

Montana State University - Federal Initiative requests for FY2012

	<u>COMMITTEE</u>	<u>CAMPUS</u>	<u>REQUESTED</u>
1.	<u>AGRICULTURE</u>		
	<u>Continuation Requests:</u>		
	<ul style="list-style-type: none"> USDA/ARS Animal Biosciences Research Facility (Note: this will be a USDA-ARS facility) 	Bozeman	\$10,340,000
	<u>New Requests:</u>		
	<ul style="list-style-type: none"> Economic Development of Sustainable Food Systems in Montana Expanding Host Plant Resistance for Integrated Pest Management of Wheat Stem Sawfly Development of More Nutritious Crops USDA/ARS Functional Genomics Research Program (Note: this will be a USDA-ARS facility) 	Bozeman Bozeman Bozeman Bozeman	\$ 550,000 \$ 500,000 \$ 650,000 \$ 9,000,000
2.	<u>COMMERCE, JUSTICE AND SCIENCE</u>		
	<u>New Requests:</u>		
	<ul style="list-style-type: none"> Doubling Montana's Manufactured Exports Pathways to Success in the Montana Prison System 	Bozeman Billings	\$ 750,000 \$ 500,000
3.	<u>DEFENSE</u>		
	<u>New Requests:</u>		
	<ul style="list-style-type: none"> Montana Mississippi Partnership Unmanned Aerial Systems for Defense Applications Innovative Medical Technologies for Improved Medical Care Metabolomic Diagnosis of Wound Infection 	Bozeman Bozeman Bozeman	\$ 6,000,000 \$ 2,000,000 \$ 2,000,000
4.	<u>ENERGY AND WATER</u>		
	<u>Continuation Requests:</u>		
	<ul style="list-style-type: none"> Developing Bio-Refineries and Bio-Based Aviation Jet Fuel in the North Central United States Montana Algal BioDiesel project 	Northern Bozeman	\$ 2,400,000 \$ 1,000,000
	<u>New Requests:</u>		
	<ul style="list-style-type: none"> Enhancing the Value of Renewable Energy Storage and Conversion for Rural America 	Bozeman	\$ 1,500,000
6.	<u>INTERIOR AND ENVIRONMENT</u>		
	<u>New Requests:</u>		
	<ul style="list-style-type: none"> Yellowstone Hydrothermal Flow System in the Yellowstone Controlled Ground Water Area 	Bozeman	\$ 600,000

7. **LABOR – HEALTH & HUMAN SERVICES – EDUCATION**

Continuation Requests:

- Montana Energy Training Center Billings-Great Falls-Northern \$ 450,000
- Expanding the Success of First Generation College Students in STEM Disciplines Bozeman \$ 300,000

New Requests:

- Great Falls Center for Healthcare Education and Stimulated Hospital Training Great Falls \$ 300,000
- Rural Professional Development Partnership Billings \$ 300,000
- Native American Bridge/Degree Program Northern \$ 325,000

8. **TRANSPORTATION**

New Requests:

- Montana Mississippi Partnership Unmanned Aerial Systems for Civilian Applications Bozeman \$ 5,000,000

Montana State University-Bozeman – Annual Research and Technology Transfer Report

Data Elements for MUS Policy	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
R&D Expenditures	\$103,048,865	\$102,116,323	\$96,150,553	\$98,431,691	\$109,481,694
Number of new invention disclosures filed	32	30	22	25	22
Number of new start-up companies which have licensed or commercialized university-developed intellectual property	5	1	2	3	1
Number of new intellectual property licenses issued	29	35	43	48	50
Total intellectual property licenses in effect at the close of the fiscal year	109	130	152	182	191
Total gross revenues from intellectual property licenses	\$219,931	\$257,621	\$664,244	\$557,832	\$466,181

Data Elements for Strategic Plan	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010
Patents Issued	3 patents, 1 trademark	13 patents	13 patents, 3 trademarks	20 patents, 1 trademark	9 patents, 2 plant variety protection
Active Licenses (Total)	109	130	153	184	191
Active Licenses (MT Companies)	68	81	89	105	109
Percent Licenses w/ MT Companies	62%	62%	59%	57%	57%
License/Patent Revenues	\$49,949	\$69,165	\$221,614	\$290,690	\$256,690
Reimbursed Patent Costs from Licenses	\$169,982	\$138,562	\$442,630	\$267,142	\$209,491

Montana State University-Billings; Bozeman, Great Falls; Northern -- Annual Research and Technology Transfer Report
(These campuses do not have information to report for the other data elements)

Data Elements for MUS Policy-R&D Expenditures	FY 2006	FY2007	FY2008	FY2009	FY2010
MSU-Billings	\$713,093	\$625,580	\$818,395	\$339,241*	\$527,330
MSU-Great Falls	\$0	\$0	\$0	\$0	\$0
MSU-Northern	\$0	\$61,337	\$334,556	\$434,634	\$1,590,466

*corrected number

**MONTANA STATE UNIVERSITY
RESEARCH AND OTHER SPONSORED PROGRAMS
FISCAL YEAR 2010 EXPENDITURES BY COLLEGES AND DEPARTMENTS**

<u>College of Agriculture</u>		<u>College of Engineering</u>		<u>College of Nursing</u>	
Dean's Office	\$260,628	Dean's Office	\$132,388	Nursing	\$1,629,027
Agricultural Economics and Economics	\$375,709	Chemical Engineering	\$1,312,239	Area Health Education Center (AHEC)	\$1,146,855
Agricultural Education	\$28,687	Civil Engineering	\$54,392	TOTAL	\$2,775,882
Animal and Range Sciences	\$1,472,284	Computer Science	\$732,813		
Plant Sciences and Plant Pathology	\$3,151,094	Electrical and Computer Engineering	\$2,307,488	<u>University Programs</u>	
Land Resources and Environmental Sciences	\$5,542,305	Industrial and Mechanical Engineering	\$1,018,459	Academic Affairs	\$85,014
Research Stations	\$394,598	Center for Biofilm Engineering	\$3,074,656	Animal Resource Center	\$30,847
Veterinary Molecular Biology	\$9,504,351	MT. Manufacturing Extension Ctr.	\$2,402,395	Athletics & ASMSU	\$156,724
TOTAL	\$20,729,656	Western Transportation Institute	\$7,853,197	Big Sky Institute	\$934,454
		TOTAL	\$18,888,027	Center for Community Involvement	\$49,278
<u>College of Arts and Architecture</u>		<u>College of Letters and Science</u>		Division of Health Sciences:	
Dean's Office	\$176,861	Dean's Office	\$181,014	American Indian Research Opportunities (AIRO)	\$511,666
Architecture	\$117,002	Cell Biology and Neuroscience	\$3,373,134	Office of Rural Health	\$599,304
School of Film & Photography	\$42,678	Chemistry and Biochemistry	\$12,270,691	WWAMI	\$350,266
Shakespeare in the Parks	\$42,996	Earth Science	\$961,613	EPSCoR Programs	\$4,372,748
TOTAL	\$379,537	Ecology	\$2,586,373	Extended University	\$213,016
		English	\$45,104	Extension Service	\$1,517,221
<u>College of Business</u>		History and Philosophy	\$273,428	Fire Training School	\$25,392
Dean's Office	\$37,898	Mathematical Sciences	\$899,316	INBRE	\$3,536,221
TOTAL	\$37,898	Microbiology	\$1,285,572	International Programs	\$480,339
		Modern Languages	\$64,794	KUSM	\$1,378,456
<u>College of Education, Health and Human Development</u>		Native American Studies	\$1,614	Library	\$30,363
Dean's Office	\$1,829,878	Physics	\$6,728,448	Montana Water Resources Center	\$489,355
Education	\$2,309,768	Political Science	\$162,814	MSU TechLink	\$3,327,243
Health and Human Development	\$3,954,263	Psychology	\$135,020	Museum of the Rockies	\$1,394,083
TOTAL	\$8,093,909	Sociology	\$144,842	Special Projects	\$9,476,343
		TOTAL	\$29,113,777	Student Affairs (ABC)	\$430,319
				Undergrad Scholars	\$74,356
				TOTAL	\$29,463,008

GRAND TOTAL \$109,481,694

Montana State University - Federal Initiative requests for FY2012

	<u>COMMITTEE</u>	<u>CAMPUS</u>	<u>REQUESTED</u>
1.	<u>AGRICULTURE</u>		
	<u>Continuation Requests:</u>		
	<ul style="list-style-type: none"> USDA/ARS Animal Biosciences Research Facility (Note: this will be a USDA-ARS facility) 	Bozeman	\$10,340,000
	<u>New Requests:</u>		
	<ul style="list-style-type: none"> Economic Development of Sustainable Food Systems in Montana Expanding Host Plant Resistance for Integrated Pest Management of Wheat Stem Sawfly Development of More Nutritious Crops USDA/ARS Functional Genomics Research Program (Note: this will be a USDA-ARS facility) 	Bozeman Bozeman Bozeman Bozeman	\$ 550,000 \$ 500,000 \$ 650,000 \$ 9,000,000
2.	<u>COMMERCE, JUSTICE AND SCIENCE</u>		
	<u>New Requests:</u>		
	<ul style="list-style-type: none"> Doubling Montana's Manufactured Exports Pathways to Success in the Montana Prison System 	Bozeman Billings	\$ 750,000 \$ 500,000
3.	<u>DEFENSE</u>		
	<u>New Requests:</u>		
	<ul style="list-style-type: none"> Montana Mississippi Partnership Unmanned Aerial Systems for Defense Applications Innovative Medical Technologies for Improved Medical Care Metabolomic Diagnosis of Wound Infection 	Bozeman Bozeman Bozeman	\$ 6,000,000 \$ 2,000,000 \$ 2,000,000
4.	<u>ENERGY AND WATER</u>		
	<u>Continuation Requests:</u>		
	<ul style="list-style-type: none"> Developing Bio-Refineries and Bio-Based Aviation Jet Fuel in the North Northern Central United States Montana Algal BioDiesel project 		\$ 2,400,000 \$ 1,000,000
	<u>New Requests:</u>		
	<ul style="list-style-type: none"> Enhancing the Value of Renewable Energy Storage and Conversion for Rural America 	Bozeman	\$ 1,500,000

