

Research Priorities for MSU and the College of Engineering

Fall 2006

University Themes in Research Development

University research initiatives

(in progress)

Vice President for Research

Spring 2006

- *Bioeconomy - biotechnology*
- *Environmental science and public policy*
- *Family, community, and economic involvement*
- *Health and biomedical research*
- *Homeland security*
- *Nanotechnology*

Selecting Research Themes in the College of Engineering

The rate of growth of scientific knowledge, the related explosion in development of new technologies, and the evolution of a global economy present an exciting but challenging scenario for setting the research agenda of colleges of engineering across the nation.

In order for the College of Engineering at MSU to be a world-class contributor we have identified a targeted set of research themes on which to focus our near-term efforts and available resources.

Our Priority Research Themes

- *Bio-economy / renewable resources / environmental protection*
- *Biomedical engineering and health services*
- *Energy and transportation*
- *Materials and nanotechnology*
- *Security: High-assurance systems / resilient structures / risk assessment*

Biomedical engineering and health research

Expected outcomes of establishing the **Institute for Engineering and Health:**

- **Research.** *Increased number of research proposals to NIH and other agencies with an interest in health-related research. Increased research expenditures. Larger-scale proposals submitted (e.g., NIH Program, NSF center). Enhanced academic reputation in biomedical research (e.g., increased publication citations). Stronger interaction with industry (more ties, increased support).*
- **Education.** *New and modified courses with biomedical content, serving engineering, natural science, and professional majors. New certificate and option programs. Joint MD/PhD degree program.*
- **Outreach.** *Increased patent and commercialization activity. Perhaps a measurable impact on health care delivery through our community hospital affiliations.*

Energy and transportation research

Energy plays a crucial role in our society, affecting the economy, our health and well-being, our strategic position globally, and the environment. The major facets of energy are generation, conversion, distribution, and end use. We have identified three pillars on which to build a robust, integrated and collaborative energy research program.

- *BIOECONOMY and RENEWABLE RESOURCES*
- *TRANSPORTATION*
- *ENERGY CONVERSION DEVICES AND SYSTEMS*

Energy and transportation research

RENEWABLE ENERGY

- **Research Topics:** *bio-based fuels, bio-based energy, bio-based materials, biomass conversion*
- **Colleges/Units involved:** *ANR, COE, CNS, CSS, MAES, MSU Extension*
- **Educational/other impact:** *undergraduate option, graduate MS option, commercialization*
- **Leadership:** *D. Miller, B. Dale, A. Srivastava*

Energy and transportation research

ENERGY CONVERSION DEVICES AND SYSTEMS

- **Research Topics:** *photovoltaics, engineered photosynthesis, nanoscale devices*
- **Colleges/Units involved:** *COE, CNS*
- **Educational/other impact:** *undergraduate research, graduate research, commercialization*
- **Leadership:** *M. Mackay, T. Hogan, N. Kanatzidis, D. Tomanek, F. Peng, E. Strangas*

Nanotechnology

Nanotechnology is a university-wide research initiative led by the College of Engineering jointly with the College of Natural Science. The impact of nanotechnology research is felt in the following areas:

- *Biomedical and health research (e.g., CNBI)*
- *Materials science and engineering research*
- *Energy/transportation research*
- *Environmental research*

Sustainable economy / Renewable resources / environmental protection

This is a major university initiative. The ESPP is a lead organization. Topics of interest include

- *Bioeconomy*
- *Environmental monitoring and remediation*
- *Sustainable agriculture and food supply*
- *Water quality and quantity*
- *Renewable resources – green materials, manufacturing and energy*

Safety and security – high-assurance systems

- **Research Topics:** *high-assurance (computing) systems -- applications in financial, health, supply chain, automotive, ecological areas*
- **Colleges/Units involved:** *CANR, CAS, CBUS, COE, CNS, CSS*
- **Educational/other impact:** *undergraduate courses and research, graduate courses and research, commercialization*
- **Leadership:** *B. Cheng, P. McKinley*
- **Focus:** *Center for High-assurance Systems*

Safety and security – resilient structures

Concept: *mitigate dangers from fire and blast in critical structures, such as aircraft, large buildings, buildings that house hazardous materials or animals.*

- **Research Topics:** *fire- and blast-resistant structures – sensors and warning systems, design, materials.*
- **Colleges/Units involved:** *COE, CNS, CSS, CVM*
- **Educational/other impact:** *undergraduate courses and research, graduate courses and research, commercialization*
- **Leadership:** *V. Kodur, R. Burgueno*