures for AIChE. The following activities are proposed:

5-1 Physical Properties for Real Fuel Systems
5-2 Combustion Simulation Modeling
5-3 Energy Innovation Consortium

Suggested Metrics to Evaluate Proposed Activities

Following the work of the CEC, the Board of Directors Leadership Team on Energy will be tasked with leading the BOD in a strategy for development of AIChEs activities and programs in energy technology, policy, and education. The following criteria, questions, and examples of past AIChE projects are provided as a guide for the decision process. Additional evaluation, with weighted criteria is recommended, as the proposed activities become more detailed. Preliminary evaluations are provided in the Exhibits.

BENEFIT

- **Advancement of energy solutions**
  - How effective is the activity in advancing technology, education, or policy towards solutions?
  - Example: n/a
- **Effectiveness in raising awareness of AIChE and the chemical engineering profession**
  - Does the project effectively increase the visibility of chemical engineers, their expertise, and their role in energy?
  - Example: Society for Biological Engineering (SBE)
- **Impacts on membership**
  - Will the proposed activity increase membership to AIChE?
  - Help with membership retention?
  - Membership to Technical Societies or Technical Division? Corporate membership?
  - Example: Young Professional Advisory Board (YPAB)
- **Profitability**
  - Will the proposed activity increase AIChEs net assets?
  - Example: n/a

IMPLEMENTATION

- **Ease of implementation**
  - Does the course of action require minimal effort to initiate?
  - Does it have a short time to market and will it produce immediate positive impact?
  - Example: CCPS SVA Guidelines
- **Uniqueness**
  - Are there other competitive products or services that may effect market penetration?
  - If this is a competitive or duplicative activity, what competitive advantage does AIChE possess?
  - Example: CHO Consortium
- **Risk/likelihood of success**
  - How likely will the project be developed on budget an on time?
  - How likely will the project have value in the marketplace?
  - Example: New AIChE Website

RESOURCES

- **Ability to leverage existing resources**
  - Can existing infrastructure, volunteers, technical divisions, or staff be utilized to implement and maintain the project?
  - Example: Process Development Division Conference
- **Feasibility of funding**
  - Is there significant probability of obtaining seed and operating funds from corporate or government sources or from revenues?
  - Is funding feasible for the lifetime of the project?
  - Example: Center for Chemical Process Safety
- **Interdependence on other proposed activities**
  - Does the project compliment other proposed initiatives?
  - Example: n/a

Appendices

Appendix 1 – Energy Information Analyses

Appendix 2 – Energy Outreach

Appendix 3 – Energy Education

Appendix 4 – Energy, Environment & Sustainability

Appendix 5 – Energy Cooperatives

Exhibits

Exhibit 0 – Preliminary Average Evaluation of Proposed Activities

Exhibit 1 – Preliminary Evaluation of Energy Information Analyses Projects

Exhibit 2 – Preliminary Evaluation of Energy Outreach Projects

Exhibit 3 – Preliminary Evaluation of Energy Education Projects

Exhibit 4 – Preliminary Evaluation of Energy, Environment & Sustainability Projects

Exhibit 5 - Preliminary Evaluation of Energy Cooperative Projects

Proposed Activity 1-1	Energy Information Data Center (Validated Domains of Knowledge)
Objective:	Establish an Energy Information Data Center to collect and make available valuable information, which has been validated for the conduct of technical and economic analyses of energy options.
Approach:	• The data center would reside within the aiche.org website and contain links to varied online resource collections. • The links would be validated by subject-matter-experts. • Funding and subject-matter-experts to come from industrial and government partnerships. • Such a site could eventually evolve beyond its clearinghouse function to include topical message boards, on which users could share viewpoints, ideas, and knowledge resources on specific topics. • Possible coordinated by Energy Innovation Consortium (See Proposed Activity 5-3)
Examples:	The data center could provide some level of comfort to the end-user as to the credibility of the data resources he or she is using and impede the flow of questionable data (which is available in abundance, on-line) into end-user analysis. Some of the knowledge resources the clearinghouse could address include: A. Global Energy Information 1. Energy sources (fossil fuels: petroleum, natural gas, coal, and oil sands; proposed non conventional sources: shale oil, and gas hydrates; renewables: solar, wind, hydro, biofuels; proposed alternatives: hydrogen; nuclear, etc.) 2. Historical and forecast exploration/production/consumption/storage/imports/exports/trade/etc 3. Historical and forecast reserves and production; reserve to production ratios 4. "peak oil" and "peak gas" projections 5. Historical and forecast capital and operating costs (? – may be too diverse to make sense beyond general trends) 6. Historical and forecast use patterns by country 7. Use patterns by economic sector 8. Use patterns by function (power, transportation, domestic heating, industrial production, etc.) 9. Environmental impacts and costs 10. Health and safety impacts and costs 11. Security impacts and costs B. Primary Energy Recovery Facts 1. Exploration costs and impacts (environmental, cultural, sustainability?) 2. Production capital and operating costs, lifetime, efficiencies, and impacts 3. Primary energy storage capital and operating costs, lifetime, and impacts 4. Energy transportation and distribution capital and operating costs, lifetime, and impacts C. Energy Facts Specific to the Processing Industries (fuels, chemicals, metals, nonmetals, etc.) 1. Historical and forecast production rates 2. Heat and material balances for major processes 3. Utility requirements for major processes 4. Energy content in feedstocks and products for major processes 5. Energy and other thermodynamic targets for major processes 6. Energy and other thermodynamic targets for major units such as engines, compressors, separators, lighting, etc 7. Energy implications of alternatives (feedstocks, chemistries/processing conditions, equipment/unit operations, environmental constraints, security constraints, etc.) D. Energy Facts Specific to Transportation 1. Power and performance requirements 2. Energy conversion efficiencies 3. Volumetric and gravimetric energy density 4. Mobile energy storage 5. Environmental implications E. Accepted Standard Data 1. Physical and chemical data (energies of formation, reaction, heating values, latent and specific heats, weather data, solar insulation, etc.) 2. Health, safety, and environmental data (toxicity, etc.) 3. Economic data (construction cost indices, inflation data, etc.) 4. Standard capital cost data (equipment cost estimation standards/procedures/ cost index, etc.) 5. Standard financial data (cost of capital, tax rates, etc.)
Desired deliverable/outcome	Collection of validated information disseminated by AIChE and accessible to individual or corporate users requiring specific knowledge, across the energy landscape.