6. **INTERIOR AND ENVIRONMENT**

New Requests:

- Yellowstone Hydrothermal Flow System in the Yellowstone Controlled Ground Water Area Bozeman \$ 600,000

7. **LABOR – HEALTH & HUMAN SERVICES – EDUCATION**

Continuation Requests:

- Montana Energy Training Center Billings-GreatFalls-Northern \$ 450,000
- Expanding the Success of First Generation College Students in STEM Disciplines Bozeman \$ 300,000

New Requests:

- Great Falls Center for Healthcare Education and Stimulated Hospital Training Great Falls \$ 300,000
- Rural Professional Development Partnership Billings \$ 300,000
- Native American Bridge/Degree Program Northern \$ 325,000

8. **TRANSPORTATION**

New Requests:

- Montana Mississippi Partnership Unmanned Aerial Systems for Civilian Applications Bozeman \$ 5,000,000

Project: USDA-ARS Animal Biosciences Research Facility

Brief Description: Montana State University requests support from USDA-ARS for construction of an Animal Biosciences Research Facility that would include state-of-the-art multi-user research facilities, technology transfer capabilities, new opportunities for increased grant funding and industry partnerships, and increased competitiveness of the nation's livestock industry. The \$24 million research building funded, built, and staffed by USDA-ARS will be dedicated to work on functional genomics in partnership and in cooperation with the MSU College of Agriculture, USDA-ARS in Miles City, MT, and USDA-ARS in Clay Center, NE. The goal is to apply the genetic information secured from mapping the bovine genome (e.g. from a Montana Line 1 Hereford) to enhance the efficient production of safe, consistently high-quality meat products and add value to rural communities.

Executive Summary: Agriculture is the largest basic industry in the Montana economy and the livestock industry is its largest segment. The progressive evolution of animal and range sciences has generated increasingly complex opportunities for research, student training and outreach. Montana is a global leader in the production of high quality seed stock, genetics, and resource stewardship, leading to quality exports around the world. The USDA-ARS facility programmatic efforts will use the bovine genome sequence to identify ways to improve the economic and environmental sustainability in the production of safe, high quality and consistent beef products by: identifying genes and their function, developing tools to control disease and improve animal well-being, improving nutrient utilization, management and production efficiency and enhancing the nutrient composition of a safe supply of beef for the consumers in the United States and abroad. Enhancing the strong relationships with USDA-ARS at Fort Keogh and MSU scientists, will strengthen global research and outreach outcomes in beef (and other species such as sheep) biosciences. This research and teaching complex combination will be unique to Montana and the intermountain region.

Congressional Action Needed: A final appropriation of \$10,340,000 for construction (\$13 million appropriated to date) of the research facility is requested. This will match the newly operational Montana academic facility and complete this unique partnership.

Importance to Montana: The production of high quality livestock and the unique seed stock industry significantly contribute to Montana, regional and national economies. Cutting-edge research, training and outreach programs are essential to ensure the long-term sustainability of livestock production and profitability. An Animal Biosciences Research Facility would bring the combined federal and state genomic expertise together in a location and using unique herds and large-scale rangeland facilities to increase the quality of Montana seed stock and the commercial livestock industry. In addition, this will improve northern Great Plains cattle and range production practices, enhance management efficiencies, and secure food safety and quality for consumers everywhere, through collaborative research and outreach activities.

Contacts at MSU:

Thomas J. McCoy, Vice President for Research

(406) 994-2891

Jeff Jacobsen, Dean of Agriculture and MAES Director

(406) 994-3681

Project: Economic Development of Sustainable Food Systems in Montana

Brief Description: Montana State University requests \$557,774 to continue assisting agricultural producers at all scales in improving the sustainability of their operations, as well as creating and improving value-added food products. Research personnel will provide answers about sustainable agronomic practices for market gardens and other local food operations, while assisting with local food processing and product development.

Executive Summary: Numerous research challenges and opportunities face small-scale agriculture and market gardens in Montana. First, substantial labor requirements for highly intensive hand operations often create unsustainable and prohibitive input costs. Second, agronomic problems like weed and pest management, maintaining soil fertility, and optimizing crop rotations have not been experimentally addressed. Third, commodity market-driven price variability is causing many conventional producers to experiment with alternative crops, local foods, and on-farm bioenergy production. And fourth, Montana farmers operating at all scales could benefit from nutrition-based, localized food systems to diversify their operations and improve their earning potential through more vertical integration. The Sustainable Food and Bioenergy Systems (SFBS) Program will facilitate fundamental research to address and answer these challenges. For example, agronomic and food science research will develop sustainable practices and new Montana food products. Each of these research areas provides opportunities for improving local economies, enhancing public-private collaborations, and strengthening the sustainable operation of Montana agricultural enterprises.

The SFBS Bachelor of Science degree program at MSU (<http://www.newsweek.com/id/210906>) reflects a new model of interdepartmental and cross-College collaboration. Towne's Harvest Garden (THG), the SFBS program's outdoor classroom and research laboratory, the THG Community Supported Agriculture (CSA) program, relationships with the Gallatin Valley Food Bank, and the statewide SFBS Internship Program are already in place, but need additional funding to continue their success. The SFBS program and THG provide an ideal infrastructure for conducting the proposed research and for expanding relationships with other researchers, students, producers, and private enterprises.

Significantly, a new research thrust will identify and characterize nutritional components in Montana foods that enhance human health, particularly immune function. Interdisciplinary collaborations among faculty and staff in the College of Agriculture and College of Education, Health & Human Development will investigate the roles of polyphenol and other secondary plant compounds in strengthening innate immune response and reducing chronic disease indicators. This work will be closely linked to field and greenhouse research to identify practical agronomic treatments that increase plant concentrations of these important compounds. Related laboratory research will investigate the biochemical and molecular mechanisms controlling polyphenol synthesis in plants. Our results will enable us to compete for NIH funding (<http://ods.od.nih.gov/Research/BRCProgram>) to better understand the basic mechanisms underlying these effects. A specific and practical outcome will be a set of agronomic recommendations for market garden and other Montana farmers to improve the nutritional and health-promoting qualities of their crops.

Importance to Montana: Linking the SFBS program with a strong research effort will provide the technical base and critical mass of MSU faculty to train the future developers of Montana's nutrition-based food system and locally-focused energy production. Research personnel will work closely with organizations like the Mission Mountain Market Food Enterprise Center, the Glendive Farm to Table program, and the Montana Manufacturing Extension Center. Private enterprises benefitting from this funding include companies such as Cream of the West, Inc. (value-added Montana food products), Timeless Seeds (organic grains), and Rocky Creek Farm (agrotourism). This investment will create significant economic, environmental, and public health benefits for the state and region.

Contacts at MSU:

Thomas J. McCoy, Vice President for Research
Jeff Jacobsen, Dean and Director, COA/MAES
Larry Baker, Dean, College of EH&HD

(406) 994-2891
(406) 994-3681
(406) 994-4133

Project: Expanding Host Plant Resistance for Integrated Pest Management of Wheat Stem Sawfly

Brief Description: Montana State University requests support to improve economic and environmental sustainability of Northern Great Plains wheat production by developing new host plant resistance mechanisms for use as components in integrated pest management (IPM) of wheat stem sawfly (WSS). Host plant resistance mechanisms to be developed include host-plant induced mortality of immature WSS, in addition to identifying varieties that are less suitable choices for WSS and utilizing the capacity of some varieties to compensate for yield losses due to WSS feeding. Multiple mechanisms of resistance will be exploited in planting scenarios that enhance the efficacy of host plant resistance for sustainable pest suppression.

Executive Summary: WSS is the most destructive insect pest of wheat in Montana, with annual crop losses exceeding \$100 million in each of the past two years. Outbreak populations are expanding and causing heavy losses in winter, spring and durum wheat grown throughout the State. Larval feeding in stems reduces grain weight by an average of 20%. Infested stems lodge, causing additional losses and increased costs at harvest. Stem lodging decreases snow retention and germination of lodged seed further depletes soil moisture. Agricultural inputs must be increased to control resulting volunteer wheat plants and crop disease. Existing insecticides and cultural management practices are ineffective.

This collaboration between entomology and spring, winter and durum wheat breeding matches the national need for the highest quality grain from the Northern Great Plains. Resistance must be a component in IPM strategies because recent infestations have shown that genetic resistance alone does not always provide a high level of control

Lodging-resistant varieties with solid, pith-filled stems, have been continually used as a stand-alone management strategy for decades. These varieties cause limited mortality of larval WSS, but there is evidence that other sources of innate cereal crop-produced toxins can cause even greater mortality in all three wheat classes. Trap cropping, based on varieties that attract and retain WSS paired with unattractive varieties, has shown promise against heavy infestations by exploiting the ability to kill larvae in the attractive variety. Recently, tolerance to feeding WSS has also been elucidated. The determination of the genetic, biochemical, and molecular basis for resistance mechanisms is required for sustained development of varieties to be used in an IPM strategy. Exploration of candidate compounds linked to resistance mechanisms is being explored biochemically and metabolically so that the genes controlling expression may be incorporated into targeted wheat lines using classical and marker assisted plant breeding.

