



**Precourt Institute Energy
Advisory Council**

Stanford University

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The Precourt Institute for Energy and Affiliated Research Programs

Motivation and Background

Use of energy is deeply woven into the fabric of modern societies, with impact on human activities, climate, and oceans. Energy is essential in providing for human needs, including access to fresh water, food, shelter, health and safety. Our challenge is to provide affordable and efficient energy to meet the needs of people today while ensuring future generations enjoy the same benefits. Because energy underpins all economic activity, it also has significant implications for national security, international trade and relations, and employment. The need to transform the world's energy system into one that is equitable, efficient, secure and sustainable has become increasingly urgent.

World population has now reached 7 billion, and it is expected to peak above 9 billion in this century. Standards of living are increasing in the growing economies of the developing world, raising demand for energy, water, food, land, and materials. Protecting, restoring and sustaining global biogeochemical systems will be a significant new challenge that must be met even as we meet growing energy needs. An energy transition has begun, although world energy use and fossil fuel consumption continue to grow. Increases in greenhouse gas concentrations in the atmosphere, primarily energy related, are modifying climate and changing the acidity of the oceans, impacting the natural systems we rely upon for human needs.

So how do we change paths going forward? There is a quite substantial opportunity to improve the efficiency with which we use energy in many areas with technologies we have in hand today. Finding ways to help individuals, companies and governments at all levels recognize and act on those opportunities will benefit them all financially. This will reduce energy use and greenhouse gas emissions from what they would otherwise have been. We will also need to work to mitigate and adapt to built-in impacts. Setting a price on greenhouse gas emissions would help, while engaging in a vigorous research effort to lay the foundations for future energy technologies. We need to adopt a portfolio approach, working on the full spectrum of energy resources, energy conversions, and time scales for application and market penetration.

Finding solutions to these challenges requires a collaborative approach: engineering solutions are built on basic science, and business initiatives combined with policy advances encourage adoption. Stanford University, with its history of research and its entrepreneurial culture, is well positioned to foster collaborative efforts. Stanford has ongoing energy research from the basic science of materials, to the design and fabrication of devices that convert energy to human use, to the economics, finance and behavioral expertise to encourage energy efficiency and new forms of energy use and distribution.

Stanford is working to develop its comprehensive network of about 200 faculty members (see Appendix A) who deal with energy in their teaching and research. These faculty and

their students, who work individually and in teams and centers across campus, are the foundation of Stanford's interdisciplinary energy activities. Faculty also engage beyond Stanford with industry leaders to learn from each other about areas of commercial promise and what it will take to bring breakthroughs in the laboratory to market at scale. Researchers serve on scientific and policy advisory boards and testify before committees to encourage science-based decision making in the policy arena on current topics. An example is the current discussion of the challenges and opportunities that arise in the development of unconventional natural gas resources in the United States.

Through a coordinated effort Stanford also aims to increase energy literacy and inspire Stanford's students to become the energy researchers and other leaders who will bring about the energy transformations of tomorrow. The university hopes to develop linkages early on between students, faculty and staff interested in energy, so that students may make the most of their time at Stanford.

The primary components of the energy effort at Stanford include:

Precourt Institute for Energy

The formation of the Precourt Institute for Energy (PIE) was announced in January 2009, and the designation of PIE as an independent laboratory with the authority to make faculty appointments was approved by the Vice Provost and Dean of Research in the spring of 2009. Lynn Orr was named the founding director. Twenty PIE senior fellows were selected to determine the research and education efforts at the institute. Their role is to guide and participate in the activities of PIE, including voting on new faculty appointments. Please see Appendix A for a list of the faculty members who serve as senior fellows (marked *). The institute also has a larger group of 98 affiliated faculty members. They are also listed in Appendix A. Stanford has a wide-ranging group of over 206 faculty members (from 22 departments) who touch energy in their research and teaching, according to a recent count (which includes consulting faculty and active emeriti).

The Precourt Institute for Energy (PIE) senior fellows adopted the following mission statement in 2010:

The Precourt Institute for Energy at Stanford (PIE) serves as the hub of a broad and deep network of experts—from various science, technology, behavioral, and policy disciplines—who are working independently and collaboratively to solve the world's most pressing energy problems.

PIE's mission is to advance the goal of major and rapid energy transformations. PIE provides funding and associated support for cutting-edge energy research, creates and maintains avenues for effective communication and intellectual exchange among scholars and others seeking energy solutions, and develops energy-literate leaders and communities through educational programs and the dissemination of research results.

Specific goals for PIE include:

1. Bring together elements of our wide-ranging energy research effort to work on energy challenges that require an interdisciplinary approach
2. Make new faculty appointments that fill gaps in energy research and teaching at Stanford
3. Communicate effectively internally and externally the results of energy research at Stanford. Make results available to decision makers to inform the national research agenda, the research community, and the public
4. Strengthen the energy educational effort at Stanford
5. Build support for graduate students and postdocs working on energy
6. Work more effectively with companies to identify research opportunities, to provide support for innovative research, and to contribute ideas and results that can lead to commercialization

Energy Research Centers and Programs

The following energy centers, programs, and projects are significant strands in the fabric of interdisciplinary research at Stanford. (please see Table 1 for a reminder of definitions of the alphabet soup of acronyms that are often used by campus denizens to refer to these groups).