Proposed Activity 1-1	**Energy Information Data Center (Validated Domains of Knowledge)**			
	Target Audience: Industrial, academic, and government investigators			
Metrics of success:	**AIChE Membership**	**AIChE Financial Reserve**	**Market Penetration**	
	Help establish AIChE as a premier organization, pertinent to the issues of energy supply, usage, and sustainability	Contributions via the Energy Innovations Consortium	Measured in "hits" to the site or via user feedback, citations, and additions to the list of selected credible sources (EIA, BP, etc.)	
Impact on relevant entities	**AIChE**	**Industry/Gov/Academia**	**ChE Profession**	**Society**
	Improved traffic on the aiche.org site creates another link between its membership and the institute	Improved quality of analysis and greater focus on the "real" critical technical/economic issues	Additional resource/channel for the information critical to making sound judgments	Benefit from better solutions that come from improved availability/validity of data resources

Proposed Activity 1-2	Energy Evaluation Resource ("Energy Toolkit")
Objective:	Assemble teams of industrial and academic experts to create the components of Energy Evaluation Standards or a "toolkit", which would provide a framework for engineers to address a number of critical issues in the evaluation of technology options
Approach:	• Provide a valuable starting point, or "how to guide" for engineers as they set about performing their investigation. • A framework enhanced by AICHE may also enhance the credibility of the analyses and promote greater consistency in how such analysis is conducted. This would in turn, provide a clearer means for careful comparison of the benefits and drawbacks of particular options. • The design and execution of the content development could be modular to improve focus and knowledge capture while reducing the "scale" of the endeavor for contributors. • Funding to come from industrial and government partnerships. • Validated energy analyses using the "toolkit" may be conducted by the Energy Innovation Consortium (Proposed Activity 5-3)
Examples:	Sample products are listed below. We should be explicit about which of our products are standard data, which are standard definitions, which are standard assumptions, which are standard formulae, which are standard methods (of synthesis, design, optimization, calculation, engineering practice, analysis boundaries, etc), etc. Some of the modules that could be contained in the toolkit include: A. Assessing production potential (extraction practices, mining practices, agricultural practices, etc) B. Performing technology assessments with common assumptions and analysis methods 1. Clear scope definition 2. Stated assumptions, data, and data uncertainty 3. Stated future scenario 4. Generation of alternatives to be compared 5. Analysis of each alternative 6. Uncertainty analysis for each alternative 7. Comparison of alternatives C. Consistency of process synthesis techniques employed and analysis process flow diagrams generated. D. Performing detailed heat and material balances including environmental impact mitigation E. Conducting process integration and other efficiency and environmental targeting evaluations F. Consistent optimization of equipment design and process operation G. Consistent operability, controllability, hazard, and safety analysis 1. Environmental Analyses 2. Cumulative Energy Analyses 3. Other metrics as identified by IfS H. Performing economic evaluations and sensitivity studies 1. Consistent level of detail 2. Assumptions consistent with level of detail 3. Sensitivity to Assumptions I. Cost estimation and financial analysis standards 1. Capital cost indices 2. Utility specifications and capital and operating costs 3. Standard waste treatment and disposal capital and operating costs 4. Labor rates 5. Maintenance labor ratio 6. Analytical labor ratio 7. Maintenance materials 8. Operating supplies 9. Plant overhead ratio 10. Taxes and insurance rates 11. Depreciation schedules 12. General and administrative rates 13. Research and development rates 14. Allocation rules for coproducts and recovered materials and energy 15. Financial metrics 16. Carbon Taxes J. Assessing capital and operating cost and cost uncertainty 1. Design basis 2. Production rate 3. Operating year 4. Battery limits capital investment 5. Outside battery limits capital investment 6. Raw material costs 7. Byproduct/Co-product credits 8. Utility usage 9. Operating labor K. Performing standard financial analyses with consistent financial return criteria L. Performing Stakeholder Analysis M. Performing Value Chain Analysis

Proposed Activity 1-2	Energy Evaluation Resource ("Energy Toolkit")			
Desired deliverable/outcome:	Product available for sale on aiche.org website for some nominal fee (tiered member/non-member/corporate pricing) Target Audience: Industrial, academic, and government investigators evaluating techno/economic options.			
Estimated Resources:	Requires more analyses			
Metrics of success:	**AIChE Membership**	**AIChE Financial Reserve**		**Financial Risk**
	Help establish AIChE as a premier organization, pertinent to the issues of energy supply, usage, and sustainability	Revenues from tool kit sales		Minimal if funded though government and industrial partnerships
Impact on relevant entities	**AIChE**	**Industry/Gov/Academia**	**ChE Profession**	**Society**
	initiative may provide the means for greater involvement and interaction existing membership ranks	Useful tool to objectively examine options, currently there is no such tool in the public domain	Elevate ChEs role in energy systems evaluation	Promotes responsible evaluation and dialogue of energy alternatives

Proposed Activity 2-1:	**Energy Forums at AIChE Meetings**			
Objective:	Leverage presence at AIChE Meeting cities to engage in energy dialogue; Critical Issues Series			
Approach:	• Create task team to organize public forum on Sunday afternoon prior to meeting; include local representation on task team • Select a topic of special interest to region; less technical discussion which includes policy and societal issues • Conduct "Energy Systems Analysis" • Invite open dialogue between public, media, panelists • Obtain corporate sponsorships • Publicize broadly • Webcast the Forum to increase exposure			
Examples:	• 2006 Annual Meeting, San Francisco, CA: Hydrogen Power or LNG • 2007 Spring Meeting, Houston, TX: Refinery Construction, Oil & Gas Production/Exploration, or Clean Fuels			
Desired deliverable/outcome:	• Opportunity to support local section energy interests where appropriate • Opportunity to invite and dialogue with state officials, regional legislators, local officials, public, media recognition of role of chemical engineers. • Target Audience: current and new AIChE meeting attendees			
Estimated Resources:	• ¼ - ½ FTE to manage task team, promotion efforts, and garner corporate sponsorships • Speakers and analyses to be conducted by volunteers • Funds for public relations and promotions			
Metrics of success:	**AIChE Membership**		**AIChE Financial Reserve**	
	Opportunity to connect and increase visible with regional chemical engineers who are not currently members		Incremental contributions to meeting revenues	
Impact on relevant entities	**AIChE**	**ChE Profession**	**Industry/Gov/Academia**	**Society**
	Increase regional visibility; outreach to non-members; gain regional and national attention	Make ChEs proud and more visible	Opportunity for new partnerships; connections that may result in new initiatives in the region	Opportunity to learn from the experts

Proposed Activity 2-2:	**State-level Outreach Program**		
Objective:	Focus on education and outreach at the state level through Local Section programs		
Approach:	• For many chemical engineers, there is more interest at the state level since universities have interests in funding and technology related to their energy focus • Select one state with a key energy issue • Identify a lead volunteer and assemble a task team; include local faculty and local section • Define specific objectives for the region and implement (e.g. Local conference or workshop) • Leverage existing resources like GRC, other local sections, and volunteers to recruit speakers and local sponsorships • Publicize to region • Replicate national model of "Proposed Activity 2-1: Energy Forums at AIChE Meetings" at the state level		
Examples:	• West Virginia: coal, Iowa: biomass, etc.		
Desired deliverable/outcome:	• Deliverable to be defined by the region/local section • Database of speakers • Results would inform federal agenda, feed CEP critical issues forum, feed opportunities for GRC • Target Audience: All chemical engineers who may or may not attend AIChE national meetings		
Estimated Resources:	• Regional leadership required • Minimal staff to assist with speaker coordination • Promotions through AIChE promotional vehicles		
Metrics of success:	**AIChE Membership**		
	Focus on an important issue could result in greater interest in local section and membership		
Impact on relevant entities	**AIChE**	**Industry/Gov/Academia**	**Society**
	Increase regional visibility; outreach to non-members; gain regional and national attention	Opportunity for increased dialogue and new partnerships in the region	Objective to be an integral part of creating the energy future

Proposed Activity 2-3:	**Energy R&D Website**	
Objective:	Develop a comprehensive website containing links to all R&D activities in the area of energy	
Approach:	• Gather information on DOE, government laboratories, university and government funded research • Obtain permission to include privately funded and corporate R&D • Develop webpage, hosted on AIChE website, to include links to various R&D projects • Tie in to other relevant professional society and university web sites • Update on a regular basis	
Examples:	• Links to DOE demonstration projects • Links to National Renewable Energy Laboratory 2 main programmatic areas	
Desired deliverable/outcome:	• The "Go-to" information page of Energy R&D research activities • Completed website could be integrated into "Energy toolkit" • Target Audience: Industrial, academic, and government investigators	
Estimated Resources:	• ¼ FTE during startup to manage website development, IT assistance • Professional guidance via dedicated volunteers to provide initial content and updates	
Metrics of success:	**AIChE Membership**	**AIChE Financial Reserve**
	Membership retention and potential new membership as we increase the number of useful tools	Incremental contributions to revenue of "Energy toolkit"
Impact on relevant entities	**AIChE**	
	Strengthen exchange between chemical engineers	

