Welcome to Stanford Energy 3.0

Sally Benson
Director, Precourt Institute for Energy;
Director, Global Climate and Energy Project;
Professor, Energy Resources Engineering

We are very pleased to announce Stanford Energy 3.0 as your connection to innovative research in energy, materials, chemistry, and sustainability at Stanford University. In the coming years we can expect to make big improvements in batteries for automobiles and the electrical grid, much more efficient engines, more affordable solar photovoltaics, better fuel cells, and technologies that capture CO2 from coal and gas-fired power plants. The scale of the opportunity to contribute is enormous, and industry know-how is essential to bring new energy technologies to market. This, indeed, is the opportunity and challenge of the century. We hope you will join us to create solutions for an affordable, secure, and environmentally sustainable energy future.
Leadership

Jim Chen
Managing Director, Stanford 3.0

Paul McIntyre
Professor and Department Chair, Materials Science and Engineering

Fritz Prinz
Professor, Materials Science and Engineering and Mechanical Engineering
Director, Nanoscale Prototyping Laboratory
Co-Director, Center on Nanostructuring for Efficient Energy Conversion
**Mission**

The Stanford Energy 3.0 program promotes excellence in energy research, education, and policy. With an emphasis on private sector partnerships, Stanford Energy 3.0 fosters cutting-edge energy research and provides support for academic education. The research areas are broadly defined and can be customized by choosing focus areas.

**Goals**

- Share knowledge and resources to create solutions to advance energy technology
- Engage industry in flexible ways
- Create opportunities for industry to work with students and faculty at Stanford
- Accelerate the pace of innovation and scale-up of advanced energy technologies
Building Relationships

Innovation flourishes when companies and universities collaborate. Stanford Energy 3.0 is Stanford’s industry liaison for research and relationships in energy technologies and efficiency, materials, chemistry, and sustainability. We work with you to build a relationship customized to your company’s needs. Your company gains extraordinary access to people and research across the entire Stanford campus, and Stanford faculty and students benefit from your valuable perspective on real-world opportunities. We look forward to working with you to create the future.

Stanford Energy 3.0 at Stanford, hosted by the Precourt Institute for Energy, will engage faculty across the university to carry out the many types of research needed to support, improve, and extend the university’s ongoing efforts related to new energy technologies.
Energy Research Overview
A Major Stanford Theme
Energy research is a major theme at Stanford and is found in nearly every academic discipline. Stanford emphasizes an interdisciplinary approach, recognizing that energy is interwoven within the fabric of nearly all Stanford academics.

Finding Research Germaine to Your Interests
It can be difficult for outsiders to quickly grasp the scope of energy research activities or to understand where specific research is being conducted in a particular area of commercial interest.

Where the Affiliate Program Can Help
Among the benefits that Stanford Energy 3.0 will deliver to our members is assistance in understanding what specific research is taking place at Stanford, who is conducting it, and how to engage more directly with those activities.

Research Areas Include
- Batteries
- Data Analytics
- Energy Efficiency
- Fuel Cells
- Hydrogen Materials
- Renewable Energy
- Sensors
- Smart Grid
- Solar

Focused Groups
Focused groups are groups of faculty with expertise in a specific energy area. Focused groups provide members with the opportunity to engage with a team of researchers in a focus area. Current focus areas include energy storage, smart grid, and solar photovoltaic. Additional focus areas are being considered.
The Batteries Focused Group highlights research on batteries and similar forms of energy storage such as supercapacitors. The group is comprised of Professors Zhenan Bao, Will Chueh, Yi Cui, Hongjie Dai, and Fritz Prinz and their students and post docs. Current research topics include:

- Improved lithium ion batteries
- New batteries for grid-scale storage
- Metal-oxide capacitors
- Devices using organic materials, carbon nanotubes, and graphene

Corporate membership in the Batteries Focused Group provides extraordinary access to faculty, grad students, and cutting edge research in energy storage. Annual review meetings will present the latest Stanford research and provide ample opportunities to discuss research plans. Stanford 3.0 Membership includes membership in the Fellow-Mentor-Advisor Program or a focused group such as the Batteries Focused Group, Smart Grid Focused Group, or Solar Focused Group. Companies will have opportunities for informal interactions with professors, grad students, and other companies. Hosted visits to Stanford and facilitated visits to corporations will be arranged as requested.

