In the past decade, WSU has become one of the nation’s top chemical engineering programs in catalysis with high-impact research in transformational energy technologies.

Critical in the Petroleum Industry
Catalysts, which facilitate and direct molecular transformations in a chemical reaction, are critically important to more than 35 percent of the global Gross Domestic Product (GDP) and are a vital key to our economic, environmental, and public health. Ninety percent of the world’s chemical processes use catalysts to manufacture 60 percent of chemical products. They are particularly important in the petroleum industry, responsible for 75 percent of the value of its derived products, and as seen in the recent problems encountered by Volkswagen, critically important for environmental health. Catalytic systems enable modern transportation systems, safe foods, a clean environment, and life-saving vaccines and pharmaceuticals. Moreover, faculty who conduct catalysis research also teach courses that are core to the chemical engineering curriculum, including thermodynamics, reaction engineering, process control, numerical methods, and transport phenomena.

WSU Becomes a National Leader
WSU Voiland School researchers have a long history in conducting applied research that impacts the economy. Industry-related research has been a significant portion of the school’s work since its earliest days. In the past decade, the school looked at the way to strategically grow its program, considering factors such as the industries in which our graduates have traditionally had impact, challenges facing our nation that chemical engineers and bioengineers are uniquely equipped to address, and foundational strengths of the program.

With significant support from individuals like O. H. Reaugh, who provided the gift in 1992 that enabled the O. H. Reaugh Laboratory for Oil and Gas Processing, to the transformative gifts from Gene (’69 ChE) and Linda Voiland, which enabled us to hire some of the world’s top catalysis faculty, WSU has positioned itself as a national leader in developing, testing, and using catalysts to advance society. Voiland School researchers are developing new catalysts for alternative fuels, clean conversion of liquid fuels to electricity, and reduced vehicle pollution. They are also enabling the manufacture of new consumer products that would result in a cleaner environment, better fertilizers, and new drugs that will save lives worldwide.

Voiland School: Growing Programs and New Partnerships
The Voiland School has grown significantly. Since 2009, undergraduate chemical engineering student enrollment has tripled from 99 to 298 students. This growth is attributed, at least in part, to the enhanced reputation of our catalysis research program. The catalysis research program also benefits from extensive collaboration with the U.S. Department of Energy’s Pacific Northwest National Laboratory (PNNL), where Voiland Distinguished professors Yong Wang and Norbert Kruse hold joint appointments. Voiland School faculty members are mentoring more than 60 doctoral students, training the next generation of researchers to tackle critical energy challenges. In the past year, the school has developed education partnerships with the University of Alaska and with China’s Chambroad Holding Co., Ltd. to train students in chemical engineering.

“Our faculty are working synergistically to design, develop, test, and implement catalytic systems, and our chemical engineering program can be counted among the nation’s best.”
—Jim Petersen, director of the Voiland School
Grant To Fight Devastating Citrus Disease

Haluk Beyenal is a part of a WSU research team to receive a $2.1 million USDA grant to help save the United States and global citrus industry. The researchers are developing methods of growing a citrus-destroying bacteria so that strategies to fight the disease it causes can be pursued. Citrus greening disease is destroying citrus trees around the world, but scientists haven’t been able to grow and maintain culture of the bacterium that causes the disease. Beyenal is an expert in biofilm culturing.

Antibiotic Alternative To Treat Infections

Washington State University researchers for the first time have discovered how electrical stimulation works for the treatment of bacterial infections, paving the way for a viable alternative to medicinal antibiotics. The researchers passed an electric current over a film of bacteria and, in 24 hours, killed almost all of a multidrug resistant bacterium that is often present in difficult-to-treat infections. The research appeared in *Nature Scientific Reports*, an open-access online journal from the publishers of *Nature*.

Improving Catalyst Efficiency For Clean Industries

Researchers developed a way to use less platinum in chemical reactions commonly used in the clean energy, green chemicals, and automotive industries, according to a paper published in *Science*. Led by the University of New Mexico in collaboration with Washington State University, the research team developed a unique approach for trapping platinum atoms that improves the efficiency and stability of reactions. 

“This work provides the guiding principles so that industry can design catalysts to better utilize precious metals and keep them much more stable,” said Voiland Distinguished Professor Yong Wang.

New Catalyst Paves Way For Bio-Based Plastics, Chemicals

WSU researchers developed a catalyst that easily converts bio-based ethanol to a widely used industrial chemical, paving the way for more environmentally friendly, bio-based plastics and products. The catalyst works on bio-based ethanol to create isobutene, a widely used chemical used in everything from plastic soda bottles to rubber tires.

