Two commodities that are extremely important to the state of Wyoming are energy and water—the former is abundant and the latter is scarce. Our average annual precipitation for the state is around 13 inches, less than the standard prediction for evaporation. Therefore, if we use any of our water and it does not return via the natural cycle, we are moving toward a deficit in the long term. On the energy side, the state is the largest producer of coal in the United States, producing 370 metric tons resulting in 35 percent of the electricity generated in the United States. The state ranks third in natural gas production and sixth in oil, making us number one in net fossil energy production. On top of this, the state holds significant reserves of uranium, a ubiquitous and steady wind, and over 300 days of sunshine.

Water and energy, as we utilize them, are intimately coupled. For example, the fate of water produced during coal bed methane production is one of the state's greatest technical challenges. In addition, conventional power production from coal or nuclear sources requires significant amounts of water for cooling purposes.

The College of Engineering has been working to build strength in both education and research related to water and energy for several years. Regarding water, the focus of our effort is in civil and architectural engineering, where we have teaching and research efforts related to both water quantity and water quality. Research efforts are focused on anaerobic water treatment processes that are energy efficient, producing methane or hydrogen, membrane technology for water purification processes, conveyance losses and water conservation, stream and river hydraulics and channel restoration, modeling of hydraulic systems and erosion, effects of climate on surface water resources, contaminated soil remediation, and enhanced coal bed methane production and water management. In addition, faculty in atmospheric science are actively engaged in fundamental research related to the origin of precipitation, cloud and aerosol physics, and chemistry.

Research and education related to energy occurs in the Departments of Chemical and Petroleum Engineering, Mechanical Engineering, Civil and Architectural Engineering, Electrical and Computer Engineering, and Atmospheric Science. The reintroduction of the B.S. program in petroleum engineering is one of the significant changes related to energy. We will expect to graduate the first group of petroleum engineers in the spring of 2008 and ultimately enroll at least 100 undergraduates, producing 20 or more B.S. degrees per year. These graduates coupled with those in chemical, architectural, mechanical, civil, and electrical will result in a steady supply of B.S.-educated engineers who can and will work in various aspects of the energy field. As indicated above, the Department of Civil and Architectural Engineering is engaged in research on water utilization and treatment related to energy production. In addition, work on building energy consumption is ongoing in the department.
We have a very strong research group in the Department of Chemical and Petroleum Engineering working on multiphase and multicomponent fluid flow problems related to improved understanding of flow during production in oil and gas reservoirs. Much of this work is related to enhanced oil recovery. In addition, we have a significant effort in carbon dioxide capture and sequestration and ongoing work related to coal utilization.

In the Department of Electrical and Computer Engineering, the focus is on the power grid and efficient use of electrical power. A group that involves faculty from mechanical engineering, electrical and computer engineering, and atmospheric science have been involved in research related to wind energy. This includes control, aerodynamics, materials, and power conversion.

For FY2006, the college’s research awards exceeded $10 million for the first time. The college’s goal in the 2004–2009 Academic Plan was $9.5 million. A significant portion of these research dollars are a result of the above-mentioned research activities related to energy and water. Sponsors include the Department of Energy, state of Wyoming, and Wyoming Water Development Commission. These research programs contribute significantly to the education of our undergraduates by assuring that faculty remain at the forefront of knowledge in their respective fields, providing research experience for undergraduates that helps them to develop the tools necessary to become lifelong learners, and providing support for the education of our graduate students. They also clearly contribute to the solution of some of the most challenging problems that face our state and nation.

The 2006 legislature established funding for a School of Energy Resources at the University of Wyoming. This will help us strengthen our research, education, and service programs. The funding for the School of Energy Resources includes faculty positions, visiting professors, an outreach component, start-up support for new faculty, and support for special programs for undergraduates and K–12 related to energy. The College of Engineering’s first priority for funding from the school is a senior faculty position in chemical and petroleum engineering to recruit a nationally known educator who works in the area of transportation fuels from coal.

As you read this fourth Biennial Report for the college, you will learn more about research and education in the energy and water areas as well as many other areas critical to the state and the nation.

### Carbon Dioxide Research Critical to Energy Future

The development of economically viable processes for the capture of carbon dioxide from flue gas streams is the objective of research being conducted by Mac Radosz and Youqing Shen in chemical and petroleum engineering. Their work focuses on polyionics, polymerized ionic liquids that are strong absorbers for carbon dioxide and can be used to construct membranes or as sorbents to capture carbon dioxide in gas streams from power plants, coal gasification facilities, and other processes that produce large amounts of carbon dioxide.

This work is coupled with research on sequestration of carbon dioxide in oil and gas reservoirs by the Department of Chemical and Petroleum Engineering’s reservoir engineering group that includes Norman Morrow, Brian Towler, Tara LaForce, Mohammad Piri, and Vladimir Alvarado.

Both projects are funded by the state of Wyoming through the University of Wyoming Enhanced Oil Recovery Institute.
Undergraduate education is the primary focus of the College of Engineering. The college prides itself on its high-quality academic programs, talented faculty, and competitive research programs. Faculty are in the classroom at all levels of the curriculum. The college attracts high-quality students, and its graduates are in demand in the Mountain West region and beyond. Many opportunities exist outside the classroom for students to participate in extracurricular and cocurricular activities. Students from the college are active in student chapters of professional societies, student government, varsity and club sports, social and service groups, and many other organizations to help them balance their technical development with their growth as responsible, contributing members of society.

Enrollment
The Department of Computer Science joined the College of Engineering in 2001. Since then, enrollment in the college has remained relatively stable. In fall 2005, enrollment in the college included 1,128 undergraduates and 177 graduate students. In the past two years, civil engineering has seen the largest increase in enrollments. Computer science and management information systems have experienced the largest decreases, consistent with nationwide trends. With the booming energy sector and the reintroduction of the B.S. in petroleum engineering, enrollments are expected to grow over the next few years. The new Hathaway Scholarship Program established this year by the Wyoming Legislature has fostered a spike in applications and admissions to the college; resulting increases in enrollments are expected due to this new program for residents of Wyoming.