Proposed Activity 2-4:	Educational Television and Radio Programs on Energy
Objective:	Leverage AIChE technical expertise to contribute to educational television and radio programs
Approach:	• Identify energy expertise among AIChE volunteers • Identify cable/public/network television and radio programs (existing or in development) with energy focus • Obtain assistance from public relations specialists to connect AIChE volunteers with technical needs of programs • Be proactive in offering the AIChE name selected speakers to such programs.
Examples:	• Discovery Channel programs like Engineering Marvels or Extreme Engineering • National Public Radio subject matter expert interviews
Desired deliverable/outcome:	• AIChE recognition/credit • Exposure to a broad general audience – mostly people we would not reach through all other approaches • Target Audience: Persons unfamiliar with AIChE
Estimated Resources:	• Minimal staff time for coordination • Leverage current public relations services to reach out to television and radio programs • Minimal resources required as long as AICHE avoids television program production
Metrics of success:	**AIChE Membership**
	Potential new membership
Impact on relevant entities	**AIChE**
	Increase level exposure of AIChE to media and the public

Proposed Activity 2-5:	Government Outreach (including Advocacy of Relevant Energy Issues)	
Objective:	Establish AIChE as a valued agency, congressional and administration resource on energy technology and for providing support on energy policy	
Approach:	• Task the GRC to establish an energy task team to review and evaluate the GRC operating plan approved by the GRC at their April 2005 meeting and present recommendations for how AIChE may more effectively serve as a technical resource for congress and the administration on energy issues • The approach is to build on the work currently being carried out by the GRC and other AIChE initiatives; consider how to leverage opportunities with other societies with respect to energy; assess the risks and benefits for different activities and roles (e.g. education, advocacy, advisory, service) • It is recommended that a representative of the BOD be included as part of the task team and that the GRC call upon resources from the councils to support their effort as needed. • The GRC presents recommendation to the Board of Directors for decision and follow-through	
Examples	• Among the relevant topics to be considered for advocacy are: • Sustainable development • Increased R&D funding for Energy related topics • Conservation (e.g., stricter application of CAFE Standards) • A comprehensive national energy policy • Robust environmental protection (e.g., compliance with the clean air and water acts) • A more educated national debate on energy (e.g., using proposed "Energy Toolkit")	
Desired deliverable/outcome:	• The product of this activity is a summary of the options considered with a recommendation that includes targeted energy related opportunities, projected benefit from each opportunity, implementation plan, and resource estimates • Target Audience: Law and policy makers, persons not familiar with AIChE, members	
Estimated Resources:	• The resources for carrying out this initial activity include the volunteer services of the GRC and others that may be called upon to support the effort. Limited staff support would be used to facilitate communication or to obtain information related to candidate opportunities.	
Metrics of success:	**AIChE Membership**	
	Potential to increase membership through increased relevance by addressing an important national challenge	
Impact on relevant entities	**AIChE**	**Industry/Gov/Academia**
	Increase level of exposure of AIChE to government; bring AIChE Groups/Divisions working in different areas together to address important energy system issue.	Opportunity for members in industry and universities to meet and dialogue with various segments of the government