The Precourt Energy Efficiency Center (PEEC)

Under the leadership of Jim Sweeney and John Weyant, the Precourt Energy Efficiency Center, works to understand and overcome market, policy, technology, and behavioral barriers to economically efficient reductions of energy use, and to inform public and private policy making.

The Global Climate and Energy Project (GCEP)

The Global Climate and Energy Project, led by Sally Benson, supports research worldwide into technologies that will significantly reduce emissions of greenhouse gases while still meeting the world's energy needs. GCEP is a collaboration of premier research institutions.

The TomKat Center for Sustainable Energy (TomKat)

The TomKat Center for Sustainable Energy identifies and supports research on energy systems. The center's efforts focus on meeting challenges in the areas of electricity and transportation, including generation and conversion, transmission and distribution, energy storage, and land and water use. Stacey Bent is the director of the center.

The Stanford Environmental and Energy Policy Analysis Center (SEEPAC)

The Stanford Environmental and Energy Policy Analysis Center, a new research center founded by Larry Goulder and launched by PIE and the Stanford Institute for Economic Policy Research, analyzes and evaluates policies to address a range of issues, including climate change, air pollution, vulnerability to oil supply disruptions and energy conversions.

The Steyer-Taylor Center for Energy Policy and Finance (STCEPF)

The Steyer-Taylor Center for Energy Policy and Finance, under the direction of Dan Reicher and launched by Stanford Law School and the Graduate School of Business, advances the financing, management, and regulation of clean energy technology.

The Stanford Institute for Materials and Energy Science (SIMES)

Under the leadership of Z-X Shen, the Stanford Institute for Materials and Energy Science researches combinations of complex and novel materials for clean and economical energy. SIMES is jointly run by SLAC National Accelerator Laboratory and Stanford.

The Program on Energy and Sustainable Development (PESD)

The Program on Energy and Sustainable Development, led by Frank Wolak, studies the economic, political, legal and business aspects of pathways to achieve a more environmentally friendly energy future.

Bay Area Photovoltaics Consortium (BAPVC)

Jointly managed by Stanford and the UC-Berkeley with guidance from industry, the Bay Area Photovoltaics Consortium funds research to overcome technical barriers to, and reduce the cost of, solar installations. Yi Cui is the faculty leader at Stanford.

Shultz-Stephenson Task Force on Energy Policy (SSTFEP)

The Hoover Institution's Shultz-Stephenson Task Force on Energy Policy addresses energy policy on domestic and international political priorities, including the economy, the environment and national security. George Shultz and Thomas Stephenson lead the task force.

Energy Modeling Forum (EMF)

The Energy Modeling Forum improves understanding of energy/environment problems and solutions by examining the strengths and limitations of alternative analytical approaches. Hill Huntington and John Weyant lead the EMF.

Center for Advanced Molecular Photovoltaics (CAMP)

The Center for Advanced Molecular Photovoltaics at Stanford University, led by Mike McGehee, develops organic molecular solar cells aimed to produce electricity at costs comparable to fossil fuels through greater efficiency and lifespan.

Center on Nanostructuring for Efficient Energy Conversions (CNEEC)

The Center on Nanostructuring for Efficient Energy Conversion, a federal Energy Frontier Research Center jointly led by Fritz Prinz and Stacey Bent, seeks to increase the efficiency of advanced energy conversion and storage devices by manipulating materials at the nanometer scale.

Center for Sustainable Energy through Catalysis (SUNCAT)

The Center for Sustainable Energy through Catalysis, a partnership between SLAC National Accelerator Laboratory and the Department of Chemical Engineering led by Jens Norskov, explores atomic-scale design of catalysts critical to future energy technologies, like artificial photosynthesis, batteries, fuel cells and cleaner fuels.

Table 1 Acronyms

Acronym	Title	Director/ Leader
BAPVC	Bay Area Photovoltaic Consortium (Stanford & UC-Berkeley)	Yi Cui, Stanford Ali Javey, UC Berkeley
CAMP	Center for Advanced Molecular Photovoltaics	Michael McGehee
CNEEC	Center for Nanostructuring for Efficient Energy Conversion (DOE Energy Frontier Research Center)	Fritz Prinz Stacey Bent
EEAP	Energy and Environment Affiliates Program	Steve Eglash
EMF	Energy Modeling Forum	John Weyant
FSI	Freeman Spogli Institute for International Studies	Chip Blacker
GCEP	Global Climate and Energy Project (funded by industry)	Sally Benson
GSB	Graduate School of Business	Garth Saloner
Hoover	Hoover Institution	John Raisian
PEEC	Precourt Energy Efficiency Center	James Sweeney
PESD	Program on Energy and Sustainable Development (FSI)	Frank Wolak
PIE	Precourt Institute for Energy	Franklin (Lynn) Orr, Jr.
SEEPAC	Stanford Environmental and Energy Policy Analysis Center (PIE & SIEPR)	Lawrence Goulder
SIEPR	Stanford Institute for Economic Policy Research	John Shoven
SIMES	Stanford Institute for Materials and Energy Science (SLAC & Stanford)	Thomas Devereaux
SLAC	SLAC National Accelerator Laboratory	Persis Drell
SSTFEP	Shultz-Stephenson Task Force on Energy Policy (Hoover Institution)	George Shultz Thomas Stephenson
STCEPF	Steyer-Taylor Center for Energy Policy and Finance (Law and GSB)	Daniel Reicher
SUNCAT	Center for Sustainable Energy through Catalysis (SLAC & Chemical Engineering)	Jens Nørskov
TomKat	TomKat Center for Sustainable Energy	Stacey Bent