Program Quality
The Fundamentals of Engineering (FE) exam, taken by all engineering students in their senior year, is an objective measure of program quality. This exam is one of the requirements for engineers to become registered professionals. UW
Business for Engineers

The College of Engineering has developed a certificate program in Business for Engineers. This program is in response to a national need for engineers with broad exposure to basic business fundamentals as well as a strong interest by students. Students who complete the program will receive a certificate documenting their successful effort as well as an appropriate transcript notation.

The program consists of two courses: Engineering Economics and Professional Ethics, which is taught each semester as a regular part of the curricula in Civil and Architectural Engineering, and Business Basics for Engineers, which is taught in seminar-mode as 10 six-hour blocks offered in the evenings and on weekends. The 10 blocks included are:

- Business for Engineers: An Overview
- The Organization and Management
- Making Decisions
- Uses of Accounting Information
- Financial and Risk Management
- Project Management
- Human Resources Management
- Principles of Marketing
- Customer Support: The Sales Process
- Entrepreneurship/Business Planning/Intellectual Property

Students are admitted to the certificate program based on their academic credentials and their professional interests in business.

Practicing professionals are welcome to take the courses through the UW Outreach School. Initial delivery of the courses will be by distance education with lectures presented at the UW campus in Laramie and delivered to the UWCC campus in Casper.

Opportunities for Enrichment

The College of Engineering supports more than 20 different professional, student government, and special-interest society chapters and clubs. Each department contains at least one student chapter of a professional society. In addition, college-wide organizations and clubs include the Minority Engineering Program, the Society of Women Engineers, the Tau Beta Pi honor society, the International Engineering Club (including UW’s chapter of Engineers Without Borders), and several student government groups. Participation in these organizations helps students develop skills in leadership, teamwork, and service. Students also develop contacts with local and national professionals that can lead to career opportunities.

The UW chapter of Tau Beta Pi has twice in the last four years been recognized with the R. C. Matthews Outstanding Chapter Award, the highest award presented by the society. The award recognized the chapter for its exemplary service to students in the college and the local community through blood drives, a free campuswide tutoring service, and a variety of youth activities.

In early 2006, the International Engineering Club formed a UW chapter of Engineers Without Borders (EWB). EWB is a service organization that partners with developing communities worldwide to implement sustainable solutions to quality-of-life problems. Typical projects include development of water supply systems, water and wastewater treatment, pedestrian bridges, and power systems. EWB provides the vehicle for students from the college, as well as those from across the UW campus, to develop technical and professional skills as they increase their awareness of their social and public service responsibilities.

Students maintain a pass rate of about 80 percent on the exam, comparable to our comparator institutions and well ahead of the national average. On-campus recruiting by regional, national, and international companies gives our graduates excellent job opportunities.

Hexapod research by Professor John McInroy and student.
Atmospheric Science (ATSC) is a graduate degree-granting program (18 master’s and three doctorates in the past five years).

The curriculum was broadened to include more emphasis on global change and earth-atmosphere interactions. The goals are:

- Incorporate “real-life” problem solving into the curriculum.
- Maintain a core curriculum that accommodates the pedagogical needs of all graduate student categories (including federal civil service meteorological positions).
- Renew focus on atmospheric phenomena of horizontal scale smaller than a few hundred kilometers (i.e., the mesoscale).
- Recognize the curriculum is dynamic and that several factors will drive changes to course content, including student feedback, the discipline of atmospheric science and changing makeup of the faculty.

ATSC’s research strengths are in aerosol science, cloud physics, boundary layer phenomena, and instrumentation. Department investigators receive approximately $4.1 million in external funding annually, making it one of the leaders in research on the UW campus.

The department’s observational facilities are: 1) the King Air 200T (UWKA) aircraft; 2) the Wyoming Balloon Launch Facility; 3) the Elk Mountain Observatory at 11,000 feet altitude; 4) the Wyoming Cloud Radar (WCR) for the study of cloud structure and composition; and 5) the Keck Aerosol Laboratory. The UWKA and the WCR are designated Lower Atmospheric Observing Facilities by the National Science Foundation (NSF).

Active research areas include:

**Cloud physics and dynamics**

In a series of NASA-, NSF-, and DOD-funded projects, the structure and evolution of several cloud types continue to be investigated using the millimeter wavelength Wyoming Cloud Radar (WCR), installed on the King Air research aircraft. By combining radar observations in both vertical and horizontal planes with complementary microphysical and air motion measurements along the flight track, internal cloud structures and velocities are derived with unprecedented detail. The capability for high-quality observational data integration has made this airborne platform a prime choice for cloud research, both nationwide and internationally.

The past WCR data analysis has been very productive. The dual-beam radar observations within growing cumuli over the high plains reveal fine cloud-scale circulations of cumulus clouds were previously unattainable. In winter 2004–05, the WCR and King Air collected a rich data set to study rain formation mechanisms and processes that control the growth and maintenance of cumuli and cumulus clusters over the tropical Atlantic during the international project, Rain in Cumulus over the Ocean (RICO). To further advance our understanding of marine stratocumulus drizzle formation and its impact on global climate, the Dynamics and Microphysics of Marine Stratus Project (DMIMS 2006) is conducted near the California coast. Another ongoing project is a study of how cumuli interact with the environment, and diagnose the initiation of precipitation, mostly through the intermedicy of ice crystals, with the WCR. The field observation was conducted in summer 2006 over the Catalina Mountains of Arizona. As supported by NASA, the WCR and the King Air are the main platform for NASA CloudSat validation. In June 2006, the WCR provided the first CloudSat validation measurements near Mt. Lassen, California. The CloudSat validation campaign continued in June 2006 over the East Pacific near California for marine boundary-layer cloud validation and fall 2006 near Laramie for other types of cloud validation.