<table>
<tr><th>Proposed Activity 3-1:</th><th colspan="4">Energy Research Fellowships in Chemical Engineering</th></tr>
<tr><td>Objective:</td><td colspan="4">Provide graduate fellowships in order to impact the number and quality of graduate students in energy science and technology</td></tr>
<tr><td>Approach:</td><td colspan="4">• Organize a “Fellowship Committee”, operating under CEOC, of distinguished chemical engineers from academe, industry and government
• Develop criteria for the fellowships (e.g. academic record, description of proposed research, supporting letter from the students’ academic advisors, and additional reference letters, etc.)
• Develop logistics for competition among graduate students (e.g. application, review process, decision process, etc.)
• Obtain funding from corporate sponsors.
• Publicize the fellowship program broadly</td></tr>
<tr><td>Examples:</td><td colspan="2">Research Awards
• $5000 annual research award (as many as fund raising allows)
• To be awarded in a national competition
• These awards are meant to be complementary to the student’s normal financial support from his/her university, and may be applied toward tuition, stipend, or research expenses.
• These awards are to be considered a high honor
• Total direct cost = $250,000 per year
• Corporate support should be pledged at a minimum of $5000.</td><td colspan="2">Full Grants
• Five $50,000 fellowships in place at any time (or as many as fund raising allows)
• To be awarded in a national competition
• These are intended to fully support faculty, no additional assistance is required
• These fellowships are to be considered a high honor
• At end of the award term, the recipient is obligated to give a presentation his/her research at a designated AIChE Annual or National Meeting.
• Total direct cost = $250,000 per year
• Corporate support should be pledged over a 4 years, $50,000 per year.</td></tr>
<tr><td>Desired deliverable/outcome:</td><td colspan="4">• Nationally recognized honor for faculty which helps development of future manpower for corporate needs and attracts the best of students and faculty to the energy sciences/technologies.
• Target Audience: Chemical Engineering graduate students</td></tr>
<tr><td>Estimated Resources:</td><td colspan="4">• 2-3 volunteer team to develop proposal (1-month duration)
• Volunteer committee, led by leadership donors, to raise funding (on-going)
• Volunteer committee to review and judge applicants (on-going)
• Minimal - ¼ FTE to serve in a coordination role or as a contact point for volunteers and assist with promotions</td></tr>
<tr><td rowspan="2">Metrics of success:</td><td>AIChE Membership</td><td>AIChE Financial Reserve</td><td colspan="2">Program recognition</td></tr>
<tr><td>Bond between students and AIChE could lead to membership</td><td>Cash neutral</td><td colspan="2">High participation among students, faculty, and industrial stakeholders</td></tr>
<tr><td rowspan="2">Impact on relevant entities</td><td>AIChE</td><td>Industry/Gov/Academia</td><td>ChE Profession</td><td>Society</td></tr>
<tr><td>Help establish AIChE presence in the field of energy science and technology.</td><td>Good public relations (i.e. beneficial manner to utilize recent profits in oil industry)</td><td>Increase future intellectual capital of the nation in this critical area.</td><td>Attract the brightest students into chemical engineering, with applications toward the energy challenge.</td></tr>
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<table>
<tr><th>Proposed Activity 3-2:</th><th colspan="4">Public Speakers Team on Energy and Sustainability</th></tr>
<tr><td>Objective:</td><td colspan="4">Develop and arm a Public Speakers Team (PST) to deliver a “fact vs. fiction” message on energy and sustainability</td></tr>
<tr><td>Approach:</td><td colspan="4">• Volunteers from our membership would be screened and selected for rationality, communication ability, and charisma. Those elected would receive the prepared presentation material and be checked-out on its usage. A practice presentation, with feedback comments, would be part of the qualification process.
• A Public Speakers Committee (PSC) would be formed by and operate under the SIOC. The PSC would assemble and edit the core information for the presentations, preparing the PowerPoint file. PSC would update the material on a regular basis.
• The PSC is also responsible for all operational aspects of the Public Speakers Team, including the selection and qualification of the speakers. Initially, and on an annual basis, a call would be issued to AIChE members, seeking volunteers to be qualified and trained as PST members. There need not be any upper limit to the Team size, but broad geographic coverage would be desired.
• A part-time staff would be assigned as liaison for this program. He/she would maintain a list of PST members, and work with PSC and PST to publicize the program and to line up speaking opportunities (e.g. public schools, community bodies, churches, civic organizations, Lions Clubs, etc.).
• Once a speaking opportunity is identified, the staff liaison would then invite and schedule a Team member in the region.
• Travel expenses should be minimal or negligible, as speakers are expected to come from the locale of the event. If necessary, travel reimbursement should be sought from the hosting organization that invites the speaker. No honorarium is expected – this is a volunteer task for the public good.
• The hosting organization would publicize the event and invite the general public if possible.
• This program may be attractive for external funding, as it seeks to benefit society. Both governmental grants and industrial grants may be sought, say for a 3-year startup and trial period and continued funding.</td></tr>
<tr><td>Desired deliverable /outcome:</td><td colspan="4">• A PowerPoint presentation distilling and organizing the best information we can assemble regarding energy sources, production, utilization, and conservation, relating these issues to that of environmental impact and sustainability.
• PST of several hundred qualified speakers, located in all regions of the country.
• Target Audience: Persons unfamiliar with AIChE</td></tr>
<tr><td>Estimated Resources:</td><td colspan="4">• Volunteer team to develop presentation materials
• Minimal - ¼ FTE to serve in a coordination role or as a contact point for volunteers and assist with promotions</td></tr>
<tr><td rowspan="2">Metrics of success:</td><td colspan="2">AIChE Membership</td><td colspan="2">Financial Risk</td></tr>
<tr><td colspan="2">Help establish AIChE as a premier organization, pertinent to the issues of energy supply, usage, and sustainability</td><td colspan="2">Minimal, if volunteers are utilized</td></tr>
<tr><td rowspan="2">Impact on relevant entities</td><td>AIChE</td><td>Industry/Gov/Academia</td><td>ChE Profession</td><td>Society</td></tr>
<tr><td>Opportunity for participation and contribution by AIChEs grass root membership</td><td>Improving public knowledge and understanding</td><td>Opportunities to showcase chemical engineering and the role of our profession in addressing human needs.</td><td>Attract young men and women to the fields of science and technology, especially to chemical engineering.</td></tr>
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<tr><th>Proposed Activity 3-3:</th><th colspan="3">CEP Critical Issues Forum</th></tr>
<tr><td>Objective:</td><td colspan="3">Elevate the existing CEP Critical Issues forum for presenting critical energy issues and encouraging dialogue</td></tr>
<tr><td>Approach:</td><td colspan="3">• Build on work carried out in CEP
• Select specific energy topics and invite contributions from members and subject-matter-experts
• Leverage relationship with Wiley to distribute the forum through more general/popular publications
• Seek other channels for delivery; establish capability for real-time exchange</td></tr>
<tr><td>Examples:</td><td colspan="3">• Articles, presentations, webcasts, workshops on the selected topic
• Features in Scientific American, et. al.</td></tr>
<tr><td>Desired deliverable/outcome:</td><td colspan="3">• Educate and exchange insights, sharpen understanding of the issues
• Improved interest in CEP
• Target Audience: AIChE Members, CEP readers</td></tr>
<tr><td>Estimated Resources:</td><td colspan="3">• CEP staff
• Core volunteer team to select topics and contributors
• Volunteers and some staff to facilitate presentations or webcasts
• DOE funding
• IT resources electronic exchange is pursued</td></tr>
<tr><td rowspan="2">Metrics of success:</td><td colspan="2">AIChE Membership</td><td>Financial Risk</td></tr>
<tr><td colspan="2">Membership retention would be primary benefit since non-members do not receive CEP</td><td>Minimal, if volunteers and existing resources are utilized</td></tr>
<tr><td rowspan="2">Impact on relevant entities</td><td>AIChE</td><td>Industry/Gov/Academia</td><td>ChE Profession</td></tr>
<tr><td>Strengthen CEP and exchange between chemical engineers</td><td>Improving public knowledge and understanding</td><td>Opportunities to showcase chemical engineering and the role of our profession in addressing human needs.</td></tr>
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<tr><th>Proposed Activity 4-1:</th><th colspan="4">Energy System Metrics</th></tr>
<tr><td>Objective:</td><td colspan="4">Utilize AIChE integrated systems analysis view to drive public exchange on energy.</td></tr>
<tr><td>Approach:</td><td colspan="4">• Select a project leader from either academia or industry to provide overall management to the effort.
• Choose an Advisory Committee of individuals with recognized expertise in pertinent areas of technology. The committee will provide guidance to the study as well as critique the results.
• Assemble a staff of a few committed individuals to perform the study. It is anticipated that a few man years (3-5) of effort will be required. These might be graduate students, interns or assignees from sponsoring corporations.
• Develop metrics to evaluate energy systems (similar to those drafted at critical issues in Orlando) and the sustainability of energy sources or applications
• Demonstrate the evaluation techniques in one or more sample applications.
• Conduct organized outreach to the technical community to communicate the results and to stimulate feedback.
• Leverage metrics in multiple areas (can be incorporated as part of activities listed below) including use by GRC on exchanges with congressional staff and statements at hearings.
• Coordinated under the Institute for Sustainability</td></tr>
<tr><td>Desired deliverable/outcome:</td><td colspan="4">• Deliverables will depend on each activity; when used by GRC, outcomes would be ability to arrange statement at hearing, connections with congressional staff
• Completed deliverable could be integrated into “Energy toolkit”
• Target Audience: Industrial, academic, and government investigators</td></tr>
<tr><td>Estimated Resources:</td><td colspan="4">• Approximately $200,000 per year, and take 18 to 24 months to complete.
• Need to define a small focused initial effort with initial resources</td></tr>
<tr><td rowspan="2">Metrics of success:</td><td colspan="2">AIChE Membership</td><td colspan="2">AIChE Financial Reserve</td></tr>
<tr><td colspan="2">Potential increase in membership from people interested in system-analysis of energy systems</td><td colspan="2">The return will be determined by the resources available</td></tr>
<tr><td rowspan="2">Impact on relevant entities</td><td>AIChE</td><td>Industry/Gov/Academia</td><td>ChE Profession</td><td>Society</td></tr>
<tr><td>Demonstrate leadership in an area of great national importance</td><td>Provide objective and technically sound guidance for corporate decision making.</td><td>Demonstrate leadership in an area of great national importance</td><td>Provide objective and technically sound guidance for corporate decision making.</td></tr>
</table>

Proposed Activity 4-2:	**Energy, Environment and Sustainability focus at an AIChE meeting**			
Objective:	Identify one or more national meetings as having an energy, environment, and sustainability focus or theme.			
Approach:	• Identify a nationally recognized Technical Chairman to guide the effort • Select a program committee composed of individuals with recognized expertise in selected energy related areas • Determine the scope of the meeting, select session topics, and to solicit papers in their areas of expertise. • Coordinate with the National Program Chair.			
Examples:	• Session topics Program Committee might select may include such areas as: • Carbon Capture • Cellulosic Conversion • Enhanced Oil Recovery • Improvements in End Use Efficiency • Forum on Biofuel Experience • Packaging of High Level Nuclear Waste • Impact of State and Federal Regulatory Policies on Energy Choices			
Desired deliverable/outcome:	• Cover a relatively broad range of energy topics which might illuminate the factors involved in selecting a portfolio of energy solutions • Target Audience: Current and new AIChE Meeting attendees			
Estimated Resources:	• No additional resources required beyond those to run a national meeting. • Key volunteers from RANTC, Heat Transfer & Energy Division, and other relevant entities • DOE support can help defray costs			
Metrics of success:	**AIChE Membership**		**AIChE Financial Reserve**	
	Help establish AIChE as a premier organization, pertinent to the issues of energy supply, usage, and sustainability		Incremental benefit from meeting attendance based on topics relevancy	
Impact on relevant entities	**AIChE**	**Industry/Gov/Academia**	**ChE Profession**	**Society**
	Advance AIChE expertise	Strengthen relationships with DOC	Opportunities to showcase role of our profession in addressing environmental issues	Elevate environmental issues in energy