In summary, expanded host plant resistance is the basis for sustainable strategies that are being developed for WSS in Montana. New forms of host plant resistance can be utilized in ongoing efforts to enhance and conserve innate beneficial biocontrol agents. Matching funds provided by state and industry sources will increase grower awareness and participation in these efforts and development of new host plant resistance and IPM strategies are an impetus for agribusiness.

Congressional Action Needed: An appropriation of \$500,000 is requested. These funds will be divided equally among entomology and three wheat breeding programs across three MSU Departments.

Importance to Northern Great Plains and Montana: Montana and other WSS impacted areas are leaders in the U.S. wheat industry, with annual economic yields of more than \$2 billion being threatened by WSS. Wheat is also a key resource in critical new efforts at value-added crop production in the Northern Great Plains, so WSS IPM research is needed to sustain the development of these markets. Education and training of Montana producers and students will be strengthened by establishment of innovative wheat breeding and IPM research programs that graduate leaders in agriculture and biotechnology. Montana and Northern Great Plains wheat varieties must remain competitive with those developed in Canada, and innovative IPM hinges on developing varieties that ensure that our producers maintain their advantage. Overall, this appropriation will provide an innovative, sustainable, and deliverable IPM approach for WSS. In turn, this will enhance our ability to remain among nation's leaders in wheat production.

Contacts:

Thomas McCoy, Vice-President for Research, Creativity and Technology Transfer (406) 994-2891
Jeffrey Jacobsen, Dean, College of Agriculture & Director, Agricultural Experiment Station (406) 994-3681

Project: Development of More Nutritious Crops

Brief Description: MSU-Bozeman and Montana Agricultural Research Centers in Havre, Sidney and Huntley will work together to develop food and feed crops with enhanced nutritional properties. Development of improved “nutrifood” varieties of wheat, legumes, potatoes, and specialty grains will provide foods with higher nutritional value for consumers, greater farm profitability, and increased instate processing to create high margin food products.

Executive Summary: The human diet has a tremendous impact on health and disease. Our current diet has contributed to alarmingly high incidence of a number of diseases including type 2 diabetes, heart disease, and obesity (c.f. Sands et al. 2009, Plant Science; Morris and Sands 2006 Nature Biotechnology). We propose that there is great opportunity for Montana agriculture in continued development and production of crops that are more desirable for consumers, provide enhanced human nutrition, and for reduction of chronic diseases. The healthier that we can make our food, the less we might need to spend on treating chronic health problems that are aggravated by our current dietary intake.

Montana has an excellent track record in the quality food business. We grow high protein wheat with few pesticides. Montana barley brings a premium for malting. Our local beef is grass fed with increasing demand across the US. Our potato seed industry delivers high-quality, disease-free germplasm to surrounding states. MSU is an established leader in new niche market, non-commodity crops, as we have demonstrated with our release of low glycemic peas, with our high omega-3 camelina, and with our entirely new gluten-free Proatina, Timtana and Montina grains now produced in Montana and available to consumers . The development of these new crops has led to the emergence of several industries focused on production of gluten-free foods and the production of omega-3 enriched foods and animal feeds. Many of the relationships between diet and chronic disease have only become clearly apparent in the last few years. Foods with high omega-3 content, low glycemic index, and that are gluten-free are widely recognized as important for health and thus are desired by consumers, especially in higher-margin niche markets. As we develop improved crops specifically aimed at alleviating diabetes, heart disease, and obesity, it will be necessary to work with the nutrition and medical sectors to validate their dietary importance.

Project Description: High intake of starchy (high glycemic) grains, legumes and potatoes is one of the leading causes of obesity and heart disease. In response, MSU has recently released a new variety of pea that has very low branched starch and can be used for production of low glycemic index flour and food products. Additional low glycemic varieties of legumes can be developed. We will expand selection of low glycemic varieties to include spring, winter and durum wheats, legumes, and potatoes. Such low glycemic index crops could demand a premium in price at farm gate. Similarly, we will continue to develop high omega-3 and high vitamin E camelina for both food and animal feed, because of its human and animal health benefits. MSU biochemists and geneticists will follow nutritionally important genes through crosses, using recently developed and sophisticated molecular (but not transgenic) techniques, greatly reducing the time to improve crops. The resultant varieties will be tested for growth and productivity statewide at the MSU Agriculture Research Centers and the nutritional composition of the new varieties will be assessed.

Congressional Action Needed: MSU- Bozeman requests a \$650,000 appropriation.

Importance to Montana: Montana has been quick to realize that nutritionally enhanced crops could lead to economic development. New high protein gluten-free crops are now grown and processed throughout the state and marketed nationally. By targeting specific health conscious consumer groups (e.g. celiacs, diabetics, and obese people) we can further expand the production of high margin “nutrifoods” in Montana. Our wheats, potatoes, legumes and oil crops (such as Camelina) can all be selected for enhanced nutritional properties. This shift away from commodity and yield driven agriculture will lead to more profitability and sustainability of our agricultural sector. The health benefits to consumers will be considerable.

Contacts at MSU:

Thomas J. McCoy, Vice President for Research
Jeff Jacobson, Dean of Agriculture

(406) 994-2891
(406) 994-3681

Project: USDA-ARS Functional Genomics Research Program

Brief Description: Montana State University requests support from USDA-ARS for creation and on-going funding for a functional genomics research program on the Bozeman campus and to enhance the genomics program at the USDA-ARS Fort Keogh Livestock and Range Research Laboratory at Miles City. Both programs are components of an integrated effort involving collaboration with the USDA-ARS U.S. Meat Animal Research Center at Clay Center, NE. This research will use the bovine genome sequence to identify genetic technologies to improve the economic and environmental sustainability of the production of safe, high quality and consistent beef products by identifying genes and their functions. The ARS share of the integrated plan includes 7 (SY) to create a research unit at Bozeman composed of functional genomics scientists (with expertise in mammalian species, including the cattle and sheep and microbial ecology). Reoccurring support for these scientists would require \$6 million in base budget funding. The USDA-ARS Fort Keogh Livestock and Range Research Laboratory with its wealth of phenotypic data and matching DNA resources would add 2 SY as quantitative/genomic scientists (\$3 million in base budget funding). The goal is to apply the genetic information secured from mapping the bovine genome (e.g. from a Montana Line 1 Hereford) to enhance the efficient production of safe, consistently high-quality meat products and add value to rural communities. To meet this goal, base program funding in the amount of \$9 million is requested.

Executive Summary: Agriculture is the largest basic industry in the Montana economy and the livestock industry is its largest segment. Montana is a global leader in the production of high quality seed stock, genetics, and resource stewardship, leading to quality exports around the world. Innovations in Montana seed stock are quickly incorporated in herds across the United States. The USDA-ARS facility programmatic efforts will build upon bovine genome sequence to discover new technologies. World competitors in the animal protein foods such as Australia and New Zealand have begun their scientific effort in this arena. To advance our standing and world leadership in quality beef production we will need to move the science to emphasize functional genomics. Enhancing the strong relationships between USDA-ARS at Fort Keogh and MSU scientists will strengthen global research, training and outreach outcomes in beef (and other species, such as sheep) biosciences. The production of high quality livestock and the unique seed stock industry significantly contribute to Montana, regional and national economies. This research mission and team effort will be unique to Montana and the intermountain region.

Congressional Action Needed: An annual appropriation of \$9,000,000 for ARS base funding increase is requested to support the program and staff that will utilize the facility. This will complement the Montana academic facility and program commitment and complete this unique partnership.

Importance to Montana: The production of high quality livestock and the unique seed stock industry significantly contribute to Montana, regional and national economies. Cutting-edge research, training and outreach programs are essential to ensure the long-term sustainability of livestock production and profitability. A Functional Genomics Research Program would bring the combined federal and state genomic expertise together in a location and using unique herds and large-scale rangeland facilities to expand genetic knowledge and promote innovation to increase the quality of Montana seed stock and the commercial livestock industry. At the same time, this will improve northern Great Plains cattle and range production practices, management, and enhance food safety and quality for consumers everywhere, through collaborative research and outreach activities.

Contacts at MSU:

Thomas J. McCoy, Vice President for Research
Jeff Jacobsen, Dean of Agriculture and MAES Director

(406) 994-2891
(406) 994-3681

Project: Doubling Montana's Manufactured Exports

Brief Description: Montana State University requests \$750,000 in the FY 2012 Commerce budget for a new pilot program to double manufacturing exports from Montana. In support of the National Export Initiative (NEI), the Montana Manufacturing Extension Center (MMEC) will use these funds to develop a program in Montana to double manufactured exports from rural areas. Doubling exports from Montana will result in 1,500 to 2,000 new manufacturing jobs for a total of 5,400 -- 7,200 new direct and indirect jobs in Montana alone. Montana serves as an excellent pilot location because training and services that work for Montana's companies will effectively transfer to any rural area in the United States. Information, training programs and procedures will be shared throughout the country through the National Institute of Technology's Manufacturing Extension Partnership (NIST MEP).