Goals and Current Status

Goal 1: Bring together the elements of our energy research effort for interdisciplinary research

The primary vehicles for communication and coordination across the many different centers and research groups are the PIE Executive Committee (members include Sally Benson, Stacey Bent, Tom Devereaux, Larry Goulder, Dan Reicher, Jim Sweeney, and Frank Wolak—see biographies in Appendix C), the PIE senior fellows, all of whom lead significant energy research efforts, and in a more informal way the larger group of affiliated faculty. While we have much still to do to improve links across the campus, we have made significant progress.

Seed Funding Competitions

An important tool in the campaign to create productive links is a set of competitions for research funding. For example, seed funding competitions have been conducted by PIE, the TomKat Center, Precourt Energy Efficiency Center, and Global Climate and Energy Project. Those competitions use a rapid review process, and they can allow researchers to do research that would be judged to be too risky for the standard Federal funding mechanisms. Given the strictures on Federal funding for energy that are very likely to be in place for the next few years, these seed funding projects will be particularly important in sustaining interest in the energy research enterprise. These competitions provide modest levels of funding for a relatively short period (1-2 years) to allow research groups to do a proof-of-concept experiment or analysis that will equip them to compete effectively for additional external funding (if the research is successful). Seed grants also serve to entice faculty not currently working on energy research to engage in energy-related research, and they will help sustain the flow of ideas that will be the basis for the future. This is an area where some additional fundraising would help us do this more effectively in tough budget times for federally-funded research.

In September PIE and TomKat Center awarded \$2.2 million for clean tech and solar research. Thirty proposals were received, and eight were funded. The TomKat Center employed a thematic research approach that brings together experts from various disciplines to work on different aspects of a major problem – in this case, greater deployment of large-scale solar power. Researchers received seed grants in four areas of expertise: energy storage; generation and conversion; transmission and distribution; and land and water impacts.

TomKat continued to make progress on its Smart Grid initiative, involving ten faculty and six graduate students, and increased collaboration with industry and utilities.

In September GCEP awarded \$3.5 million to researchers in five universities that could dramatically improve energy storage capacity on the electric grid. Additionally \$9.3M of new research awards in a number of energy areas were made to Stanford faculty. The awards bring the total number of GCEP-supported research programs to 86, with total funding of approximately \$104 million since the project's launch in 2002. GCEP held a second call for Carbon Capture. Sixteen proposals requesting a total of \$21.8M were received. Decisions have been made to fund three of these proposals for a total of \$4.7M, and the research awards will be made in March, 2012.

See Appendix B for a list of seed funding projects that are active at present. Appendix B also lists the currently active GCEP projects along with those supported with DOE funding in the Stanford Institute for Materials and Energy Science.

Goal 2: Make new faculty appointments

PIE is using faculty appointments to add to our strength in energy research. The first appointment of a faculty member, William Chueh, who will hold a joint appointment with the Department of Materials Science and Engineering and PIE, was made recently. He studies electrochemical reactions such as the high temperature processes for applications in energy conversions and storage, and is completing a postdoctoral fellowship at Sandia National Laboratory and will join us in June 2012. That appointment is supported by the Kimmelman Provostial Chair. A second broad search identified a candidate, Hemamala Karunadasa, who was offered a faculty position in the Chemistry Department with an option to make the appointment a joint one with PIE. Her work examines sustainable chemistry cycles, such as using efficient and inexpensive catalysts that can produce large quantities of hydrogen gas from water. In the end, it was decided that her position would reside 100% in Chemistry, and we will appoint her as a courtesy faculty member with PIE. That will allow us to make an additional appointment using funding from the Precourt Faculty Fund. We will restart that search soon. A search for a senior fellow who will work with the Stanford Environmental and Energy Policy Analysis Center has identified a candidate, and the assembly of the required appointment papers is underway.

Two newly funded provostial chairs will also provide significant opportunities to strengthen our faculty in energy. These chairs make use of matching funds from the provost to create endowments that support the faculty salary and provide funding for laboratory startup, similar to the Kimmelman Provostial professorship. The Jay Precourt Provostial Chair will fund a joint appointment between PIE and an appropriate department. We are ready to begin that search for a new senior hire. The second new provostial chair is the Kevin and Michelle Douglas Chair. This chair funds a position that will be a joint appointment in PIE, Woods, and a department. That search has just begun and the target is at the senior level. Senior searches are often done by word of mouth to identifying potential candidates, who then have to be approached after going through a vetting process to see if they want to be considered. We received about 90 nominations. Not all of those were senior investigators, so we have created a separate list of "junior

hotshots,” because it is always a good idea to keep an eye out for other opportunities. So this committee, in addition to looking for a senior person, will pass along information to the other searches that are also underway.