To upgrade our airborne remote-sensing capabilities for cloud observations, a compact polarization lidar is under development that will work together with...
the WCR from the King Air. The combination of a lidar and the WCR will make the King Air a more attractive platform for cloud physics and dynamics observations in the near future.

**Tropospheric aerosol and clouds**

There are several NSF-funded studies relevant to climate prediction. One which focuses on comparisons of predicted and measured growth of aerosol particles to cloud drops in both maritime and continental environments is providing new insights into the factors influencing particle activation and the interrelationship of aerosol and cloud properties. Another is investigating the dependence of aerosol radiative properties on aerosol chemical composition with measurements in Laramie and at the Elk Mountain Observatory.

**Stratospheric aerosol and ozone**

The last stratospherically important volcanic eruption occurred more than a decade ago. Thus, stratospheric aerosol loading has fallen to historic minima. Balloon-borne measurements from Laramie document this background stratospheric aerosol and provide tests for models of the processes that maintain that aerosol. Ozone measurements above Antarctica continue as the maximum in halogen abundance in the stratospheric passes. In addition to laying the groundwork for future detection of ozone recovery, these measurements, 1989-2003, are being compared with 3D-chemical transport models to further our understanding of ozone loss chemistry. The most recent 2005 measurements included coordination with the French Space Agency (CNES), which released long-duration balloons to test polar vortex dynamics. These research efforts are supported primarily with funding from NSF.

**Boundary layer**

NSF funding has supported measurements with the high-precision GPS system of the King Air, to characterize pressure gradients that generate the low-level jet in the marine boundary layer off the coast of northern California. Recently funded NSF analyses of aircraft and tower data from project FLOSS focus on fluxes in the heterogeneous environment of the night-to-day transition over complex terrain with varying snow cover. NSF funding has also supported work on convergence zones that are displayed as radar fine lines and their role in convective initiation. Other studies employ the WCR to examine the vertical echo and kinematic structure of the optically-clear convective boundary layer. Other NSF-funded projects include studies of the Antarctic surface winds.

National Renewable Energy Laboratory (NREL) studies are characterizing turbulence during situations adverse to wind turbine operations, and models to predict such adverse turbulent conditions are being developed. Modeling studies of the influence of topographic features on surface winds in Wyoming have allowed resource maps of seasonally varying wind power to be produced to help with wind turbine siting.
In fall 2005, the University of Wyoming Trustees voted to reinstate the Petroleum Engineering Program for the fall of 2006. After preparing the new curriculum, hiring new faculty, funding and developing labs, Petroleum Engineering (PETE) will, once again, be an undergraduate major leading to a B.S. in Petroleum Engineering. We welcome Vladimir Alvarado, Tara LaForce, Patrick Johnson, and Mohammad Piri as new faculty.

An exciting event in support of the new petroleum and chemical engineering program is a major gift to the University of Wyoming by EnCana Corporation of $2 million, matched by the state to become $4 million, which will be used to construct and outfit state-of-the-art laboratories. Other energy corporations are interested in supporting chemical and petroleum education as well, and we are working with them to further our research and share information.

Our students continue to excel, including Kim Nicholas, who accomplished an engineering “grand slam” because she was named outstanding freshman, sophomore, and junior, and as a senior was named the Wyoming Engineering Society (WES) Outstanding Student Engineer. Also, Zachary Tyrell was the department’s outstanding graduate, nominee to WES, Joint Engineering Council (JEC) Outstanding Senior, and an honor book recipient; Tyrell gave the student response during spring commencement.

In the spring of 2005, at the AIChE Regional Conference in Golden, Colorado, our ChemE Car came in first place and was ninth in nationals. This spring, it was our AIChE Student Chapter’s turn to host the regional conference, and UW placed second to qualify for the National ChemE Car competition to be held in San Francisco in November 2006. Both cars were powered by hydrogen peroxide with a manganese dioxide catalyst.

Our faculty continue to be successful in their research as well as in their teaching, including acquiring a total of $1.6 million in new research funding for the department this year.

- Assistant Professor Morris Argyle was awarded the 2005 Tau Beta Pi College of Engineering Outstanding Undergraduate Teaching Award, and for three years running, students voted to award him the David O. Cooney Outstanding Chemical Engineering Teacher Award. Argyle, together with Tom Barton of WRI, received a grant to develop a compact reactor for hydrogen production.
- Research in the area of molecular and macromolecular thermodynamics (Assistant Professor Hertanto Adidharma) for CO2 sequestration, enhanced oil recovery, and enhanced coal bed methane recovery.
- New oil well core cleaning technique (David Bell).
Randy Eresman, President & Chief Executive Officer, EnCana Corporation

Randy Eresman (B.S. petroleum engineering, 1984) is proof that a UW education coupled with energy and drive to exceed can get you “to the top.” After two years at Northern Alberta Institute of Technology in Edmonton, Alberta, he continued his education at UW in petroleum engineering. “The University of Wyoming and the town of Laramie were a perfect fit for me, a small-town boy, to get a great education in a learning-friendly environment. I will always remember the approachability of the professors and the camaraderie of my classmates,” says Eresman about his UW experience. Now as the president and CEO of EnCana Corporation, one of the largest independent energy companies in North America, he continues to value education as is shown by EnCana’s generous support to various universities and colleges, including a $2 million gift to UW’s Petroleum Engineering Program in 2006.

Eresman is the key architect of EnCana’s resource play strategy, which focuses on the extraction of technically challenging oil and natural gas deposits in onshore North America. He was instrumental in achieving the company’s strong long-term growth profile and the company’s move to be one of the most significant independent oil companies operating in the U.S. Rockies, including the very prolific Jonah field in Southwest Wyoming.