In collaboration with the Archer Daniels Midland (ADM) Company, Voiland Distinguished Professor Yong Wang and his colleagues developed a catalyst to convert bio-based ethanol, which is made from corn or other biomass, to isobutene in one easy production step. The researchers examined the costs and lifetime of their catalyst to determine its practicality for the marketplace and determined that it could be used for other closely related feedstocks.

Breakthrough Catalysis Research

Researchers Shed Light on Important Catalyst Structure

Volkswagen’s disgrace last year for altering software to pass emissions tests highlighted a problem for the auto industry: People want vehicles that are both nonpolluting and fuel efficient, but they are difficult to produce with current technologies. Washington State University and Tufts University researchers developed a model of an important catalyst that is key to solving that challenge. Their work, featured on the cover of *Journal of Physical Chemistry*, could lead to cleaner, fuel efficient vehicles, as well as advances in industrial processes for common products.

The WSU and Tufts team developed a model of a common copper catalyst and, in particular, a thin layer on the surface of the copper that contains oxygen.

Grant To Improve Biofuel Production

Jean-Sabin McEwen, assistant professor in the Voiland School, has received a three-year $450,000 federal grant to develop computer models for using iron to more efficiently refine bio-oils and make better biofuels. McEwen will collaborate on the U.S. Department of Energy Office of Basic Energy Sciences grant with colleagues at Pacific Northwest National Laboratory and the Université Libre de Bruxelles. McEwen and his colleagues will develop and test computer models to accurately predict catalysts’ behavior under real-life conditions.
The Voiland School has recognized several faculty members and alumni for their significant contributions to the field of chemical engineering and related disciplines. Here are some notable achievements:

- **Yong Wang**, National Academy of Inventors. Election is accorded to academics who have demonstrated innovation in creating or facilitating inventions that have made a tangible impact on quality of life, economic development, and the welfare of society. Wang is an internationally known researcher in catalysis and reaction engineering for energy and renewable fuels and chemicals.

- **Bernard Van Wie**, inaugural recipient of WSU’s Innovation in Teaching Award. The award recognizes full-time WSU faculty members who have developed truly innovative teaching tools and formats that enhance the depth and quality of the student learning experience. Van Wie is known internationally for his desktop learning modules, a learning system that he developed and tested to provide hands-on experiences of in-class materials.

- **David Ensor**, (BS, Chem E, ’63 WSU) Alumni Association’s Outstanding Alumni Achievement Award, for his internationally recognized contributions to aerosol science that have helped protect workers and the public from potential air pollution hazards. His career accomplishments have included: methods to characterize emissions from coal-fired power plants; technology to control ultrafine airborne contaminants of semiconductor chips; participation in government-private sector-academic efforts to detect and limit environmental threats; and innovative approaches to characterizing nanomaterials.

- **Norbert Kruse**, Inaugural Fellow, International Field Emission Society (IFES), for his work in the development of catalytic processes for providing sustainable chemical feedstock under environmentally benign conditions using nanotechnology.

- **Greg Collinge**, National Science Foundation Graduate Research Fellowship. Collinge, a graduate student working with professor Jean-Sabin McEwen, was one of 2,000 students nationwide, in all disciplines from anthropology to zoology, to receive the award. He is conducting research in computational catalytic chemistry.

- **Alyssa Hensley** was one of twenty recipients of a travel award from the American Institute of Chemical Engineers’ (AIChE) Catalysis and Reaction Engineering Division. Hensley, who received her doctorate in December, was able to present her research at the AIChE conference. Hensley’s research focuses on performing computational modeling of hydrodeoxygenation.

- **Erhan Keles**, a doctoral student in chemical engineering and bioengineering, received a WSU international student scholarship. Keles is working to create a biosensor for detection of cardiac troponin levels in human blood, an early indicator of heart attacks.

- **Brennan Pecha**, Frontier Lab’s Young Scientist Award, for significant contributions to analytical and applied pyrolysis. Pecha, a graduate student in the Voiland School, received the award at the International Symposium on Analytical and Applied Pyrolysis in Nancy, France.

**New WSU, Alaska Chemical Engineering Degree**

Washington State University is joining with University of Alaska Anchorage and University of Alaska Fairbanks to offer a WSU chemical engineering degree for Alaska students. The program will allow students to fulfill the first two years of core requirements at the Alaska universities and the final two years at WSU’s Voiland School of Chemical Engineering and Bioengineering. Graduates will receive a bachelor’s degree in chemical engineering from WSU’s ABET-accredited program.