Proposed Activity 5-1:	**Physical Properties for Real Fuel Systems**			
Objective:	Create a searchable database of physical properties for commercial fuels, bio-derived fuels, and intermediate process streams involved in the manufacture of bio-derived fuels, which could be used for optimizing the use of various fuels, and fuel precursors, in refining, petrochemical operations, commercial fuel use and regional fuel supply to local power/utility companies			
Approach:	• Use the DIPPR model and form a consortium of users for the information. • Identify advocate at DOE or other funding organization. • Collect information that is already available in the archives of refining and petrochemical companies. • Develop new data with contributed R&D money. • Information to feed workshops and other technological discussions • Coordinated by Energy Innovation Consortium (See Proposed Activity 5-3)			
Desired deliverable/outcome:	• Searchable database that could be distributed via CD-ROM or web. • Target audience: users of technology in the fuels area			
Estimated Resources:	• $100,000/yr. to start up • ½ FTE to initialize and maintain project and funding			
Metrics of success:	**AIChE Membership**	**AIChE Financial Reserve**	**Time until cash positive**	**Financial Risk**
	Expand AIChE membership into refining, auto, engineers	Cash neutral at start-up. Could generate tens of thousands of profit when completed.	2-3 years	Minimal if R&D is pre-funded through consortium
Impact on relevant entities	**AIChE**	**Industry/Gov/Academia**	**ChE Profession**	**Society**
	New program for DIPPR and Fuels and Petrochemical Division Div.	Positive interaction with NIST and DOE	Elevates ChE role in energy systems evaluation.	Promotes efficient use of energy resources.

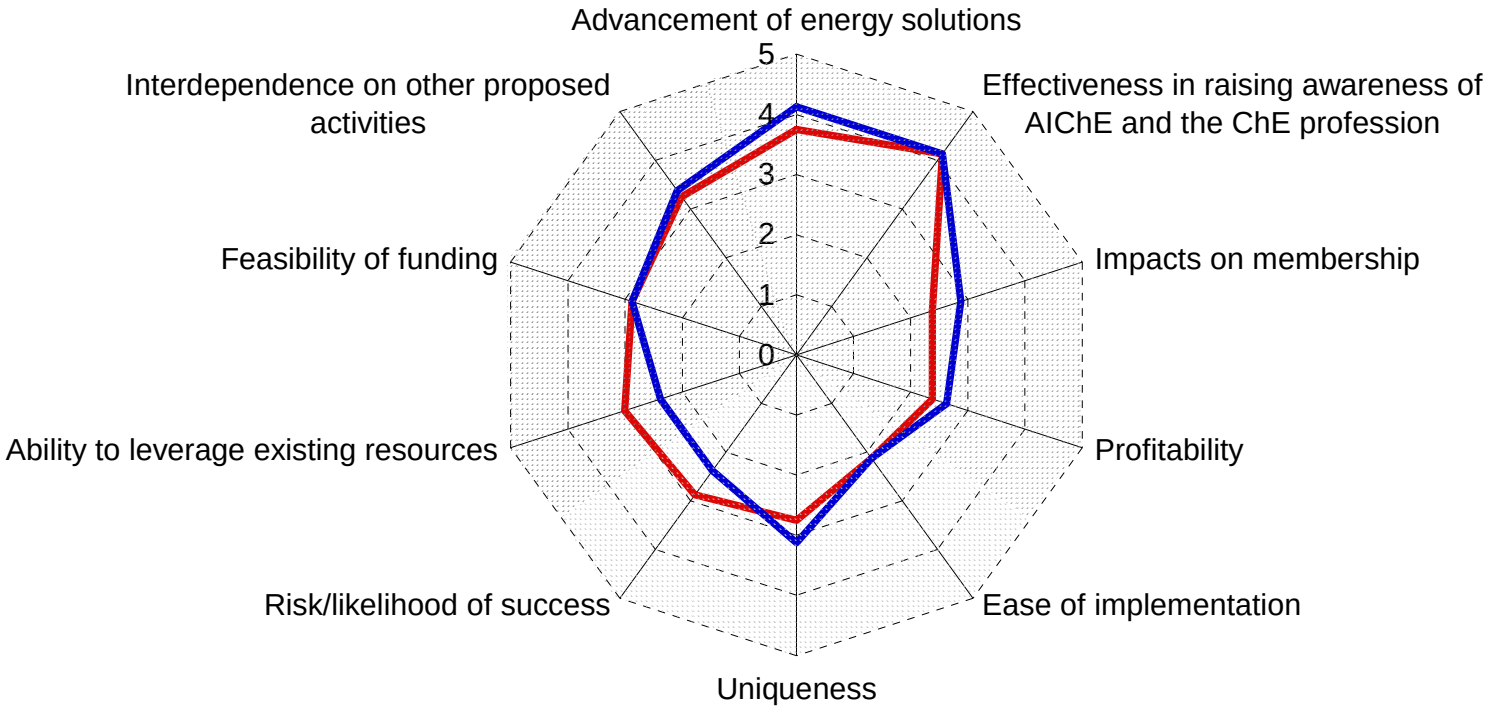
<table>
<tr><th>Proposed Activity 5-2:</th><th colspan="4">Combustion Simulation Modeling</th></tr>
<tr><td>Objective:</td><td colspan="4">Use fundamental physical property data for DIPPR and Project #1 to develop simulation programs for the combustion of fuels. These would be useful in predicting high efficiency of operation or design and also useful for optimal fuel selection for various uses.</td></tr>
<tr><td>Approach:</td><td colspan="4">• Use the DIPPR model of a consortium of users for the information.
• Identify advocate at DOE or other funding organization.
• Elevate this activity, which has already started as part of ComSEF.
• New data could be developed with contributed R&D money.
• Coordinated by Energy Innovation Consortium (See Proposed Activity 5-3)</td></tr>
<tr><td>Desired deliverable/outcome:</td><td colspan="4">• Searchable database that could be distributed via CD-ROM or web.
• Target audience: users of technology in the fuels area</td></tr>
<tr><td>Estimated Resources:</td><td colspan="4">• Minimal resources to elevate on-going work of ComSEF
• Most support would come from NIST and consortium</td></tr>
<tr><td rowspan="2">Metrics of success:</td><td>AIChE Membership</td><td>AIChE Financial Reserve</td><td>Time until cash positive</td><td>Financial Risk</td></tr>
<tr><td>Expand AIChE membership into refining, auto, engineers</td><td>Cash neutral at start-up. Could generate tens of thousands of profit when completed.</td><td>2-3 years</td><td>Minimal if R&D is pre-funded through consortium</td></tr>
<tr><td rowspan="2">Impact on relevant entities</td><td>AIChE</td><td>Industry/Gov/Academia</td><td>ChE Profession</td><td>Society</td></tr>
<tr><td>New program for DIPPR and Fuels and Petrochemical Division</td><td>Positive interaction with NIST and DOE</td><td>Elevates ChE role in energy systems evaluation.</td><td>Promotes efficient use of energy resources.</td></tr>
</table>