Executive Summary: President Obama has set a challenging goal of doubling U.S. manufacturing exports in five years through the NEI. Montana, starting from a low base of 8.5% of manufacturing output exported, is well suited for a pilot project to accomplish this goal. MMEC will work with existing partners such as the U. S. Commercial Services, Montana World Trade Center, the Montana Department of Commerce, Montana's Small Business Development Centers, the Small Business Administration, the University of Montana, and Montana State University - Billings to build programs that enable manufacturers to double their exports.

Doubling manufacturing exports from the state will create a 6.3% - 8.5% increase in the number of high-paying manufacturing jobs with benefits in a five-year period. The effort will build on the successful ExporTech program to provide services to manufacturers who want to export products to new or expanded markets, and will follow up with MMEC services to ensure that the companies have the capability and expertise to enter these markets. Areas where assistance, support and training are needed include export plan development, ITAR training, trade mission support, market research, export paperwork, product development, quality certifications (ISO, CE Mark, etc.), plant capacity planning, cost analyses, and distribution system development.

As an initial part of this program, a study will be conducted to determine what training and services are most needed by small manufacturers looking to start and expand exporting. This study will help ensure that funding for training and services from all sources is targeted where it will do the most good. The study will tap expertise at Montana State University in Bozeman and in Billings and at the Bureau of Business and Economic Research (BBER) at the University of Montana. The study will focus on the export-market needs of Montana's manufacturers and the best ways of delivering services to meet these needs, provide training on how to enter or expand the export market, and provide assistance in developing and implementing export plans. Export growth will be in addition to current domestic production, adding over \$1.0 billion in manufacturing sales per year.

Congressional Action Needed: Montana State University requests funding of \$750,000 in the FY 2012 Commerce Bill.

Why is this Project a Good Use of Taxpayer Money? Small and medium-sized manufacturing enterprises have historically created a large percentage of new jobs in the US and currently produce about one-third of all US exports. This project will help Montana companies find new or expanded markets internationally. It promises to create dramatic job growth, improve the economy, increase state and federal tax collections, and increase the number of families covered by health care insurance.

Importance to Montana: Montana has over 3,000, small and medium-sized manufacturing enterprises (SMEs) that provide some of the best jobs in the state. Roughly 8.6% of their sales are to other countries. Doubling this level will create dramatic job and economic growth in the state.

Contacts at MSU: Thomas J. McCoy, MSU Vice President for Research (406) 994-2891
Steven L. Holland, Executive Director, MMEC (406) 994-3974

Project: Pathways to Success in the Montana Prison System

Brief Description: Montana State University, Billings requests funding of \$500,000 to **expand academic and workforce development programming targeted to inmates in the Montana prison system** based on a successful program at the Montana Women's Prison (MWP). Through the use of distance learning technology, the **Pathways to Success** at MWP will be expanded and delivered to male offenders at other Montana correctional facilities. MSUB will continue to develop curriculum and collaborate with community colleges/universities located near other prison facilities to provide on-site academic support, workforce training and mentoring assistance to participants.

Executive Summary: By 2018, 62% of jobs in Montana will require some postsecondary training; however one-third of the offenders in the Montana prison system lack a high school diploma or GED. Participation in education and job training during incarceration equips offenders to obtain and keep stable, well-paying jobs, thereby reducing recidivism rates and lowering risks to the community. The MSU Billings project at the Montana Women's Prison provides "boot camp academic preparation" for offenders at MWP and Passages pre-release facility to help them obtain skills and credentials essential for success in the workplace. During the past two years (2008 to 2010), 40 female offenders have completed the program. Post-release follow-up indicates that most participants have found jobs and/or sought additional education and *have not returned to prison*. Funds will be used to continue programming for approximately 50 female offenders at the women's prison, and expand the program using Vision Net (distance learning system) to an additional 100 male offenders at correctional facilities in Deer Lodge (Montana State Prison) where no post-secondary coursework currently exists. In addition, on-site tutors will work with male offenders participating in the training/curriculum. MSUB, in conjunction with the Montana Department of Labor and Department of Corrections, has also been selected to participate in USDOJ Adult Reentry Demonstration program; this effort will complement the ongoing MWP remedial education programming.

The **Pathways to Success** program, initially funded in 2008, includes: academic and career planning, developmental math, reading comprehension, personal finance, general college education courses, occupation-specific training (e.g. electrical, construction) along with mentoring, tutorial and other programs critical to post release success. The expansion will introduce **pre-apprenticeship tracks** for female offenders (Office Assistant, Computer Technician, and Pre-Vet Assistant). The progress of all participants is tracked as they move from incarceration to community supervision; assistance with job coaching, application to college is provided for women in the Billings region.

Congressional Action: An appropriation of \$500,000 is requested to support this project for 1 year.

Good Use of Taxpayer Funds: Improving the educational status/employability of offenders can reduce both recidivism and reliance upon government funding/support. Offenders with stable employment/living situations are less likely to recommit crimes, and in turn, positively affect public and community safety. Incarceration costs per offender are \$100 plus per day or \$36,000/year; community supervision (of ex-offenders) costs less than \$10/day or \$3,650/year. If a minimum of 27 offenders per year do not recidivate, the project will save Montana taxpayers approximately \$1 million. Over 1 year, reducing the number of offenders returning to prison by 16 will be the equivalent of the \$500,000 appropriation request.

Importance to Montana: As Montana faces budgetary challenges, the potential rising costs for Corrections and incarceration competes with the state's investment in other critical needs, such as K-20 educational system, infrastructure, social services. Efforts to reduce or slow the growth of Correctional spending can save taxpayers money as well as shift investments to more proactive public programs.

Contacts at Montana State University Billings:

Tom McCoy, Vice President, Research, 406-994-2891

Rolf Groseth, Interim Chancellor 406-657-2300

Robert Carr, MSUB, Downtown Executive Director, 406-896-5890

Kim Gillan, Montana Women's Prison Pathways to Success Project Director, 406-896-5878

Project : A Montana-Mississippi Partnership in Unmanned Aircraft Systems for Defense Applications

Brief Description : This request seeks support for the development of unmanned aircraft system (UAS) technologies to enhance mission capabilities, interoperability, and airspace integration of military UAS through a Montana-Mississippi partnership.

Executive Summary : UAS technology has transformed military operations by offering significant benefits in signal intelligence, image acquisition, targeting, and risk reduction. While undisputed as a force multiplier, the proliferation of military UAS creates a number of challenges in interoperability, multiplicity of platforms, logistics and safety. Resolution of these issues is a significant challenge and priority for DoD, with implications for the integration of UAS in the national airspace and in combat operations alongside manned aircraft. Montana and Mississippi State University have formed a partnership with the broad vision of advancing UAS technology. Within this partnership, we have identified multiple technologies, of independent scientific and intellectual interest to our respective institutions, that could collectively help DoD with requirements and a technical road-map for a joint, multi-role small UAS. This project would support the co-development of UAS-related technologies in the partnership, and provide DoD with results and new capabilities for a next generation of small UAS. The development of these technologies in Montana and Mississippi will help incubate high-tech industry, encourage economic development, and train students to work in a growing area of national importance.

Project Description : The Montana-Mississippi partnership includes a range of research and development activities that can benefit DoD by providing new capabilities to small UAS platforms.

Flight time and battery management limit the mission profile in many small UAS. While electric propulsion has many tactical advantages, batteries are a logistical challenge and can be difficult to recharge under field conditions. Montana State has expertise in developing rugged solid-oxide fuel cell systems that can replace or supplement battery power in small UAS while using a variety of hydrocarbon and logistical fuels. The partnership also has expertise in power electronics that can integrate novel power sources with motor drives, including the possibility of creating hybrid systems that combine high power density from a storage source with high energy density from fuel cell energy conversion. The partnership is unique in its ability to conduct electric propulsion system tests using a single reference cell. This allows rapid assessment of fuel cell and battery technologies at the bench, without stacks. Developments in propulsion and on-board power for small UAS can help DoD extend flight time, performance, and accommodate a broader range of payloads. This could ease payload interoperability concerns and reduce the number of platforms.

Researchers and small companies in Montana are developing a variety high-performance, compact hyper-spectral and other laser and photonic systems for advanced imaging applications. This instrument and sensor development capability is complemented by expertise in remote sensing data processing at Mississippi State. Military applications of these technologies in UAS include stand-off chemical detection, signature analysis and target recognition, and UAS-based detection of improvised explosive devices (IEDs). Imaging sensors require fairly stable flight characteristics and high-performance mounts to provide useful results, requirements that relegate these technologies to larger profile, more expensive platforms. Advanced computational fluid dynamics capabilities at Mississippi State and composite airframe expertise at both universities have the potential to produce airframe designs that optimize stability for optical applications. Fast micro-optical electronic devices being developed in Montana have the potential for real-time compensation of images, and work in high-bandwidth control of electric propulsion systems could further enhance roll-axis stabilization. Collectively, these technologies could enable advanced optical sensing on a new generation of small UAS that would significantly improve DoD capabilities.

Congressional Action Needed: Funding of \$6 million dollars in FY12. Contact : Ken Morton, NAVAIR, kenneth.l.morton@navy.mil

Importance to the Nation: There is a pressing need for DoD to address interoperability, airspace integration, and increase mission capability for military UAS. The proposed project would help DoD achieve these goals by providing targeted results from a Montana-Mississippi UAS research and development partnership.