Eresman’s career spans 25 years with progressively increasing responsibilities with EnCana and prior to that Alberta Energy Company (AEC), which he joined in 1980 and returned to after graduation from the University of Wyoming. At AEC, he played progressively increasing roles in oil and natural gas exploration, development, production and acquisitions. He was appointed vice president of AEC Oil and Gas, a division of AEC, in 1996.

When EnCana was created in 2002, Eresman was named executive vice president responsible for the company’s Onshore North America division, and in December 2002, about eight months after EnCana’s formation, he was named EnCana’s chief operating officer. He became president and chief executive officer of EnCana Corporation on January 1, 2006.

Eresman is a professional engineer and an active member of the Young President’s Organization. He was born and raised in the Medicine Hat area of southeastern Alberta. He and his wife, Shelly Eresman, live in Calgary, Alberta, where they have raised two children, both currently enrolled in Canadian universities.

- Conversion of coal to synthetic petroleum (David Bell).
- Research on carbon dioxide separation, transportation, and sequestration (Professor H. Gordon Harris).
- Professor Norman Morrow appointed Wold Chair of Energy in 2005 and received Presidential Faculty Achievement Award in 2006. He continues to be internationally recognized for his research on oil recovery.
- Soft Material Laboratory founded for research in bionanomaterials, living polymerization, carbon recovery, polyionics, and molecular energy systems (Professor Maciej Radosz, Youqing Shen, and Hertanto Adidharma), published more than 60 papers in the past two years.
- 1st Place Conference Paper Award at the ASEE (Gulf and SW Region) and ASEE (national) sponsored delivery of workshops for engineering educators on “computer-based active teaching-learning” (Professor M. P. Sharma).
- UW Graduate School Best M.S. Thesis Award (S. K. Annapragada working with M. P. Sharma) for the “study of production of micronized powders using decompressive atomization technology.”
- International recognition for work in developing new delivery systems for cancer treatment using nanotechnology and chemical engineering principles (Assistant Professor Youqing Shen).
- Professor Youqing Shen receives Samuel B. Hakes Outstanding Graduate Research and Teaching Award at the 2006 Annual Tau Beta Pi Honors Banquet.
- UTEK Corporation and Avalon Oil and Gas licensed Professor Brian F. Towler’s technology to mitigate wax deposition using ultrasonic waves. Also, SPE has declared his reservoir engineering textbook a bestseller. Prof. Towler recently traveled to Australia to be honored by the Queensland SPE for his work in setting up the SPE in Brisbane 23 years ago.

Graduate student Sanil John and Assistant Professor Morris Argyle examine a reactor designed for evaluating catalysts that produce hydrogen from water and carbon monoxide.
The Department of Civil and Architectural Engineering (CAE) continues to offer outstanding programs in both of these dynamic disciplines. Our Architectural Engineering program is one of 14 ABET-accredited programs in the United States. We offer curricular tracks in structural and mechanical engineering (HVAC) that provide an excellent education related to building systems. Our civil engineering program offers breadth at the undergraduate level to address such areas of civil engineering, including water resources, geotechnical, transportation, structures, and environmental engineering. Our graduate program offers opportunities in all areas of civil engineering supported by well-equipped laboratories ranging from a large structural engineering laboratory to a large hydraulic flume. Much of our research is conducted in the field, e.g., embankment slopes, bridges, and environmental remediation sites.

In support of the strong CAE program at UW, we have recently hired six new faculty. • Glenn Tootle, Ph.D., P.E. Tootle joins UW after completion of his graduate work at UNLV. Formerly a consultant for 13 years, he is also a commander in the Navy Seabees. His expertise is in water resources, specifically hydrology.
• Dave Bagley, Ph.D., P.E. Bagley joined UW after 10 years at the University of Toronto, where he gained an international reputation for sustainable water treatment processes, including solutions for treatment of water from coal bed methane developments.
• Sue Niezgoda, Ph.D. Niezgoda conducted her graduate studies at Pennsylvania State University in the area of streambed restoration. Her primary expertise lies in hydraulics and river mechanics, including scour and restoration.
• Anthony Denzer, Ph.D. Denzer comes to UW from UCLA. His creative endeavors include architecture history and design.
• Keith Hedges, AIA, NCARB Hedges recently taught at the University of Nebraska and continues his Ph.D. work there. He teaches CAE’s office practice course and junior architectural studio. Both Denzer and Hedges are involved heavily in the introduction of building information modeling in UW courses.
• Fred Ogden, Ph.D., P.E. Ogden joined the CAE faculty as the Roy and Caryl Cline Distinguished Chair of Environment and Natural Resources and holds a shared appointment between the department and the Haub School and Ruckelshaus Institute of Environment and Natural Resources. Ogden is an internationally known scholar in water resources and hydro meteorology. Without the extreme generosity of Roy and Caryl Cline, this significant advancement of our program would not have been possible.
Wind River Glacier Project
Sponsor: Wyoming Water Development Commission
The project will investigate water supply issues in the Upper Wind River Basin, most notably the impact of climate and the continuing recession of glaciers. Researchers will perform a field survey of Dinwoody Glacier to assess changes in size (volume) and determine potential impacts to late-summer streamflow. Streamflow and snowfall variability due to climatic influences will also be investigated.

Upper Green River Drought Project
Sponsor: Wyoming Water Research Program
This project will assess long-term variability in Upper Green River streamflow through the use of tree-ring reconstructions. Tree-ring collections will be obtained in and around the Upper Green River Basin and will be utilized to develop tree-ring chronologies in the new UW CAE Dendrochronology Lab. This will allow for the reconstruction of streamflow records for upwards of 500 years. The increased period of record will allow researchers to assess long-term drought variability including duration and frequency.