All companies interested in energy storage are invited to join, including battery manufacturers, consumer electronics manufacturers, electric vehicle and automobile companies, electric vehicle supply equipment manufacturers, electric utilities, grid storage companies, materials companies, and chemical companies.
Zhenan Bao  
Professor, Chemical Engineering  

William Chueh  
Assistant Professor, Materials Science and Engineering  
RESEARCH FOCUS  Fundamental and applied electrochemistry: solar fuels, fuel cells, and batteries. Apply knowledge to enhance the efficiency of energy conversion and storage technologies.  

Yi Cui  
Associate Professor, Materials Science and Engineering  
RESEARCH FOCUS  Fabrication of nanoscale materials and study of their electronic, photonic, electrochemical and catalytic properties. Applications include lithium ion batteries, supercapacitors, CIGS solar cells, transparent electrodes and fuel cell electrodes.  

Hongjie Dai  
Professor, Chemistry  
RESEARCH FOCUS  New ways to synthesize graphene and carbon nanotube architectures for potential future device applications, such as fuel cells, catalysis, and lithium-air and nickel-metal batteries. New materials of various nanocrystals and nanoparticles.  

Fritz Prinz  
Professor, Mechanical Engineering  
RESEARCH FOCUS  Quantum confined solar cells, including quantum dots, thin barrier layers, and transparent electrodes. Solid oxide fuel cells. Photosynthetic membranes and their catalytic behavior.
To help realize the promise of a smarter, sustainable and reliable electric grid for the future, the Smart Grid Focused Group brings together a number of interdisciplinary Stanford researchers working on issues such as analyzing large-scale individual smart meter data to enhance our knowledge on consumption behavior, developing scalable data analytics for demand-side energy management strategies, modeling and simulation of the electric grid, integration and coordination of distributed energy resources, and grid stability with renewable energy. Smart grids provide more accurate and timely information to companies for making informed energy management decisions, and include technologies such as sensing, forecasting, and data analytics.

Corporate membership in the Smart Grid Focused Group provides extraordinary access to faculty, grad students, and cutting-edge research in smart grid. Annual review meetings will present the latest Stanford research and provide ample opportunities to discuss research plans. Companies will have opportunities for informal interactions with professors, grad students, and other companies. Stanford Energy 3.0 includes membership in the Fellow-Mentor-Advisor Program or a focused group such as the Batteries Focused Group, Smart Grid Focused Group, or Solar Focused Group.
Abbas El Gamal  
*Professor, Chair, Electrical Engineering*

**CATEGORIES**  Simulation, sensors, and modeling  
**RESEARCH FOCUS**  Development of cloud-based simulation package to model demand response and electric system reliability and efficiency, statistical tools, signal processing, and system-on-chip design techniques to problems in imaging and configurable circuits, theoretical problems arising in communications and networks.

Andrea Goldsmith  
*Professor, Electrical Engineering*

**CATEGORIES**  Communications and networks  
**RESEARCH FOCUS**  Design, analysis, and performance limits of wireless systems and networks, novel techniques, protocols, design and capacity analysis, multiple-antenna wireless networks, cognitive radios, sensor and networks, cross-layer wireless network design, and applications of communications and signal processing.

Ramesh Johari  
*Associate Professor, Management Science and Engineering*

**CATEGORIES**  Systems and networks  
**RESEARCH FOCUS**  Design and management of large-scale complex networks, such as the internet, using tools from operations research, engineering, and economics, models to analyze efficient market mechanisms for resource allocation in networks, and network densification.

Arun Majumdar  
*Professor, Mechanical Engineering*

**CATEGORIES**  Thermoelectric energy conversion  
**RESEARCH FOCUS**  Thermoelectric energy conversion using solid-state material and devices, heat and mass transfer in nanostructured materials, waste heat recovery, phonon dynamics and transport in low-dimensional materials, transport and reactions in confined liquids (nanofluidics), chemomechanics of small and macromolecules with applications in chem/biosensing, and nanoscale imaging.

Ram Rajagopal  
*Assistant Professor, Civil and Environmental Engineering*

**CATEGORIES**  Simulation and modeling  
**RESEARCH FOCUS**  Use of demand-side data analytics to integrate and distribute renewable energy systems, hardware and software for sensing and control, customer segmentation using load profiles, demand response targeting and management with smart meter data, design and control of local grids.