Contacts: MT - Dr. Thomas J. McCoy, VP for Research (406) 994-2891,
MS - Dr. David Shaw, VP for Research (662) 325-3570
MT – Dr. Robert Marley, Dean, College of Engineering, (406) 994-2272

Project: Innovative Medical Technologies for Improved Medical Care

Brief Description:

Montana State University requests funding of \$2 million in the FY 2012 Defense Appropriations Bill for a new pilot program to (1) inventory and evaluate new medical technologies being developed in US Department of Defense (DoD) labs, (2) transfer the best of these technologies to the private sector, and (3) help companies to successfully commercialize these technologies. These technologies have the potential to enhance medical care for the US military, veterans, and American public as well as to create substantial numbers of new high-skill, high-wage jobs.

Executive Summary:

DoD is the largest R&D organization in the world and is a rich source of new technology. The 100-plus DoD R&D laboratories generate some 400 to 500 patented inventions a year in all major technology fields, with hundreds of additional unpatented inventions. A sizeable number of these new technologies are in the medical arena. Collectively, these DoD medical innovations represent an enormous US government investment that could substantially improve medical care for the US military, veterans, and the American public. In addition, they could lead to substantial new job creation and economic development. However, at present, only a small percentage of DoD's medical inventions are transferred to industry and converted into new medical products and services.

The **project goal** is to harness the productive potential of DoD-developed medical inventions by helping US companies to acquire these innovations and convert them into new products and services, so they can enhance US medical care and benefit the US economy. Specifically, this initiative will:

- Seek out the best medical technologies in the DoD R&D laboratory system;
- Market these technologies to industry and broker licensing agreements so that US companies can convert the DoD technologies into new medical products and services;
- Provide hands-on product design and industrial engineering assistance to help companies that have licensed DoD technologies to successfully produce these technologies;
- Provide other assistance (such as market research) to ensure that the licensed DoD medical technologies result in new medical care products and services that substantially benefit the US military, veterans, and the American public.

Congressional Action Needed: An appropriation of \$2 million in the FY12 Defense Appropriations Bill

Why is this Project a Good Use of Taxpayer Money? This project promises to achieve a high return on investment (ROI) by contributing to better medical care and creating new high-skill, high-wage jobs. New products expected to result from this project will improve medical care for the US military and help prevent medical conditions and disabilities that can lead to expensive, long-term care for veterans. More generally, this project will help the US taxpayer more fully reap the benefits from the enormous federal investment in medical R&D in the DoD laboratory system.

Importance to Montana: This project will help grow the medical, healthcare, and biotechnology sectors in Montana. It promises to create significant numbers of new high-paying, high-skill jobs in the state, particularly in the state's medical centers such as Billings, Bozeman, Great Falls, and Missoula.

DoD Program Element (PE) and Contact Person:

- DoD PE Number: PE 0603942D8Z: *Technology Transfer and Transition*
- DoD Program Manager: Cynthia Gonsalves, Director, Office of Technology Transition, Office of the Secretary of Defense, 1851 S. Bell St., Arlington, VA. Tel (703) 607-5315

Contacts at MSU: Thomas J. McCoy, MSU Vice President for Research (406) 994-2891
Will Swearingen, Executive Director, MSU TechLink (406) 994-7704
Steve Holland, Executive Director, MMEC (406) 994-3974

Project: Metabolomic Diagnosis of Wound Infection

Brief Description: MSU requests \$2.0 million to develop metabolomics-based diagnostic techniques for complex military wounds, as well as civilian burn wounds, diabetic foot ulcers, and chronic venous leg ulcers. The project includes MSU's Center for Biofilm Engineering and Department of Chemistry and Biochemistry as well as Walter Reed Army Medical Center and clinical collaborators from the Southwest Regional Wound Care Center in Lubbock Texas and Johns Hopkins Bayview Medical Center in Baltimore Maryland.

Executive Summary: Severe, potentially fatal infections occur frequently in traumatic military wounds. In addition, many veterans and others suffer from chronic nonhealing wounds such as pressure ulcers and diabetic foot ulcers. Increasing evidence suggests that microorganisms infecting wounds exist as polymicrobial biofilm communities. Analyses using molecular biological techniques (MBT) has revealed that these communities often harbour strictly anaerobic bacteria that are difficult if not impossible to culture. These slow-moving but persistent infections are therefore extremely difficult to diagnose. While an excellent research tool, MBT require specialized expertise and equipment and are not available for routine clinical diagnosis. Metabolomics is an emerging field that involves the quantification of small-molecule metabolites (< 1000 Da) in bodily fluids, tissues, or cells to gain insight into the operation of biological systems. We propose to use nuclear magnetic resonance (NMR) and mass spectrometry (MS) based metabolomic analyses to identify signature metabolites associated with the presence of particular microbial species or combinations of species in human wounds that are correlated with poor healing. In addition to providing a better understanding of the role of microorganisms in wound healing, this approach promises to identify new diagnostic and therapeutic targets in wounds. Furthermore, metabolomics will provide a more functional analysis of wound microbes than MBT, by providing an indication of the activities of certain microbes rather than just their presence. The development of new wound healing diagnostics is anticipated to improve military and civilian wound care patient outcomes and reduce healthcare costs.

Congressional Action Needed: An appropriation of \$2.0 million is requested from the Department of Defense.

Why is this project a good use of taxpayer money? This project develops wound infection diagnostic technology leveraging existing strength and collaborations in wound biofilm research at MSU to ultimately improve wound care practices, while reducing healthcare costs.

Importance to Montana: This project will support research at MSU and promises to improve military and civilian wound care.

Contacts at MSU: Thomas J. McCoy Vice President for Research (406) 994-2891
Robert Marley Dean, College of Engineering (406) 994-2272

Project: Developing Bio-Refineries and Bio-Based Aviation Jet Fuel in the North Central United States

Brief Description: MSU-Northern is requesting continuation funding of \$2.4 Million for bio-based aviation fuel development. This funding will take the project to pilot processor scale, provide research studies for feedstock, primarily focusing on feedstock available in Montana and surrounding areas as well as promote the new product to commercial sector, farming community and government sector.

Executive Summary: The Bio-Energy Center at Montana State University-Northern in Havre, Montana is developing novel and innovative technologies that will tap biomass and other agricultural residues available in Montana for the production of transportation fuels and other industrially important materials. The Bio-Energy Center has recently received federal appropriations to conduct advanced research in this area particularly in the development of aviation fuel from forest biomass and camelina oil. Furthermore camelina, which is very promising industrial crop that grows well in all areas of Montana, will be used primarily for the development of other high-value materials such as polymers and fuel additives. The Bio-Energy Center is seeking support to complement our present activities and to further this research through process scale-up investigation and feedstock investigation aimed at developing bio-refineries that would impact Montana and the surrounding regions.

Project Description:

Bio-refineries and Aviation Fuel - The Bio-Energy Center has received federal appropriations to conduct basic research in advanced fuels development. This project has three Phases: Phase I (Facility Expansion and Proof of Concept), Phase II (Process Development and Optimization) and Phase III (Process, Engineering and Reactor Scale-Up). The Center has received funding for Phase I and II and are requesting \$1.5 million to support Phase III. The support of this Phase is critical in commercializing the technology for next generation bio-refineries.

Bio-refineries and Feedstock development - The US Federal government has acknowledged the vital role of rural America in achieving its goal of producing 36 billion gallons of biofuels annually by 2022. North Central Montana plays a critical role in realizing this goal considering the available biomass including forest, agricultural wastes and energy crops that could be grown in the state. The Center is requesting \$500,000 primarily to explore the available feedstock in Montana that would support the development of bio-refineries. The Center will explore several pre-treatment technologies suitable for the process, economic feasibility study, outreach to farmers, increasing industry partnerships and market development.

Congressional Action Needed: Continuation appropriation of \$2.4 Million for FY 2012 is requested.

Importance to Montana: Recent studies indicate that aircraft are responsible for about 3.5% of global warming, a figure that could rise to 15% in 50 years. The United States consumes about 22 billion gallons of jet fuel from the 73 billion gallons produced worldwide. Based on current consumption, If 20% of jet fuel came from renewable sources, U.S. oil imports could be reduced by about 3.2 billion gallons annually. Agriculture is a cornerstone of the great part of Montana's economy. With the recent decision by the FDA approving Camelina feedstock up to 10% blend for beef feed, it is estimated that Camelina as a feedstock for biodiesel will become profitable. In Montana alone, cultivation of Camelina has dramatically increased from 450 acres in 2005 to over 50,000 acres in 2007. Camelina is a low-input crop that can grow on marginal lands, requires very little fertilizer and compliments wheat farms for use as a rotational crop to help protect against disease. Most importantly, Camelina is an industrial oilseed and does not conflict with the food market. The market for Camelina will grow as more industrial-value added products are developed. Customers from local, national and International markets have identified Northern as a leader in the development of some of the technologies that will lead to these products.

Contacts: Dr. Frank Trocki, Chancellor, Montana State University Northern (406) 265-3720

Project: Montana Algal BioDiesel Initiative

Brief Description: This funding will be used to harness the CO₂-rich emissions from fossil fuel burning power plants as a feedstock to support the growth of biodiesel producing algae.