Proposed Activity 5-3:	**Energy Innovation Consortium**			
Objective:	Establish AIChE as a source of long-range technical innovations in the area of energy and energy related petrochemical challenges.			
Approach:	• Develop a consensus of process evaluation parameters that would be futuristic, and used as a set of standards for project evaluations done in government agencies, academia and as a guideline for long-range research in industry. • Run workshops that identifies the key leveraging technologies that need to be developed and/or could be donated to AIChE. • Form a consortium of industry partners for the development of key chemical/energy related projects. These would be a greater scope and risk than those taken on by the companies on their own. They would also be leveraging to the whole economic vibrancy of the US chemical enterprise. • Identify advocate at DOE or other funding organization. • Develop projects for consortium to manage and execute.			
Examples	• Activities the consortium could perform, promote, assist, or coordinate entities to do the following: • Assist the GRC in forming a team AIChE and IEEE members charged with preparing a position paper which verifies the need for massive energy storage when solar power assumes a growing role in our power supply, and then identifies potential technologies that show promise to meet the storage needs. The position paper, currently under consideration by GRC, could help generate public interest and support to stimulate innovation and advancement in technology to meet this challenge. • Coordinate Energy Information Data Center "Validated Domains of Knowledge" (Proposed Activity 1-1) • Conduct Validated Energy Analyses using the "Toolkit" (Proposed Activity 1-2) • Develop Physical Properties for Real Fuel Systems (Proposed Activity 5-1) • Help promote Combustion Simulation Modeling (Proposed Activity 5-2)			
Desired deliverable/outcome:	• Standards for evaluations in published forms. • Commercialize technology through licensing arrangements. • Target Audience: Trackers of technology in the fuels and petrochemicals area			
Estimated Resources:	• $100,000/yr. to start up • ½ FTE staff time. • Additional funding from DOE, NIST and industry. • Ultimately, this would entail running a multi-million dollar budget through a consortium mechanism.			
Metrics of success:	**AIChE Membership**	**AIChE Financial Reserve**	**Time until cash positive**	**Financial Risk**
	Visibility to senior leaders rather than a route to significant membership	Cash neutral at start-up. Could generate hundreds of thousands of profit when completed.	3-5 years	Minimal if R&D is pre-funded through consortium
Impact on relevant entities	**AIChE**	**Industry/Gov/Academia**	**ChE Profession**	**Society**
	Opportunity for new program to most AIChE divisions.	Positive interaction with CEOs, CTOs of industry	Elevates ChE role in energy systems evaluation.	Promotes efficient use of energy resources.

EXHIBIT 0 | **PRELIMINARY AVERAGE EVALUATION OF PROPOSED ACTIVITIES**

		Evaluation of CEC Proposed Activities	Advancement of energy solutions	Effectiveness in raising awareness of AIChE and the ChE profession	Impacts on membership	Profitability	Ease of implementation	Uniqueness	Risk/likelihood of success	Ability to leverage existing resources	Feasibility of funding	Interdependence on other proposed activities	Total
Energy Informatio	1-1	Energy Information Data Center (Validated Domains of Knowledge)	3.8	4.1	2.4	2.4	2.1	2.8	2.9	3.0	2.9	3.3	29.5
	1-2	Energy Evaluation Resource ("Energy Toolkit")	4.1	4.1	2.9	2.6	2.1	3.1	2.4	2.4	2.9	3.4	30.0
Energy Outreach	2-1	Energy Forums at AIChE Meetings	3.4	4.0	3.1	2.5	4.0	3.5	4.6	4.8	3.6	3.6	37.1
	2-2	State-level Outreach Program	3.4	3.5	3.5	1.8	1.5	3.0	2.3	2.8	2.1	2.3	26.0
	2-3	Energy R&D Website	3.3	3.9	3.3	2.4	2.5	3.0	3.3	3.3	2.5	2.9	30.1
	2-4	Educational Television and Radio Programs on Energy	3.1	4.6	3.6	3.0	1.5	2.9	2.0	1.9	2.5	3.0	28.1
	2-5	Government Outreach	3.1	3.4	2.3	1.3	1.9	2.0	2.4	2.1	1.7	2.6	22.9
Energy Education	3-1	Energy Fellowships in Chemical Engineering	3.6	4.0	3.5	2.4	2.6	3.9	3.6	2.9	3.4	3.1	33.0
	3-2	Public Speakers Team on Energy and Sustainability	3.1	4.4	3.5	2.1	2.8	3.1	3.5	3.3	3.3	3.3	32.3
	3-3	CEP Critical Issues Forum	3.3	3.8	3.4	2.6	3.6	3.5	4.6	4.6	3.5	3.5	36.4
Energy, Env. & Sus.	4-1	Energy System Metrics	4.0	3.6	3.0	2.6	2.1	3.6	2.5	3.3	2.8	3.4	30.9
	4-2	Energy, Environment & Sustainability focus at an AIChE Meeting	3.3	3.6	3.3	3.0	4.4	3.5	4.8	4.6	3.3	3.6	37.3
Energy Cooperatives	5-1	Physical Properties for Real Fuel Systems	3.4	3.3	2.8	3.0	2.9	3.3	2.9	3.0	3.1	2.8	30.3
	5-2	Combustion Simulation Modeling	2.0	2.1	1.6	2.4	2.1	2.4	2.1	2.4	2.1	2.4	21.9
	5-3	Energy Innovation Consortium	4.1	3.5	3.5	2.8	2.6	3.0	2.5	2.5	2.8	3.4	30.6

Using a scale of 1-5, CEC members evaluated each proposed activity against the suggested criteria. "1" was the lowest score (unfavorable) and "5" was the highest score (favorable). Average evaluations are shown here.