Our CAE students continue to excel and the UW ASCE chapter received National Honors from ASCE Headquarters, and the Steel Bridge did very well at the conference meeting. Ten students and three faculty attended the ASCE Architectural Engineering Institute (AEI) national conference in Omaha, Nebraska. Several graduate students in water resources attended the ASCE World Water and Environmental Resource Congress and coauthored several papers with faculty on recent work. Field trips to offices and construction sites remain significant to student experience. Many alumni donors help every year to support these kinds of activities which mean so much to our students' education.

research & faculty highlights
The Department of Civil and Architectural Engineering continues its tradition of strong research support with contracts of $1.7 million last year.
• Steve Gray appointed director of the Wyoming Water Resources Database System. He also received the William R. Boggess Award for "The Most Outstanding Paper Published in 2004" by the American Water Resources Association.
• Charles Dolan is a member of the American Concrete Institute 318 that writes the specification for concrete design of buildings (likely the most influential committee in the United States and world on concrete design). Dolan also published a new edition of his textbook, Reinforced Concrete Design.
• Steve Gray was appointed director of the Wyoming Water Resources Database System. He also received the William R. Boggess Award for "The Most Outstanding Paper Published in 2004" by the American Water Resources Association.
• Charles Dolan is a member of the American Concrete Institute 318 that writes the specification for concrete design of buildings (likely the most influential committee in the United States and world on concrete design). Dolan also published a new edition of his textbook, Reinforced Concrete Design. Dolan, Jenny Tanner, and David Mukai are working on a project with the National Academies regarding the performance of advanced composite materials used in bridges.
• $1.4 million in transportation research support for Khaled Ksaiabti’s work over two years.
• Wyoming Water Resources Database Center funded at $350,000 to provide valuable information to various individuals and companies throughout the Rocky Mountain region (one of the most heavily used sites at UW).
• $220,000 project to study changes in Dinwiddie Glacier in the Wind River Range (Glenn Tootle, Greg Kerr).
• Jay Puckett presented three papers at the International Bridge Engineering Conference. His second edition of Design of Highway Bridges was published this fall.
• Collaborative NSF work on “An Internet Platform for Public Participation in Transportation Decision Making” continues with the University of Washington (Rhonda Young).
• Synthesis on rock-sockets drilled shafts for bridge structures for the National Academy of Engineering (John Turner).
• Monitor and model new Laramie community college building with innovative and sustainable energy devices and processes (Cenk Yavuzturk, Jay Puckett).
• Supply Autodesk SW for labs by working with Autodesk Corporation and other companies.

Fatigue testing of a traffic signal pole.
The Department of Computer Science completed the accreditation cycle in fall 2005 with a visit from a Computer Accreditation Commission (CAC) evaluation team. Thanks to the persistent leadership of Associate Professor Diana Spears, Professor Jeff Van Baalen, and lecturers Allyson Anderson and James Ward, the computer science undergraduate major program was awarded accreditation for six years. The CAC has joined ABET, the engineering accreditation group, and during the next accreditation cycle we will join the engineering college for presentations to ABET.

A key person in UW computer science, Henry Bauer, retired after 33 years of teaching, research, and administration. His retirement was celebrated at a College of Arts and Sciences dinner in March and at a College of Engineering dinner in April, where the Henry R. Bauer Computer Science Excellence Fund was announced. Bauer joined the computer science department in 1973 and was the first professor at UW with an advanced computer science degree. He was department head from 1978 to 1986 and from 1993 to 1997. Bauer was the associate dean for the College of Arts and Sciences from 1997 through 2006.

The new senior design course now concludes with the University of Wyoming Computer Science Design Symposium sponsored by OCI Integrated Information Systems of Cheyenne. This year 11 student teams supervised by 11 faculty and industry mentors gave 15-minute presentations of their work in the course. OCI provided judges and prizes for the event.

Professor Rex Gantenbein has moved to the College of Health Sciences. His work there focuses on delivery of health systems to rural communities. He continues to work with several computer science graduate students on networking issues.

We have hired Liqiang Wang from SUNY Stony Brook as an assistant professor. He began his work at UW this fall. Wang has designed and implemented algorithms for effective testing, analysis, and verification of concurrent programs. He is also interested in parallel and distributed systems, computer security, verification, database systems, and data mining. He teaches courses in operating systems, networks, and software engineering at the graduate and undergraduate levels.

This year 14 graduate students participated in the University of Wyoming Graduate Symposium. Each student gave a 20-minute presentation on their research. Dimitri Zarzhitsky received an award for best presentation for his talk on “Robot Swarm Chemical Plume Tracing.”
Professor William Spears is the recipient of the UW College of Engineering 2006 Outstanding Undergraduate Teaching Award. He received his bachelor’s degree in mathematics from Johns Hopkins University and his master’s and doctoral degrees from George Mason University.

Before coming to the University of Wyoming, Spears worked as a research scientist for the Naval Research Laboratory in Washington, D.C., for over 15 years. He says it came as quite a shock to him when he realized that he enjoys teaching as much as research! Spears views teaching as a mentoring process where the goal is to help each student expand his intellectual horizons. He feels that the greatest success occurs when the teacher-student line disappears and the class learns together. He has had a substantial impact on students because of his creative, non-traditional teaching methods. These methods include group problem solving, whereby a whole class becomes involved in solving challenging problems, and an emphasis on the use of first principles.

The Department of Computer Science has strong research programs in complexity, robotics, formal methods, and network and database systems. In the last two years we produced over three dozen papers and conference presentations. Requests for external funding produced over $300,000 per year for support of graduate students and research-related expenses.