In November, PIE hosted a meeting of PIE senior fellows and affiliated faculty. Faculty were asked, “In what areas would new faculty appointments at Stanford strengthen the overall institutional energy effort the most?” The next step in that process is to use our senior fellows as the group that selects among the many good suggestions to help guide subsequent searches, a process that the Woods Institute has used to good effect over that last few years. The faculty search committees will use this input in the recruitment process for these searches.

Goal 3: Communicate effectively about Stanford energy research

Internal and External Communications, Newsletter and Websites

A significant goal of PIE is to make the Stanford energy research effort more visible, both internally and externally. Through the communications function, the research within the internal and external network can be coordinated and enhanced and further innovations can be stimulated. Our goal is to make sure that researchers remain well informed about each other’s research and findings, that opportunities to build on combined strengths continue to be identified and exploited, and that connections between Stanford and the outside world with respect to energy solutions are strengthened.

The communications and outreach team provides shared support for the component centers/programs and to the other energy research units. One obvious advantage of the coordination that PIE can provide is that we can share staff among the centers to provide outreach and administrative support that they could not afford individually.

We have hired two energy writers. Mark Shwartz brings 11 years of Stanford energy and environment writing experience, including 4 years at the Woods Institute, and has a background in broadcast journalism, which allows him to also develop video content for us. Mark Golden worked for ten years covering energy at Dow Jones and was a frequent contributor to *The Wall Street Journal* and CNBC. He is well versed in the art of explaining energy research in the context of the market. Mark Shwartz will focus on PIE and GCEP activities, and Mark Golden will work closely with PEEC and PIE. Both will also work with other energy research centers and investigators across the campus. The writers are currently creating a set of stories about research results that are written for nontechnical audiences. Our goal is to make information available to decision makers and the public in an accessible form, with links that can allow deeper access to details for those who want it.

In November, PIE launched a monthly Stanford Energy Newsletter, covering energy research and educational activities at Stanford. Advisory Council members and your administrators are all subscribed, so if you did not receive your copy (or don’t want us to

load up your email,) please let us know. Attached in Appendix D is a copy of the newsletter and related stories.

PIE also developed a brochure to provide an overview of the institute's capabilities and to showcase Stanford's energy centers, programs, and projects. A copy is provided in your meeting materials.

We have a linked set of websites that is under steady development, though we have much to do to bring it up to the level needed. It will provide layered entry into what we do. The top layer will provide an overview of energy at Stanford, there is a searchable directory of individual energy faculty, and there are links to the energy research centers and programs, where much more detailed information is available about research activities and results. We anticipate that a web programmer will be hired in 2012 (depending on the result of budget discussions). In the meantime, PIE will be an early adopter of the new Stanford Web Services approach to Stanford website development. The web services group was recently established by the Provost to increase efficiency and reduce costs at the University. Stanford web templates have been designed that are easy to tailor and allow non-technical staff to manage the content. Additionally, below-market pricing for customization services are available.

Dialogues, Workshops, and Conferences

The centers and programs also host a series of workshops and symposia each year that improve visibility of the Stanford effort.

The Global Climate and Energy Project (GCEP) held the annual GCEP research symposium October 4-5, 2011 at Stanford. The theme of this year's meeting was *Addressing the Changing Energy Landscape* and there were close to 700 registered participants from across the energy sector. Highlights of the meeting included presentations in plenary sessions by Dan Arvizu from NREL, David Victor from UC-San Diego, Rob Gardner from Exxon Mobil, Burt Richter from Stanford, and former Governor of Colorado, Bill Ritter; a lunchtime discussion panel with Secretary George Shultz, and Ambassador Tom Stephenson of the Shultz-Stephenson Energy Task Force at the Hoover Institution; technical presentations by GCEP PI's and students, a GCEP student poster session and competition, and tutorials on fundamentals in several general energy areas given by expert GCEP PI's.

GCEP held a technical workshop on the topic of Carbon Capture on May 26 – 27, 2011. There were 25 speakers and over 100 registered attendees. The meeting addressed underpinning processes and novel applications associated with capture of CO₂ and breakout sessions covered the topics of absorption and catalysis, adsorption processes, membranes, systems and optimization, and performance targets. GCEP then issued a worldwide targeted call for proposals in this area.

Additionally, GCEP is planning three Technical Workshops in February, March, and May 2012, on the topics of "Novel Opportunities in Electron-Chemical Energy Conversions,"

Energy Supply with Co-Benefits and Negative Emissions,” and “Future Vision Roundtable on Electric Grid.” Outcomes from the technical workshops help define future calls for proposals.

GCEP encourages interactions between the Sponsors and GCEP funded researchers. Three GCEP Distinguished Lecturers, professors James Swartz, Shanhui Fan, and Tom Jaramillo, traveled to GCEP Sponsors’ research and development organizations to give lectures. Additionally, GCEP Sponsors nominated representatives from ExxonMobil, GE, and Schlumberger, who spoke at Stanford at the weekly Energy Seminar.