Executive Summary: The design and implementation of strategies to exploit emissions from fossil fuels to produce energy will make the utilization of fossil fuels more energy efficient and simultaneously reduce harmful emissions. The innovative utilization of high temperature emissions requires an expertise unique to MSU with specific knowledge of how to isolate and maintain photosynthetic CO₂ fixing organisms capable of growing optimally at high temperatures. Focus is on characterizing organisms that can convert CO₂ emissions from fossil fuels into renewable fuels and chemicals. The approach supports the effective and responsible use of existing fossil fuel reserves and at the same time provides new innovative technologies that can be directed at alternative renewable energy strategies to supplement their use.

Congressional Action Needed: An appropriation of \$1,000,000 is requested. DOE Golden Field Office to support this research.

Why is this project a good use of taxpayer money? MSU is in a key position to develop technologies to utilize the CO₂ rich emissions produced in fossil fuel utilization and has assembled world experts in the area of high temperature microorganisms. The high temperature geothermal environments in Yellowstone National Park represent one of the few environments on earth where these organisms flourish in abundance. There is a tremendous knowledge base at MSU concerning the growth characteristics of photosynthetic microorganisms in biofilms capable of producing biodiesel.

Importance to Montana: This bioenergy partnership will leverage the expertise of two internationally recognized research centers unique to Montana, the Thermal Biology Institute (TBI) and the Center for Biofilm Engineering (CBE) to implement unique approaches to maximize energy efficiencies. With the TBI and the CBE, Montana State University is in an ideal position to apply innovative strategies to improve the energy efficiency of fossil fuel utilization.

Contacts at MSU:

Thomas J. McCoy, Vice President for Research (406) 994-2891
Robert Marley, Dean of Engineering (406) 994-2272

Project: Enhancing the Value of Renewable Energy Storage and Conversion for Rural America

Brief Description: \$1.5 million is requested to develop technologies supporting efficient storage and effective deployment of clean energy resources, including wind and biomass, in rural areas where these resources are typically most viable.

Executive Summary: Renewable energy sources are difficult to use effectively in the current energy infrastructure because of their time varying nature. Wind, photovoltaic, and bio-mass sources show seasonal, daily and even minute to minute fluctuations in energy availability, in contrast to always-on coal-fired and nuclear power plants. Utilities offset the variability of renewables with fast-response gas turbines, spinning reserves, and hydroelectric power. These auxiliary sources reduce the environmental benefits of wind and other renewable energy assets. Solving this temporal mismatch of supply and demand requires an efficient storage capability that does not currently exist in the electric grid. Such capability would enhance the value of these resources in the electric energy market. The proposed project promotes integrated development of technologies needed to realize an efficient, multi-timescale “energy warehouse” that uses complementary wind and biomass resources.

Project Description: The most desirable use of renewable energy resources is to store the power they produce for on-demand access without discarding power at peak production. Such a scheme requires overcoming critical challenges of round-trip efficiency and temporal flexibility. Specifically, an energy warehouse system must provide very high energy storage and efficient conversion of stored energy at a low cost compared to the value of peak energy production. Storage must also work effectively on multiple time-scales, ranging from transient events to seasonal variations. Facile transition between energy storage and energy conversion is enhanced by bringing together multiple renewable energy resources that have complementary access times and storage costs. Montana State University has identified and begun developing cornerstone technologies that address these requirements through the interdisciplinary work of researchers across campus. Efforts include projects in engineering, physics, chemistry and materials science, and these projects are overcoming the challenges of realizing an effective, renewable energy storage solution. One promising project is a high-temperature hybrid battery that combines energy storage in a liquid metal electrode with electrolysis capability. This device offers fast- (liquid metal) and slow-response (electrolysis) energy storage mechanisms that are inherently efficient and robust. During periods of high wind availability when the liquid-metal storage is saturated, the hybrid battery will be used to convert biomass fuel streams into energy dense, low molecular weight fuels that can be used cleanly and directly at later times to generate electricity, thereby offsetting seasonal variations in wind with the seasonal availability of biomass. Efficient conversion of multiple fuel streams requires enhanced understanding of fuel reformation, interface chemistry, and degradation mechanisms in electrochemical devices including batteries, capacitors and fuel cells. Integrating battery and biofuel technology in a renewable energy storage solution allows the use of peak wind power for reversible electro-oxidation and biofuel processing, thus increasing the value of both wind and biofuel resources. Hybrid energy storage systems of this kind have no precedent on the grid, and models must be developed to couple this energy storage and conversion capability with existing infrastructure. These models will quantify the advantages of matching biofuel resources to specific local crop and agricultural by-products. The ultimate outcome of the project is a suite of technologies enhancing the value and reducing adverse environmental impacts of renewable energy.

Congressional Action Needed: Funding of \$1.5 million dollars in FY12.

Importance to the Nation: The proposed technologies would support increased development and efficient utilization of peak production capabilities of clean energy resources. This accomplishment would ultimately enhance the energy independence and security of the United States while reducing climate degrading emissions and the environmental impacts of using hydroelectric and fossil-based resources to compensate for wind variability. Because this project depends ultimately on wind energy coupled to energy conversion technologies in rural locations, Montana is a clear choice to develop the proposed energy storage and conversion facilities. Montana boasts considerable wind and biomass resources, and project participants enjoy internationally recognized leadership roles in energy research.

Contacts: MSU: Dr. Tom McCoy, Vice President for Research, (406) 994-2891

Project: Yellowstone Hydrothermal Flow System in the Yellowstone Controlled Ground Water Area

Brief Description: Geothermal energy is a renewable alternative energy source which can reduce generation of greenhouse gasses. There are known areas of potential geothermal energy generation near Yellowstone National Park. Evidence from the United States, Mexico, Iceland, and New Zealand shows that geothermal development can significantly impact natural geothermal systems and destroy surface hydrothermal features. While there is interest in geothermal energy, there is also a commitment to protect the unique hydrothermal flow system in Yellowstone National Park. In order to protect this system, the State of Montana and the National Park Service entered into a compact in 1993 to create the Yellowstone Controlled Ground Water Area (YCGA) in Montana. This controlled ground water area is designed to protect the recharge water, transmission water and discharge water for the Yellowstone hydrothermal flow system. A key component of the recharge and transmission of water to the Yellowstone hydrothermal flow system is the Madison Limestone Aquifer.

The questions that need to be answered include: Where does water recharge the Madison Aquifer? Where do large volumes of spring water discharge in watersheds within the YCGA? Is water transferred from the Madison to other units via structures or stratigraphic connections? Where are the recharge areas for Yellowstone National Park hydrothermal flow system in Montana? What geologic factors control the recharge pathways for the Yellowstone hydrothermal flow system in Montana (stratigraphic/structural)? What evidence from isotopic and geochemical data supports or denies flow to the Yellowstone hydrothermal flow system? The overall goal is to understand recharge and transmission from Montana to the Yellowstone discharge areas.

Executive Summary: In 1993 Montana entered into a compact with the National Park Service and created the Yellowstone Controlled Ground Water Area (YCGA). This compact was designed to protect the hydrothermal flow system for the Park. As pressure develops to exploit geothermal energy in Montana, more detailed information is needed to understand how water recharges the Yellowstone Flow System so that informed decisions can be made in the YCGA. This project will focus on identifying recharge locations, transmission zones and discharge areas through hydrologic, structural and stratigraphic analysis in the Big Sky region near Yellowstone National Park. The project will attack this question with stream measurements, spring inventories, geologic analysis, and geochemistry. This project has significant spinoff potential in two other areas as well. These include a better understanding of porosity, permeability and flow paths that might be important in carbon sequestration projects where the rocks are poorly exposed and with water-resource development in Montana.

Congressional Action Needed: An appropriation of \$600,000 is requested to support research and information transfer and so inform decisions made by the Technical Oversight Committee for the Yellowstone Controlled Ground Water Area regarding protection of Montana's portion of the Yellowstone hydrothermal flow system.

Why is this project a good use of taxpayer money?

This project will help Montana and the Federal Government responsibly manage water resource development adjacent to the world's first national park and advance our understanding of the nature of carbon sequestration reservoirs elsewhere in the state and nation.

Importance to Montana:

- Protect Yellowstone hydrothermal flow system and at the same time clarify where geothermal development may be appropriate.
- Support the Montana Compact and the Yellowstone Controlled Ground Water Area
- Better understand deep aquifers that have potential as carbon sequestration reservoirs
- Better understand deep aquifers for water resource development in Montana

Contacts at MSU

Tom McCoy, Vice President of Research, Montana State University (406) 994-2891
Paula Lutz, Dean, College of Letters and Science, (406) 994-4288

Project: Montana Energy Training Center

Brief Description: This funding will be used to create a multi-site regional energy training center to develop the workforce needed by Montana's emerging energy sector.

Executive Summary: The campuses of Montana State University in Billings, Great Falls and Havre (Northern) request funding to create a multi-site regional energy training center to develop the workforce needed by Montana's emerging energy sector. The funding will continue to train and retrain skilled workers who can fill high-priority jobs, as defined by industry and labor partners in various energy sectors. A combination of delivery modes will be utilized.

This project will combine and coordinate the capabilities of three Montana State University campuses to create a powerful statewide resource for curriculum development, new technologies, public outreach and training for workers in the state's energy industries. MSU-Great Falls will take the lead in wind technologies, MSU Billings will focus on short-term workforce training and credentials delivered both on campus and off-site at partner institutions and business locations. MSU Northern will continue their outstanding work in biofuels research, product development, education and training. The goal is to produce cross-trained technicians who are able to contribute in several energy technologies for design, installation and maintenance.

Congressional Action Needed: An appropriation of \$450,000 is requested.