- Assistant Professor John Hitchcock is working with two graduate students on fractal geometry in complexity classes. Last year he solved two problems from the 1999 survey paper “Twelve Problems in Resource-Bounded Measure.” Previously only two of the 12 problems had been solved.
- Professor John Cowles and Assistant Professor Ruben Gamboa study mathematical models of computer hardware and software systems. They formalize analytic and algebraic number theory, which has important applications to encryption. Gamboa also studies applications of grid computing to visualization, theorem proving, and computational number theory.
- Professor Jeff Van Baalen applies formal methods to the development of practical tools for Internet security. A project currently under way uses abstract interpretation and model checking to identify cross-site scripting vulnerabilities in Web applications.
- Associate Professor Jim Caldwell and two Ph.D. students are working on applications of type theory and constructive logics to software development. The themes of the work are related to the expressiveness of type systems for programming languages (how to use dependent types) and extracting efficient correct-by-construction programs from formal proofs.
- Associate Professors William Spears and Diana Spears are working with five graduate students on sensor and control systems for robotic swarms. This team has developed an inexpensive way for robots to localize each other, using trilateration. The system provides a unified framework with which to merge localization with the exchange of information between robots. The team now has a chemical plume generator and robots equipped with chemical sensors. They are testing the effectiveness of a robot swarm for chemical plume tracing. The graduate students on this team have co-written and published nine papers with their professors in the last two years.
- Diana Spears also works on intrusion detection. She and her students developed an intrusion detection approach that is almost fully automated and outperforms current state-of-the-art approaches. Their approach combines multiple detection methods to first select candidate packets using fast, but inaccurate, methods, and then apply a slow, but more accurate, method to analyze the selected packets.
- Professor Thomas Bailey studies query cost models for database indexing methods. Bailey and Ruben Gamboa investigate the use of velocity and acceleration bounds in the interpolation and extrapolation of position information in moving object database systems.
It has been an exciting time for the Department of Electrical and Computer Engineering. Under the leadership of department head Mark Balas, the department has aggressively moved forward in a number of initiatives to improve undergraduate and graduate education, scholarship and research, and assessment and service.

The high point has been the recent hire of two outstanding faculty members: Margareta Stefanovic (see inset) and Jeff Anderson. Anderson joins the faculty as an assistant academic professional lecturer.

Over the past academic year the department has completed a thorough review of its undergraduate and graduate curriculum, resulting in significant course updates and additions. We have also provided the bioinstrumentation course and biodata systems course with a complement of new test equipment and hands-on laboratory exercises. These improvements were made possible by a grant from National Instruments.

To enhance interdisciplinary education, the department continues a strong collaboration with the Department of Mechanical Engineering on joint senior design projects. The projects are sponsored by the National Science Foundation under the auspices of the Biomedical Engineering Program and Research to Aid Persons with Disabilities Program. Our senior design program also continues to enjoy strong support from an endowment established by Mike Volpi and Toni Cupal in honor of Jerry Cupal, who served the department with distinction for many years.

The department has been active at the college level efforts to institute an international option for our students approved at the university level in spring 2006. The department was also actively involved in developing a 2+2 program with Shanghai Normal University. Students participating in the program will complete their first two years at Shanghai Normal University and then complete the remaining two years of their degree at UW.

The department instituted a new B.S./M.S. program in electrical engineering. The purpose of the program is to entice our most promising undergraduate students to stay at UW for a graduate degree. Potentially students can complete M.S. degree requirements one calendar year beyond the B.S. degree.

The Department of Electrical and Computer Engineering has been involved in a host of service and outreach activities at all levels of participation. Notably department members participate in service to the field with representation in IEEE, SWE, ASEE, AIAA, and NCEES. In recognition of their service to the discipline, Professor Balas was recently elected to fellow status with the IEEE while John McInroy and Jerry Hamann were elevated to senior member status.

In the coming year we will meet with our department advisory board to review recent curriculum developments and assessment results. We will also pursue an M.S. program for computer engineering with the possibility for an associated B.S./M.S. program.

In Memoriam
In March 2006 our master technician, Lew Sircin, died after a lengthy illness. Lew served hundreds of students over a 30-year period at the University of Wyoming. We will sorely miss Lew and his dedicated service to undergraduate students.

ECE Advisory Board
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Assistant Professor Margareta Stefanovic joined the ECE department in the fall of 2005. Her field is control systems with expertise in robust adaptive control of uncertain, data-driven adaptive systems; supervisory and switching control; nonlinear control; and control in ground transportation (adaptive cruise control). She received her Ph.D. and M.S. in electrical engineering from the University of Southern California while on a Charles L. Powell Engineering Doctoral Fellowship. She was also a postdoctoral scholar at USC, doing research on dynamic modeling of a central pattern generator in spinal oscillations. She, along with Suresh Muknahallipatna and Mark Balas, have three pending proposals in the area of “Network Loading Theory for Net-Centric Warfare Applications” with the Air Force Office of Scientific Research, the National Science Foundation, and the Office of Naval Research.

### Research & Faculty Highlights

Department faculty are engaged in a number of cutting-edge research programs and received more than $1.58 million in research awards in 2006. Space allows only a brief mention of the myriad programs under way.

- Funding to provide alternative energy sources for stock water pumping (Sadrul Ula).
- Funding to participate in initiatives sponsored by the Department of Defense Joint Robotics Program under the National Unmanned Systems Experimental Environment (NU. S.E2) Program (John McInroy, John O’Brien, Cameron Wright, Jerry Hamann, and Steve Barrett).
- Professor Mark Balas spends second summer as a NASA Faculty Fellow at the Jet Propulsion Laboratory developing the new research area of evolving systems which considers the autonomous assembly and control of spacecraft.
- Air Force small business grant to Defense Research Technologies Inc. to develop novel biomedical diagnostic/monitor systems for combat casualty applications (Cameron Wright, Steve Barrett).
- Avalanche detection project funded by NSF (Robert Kubichek, Jerry Hamann, and John Pierre working with InterMountain Laboratories, Sheridan, Wyoming).
- Textbooks were published by Cameron Wright and Steven Barrett this past year by internationally renowned engineering publishing companies (Prentice Hall, CRC Press, and Morgan-Claypool). Also, Barrett had a textbook co-authored with Daniel Pack of the United States Air Force Academy released in a Chinese edition.