The Precourt Energy Efficiency Center (PEEC) annually convenes two flagship conferences, and convenes others that vary from year to year. The Behavior, Energy, and Climate Change (BECC) conference is convened annually by three organizations: PEEC, the California Institute for Energy and the Environment (UC Berkeley), and the American Council for an Energy-Efficient Economy. BECC is designed to explore and harness insight from various social sciences to cause behavioral changes that would reduce the use of energy and reduce emissions of greenhouse gases. The conference is held in alternate years in Washington D.C. and Sacramento, and was held in Washington November 29-December 2, 2011. The Silicon Valley Energy Summit, held in spring, is aimed primarily at members of Silicon Valley industry, commercial organizations, and governments, although it also attracts academics from Stanford and other Universities. The Summit is designed to provide insights into upcoming changes in energy policy and regulations and to provide actionable concepts and examples for energy efficiency. Additionally PEEC is planning G’Day USA, focused on Energy Efficiency: A United States-Australian Dialogue, on January 11, 2012.

The TomKat Center is actively planning the second annual “Connecting the Dots” symposium, for spring 2012, following on from the 2011 symposium “The Food, Energy, Water, and Climate Nexus.” Stanford experts from a range of disciplines will focus on water and interconnections with food, energy, climate, security, and health. Drawing on their own research, the speakers will illustrate and evaluate some of the ways in which decisions in one resource area can lead to trade-offs or co-benefits in others. Symposium attendees will participate in breakout sessions, led by Stanford graduate students, on a range of challenges associated with sustainable water systems and management.

The Program on Energy and Sustainable development, PESD’s, annual conference in September—co-sponsored by the Precourt Institute for Energy and the TomKat Center for Sustainable Energy—focused on how transmission policy can either block or facilitate the grid integration of renewable energy. The meeting convened an impressive mix of academic experts, industry players, and government policymakers from across the West. Participants discussed in depth the many obstacles to a more rational and effective grid, including the fact that transmission planning currently follows rather than leads generation planning. It is clear that such institutional hindrances must be overcome if we are to meet our aggressive renewable energy (and greenhouse gas reduction) goals. The cross-pollination of ideas and the connections that were made at the meeting will

hopefully help propel the Western grid forward into a future that is more friendly to innovation and renewable energy.

Starting in August, PESD researchers began administering web workshops on energy conservation to customers of two major California utilities. These workshops showed in a graphical way how electricity bills increase non-linearly with consumption, surveyed consumers on their household energy use, and then offered customized recommendations for energy savings based on the survey responses. By comparing subsequent electricity bills of consumers who participated in such workshops with a control group, we have a rare opportunity to assess whether such educational interventions can drive significant reductions in energy consumption. Other utilities have since approached us about evaluating similar programs in their service areas.

Stanford's Water in the West program, Precourt Institute for Energy, and Woods Institute for the Environment, and in conjunction with the Bechtel Foundation, are launching a Stanford Energy-Water Investigation. The intent is to develop a research agenda that will inform science-based decision making that will lead to co-benefits and a reduction of unintended consequences across both sectors. Water and energy are linked, especially in the arid West. For example, hydropower provides California with between 15 and 30 percent of its electricity, depending on the amount of runoff at any given time, and water consumes almost one-fifth of the state's total electricity supply. Across the U.S. 39% of fresh water withdrawals are used to cool fossil-fuel power. To develop a research agenda and encourage communication and sharing of knowledge, the group will convene in spring and fall 2012 a research workshop and two "Uncommon Dialogues" with various stakeholders, researchers, and practitioners. Participants will look at the overall goals and issues in managing the water and energy connections. The underlying assumption is that the management of water and energy are sufficiently similar that each sector can learn from better understanding lessons from the other sector. Issues to explore include: data about the energy-water nexus, joint management of resources, water technologies and practices with reduced energy use, energy technologies and practices with reduced water use, future energy and water supplies and prices for the provision of joint resources, conflict minimization for water needed for other human and ecological purposes, and implications of future energy and water supplies and prices. In addition to identifying a research agenda, a website will be created with white papers, and links to relevant sites and materials.

The Stanford-MIT Conference on Energy Game Changers was convened by the Hoover Institution's Shultz-Stephenson Task Force on Energy Policy in conjunction with MIT's Energy Initiative on June 24-25, 2011. The purpose of the conference was to identify game-changing technologies that will strengthen America's national security while contributing to the nation's economic growth and responding to environmental concerns. Topics addressed included: solar energy, energy storage, synthetic biology and biofuels, the smart grid, and combustion. In addition to members of Hoover's Task Force on Energy Policy and MIT's Energy Initiative, the conference brought together other leading engineers, economists, policy analysts, and business leaders. During the course of the two-day conference, participants explored some of the emerging energy technologies

likely to shape America's energy future and made recommendations for how the United States might meet the energy challenges it faces. This was the first of three planned game-changers conferences. The second will be held at MIT in 2012 and the third in Washington, DC, in early 2013.