Advancement of energy solutions
Effectiveness in raising awareness of AIChE and the ChE profession
Impacts on membership
Profitability
Ease of implementation
Uniqueness
Risk/likelihood of success
Ability to leverage existing resources
Feasibility of funding
Interdependence on other proposed activities
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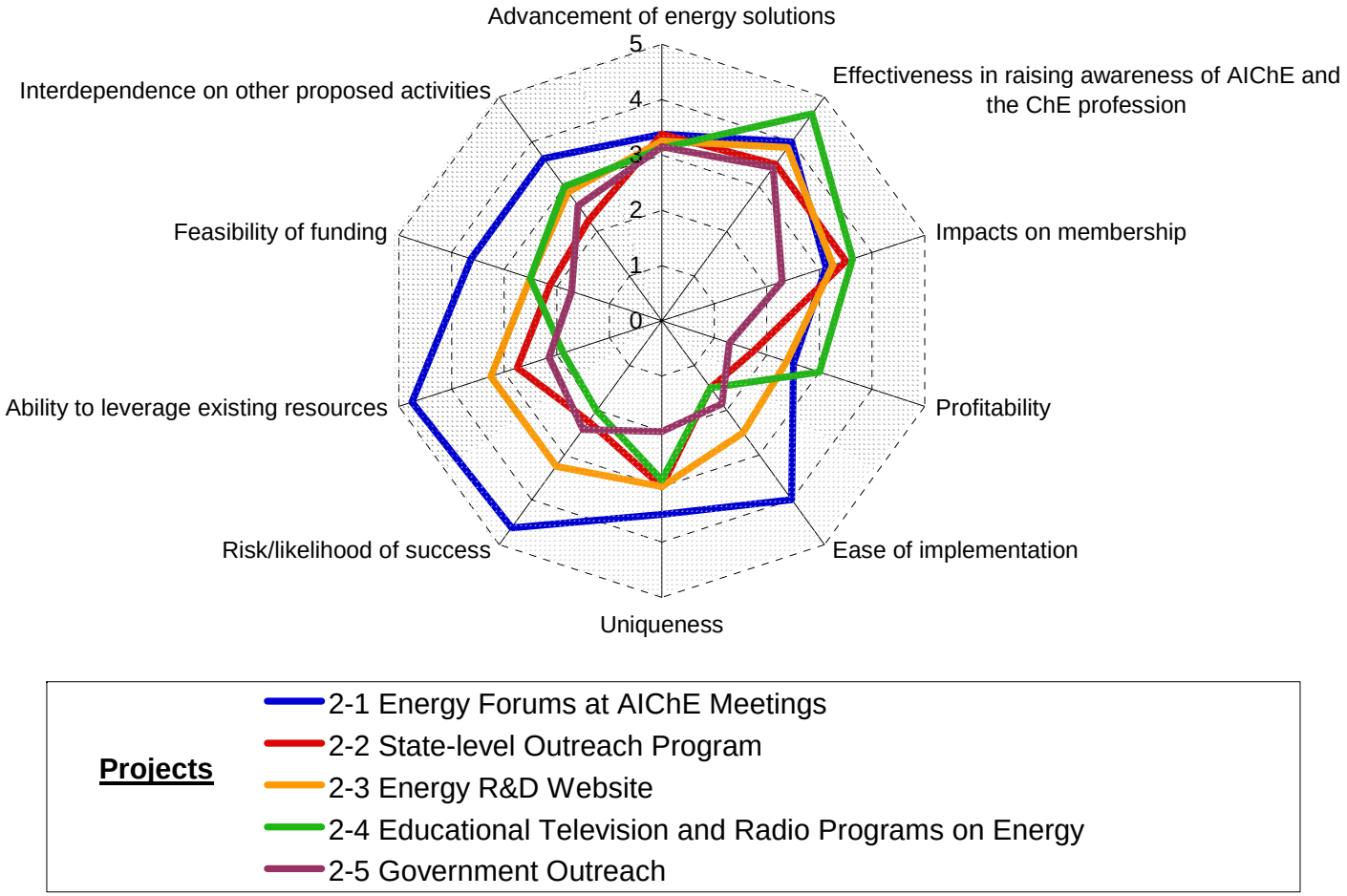
Projects
1-1 Energy Information Data Center (Validated Domains of Knowledge)
1-2 Energy Evaluation Resource ("Energy Toolkit")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Ability to leverage existing resources
Feasibility of funding
Interdependence on other proposed activities
5
4
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1
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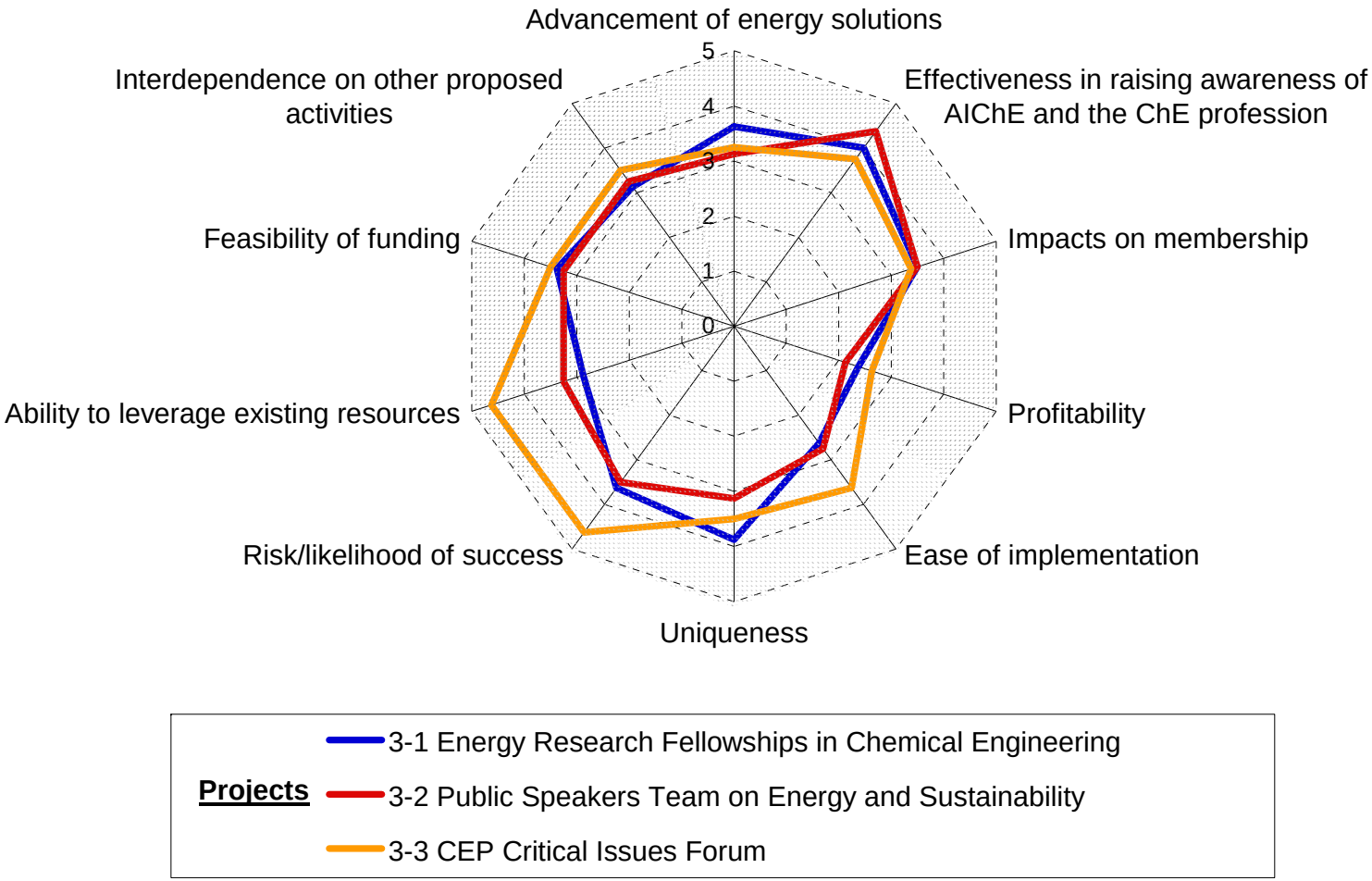
Projects
2-1 Energy Forums at AIChE Meetings
2-2 State-level Outreach Program
2-3 Energy R&D Website
2-4 Educational Television and Radio Programs on Energy