- Interdisciplinary University of Wyoming Center of Biomedical Research Excellence (COBRE) program participation (Steven Barrett, Cameron Wright) funded by the National Institutes of Health for a five-year period beginning July 1, 2006.
- $500,000 in grants to assist in developing a system to monitor power grids (John Pierre).
- McData Corporation grants $256,000 for performance analysis of large-scale storage area networks research (Suresh Muknahallipatna).
The Department of Mechanical Engineering is enjoying a second “renaissance” after the prosperous days of the early eighties. This is due to the hard work of the faculty, the success of our students, and the excellent financial condition of the Wyoming state government. Five new faculty members have joined the department since 2001, and enrollment has been steadily increasing. Last year, we received the sixth Department of Defense EPSCoR award since 2000; we believe that this is the highest number of awards received by any eligible department in the United States.

In the fall of 2005 we established a five-year B.S. in physics and M.S. in mechanical engineering program (PhysME). Both departments have a lot to gain from this cooperation, with our students being the primary beneficiaries. PhysME is a streamlined program that provides an opportunity to undergraduate physics students to continue their studies in mechanical engineering. At the end of the fourth year, students would be able to receive a B.S. in physics and automatically (after fulfilling the Graduate School requirements) enroll in the mechanical engineering M.S. program. This approach will enable them to receive their M.S. graduate degree in mechanical engineering within a minimum of one year. This integrated program becomes possible by taking advantage of similar courses in the curricula of the two departments and by utilizing a number of carefully selected engineering courses as electives within the “physics B.S. plus” degree.

The joint B.S./M.S. program in mechanical engineering is designed to present highly qualified students with the opportunity to work towards both the B.S. and M.S. degrees in mechanical engineering. These students will be admitted to the BSMS–mechanical engineering program during the second semester of their junior year of their B.S. program.

During the past two years, we have been very active in establishing an international option for our mechanical engineering students. We now have an international curriculum that is designed to accommodate undergraduate students who want to spend a semester or two at an institution abroad.
In August 2005, under the theme “Current Challenges in Mechanics of Materials,” an NSF-supported workshop was held at the University of Wyoming. Its goal was to focus on issues of current research interest in the field of mechanics of materials. These included modeling, computations, and mechanics/materials challenges in the biological world. The detailed program and presentations can be found at the following Web site: www.eng.uwyo.edu/mechanical/research/ccmm/schedule2005.html.

The workshop provided an excellent environment for the exchange of ideas and open discussions resulting from the presentation of the researchers’ latest work, augmenting efforts to advance the research frontiers in this field. The meeting also served as an opportunity to showcase some of the research performed at the University of Wyoming. In addition, it provided the framework for having the opportunity to enhance our collaboration with our Japanese colleagues.

As a result of the better coordination of courses within the Department of Mechanical Engineering than is usually possible for students who come to UW from other institutions to pursue the M.S. degree, up to six credit hours may be counted toward both the B.S. and M.S. degree programs. By successfully completing up to six credit hours of graduate classes during their senior year, these exceptional students would have demonstrated their ability to do graduate-level work as undergraduates, easing their transition to mechanical engineering’s graduate program.

research & faculty highlights

- In February of 2005, John Nydahl retired after 34 years of service to the department, college, and university.
- The department continues to strengthen its research productivity in a variety of measurable ways. The number of archival journal publications continues to increase steadily. The research expenditures have reached $100,000 per faculty, the highest in the history of the department. More importantly, these expenditures come mainly through federal, competitive grants, and are the result of the involvement of several faculty. Space will not allow describing the many success stories resulting from our faculty’s hard work, though the stories listed below serve as examples.
  - Grant from the USAF to investigate turbulent jets (Professor Jonathan Naughton, mechanical engineering, and Professors Dan Stanescu and Stefan Heinz, math). One of 27 proposals funded from 108 submitted proposals to the 2005 Defense Experimental Program to Stimulate Competitive Research.
  - Best Technical Paper Award at Supercomputing 2005 (Professor Dimitri Mavriplis). The paper, “High Resolution Aerospace Applications Using the NASA Columbia Supercomputer,” demonstrated high-performance computer simulations of aerospace vehicle aerodynamics on one of the world’s largest supercomputers. Other team members were Michael J. Aftosmis, with the NASA Ames Research Center, and Marsha Berger of New York University’s Courant Institute of Mathematical Sciences.
  - Professor Andrew Hansen named as one of 40 American Council of Education Fellows nationwide (2005). Established in 1965, the ACE Fellows Program is designed to strengthen institutions and leadership in American higher education by identifying and preparing faculty and staff members for senior positions in college and university administration. During the placement, fellows spend time working with a college or university president and other senior officers at a host institution, focusing on an issue of concern. The fellows also engage in leadership and management activities to enhance their knowledge about the challenges and opportunities confronting higher education.

Research scientist Scott Morton delivers a senior design project, “Leg-Powered Quadracycle” to Rick, Becky, and Devin Skagen.
The past two years have been both exciting and rewarding for the University of Wyoming’s (UW) College of Engineering Development and Communications Office. In July of 2005 the Distinction Campaign came to a very successful end for the University of Wyoming, which received $146 million in private gifts and pledges and $58 million in state matching funds for endowments and facilities, for a total of $204 million. The College of Engineering received $9.39 million in private gifts and pledges and $2.82 million in endowment state match funds.