The Vail Valley Foundation, in conjunction with PIE and PEEC will host the inaugural Vail Global Energy Forum, March 3 and 4, 2012, at the Vilar Performing Arts Center in the Beaver Creek Resort near Vail, Colorado. The Forum will explore how best to provide the energy the world needs to support a productive global economy while also limiting adverse effects on the environment. Participants and speakers will include distinguished government officials, corporate executives, research scientists, entrepreneurs, venture capitalists, investors and world-renowned journalists.

Miki Yu will join PIE in January as an Event and Program Planner. Miki has been on the Stanford Leading Matters team since its inception as the Event Manager, and as the Leading Matters program draws to a close we are delighted to have such an experienced addition to the PIE programs and outreach team.

Goal 4: Strengthen the energy educational effort at Stanford

Energy@Stanford&SLAC Conference for Incoming Stanford Graduate Students

For a full week before Stanford orientation programs in late September 2011, over 120 graduate and professional school students from all seven schools attended the first cross-university "[Energy@Stanford&SLAC](#)" conference for incoming students interested in energy. The goals of the 5-day program were to introduce students early in their Stanford career to a comprehensive overview of energy research and faculty at Stanford and SLAC, and to create a cohort of students across Stanford to create a basis for future interaction during their time as graduate students.

Students heard from 30 faculty about the full spectrum of the Stanford energy universe – everything from cutting-edge solar cell technology to climate modeling to the psychology of energy efficiency and much more. During the evenings, students talked over dinners at the GSB, Huang Engineering Center, SLAC, Jasper Ridge, and Lynn Orr's home. Students participated in a group project called the Stabilization Wedges Game, based upon Stephen Pacala and Robert Socolow's climate stabilization research. Visits to Silicon Valley companies, tours of Cardinal CoGen and labs were included.

Nineteen departments were represented, 80 students from the School of Engineering and 20 students from the Graduate School of Business (GSB,) two-thirds PhD candidates and one-third masters students. Some current students who requested to attend were allowed to participate this first year, and they comprised one-third of the group. In the survey of participants, 100% said Stanford should continue this program.

The Energy@Stanford & SLAC conference was co-sponsored by PIE, SIMES, GCEP, SLAC National Accelerator Laboratory, NREL, and the Office of the Vice Provost of Graduate Education (VPGE) through the Stanford Graduate Summer Institute program.

Campus-Wide Weekly Energy Seminar

Under Sally Benson's leadership, PIE manages a weekly energy seminar that fosters the campus-wide energy conversation. One hundred and seventy talks have been held since the program's inception attended by 200 people each week, a mix of students (who can enroll in the seminar for one unit of credit), faculty, research staff, and members of the community. In addition to talks by Stanford and visiting faculty, recent guest speakers have included: Zhengrong Shi, Chief Executive of China's largest solar company, Suntech, who spoke about "The Suntech Story," and Jane Long, Lawrence Livermore National Laboratory, who discussed the report on "California's Energy Future Study."

The Energy Seminar explores several themes by including four-part mini-series throughout the year. In 2011-12 Stanford energy center and program directors organized three mini-series within the program: "Solar Energy" was designed by CAMP Director Mike McGehee; "Going Underground" was designed by the STCEPF Executive Director Dan Reicher and explores geothermal, carbon capture and sequestration, natural gas exploration, nuclear waste storage, and cross-cutting themes such as water safety and seismicity; and "Saving the World and Having a Job" was designed by PESD Director Frank Wolak to highlight Stanford graduates who have pursued careers in the energy sector. The Energy Seminar, now in its sixth year, has been a joint effort between PIE and Woods Institute for the Environment, and is now administered by PIE. To leverage the series, background reading suggestions and seminar materials are available on the [Energy Seminar website](http://energyseminar.stanford.edu) (energyseminar.stanford.edu). Chevron funds the Energy Seminar, and MAP funds MAP Energy Socials following select talks.

GCEP Student Lecture Series

In June 2011 GCEP launched a weekly GCEP Student Lecture Series program during summer term where GCEP graduate students and postdocs presented their research to about 50 fellow students. Student speakers received feedback from the Stanford Center for Teaching and Learning, and the best lectures were given at the annual GCEP symposium.

Stanford Energy Club

Founded in January 2011, the Stanford Energy Club is a student organization that is working to create links among student groups interested in various aspects of energy. The Energy Club has done a real service for the campus energy community by compiling a website and email distribution service of energy activities, announcements, and job postings. In addition the club organizes student events such as an annual energy showcase and expo, and an Energy 360 panel and speaker series. PIE is working with the founders of the Stanford Energy Club to institutionalize their innovative student-driven website and services.

Goal 5: Build support for graduate students and postdocs working on energy

A generous commitment by Phil and Jennifer Satre has been made to support four Stanford Interdisciplinary Graduate Fellowships (SIGFs). The gifts that provide the endowment for these fellowships are being pledged over time, and the first of these fellowships funded by that gift was awarded in 2011. This is an area where we have an excellent beginning, but there is much more to be done. Our goal is to raise a total of twenty such fellowships. This is also an area of joint effort by the Woods Institute and PIE in the evaluation of applications and the selection of recipients of fellowships related to the environment and energy.