Juan Rivas-Davila  
*Assistant Professor, Electrical Engineering*

**CATEGORIES**  Power supplies and energy savings  
**RESEARCH FOCUS**  New generation of power electronics based on high switching frequencies, energy savings, reduced electrical noise, RF power amplifiers, resonant converters, soft switching topologies and design of power converters for operation in harsh environments.
The Solar Focused Group includes Stanford researchers who work in the areas of photovoltaics, solar thermal, solar fuels synthesis, grid integration and solar policy. The technology includes materials, such as absorber layers, contacts and transparent conductors, substrate, encapsulators, catalysts, characterization, and cell and module architecture. Applications include:

- Solar PV - thin films
- Thermionic emission devices
- Organic photovoltaic cells
- Solar fuel production
- Membranes for fuel cells
- Electrochemical energy storage materials
- Hybrid perovskite cells
- Nanowire solar cells

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Bruce Clemens
Professor, Materials Science and Engineering
CATEGORIES   CIGS/CZTS, hydrogen storage
RESEARCH FOCUS   Development of inexpensive, abundant, and non-toxic thin films such as CZTS, investigating materials for metalization, magnetic recording, electronic device, and hydrogen storage applications.

James Harris
Professor, Electrical Engineering
CATEGORIES   III-V materials, nanowire photonic devices, solar cells, thin films
RESEARCH FOCUS   Nanofabrication and device implementation of semiconductor materials with applications in optoelectronics, heterojunctions, superlattices, quantum wells, and three-dimensional self-assembled quantum dots.

Michael McGehee
Professor, Materials Science and Engineering
CATEGORIES   Organic perovskite, dye-sensitized, polymer solar cells, transparent electrodes
RESEARCH FOCUS   Improving stability of solar cells including organic electronics, hybrid perovskite cells, and polymer solar cells, patterning materials at the nanometer length scale and developing materials for renewable energy and sustainability application.
Activities & Events

Stanford Energy 3.0 hosts major conferences, focused group meetings, new faculty seminars, plus other custom meetings.

Members are invited to affiliates program annual conferences and other events. These events include technical discussions, tutorials, workshops, and student presentations, which provide a unique opportunity for industry partners to learn about leading edge research at Stanford.

**Annual conferences** provide exposure to a broad range of current research topics, including sensors, materials, smart grid, batteries and energy efficiency.

**Focused affiliate** groups provide comprehensive coverage of Stanford research in areas such as energy conversion and distribution and associated technologies.

The **New Faculty Seminar Series** provides access and visibility to new faculty and networking opportunities with other affiliates program members.

**Custom meetings** with professors enable in-depth investigations of specific topics. These meetings are arranged at the request of member companies.

**Visiting Scholars** provide an opportunity for member companies to send a researcher to Stanford to study and engage in research under the direction of a Stanford faculty member. The program is intended to build relationships for collaboration through an exchange of ideas. Appointments are usually made for up to one year, although shorter appointments are possible.
Stanford Energy 3.0 is about establishing a relationship and the exchange of ideas. Companies benefit from access to emerging technology, out-of-the-box thinking, and innovative problem solving. Stanford benefits from exposure to practical real-world problems, constraints, and opportunities.

Members are entitled to the full range of programs, including invitations to all Stanford Energy 3.0 symposia, support for Ph.D. and postdoctoral research, the opportunity to send a visiting scholar, focused research groups, and facilitated access to research programs, faculty, and graduate students. Affiliate members with diverse special interests are also provided with customized plans for engaging the Stanford community.

Organization
Stanford Energy 3.0 will be managed by Jim Chen, Managing Director, and Faculty Directors Paul McIntyre and Fritz Prinz. Industry members will be part of the Advisory Board that meets on a yearly basis to provide input to Stanford Energy 3.0 leadership.

Objectives
- Bring together a broad range of energy interests
- Create a center for research projects, academic programs, seminars, and conferences
- Contribute to future economic development in energy industries
- Use of projects as leverage for additional grant applications
- Provide deep connections to Stanford faculty and students
- Create forum for exchange of ideas with industry peers
- Timely access to unpublished research
- Focus research attention on topics of interest to partners

Membership
Members will enjoy a range of benefits

Affiliate: $250,000
- Invitations to events, workshops, symposia, and conferences
- Participate in annual affiliates meeting
- Opportunity for student recruitment
- Research-in-progress visits to company sites
- Visiting scholar program
- Facilitated access to faculty
- Three allocations, assignable to a combination of Fellow-Mentor-Advisor projects, Focus Area subscriptions, and to support a visiting scholar at Stanford
- Early access to research results
- Feedback on research direction

Please visit our website: http://se3.stanford.edu, and contact us for more information: Jim Chen, jimchen@stanford.edu