Why is this project a good use of taxpayer money? This project will likely serve the workforce development needs not just of Montana, but of a much wider area in the western United States. It will expand existing energy programs offered by the three campuses and their partners, while developing programs in sustainable energy sources such as wind and solar (Great Falls), programs and equipment to complement a Mobile Energy Training Lab used to offer training at employer work sites and educational sites (Billings), and sustainable technologies including, bio-fuels, bio-lubricants, fuel and oil additives, wind, solar and future green technologies (Northern).

Why is this project important to Montana? This request is to train workers to fill anticipated jobs in the energy sector. Estimates are that Montana may need as many as 1,000 workers in the wind industry alone. Energy has always played a major role in Montana's economic story. Although that story has been dominated by coal, water and natural gas, renewable energy in the form of solar, wind and plants along with improved coal technologies have a growing influence. Montana ranks second in the nation in wind power capacity and has the potential to provide 20% of the nation's wind energy. According to the Montana Department of Commerce, small wind systems grew 300% between 2008 and 2009 and are expected to continue grow at a rapid pace during the next decade.

In southeastern Montana, the huge coal reserves have sparked international interest in the development of a coal to gas to electricity complex that would be both a significant source of energy in the west and a massive economic development opportunity for the Crow and Northern Cheyenne communities. The economy of south- central and Eastern Montana is increasingly dependent on collaborative efforts to maximize the potential of the robust energy industry and resulting construction trades. This initiative will develop a reliable pool of trained workers to immediately increase productivity for Montana companies.

The viability of processing oil seed crops into diesel fuel has been demonstrated and programs are underway to capitalize this work to improve processes so that utilization of these crops to produce fuel on a commercial level can become a reality. MSU-Northern will continue to develop biofuels technology, products, and enlarge their educational opportunities for students pursuing careers in the biofuels and sustainable energy fields.

MSU contacts:

Joe Schaffer, Dean/CEO, MSU-Great Falls jschaffer@msugf.edu 406.771.4305

Rolf Groseth, Chancellor, MSU-Billings rolf.groseth@msubillings.edu 406.657-2300

Frank Trocki, Chancellor, MSU-Northern frank.trocki@msun.edu 406.265.3720

PROJECT: Expanding the Success of First Generation College Students in STEM Disciplines

Executive Summary: Montana State University-Bozeman requests \$300,000 to develop and implement a program to support first generation students, especially Native Americans, the disabled and veterans, in managing "barrier" courses. Certain academic courses, including math, statistics and chemistry are often "barriers" to students wishing to pursue courses and majors in the STEM disciplines. The situation is particularly acute among first generation college students. MSU, as a major research institution with strong programs in the STEM areas is well positioned to provide assistance in these areas and has a responsibility to do so.

Project Description: Montana State University-Bozeman currently offers support services to more than 300 students a year who are first generation college students. These students face a complex range of issues, both academic and social which they must deal with in order to persist in their education and graduate. Retention and graduation rates for these students tend to be lower than the rates for the student population at large.

Retention and graduation, not to mention attraction, of students from these groups is particularly challenging in the STEM disciplines. Research already conducted at MSU indicates that there are certain courses that tend to pose particular difficulties for students and can deny them the opportunity to pursue studies and graduation in STEM areas. This is particularly troubling at a time when the US is seeking an expanded and diverse workforce in these areas in order to ensure that our nation will remain competitive in the decades ahead.

Montana State University-Bozeman is particularly well positioned to assist these students, both because of its track record working with such students and also because of the broad education offerings and research which it conducts in the STEM areas. Research, generally focusing in the STM areas, exceeds \$100 million per year at MSU.

With the requested funds, MSU proposes to formalize and implement a program designed to help first generation students succeed in "barrier" courses.

Relevant courses will be selected and evaluated to determine specific deficiencies often confronted by first generation students and to identify the remedial work necessary. Current efforts invoking applied learning strategies, on-line academic support and other interventions will be strengthened and specifically targeted to the "barrier" courses.

The objective is to increase the success rate of first generation college students in "barrier" courses and to enable them to pursue degrees in STEM disciplines in order to increase both the number and diversity of students entering these areas which are so important to our nation's future competitiveness.

Congressional Action Needed: Funding of \$300,000 in FY 2012.

Importance to the Nation: The US needs an expanded workforce in the STEM disciplines in order to pursue continued technological advances, develop high paying jobs and remain globally competitive. Expanding the diversity of this workforce is a high priority both in terms of securing the numbers of trained personnel needed and in enabling less represented groups to participate more fully in these areas.

Contacts: Thomas J. McCoy, Vice President for Research, (406) 994-2891

Project: Great Falls Center for Healthcare Education and Simulated Hospital Training

Brief Description: MSU-Great Falls College of Technology and MSU College of Nursing, Great Falls Campus request \$300,153 for Healthcare Education and Simulated Hospital Training Center to serve Northcentral Montana.

Executive Summary: MSU-Great Falls has eight healthcare programs requiring students to practice clinical hours ranging from 60 to almost 2000 per student prior to graduation; MSU College of Nursing has 100 nursing students on the Great Falls Campus who require more than 1,000 clinical hours per student. But healthcare facility time and patients are at a premium. These colleges also compete for clinical space with a nursing program from MSU-Northern, as well as out-of-state programs that place students in clinical rotations in Montana. A scheduling chart shows that during the semester, students are in Benefis Healthcare every week day. Healthcare educators must find innovative ways to better use the clinical time and space available. Instruction and practice with simulation equipment prepares students to make better use of their limited clinical time. Further, evidence suggests simulation practice can replace some of those clinical requirements, allowing more students to enroll and ultimately enter health professions.

Congressional Action Needed: An appropriation of \$300,000 is requested.

Why is this project a good use of taxpayer money? Demand for healthcare workers is high, but healthcare programs cannot expand. The limited clinical space has forced the colleges to enforce enrollment caps. Each year, three times more students apply for positions in healthcare education programs than can be accepted. More than 300 healthcare and nursing students will be enrolled in education programs that will require clinical experience and will benefit from simulation practical exercises. Based on previous placement surveys, MSU-Great Falls estimates that 90-95% of the graduates will be employed or will seek additional education after graduation. In addition, this effort would serve not only pre-licensure students, but also licensed healthcare professionals needing continuing education; licensed unemployed healthcare professional seeking refresher education and training to re-enter the workforce; and healthcare faculty. MSU-Great Falls and MSU College of Nursing believes the expanded capacity for healthcare simulation could ease this pressure and play a significant role in the economic and personal health of the state. Education is a proven investment both in improving wages, but also in keeping this vital industry strong. But the cost of maintaining quality in this technologically challenging field requires a coordinated approach that includes private funding, tuition, state funds and federal support.

Importance to Montana: Healthcare is one of the truly necessary industries in our society. Not only do most of us, at some point, need healthcare services, but healthcare also is vital for the economy, especially in rural areas. The Montana Department of Labor ranks healthcare as one of the top 10 employers in all of the 11 counties in Northcentral Montana. The department projects a 1.9% employment growth rate from 2008-2018 in Montana's Health Care and Social Assistance sector, projecting there will be 72,491 jobs in this sector by 2018. A 2005 study by Paulien & Associates listed healthcare as one of the top three industries with the most potential for growth for the region. Healthcare jobs are appealing to workers. A June 2009 recent report, *Labor Availability in North Central Montana* by the Bureau of Business and Economic Research, notes that across the region, 6.4% (7,200) of adults in Northcentral Montana are unemployed, and that an additional 3.1% (3,500) are involuntarily working part time. The report said 14,200 people in the region are willing to be trained in health service fields. All of these factors point to the potential for growth and strength in the healthcare sector. But this industry faces a constant recruiting challenge. And the state's educational institutions cannot meet the demand because of the clinical limitation. How to get unemployed and underemployed workers into healthcare jobs is a huge challenge that will take creative solutions. Simulated hospitals need to be developed and tested so they can help ease the strain on clinical availability.

Contacts at MSU:

Joe Schaffer, Dean/CEO	MSU-Great Falls College of Technology	(406) 771-4305
Helen Melland, Dean	MSU College of Nursing	(406) 994-3784

Project: Rural Professional Development Partnership

Brief Description: The College of Education (COE) and the Montana Center on Disabilities (MCD) at MSU Billings in cooperation with the Sidney Montana Public Schools propose a Rural Professional Development Partnership for rural educators in Eastern Montana. Professional development efforts will focus on community literacy and use of educational technology.

Executive Summary: With Sidney, Montana as the hub, the Rural Professional Development Partnership will provide professional development opportunities for Eastern Montana educators. With emphases on literacy development and use of educational technology, educators will be able to earn bachelor or master level degrees, improve their ability to teach Eastern Montana children and youth literacy skills and increase their ability to integrate the use of educational technology in their classrooms.

Project Description: The project will involve Rural Literacy Centers and a mobile Rural Technology Lab. The Sidney Public Schools administration will serve as the initial Rural Literacy Center. Through this center, equipped by the public schools with computer and interactive television (ITV) equipment and capabilities, area educators will be able to earn a baccalaureate degree with a major in reading and/or a graduate degree in reading or educational technology. As part of the degree, literacy clinics will be offered throughout the year for individuals pre-school through adult. Clinics will focus on improvement in literacy, be that improvement in language development, early readiness, readiness for transition from high school to college or continuing development to improve workforce performance. The Rural Literacy Center will:

- Collaborate with other related agencies (head start, early head start, even start, libraries, community colleges, home schools), families and community businesses.
- Deliver diagnosis and instruction to individuals
- Teach reading and writing to small groups and classes
- Provide instructional support to anyone working toward literacy development
- Prepare highly qualified reading educators.

