CREATING A SUSTAINABLE ENERGY FUTURE

Generation, delivery, and efficient use of energy are at the center of a wide variety of technological and societal problems that will be pervasive throughout the century.

- The world uses more than 10 terawatts (TW) of power and this may double by 2050
- No single technology will provide our energy needs
- We need a combination of renewable technologies with substantial improvements in energy efficiency

BIOENERGY
The vast majority of imported oil is used for transportation. The U.S. is capable of producing over 1 billion tons of biomass annually – enough for 60 billion gallons of ethanol per year (30% of today’s transportation fuel usage). Research is focused on learning how to exploit nature’s own conversion methods to create biofuels and other bioproducts, and the development of a new generation of optimized bioenergy crops.

FUEL CELLS
Fuel cells represent a clean power source for transportation and residential and commercial applications. Whilst the original fuel cells required hydrogen, alternative fuels such as methanol and formic acid show promise. Microbial fuel cells use organisms or enzymes to convert organic matter into electricity and may be suitable for small engine replacement.

HYDROGEN
The promise of the hydrogen economy is too great to ignore. Effective storage of hydrogen is a key element of the hydrogen economy. Onboard hydrogen storage for transportation applications is a major challenge because of the stringent requirements, e.g., charge/recharge near room temperature and rapid hydrogen release rates. Because of their enormous surface areas and unique surface structures novel nanomaterials may represent the most viable approach.

NUCLEAR
Nuclear power provides about one-fifth of the electricity used for commercial, industrial, and residential power. The benefits of nuclear power are cleaner air and lower energy prices. It is essential to develop the knowledge necessary to protect the biosphere from the hazards associated with this technology. Central to finding solutions to these problems is gaining a more complete understanding of the chemistry of the long-lived radioactive materials that are created as byproducts of nuclear fission.

POWER GRID
Disabling the U.S. electricity grid could cripple the economy. The 2003 blackout in the Northeast cost between $4 billion and $10 billion in just a few days. Securing the power grid from electronic attack is critical to enhancing energy security. Integrating distributed energy sources such as solar power will significantly reduce the risk of grid failures.

SOCIAL AND ECONOMIC ISSUES AND PUBLIC POLICY
The issues associated with energy are complex and policy decisions are often based on technology issues that are not widely understood by the general public. Improving technological literacy is a key step in creating a more informed citizenry able to engage in discussions on energy policy. Understanding how societal issues impact energy demand and use are important in increasing efficient use of energy.
SOLAR ENERGY
Solar energy provides only about 1% of U.S. annual energy consumption, but represents the only source that can satisfy projected global energy demands. New technologies for solar energy capture such as the use of nanomaterials and dye-sensitized solar cells could significantly reduce the costs of this technology and increase efficiency and performance.

SUSTAINABLE DESIGN
Commercial and residential buildings consume about one-third of all U.S. energy and two-thirds of U.S. electricity. The energy demand can be reduced through the use of more efficient materials and the integration of renewable energy systems. The U.S. Green Building Council published LEED (Leadership in Energy and Environmental Design) standards that are guiding many architects and developers.

We are organizing our energy research into a number of campus level multidisciplinary centers:

AGRICULTURAL RESEARCH CENTER
The mission of the ARC is enhancing the sustainability of agricultural and economic systems. Faculty research in bioenergy is directed at the development of new sources of biomass crops and their incorporation into agricultural production systems in Washington.
arc.wsu.edu

CENTER FOR BIOPRODUCTS AND BIOENERGY
Washington’s abundant biomass resources could be converted into 50% of our annual residential electrical needs or 1 billion gallons of ethanol. Faculty in the Center for Bioproducts and Bioenergy are developing systems and technologies that grow and utilize regional biomass to produce chemicals, materials, pharmaceuticals, nutraceuticals, fuels, and energy. The center is acting as a catalyst for technology transfer in the state and region.
bbyse.wsu.edu/core/Research/Centers/CBB/cbb.html

CENTER FOR ENVIRONMENTAL RESEARCH, EDUCATION AND OUTREACH
The use of fossil fuels creates a number of environmental problems. Chemicals released by burning coal have been directly linked to cancer, developmental disorders, and adverse neurological and reproductive effects. Fine particulates from power plants cause over 24,000 premature deaths in the U.S. alone. The Center for Environmental Research, Education, and Outreach facilitates environmental research and collaboration across campus in a number of areas including: global climate change and energy and cleaner air and water.
cereo.wsu.edu

CENTER FOR MATERIALS RESEARCH
Developments in advanced materials and nanomaterials are critical for many renewable energy technologies, such as photovoltaic systems for full spectrum solar energy capture and catalysts for fuel cells. Faculty in the Center for Materials Research are also working on micro energy systems using MEMS and other portable power systems.
cmr.wsu.edu

EXTENSION ENERGY PROGRAM
This program, which was established in 1976, provides technical assistance and policy analysis in support of the developing renewable energy industry in the state of Washington and nationwide. The technical expertise areas are: bioenergy, geothermal, hydrogen and fuel cells, solar, waste heat recovery, wind, and climate change.
energy.wsu.edu

NUCLEAR RADIATION CENTER
The Nuclear Radiation Center is the only research reactor in the state of Washington. Filling a unique research role it houses numerous experimental studies and projects, which examine the environmental aspects of radiation damage and radiological effects of fission products of relevance to safe storage of nuclear waste.
wsu.edu/nrc

POWER SYSTEMS ENGINEERING RESEARCH CENTER
PSERC is a nationwide consortium of universities and power companies. Research is directed at improving the operation, security, and reliability of the electric power grid. The center is also addressing emerging challenges such as how to balance power loads and generation, for example, transferring hydroelectric power and how to integrate power generated from small and distributed renewable energy sources, such as windmills and solar cells.
www.pserc.wisc.edu/

WOOD MATERIALS AND ENGINEERING LABORATORY
Faculty in WMEL lead development of sustainable building materials such as microbial polyesters for cost effective and energy efficient wood plastic composites. Through strategic alliances with industry and faculty in the School of Architecture and Construction Management they provide a forum for research and education in how to achieve the energy efficient realization of tomorrow’s built environment.
wmel.wsu.edu

For more information about the energy research programs at WSU, contact Professor M. Grant Norton at the address below.