2-5 Government Outreach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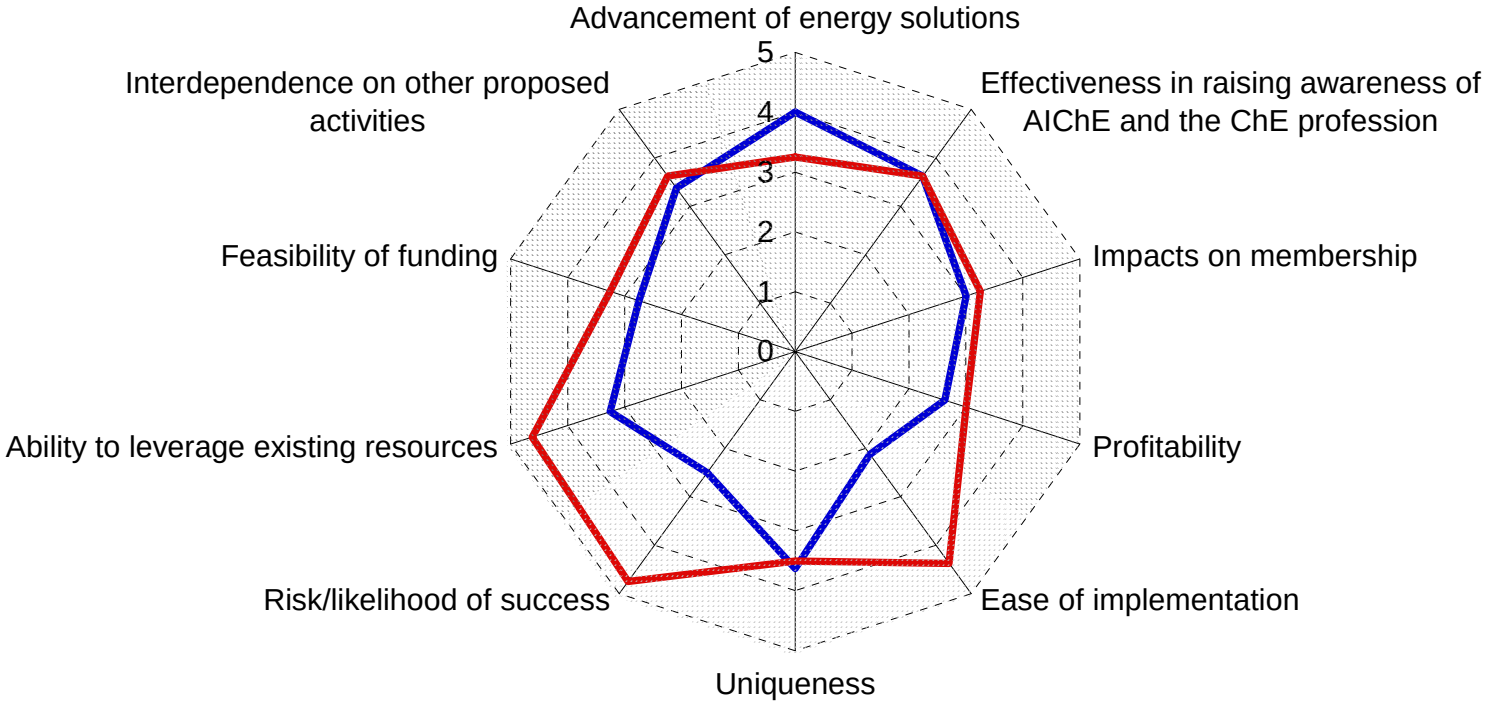
3-2 Public Speakers Team on Energy and Sustainability
3-3 CEP Critical Issues Forum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Feasibility of funding
Interdependence on other proposed activities
5
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3
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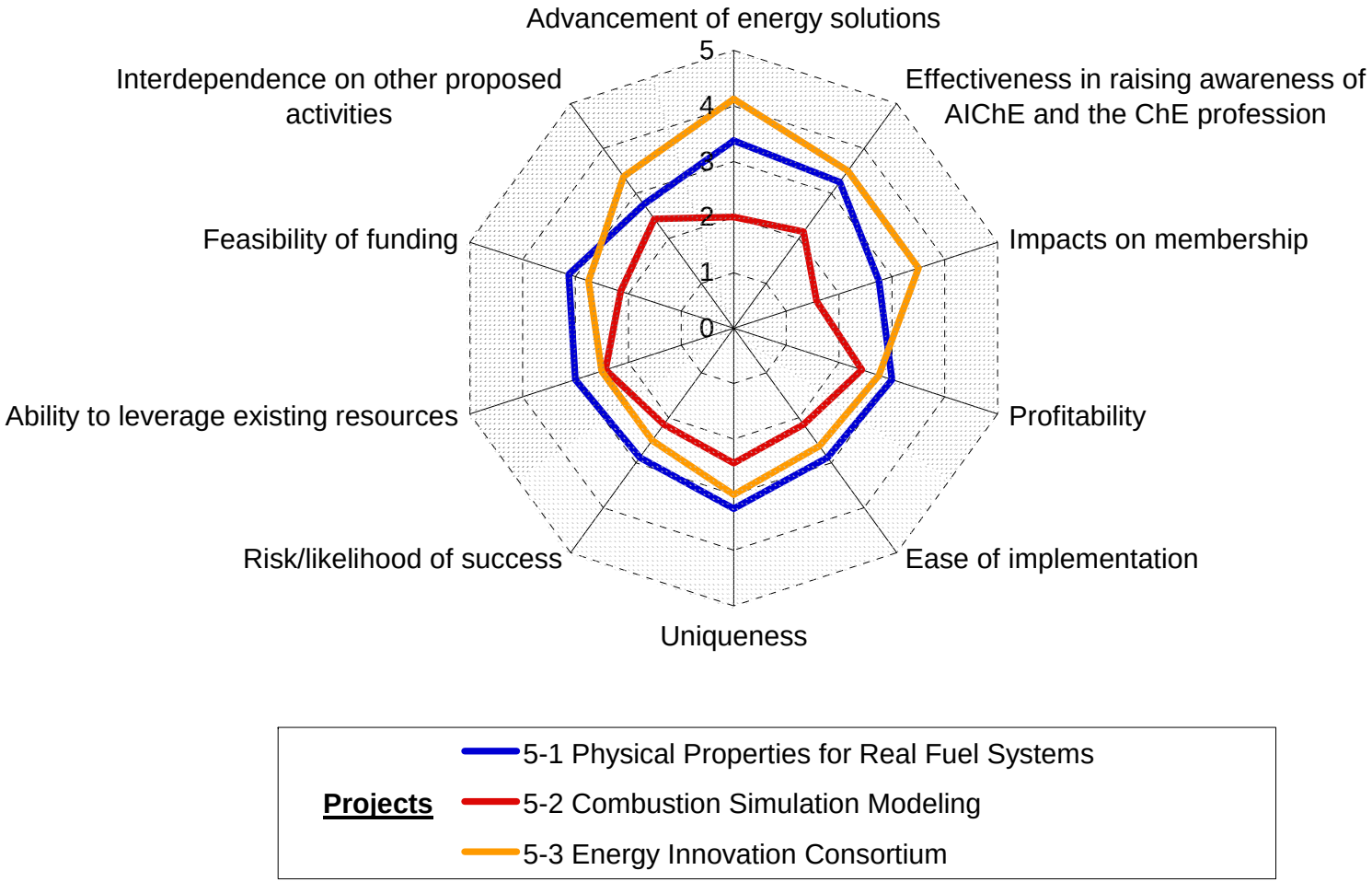
Projects
4-1 Energy System Metrics
4-2 Energy, Environment & Sustainability focus at an AIChEs Meeting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Profitability
Ease of implementation
Uniqueness
Risk/likelihood of success
Ability to leverage existing resources
Feasibility of funding
Interdependence on other proposed activities
5
4
3
2
1
0
Projects
5-1 Physical Properties for Real Fuel Systems
5-2 Combustion Simulation Modeling
5-3 Energy Innovation Consortium

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