We also will work to endow named postdoctoral fellowships, for which a well-publicized international competition will be used to attract top young Ph.D.s to come for a period of postdoctoral research at Stanford. That effort will be coordinated with the deans of the seven schools as part of a continuing discussion of the “post-campaign” needs for the interdisciplinary institutes on campus.

Goal 6: Work more effectively with companies

Interactions with companies and other organizations are an important part of Stanford’s energy research program. Companies help to identify real-world problems and thereby inform Stanford’s research agenda. Companies license Stanford technologies and then commercialize those technologies. Stakeholders, decision makers, and influencers can participate in discussions, contribute diverse perspectives, and influence public policy. Companies hire Stanford’s students, and of course, companies provide valuable financial support for Stanford research.

Energy and Environmental Affiliates Program

The Energy and Environment Affiliates Program continues to grow in membership and to have an increasingly beneficial impact on the Precourt Institute and the broader energy and environment community at Stanford. As of November 2011 the Affiliates Program has five paying members and two more verbally committed. Advanced discussions are underway with many more. The five current members are Chevron, Cisco, BP, BASF, and Tokyo Gas, with E.ON and Black & Veatch verbally committed. The Affiliates Program is currently generating \$1,050,000 per year of income, most of which goes into faculty unrestricted accounts to support PhD student research.

Even more important, the Affiliates Program facilitates a dialog between companies and other organizations, and faculty and grad students. In the last year, the Affiliates Program hosted two major conferences and a very large number of smaller meetings and workshops. These interactions build mutual awareness, create job opportunities for

graduating students, and lead to sponsored research and gifts. The Fall Conference of the Affiliates Program included a focus on advanced materials for energy and environment. The Affiliates Program is launching a new initiative on sensors and sensing in harsh environments. The Executive Director is Steve Eglash. The Affiliates Program is described in detail at <http://eeap.stanford.edu>.

Finances and Administration

The activities of PIE, the component centers, and the associated programs are supported by a complex mix of expendable gifts, endowment income, Federal grants and contracts, nonfederal grants and contracts, and industry support through the affiliates program. Table 2 lists the approximate level of annual expenditures for a number of the larger centers/programs. These numbers are estimates for the last year or in some cases for the next year. They are intended to convey the magnitude of the various efforts, not a detailed accounting. Figures 3 and 4 report the overall distributions of income and expenditures for the four centers for which PIE has financial responsibility. These numbers look back over the last 12 months (through August, 2011).

Negotiations were completed to add a new Sponsor from industry to GCEP. An announcement will be made shortly once all the documentation has been signed.

PIE has a small central staff listed in Table 3. We use a combination of support from the various centers and programs to support staff who provide shared administrative services. We have been quite careful in this period of restricted university budgets to make sure that we can support the combined administrative needs of PIE, PEEC, TKC, GCEP, and SEEPAC at levels that can be sustained over time as the mix of expendable gifts and endowment income changes. In particular, the amount of expendable gifts will decline as gift commitments are fulfilled, and the contribution from endowments will increase as planned contributions to endowment begin to produce income that can support the institute's operations.

Table 2 Approximate Annual Energy Research Expenditures

Center/Program	Director	Approximate Annual Exp. (Million \$)	Primary Source of Funds
PIE Central	Lynn Orr	2.6	Exp Gifts, Endowment
PEEC	James Sweeney	2.0	Expendable Gifts
TKC	Stacey Bent	2.1	Endowment
STCEPF	Daniel Reicher	1.0	Endowment, Exp Gifts
SEEPAC	Lawrence Goulder	0.5	Endowment
GCEP	Sally Benson	15.0	Industry Contract
SIMES	Tom Devereaux	12.0	DOE
PESD	Frank Wolak	2.0	Industry
SSTFEP	George Shultz, Tom Stephenson	0.3	Expendable Gifts
CAMP	Michael McGehee	5.0	KAUST
CNEEC	Fritz Prinz, Stacey Bent	4.0	DOE
EMF	John Weyant	1.0	Contracts/Grants/Gifts
BAPVC	Yi Cui	7.0*	DOE
EEAP	Steve Eglash	1.1	Industry
Total		55.6	

* June 2011 through May 2012

Figure 2 Consolidated income for PIE (PEEC, GCEP, TKC, SEEPAC).

Total Income for this period, September 2010 – August 2011, was \$28.6 million.