UW awareness and momentum fostered by the Distinction Campaign combined with a reorganization of the College of Engineering Development Office to become the Development and Communications Office, and the reintroduction of the petroleum engineering undergraduate degree, have propelled development at the college to achieve its highest level of giving in its history. Both the Annual Fund giving of $281,000 and total giving of $2.93 million exceed previous giving levels for UW engineering.

Engineering’s Development and Communications Office is focused on informing our alumni and friends of the exciting things happening at UW to further the college’s goal of excellence in engineering education. This goal requires high-quality dedicated faculty and staff, qualified and eager students, support from the university and state, and contributions from individuals, corporations and foundations. The college relies on these contributions to differentiate our programs from other schools, and we have been fortunate to be supported by a group of alumni, friends, corporations, and foundations at levels that enable excellence.

In support of excellence, the college has embarked on several development initiatives to support each of its departments, including interdisciplinary projects to promote teaming and project experience that emulates the working environment our graduates’ experience. Some key initiatives are as follows:

- Petroleum Engineering Program
- Henry R. Bauer Computer Science Excellence Fund
- Interdisciplinary Center for Engineering Design and Teaching
- Concrete Materials Laboratory
- Engineering’s Next Generation (outreach to K–12 grades)
- Business for Engineers Certificate Program
- International Engineering Study Option
- Engineers Without Borders Program
- Endowed Chair in Energy
- Endowed Chair in Controls/Signal/Image Processing
- Endowed Chair in Materials (Mechanical Engineering)
- Student support is critical to attracting the best students to UW, and the recent establishment of the Hathaway Scholarship Program by the Wyoming State Legislature has already produced an increase in enrollments at UW. This program, which provides scholarships to Wyoming high school graduates, allows the College of Engineering to use our existing and new scholarships to augment the Hathaway Scholarships or to provide scholarships to non-residents. It has also changed our development focus from undergraduate scholarships to graduate fellowships to increase our enrollment in engineering graduate programs.
A major part of the solution to meeting the projected workforce needs requires increasing the percentage of high school graduates pursuing engineering and computer science careers. To increase the percentage, early exposure of K–12 students and their teachers to the issues, applications, and opportunities in engineering is absolutely vital.

Currently the College reaches out to Wyoming K–12 students and teachers through visits to the various schools throughout the state, on-campus seminars and visits, support for national programs, and three specific programs including the Engineering Summer Program for high school juniors, the Middle School Girls Camp, and the Thinking and Doing Mathematics and Science with Engineering sessions for K–12 teachers.

UW's College of Engineering has established the Engineering's Next Generation Program Endowment Fund to support the above programs with a goal of raising $2 million (matched by the state to become $4 million), and have received major gifts and pledges from the John P. Ellbogen Foundation and the Vincent O. Smith Family Foundation to initiate the campaign.

**State of Wyoming Matching Program**

In the 2006 Wyoming state legislative session, the state matching program established during the Distinction Campaign was renewed with $25 million for endowment and $15 million for facilities matching funds. Gifts qualify for the endowment match if they are in the amount of $50,000 or greater, if the donor already has a matching endowment established, or if the gift is given by a group in memory of an individual. Facilities matching funds are available for approved UW projects in amounts of $100,000 or greater. Qualifying gifts may be paid over a five-year period. This program is one of many that show that the Wyoming Legislature is committed to higher education excellence in the state of Wyoming.

**Planned Gifts**

The UW Foundation’s gift-planning staff assists donors in integrating charitable gifts into their financial, tax, and estate-planning objectives, maximizing benefits to both donors and the University of Wyoming. Planned gifts provide donors with an immediate tax deduction and other benefits such as life income, continued use of gift property, or elimination of capital gains tax.

**Oliver C. Boileau Receives Honorary Doctorate**

The University of Wyoming conferred its highest award, the honorary doctor of laws degree, upon aerospace industry leader Oliver C. Boileau, Jr. He was recognized during commencement ceremonies Saturday, May 6, 2006.

Boileau began his distinguished career in service to the U.S. during World War II in the U.S. Navy in the Pacific from 1944 to 1946. This was followed by education at the University of Pennsylvania as an electrical engineer (B.S., M.S.) and later at Massachusetts Institute of Technology in industrial management (M.S.). From 1951 to 1995, a period of 44 years, he worked for the U.S. defense industry in a series of positions holding increasing responsibility and increasing significance to the defense of the United States, including being president of Boeing Aerospace Company, president and director of General Dynamics Corporation and vice chairman of the board of directors, and president of the B-2 Division at Northrop Grumman.

Boileau’s service to the University of Wyoming is extensive. He has served on the College of Engineering’s National Advisory Board, including service as the first chair. He currently serves on the College of Business Advisory Council. In addition he has served on the board of the University of Wyoming Foundation since 1998. Major gifts to the College of Engineering include the Boileau $1 Million Match Challenge to the College of Engineering National Advisory Board and the Boileau Laboratory.

**ways to give**

Thank you for your support in the past and the future for our commitment to excellence in engineering education at the University of Wyoming.

Private giving allows UW Engineering to go beyond the basics, to strive for and achieve distinction. Private giving is also an investment in the future of Wyoming and its only engineering college.

**Annual Gifts**

Whatever the amount, each gift to the Annual Fund for the College of Engineering and its departments is important because it has an immediate and tangible impact on students, faculty, academic programs, and facilities.

**Corporate and Foundation Gifts**

Corporations and foundations are key supporters of the College of Engineering. Our graduates are important to corporations as potential employees, and both corporations and foundations strive to help UW engineering provide quality education through their gifts.

**Corporate Matching Gifts**

Many companies will match employees’ charitable giving with a gift of their own to institutions of higher education, and often even match charitable contributions made by retirees or directors.
Persons seeking admission, employment or access to programs of the University of Wyoming shall be considered without regard to race, color, religion, sex, national origin, disability, age, veteran status, sexual orientation or political belief.