The Rural Technology Lab will be a van, equipped with 12 laptops, 12 iPads, 12-person clicker response system, interactive white board with 6 writing slates, 6 flip video cameras, 6 document cameras, 3 interactive gaming consoles with controllers and educational games. Based in Sidney, the van will make weekly trips to schools throughout Richland, Roosevelt, McCone and Dawson Counties. Both educators and students will benefit from technology use and training. The Rural Technology Lab will:

- Promote technology literacy in rural areas
- Introduce educators and learners with state-of-the-art computer technology
- Demonstrate enhanced uses of technology in educational settings
- Prepare educators for teaching and students for learning through on-line environments.

Congressional Action Needed: An appropriation of **\$300,000** is needed to initiate this project.

Importance to Montana: Eastern Montana is a vast and sparsely populated area. Because of its size, there remain many small, remote, rural schools. Small size often means that educators may not have opportunities for professional development and schools may not be able to purchase the latest equipment. Professional development in both areas—literacy and technology—are essential for economic development throughout this area. The Sidney Public Schools has developed goals in for reading achievement, necessary for meeting Adequate Yearly Progress (AYP) under the No Child Left Behind (NCLB) legislation. Use of technology allows high school students in small schools to access subject areas and advanced placement classes not affordable locally. The Rural Literacy Center and the Rural Technology Lab, working together, can result in significantly improved educational opportunities—opportunities that will increase the educational levels of Eastern Montana residents, increase workforce preparedness and efficiency, and ultimately improve the economies of the counties affected by this project.

Contacts at MSU Billings: Chancellor Rolf Groseth
207 McMullen Hall
MSU Billings
1500 University Drive
Billings, MT 50101
406 657 2300
rgroseth@msubillings.edu

Project: Native American Bridge/Degree Development Program

Brief Description: A Mentoring/ Peer Counseling Program for Native American students that facilitates the bridging from the Reservations and Tribal Colleges to Montana State University Northern. In addition, MSUN seeks to partner with four of Montana's seven reservations (Blackfeet, Fort Belknap, Fort Peck and Rocky Boy) in developing degrees that are highly marketable, sustainable and provide for the improvement of tribal community welfare and economic growth. These four tribes represent 46% (33,232) of the state's total Native American population residing on reservations (BIA, Tribal Labor Force Report, 2007).

Executive Summary: There is a need for a bridge program on the campus of MSU-Northern to help those Native American students coming to Northern from the Montana Reservations and Tribal Colleges. The adaptation culturally for the Native American student is often times traumatic. The Native American Bridge Program would facilitate the Native American student in bridging from their culture to another culture. The program would be set up to help in this transformation and teach survival skills within the university environment. This type of program is essential in the retention of Native Americans and in reaching the ultimate goal of graduating.

MSUN is also unique among Montana's University System (MUS) and is distinguished not only by its close geographic proximity to four of Montana's seven tribal reservations but is distinguished by having the greatest percentage of Native American enrollment (14.16%) compared to an average 3.88% for the other campuses within the college system; by having the second largest four-year graduation rates of Native Americans within the system at 23%, and having the greatest number of Native American employees with 2.6% (MUS Diversity Report, 2009). Despite these achievements, national and state data reflects an urgent need to realistically and creatively address the 65% unemployment rate and the 25% of Native Americans residing in the Indian communities adjacent to MSUN who are employed but live below federal poverty guidelines (BIA, Tribal Labor Force Report, 2007). This data clearly illustrates that despite current federal and state initiatives (HB 670) to improve the welfare and quality of life for its Native American citizens, the problems of education and poverty still persists.

Project Description: The Native American Bridge/Degree Program through mentoring/counseling would help to retain Native American students. The Mentors/ Peer Counselors would be tribal members from the different tribes around Montana who have been at Northern for at least one year and have been successful in their educational pursuits here at Northern. The establishment of an orientation to receive the Native American students and orient them to the Northern campus and all the services that are offered would be essential in making them feel comfortable in their new environment. The noting and recognition of cultural differences would help in attaining survival skills in this new environment. The Mentors/Peer Counselors would meet with their students individually on a regular basis to talk to them about their progress as well as any academic or personal concerns they might have. Also the Mentors/Peer Counselors and the students would engage in both educational and social activities that would enrich their lives.

Also, an important finding by the American Indian College Fund (2009) found that 73% of tribal college students seek to make better lives for their families and communities and the 64% wanted to use their education to help their people. MSUN seeks to build off this desire by tribal college graduates by working with tribal entities including tribal governments, tribal economic development offices, the State Tribal Economic Development Commission, as well as, each of the four tribal colleges to identify and develop needed professional or occupational 4 year degrees needed by their communities. Program identification will enable to build curriculum that would be offered in the future.

Congressional action needed: An appropriation of \$325,000 for FY 2012 is requested.

Importance to Montana: Montana has the largest enrollment per capita of Native Americans and 80% of the reservation population is unemployed. The Bridge program would assist Native American students entering college from the Montana Reservations and Tribal Colleges which is often times traumatic. The Native American Bridge Program would help in this transformation and teach survival skills within the university environment. This program could be a huge benefit in the retention of Native Americans and in helping them reach the ultimate goal of graduating. This could also help increase the employment rate in Montana.

Contact: Dr. Frank Trocki, Chancellor, Montana State University Northern (406) 265-3720

Project : A Montana-Mississippi Partnership in Unmanned Aircraft Systems for Civilian Applications

Brief Description : The safe integration of unmanned aircraft systems (UAS) and remotely piloted aircraft in the national airspace is a priority that will enable high-value applications in multiple sectors, create a new civilian UAS industry and jobs, and enhance the use of airspace. This request would fund an FAA Center of Excellence including Montana State University, Mississippi State University, MSU-Northern, and Rocky Mountain College to address policy and technology questions associated with safe of UAS integration.

Executive Summary : Safety is the primary concern in the integration of UAS in the national airspace system. UAS access to airspace requires specific authorization granted to a public agency, which impedes UAS training and development of civilian UAS, applications, and payloads. The Mississippi-Montana partnership proposes to address this issue by providing technology, training, and policy results that will help FAA move towards civilian UAS airspace integration. The Mississippi-Montana Center of Excellence represents a civilian counterpart to the DoD Joint UAS center at Nellis AFB, and is needed as a partner entity that can add data and transparency for civilian UAS applications not addressed by DoD. Through the center, Montana and Mississippi will incubate UAS applications of significant economic and intellectual value, both to FAA and our respective states. Economic benefit from the center would be distributed across both states, and favorably position universities and businesses to compete for an estimated 125 million dollars per year in additional federal funding. The partnership offers inherent operational safety through the isolation of the Hays area in Montana and the Stennis Space Center buffer zone in Mississippi. The center would produce a framework of results to help FAA move towards policies and procedures for civilian UAS integration on the basis of integrated technology, policy and training. This framework would open UAS airspace access, enable a new civilian UAS industry, and provide enhanced opportunities for UAS in support of civilian government and private-sector applications.

Project Description : The Mississippi-Montana partnership's three-sided technology, training and policy approach is intended to provide a diversity of information to FAA to integrate civilian UAS in the airspace effectively, safely, and economically.

Researchers in Montana are developing reconfigurable computer technology using off-the-shelf gate arrays. These computers can meet stringent reliability requirements at low cost and without re-use of sensitive military equivalents in civilian UAS. Similarly, Montana State is developing electrically "steerable" antennas that could prevent jamming and signal hi-jacking attempts from turning UAS into improvised weapons. Montana has expertise in aerospace prognostics and health management that could help anticipate and avoid UAS failures and increase safety. Both Montana State and the Raspet Flight Research Laboratory in Mississippi have extensive experience in development of lightweight composites that enhance safety in an integrated airspace by reducing the mass of UAS. Montana State has expertise in building high-performance optical remote sensing instruments, while Mississippi state has extensive experience modeling remote sensing data. The proposed center would involve collaboration with industry partners, particularly for the development of high-performance, compact imaging systems. These advanced instruments, combined with stable airframe design and controls, could perform a broad range of remote sensing and data collection tasks on smaller, safer UAS.

The proposed center includes Rocky Mountain College, an accredited flight school, to develop training curricula and standards for civilian UAS pilots. Both MSU partners have experts in human factors, operator attention assessment, and aviation training who could collectively define training, human interface, and operations standards for civilian UAS operators that enhance safety.

Airspace integration of UAS has an extraordinary degree of complexity and technical diversity that must ultimately converge in sound public policy. Mississippi State has a long history of melding technical expertise and public policy through the Department of Political Science and Public Administration and the Stennis Institute of Government. The partnering institutions intend to help FAA by closely coupling policy recommendations with the development of UAS technology and training through a UAS Center of Excellence.

Congressional Action Needed: Funding of \$5 Million to FAA/DOT.

Importance to the Nation: Integration of civilian unmanned aircraft systems with national airspace is a national priority that will create new industries, new jobs, and benefit government and the private sector. Montana and Mississippi State Universities have a partnership uniquely suited to help FAA meet this imperative.

Contacts: MT - Dr. Thomas J. McCoy, VP for Research (406) 994-2891,
MS - Dr. David Shaw, VP for Research (662) 325-3570
MT – Dr. Robert Marley, Dean, College of Engineering, (406) 994-2272