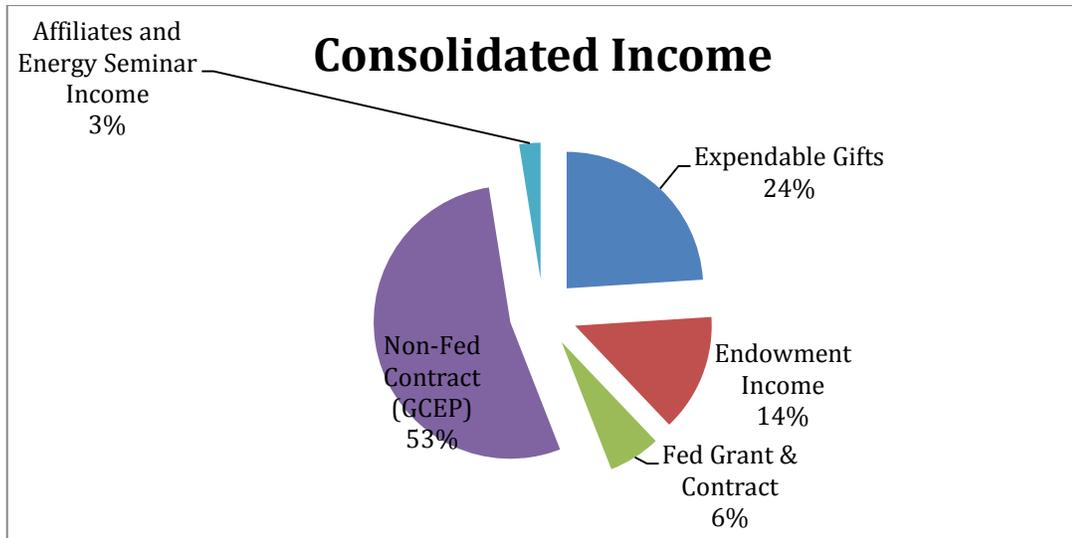


Figure 3 Consolidated expenditures for PIE (PEEC, GCEP, TKC, SEEPAC)

Total expenditure for this period, September 2010 – August 2011, was \$21.7 million (the difference between income and expenditure was the result of timing of expenditures and contributions to endowments.)

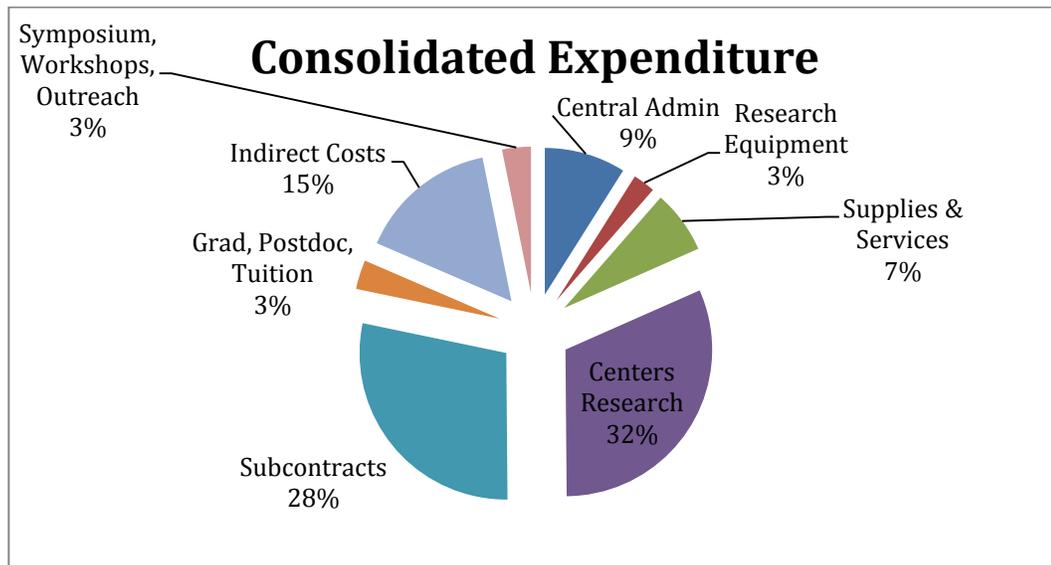


Table 3 PIE and Center Staff

Name	Title	Center/Program Support
Lynn Orr	PIE Director	PIE
Teresa Tang	Assoc. Director Finance & Administration	PIE, GCEP
Leigh Johnson	Program and Outreach Manager	PIE, GCEP, PEEC, TomKat
Steve Eglash	EEAP Executive Director	EEAP
TBA	Administrator	PIE, TomKat, EEAP
Mark Shwartz	Energy Communication Writer	PIE/GCEP
Mark Golden	Energy Communication Writer	PIE/PEEC
Miki Yu	Event and Program Planner	PIE
TBA	Web Developer	PIE
TBA	Development Officer	PIE
Clare Swan	Webmaster	GCEP, PIE, PEEC
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Sally Benson	GCEP Director	GCEP
Richard Sassoon	GCEP Managing Director	GCEP
Nancy Sandoval	Executive Assistant	GCEP, PIE
Girley Tegama	Data and Administration Support	GCEP
Maxine Lym	Communications Manager	GCEP, PEEC
Ingrid Yin	Financial Analyst	GCEP, PEEC
Emily Hung	Energy Analyst	GCEP
Jennifer Milne	Energy Analyst	GCEP
Charles Barnhart	Postdoctoral Fellow	GCEP
Mik Dale	Postdoctoral Fellow	GCEP
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Stacey Bent	TKC Director	TomKat
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Jim Sweeney	PEEC Director	PEEC
John Weyant	PEEC Deputy Director.	PEEC
Catherine Vogel	Center Manager	PEEC