Industry partners have demonstrated strong support for a chemical engineering program in Alaska, in part to reduce the need to recruit outside the state. Hiring graduates with ties to Alaska helps reduce expensive turnover.

In the past decade, the Voiland School has more than doubled enrollment. The school is known for leading research in catalysts, which are chemicals that speed up chemical reactions and are used in critically important industries such as energy production and conversion.

With strong alumni support, the school has grown its emphasis in process safety and upstream processing, which will uniquely equip students for jobs in Alaska. The new program will also build collaboration between WSU and Alaska companies for support of capstone design projects, scholarships, and industry-sponsored research.
For two bioengineering students who did not think much of entrepreneurship a year ago, Emily Willard and Katherine Brandenstein have been making quite a splash in Washington’s biotech startup space.

Their company—Engage—started as a senior design class assignment in the Gene and Linda Voiland School of Chemical Engineering and Bioengineering. It has evolved into a full-time job that they are pursuing after graduation.

“We are both more researchers at heart, and had never thought about selling a technology or starting a business,” Willard said. “But if we were going to do it, we wanted our product to mean something.”

**SafeShot: Cost Effective, Easy-To-Use**
And indeed it does. Their product, SafeShot, is a cost-effective, easy-to-use medicine vial cap that sterilizes needles so they can be reused without contamination. One of the leading causes of death in developing countries is disease spread by contaminated needles. As bioengineers, conducting the science behind the product felt natural, but creating a business plan and pitch were entirely different hurdles. Through participation in the unique bioengineering capstone design course, which is taught in collaboration with the Frank Institute for Engineering Entrepreneurship, in the past year Brandenstein and Willard learned everything they could about business. They took first place and cash prizes at University of Washington’s Health Innovation Challenge, as well as at WSU’s business plan competition. They also placed in UW’s business plan competition.

“Emily and Katherine are amazing at taking initiative,” said Marie Mayes, coprofessor of the class that launched Engage. “They are really great at finding out what they don’t know, and then researching it like they would to solve an engineering problem.”

The class that launched Engage combines bioengineering and entrepreneurship, and is a requirement for bioengineers who will be entering a professional world mostly comprised of small companies and startup environments. The class is a mix of bioengineering students, fellows from the Harold Frank Engineering Entrepreneurship Institute, Boeing Scholars, and students from any discipline who are interested in the class.

**Radically Interdisciplinary**
“The class is radically interdisciplinary,” said Howard Davis, a bioengineering professor who coleads the class, and is the director of the Frank Institute. “It is more than mechanical engineers working with electrical engineers—it is engineers of different flavors working with communication, business, and science students.”

Willard and Brandenstein also used facilities in the Frank Innovation Zone, a recent addition to the Voiland College which offers students across disciplines a collaborative space and tools to translate their ideas into designs, build class projects, or support club activities.

Brandenstein and Willard are looking forward to starting lab work again to continue testing their product. Thanks to a strong network of collaborators, two passionate bioengineers are taking on a challenge they couldn’t have imagined and making an impact along the way.

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**Engineering Entrepreneurship Institute, Boeing Scholars, and students from any discipline who are interested in the class.**

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Through the Harold Frank Engineering Entrepreneurship program and the bioengineering capstone design class, the Voiland School provides a unique opportunity for students to gain hands-on skills and entrepreneurial experience that can launch careers.
Washington State University has entered into an agreement with Shandong Chambroad Holding Co. Ltd., a private Chinese corporation, to educate WSU doctoral students to meet significant societal needs in energy and environment. The corporation will provide up to $5 million to support five new students each year, up to a total of 20 students simultaneously, in chemical engineering, chemistry, or materials science and engineering. The privately run company started in 1991 and employs about 11,000 people in Boxing, China. Chambroad is engaged in petrochemicals, fine chemicals, culture and arts, education, agriculture, and strategic investment. The Chambroad Distinguished Fellowship will provide graduate student and research support in the area of catalysis, a critical component of the manufacturing sector, especially in the production of high energy fuels and household chemicals. The fellowship program will allow students to work collaboratively with WSU researchers. Research areas will be focused on energy conversion, carbon capture technology and utilization, and petrochemical conversion with the goal of creating economical, dependable, and environmentally sustainable systems.

Yunsheng Ma, chairman of Shandong Chambroad Holding Co. Ltd., left, and WSU’s Chris Keane and Asif Chaudhry sign the agreement in China.