A scientist at the Bioproducts, Sciences, and Engineering Laboratory (BSEL), a joint Pacific Northwest National Laboratory and Washington State University research facility in Richland, Wash., uses a liquid-handling robot to prepare metal solutions for later impregnation onto catalyst supports. The instrument is one example of the BSEL Combinatorial Laboratory's high-throughput testing capabilities that allow rapid screening of catalyst compositions, a first step in determining which catalysts have the potential to be developed for purposes such as bioproduct or biofuel production.

Pictured: Alan Cooper

Our researchers are developing tools to assess water impacts when growing biomass on land or in aquatic environments.

PNNL scientists are actively involved in solving climate issues at the international level. Twenty PNNL researchers were recognized for their contributions to the Nobel Peace Prize won by the Intergovernmental Panel on Climate Change in 2007. The panel produced authoritative assessments of the state of the global climate, the impacts associated with climate change, and the set of technological, institutional and policy options available to mitigate and adapt to climate change.

COLLABORATIONS

PNNL has major leadership roles in DOE's National Advanced Biofuels Consortium (NABC), National Alliance for Advanced Biofuels and Bioproducts (NAABB), Joint BioEnergy Institute (JBEI) and member organizations of the Joint Genome Institute. PNNL partners with world-class regional, national and international universities, such as Washington State University, University of Delaware, and Technical University of Munich. We also have active collaborations with other national laboratories, such as the National Renewable Energy Laboratory, Idaho National Laboratory, Los Alamos National Laboratory, Oak Ridge National Laboratory, and Argonne National Laboratory.

PNNL partners with industry to advance commercialization opportunities for biofuels and bio-based products. Our partnerships include companies from the petroleum, chemical, biotechnology, agriculture and forestry sectors.

ABOUT PNNL

PNNL's biomass conversion work is an important element in a wider portfolio of research and development funded by the Department of Energy (DOE), other federal agencies and the private sector. PNNL is a DOE Office of Science national laboratory where interdisciplinary teams advance science and technology and deliver solutions to America's most intractable problems in energy, national security and the environment. PNNL employs 4,700 staff, has a $1.1 billion annual budget, and has been managed by Battelle since the Laboratory's inception in 1965.

Contact:
Rick Orth, Ph.D.
Chemical and Biological Process Development
Pacific Northwest National Laboratory
509-375-6709
rick.orth@pnnl.gov

John Holladay, Ph.D.
Biomass Market Sector
Pacific Northwest National Laboratory
509-375-2025
john.holladay@pnnl.gov

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PNNL-SA-88222

May 2013

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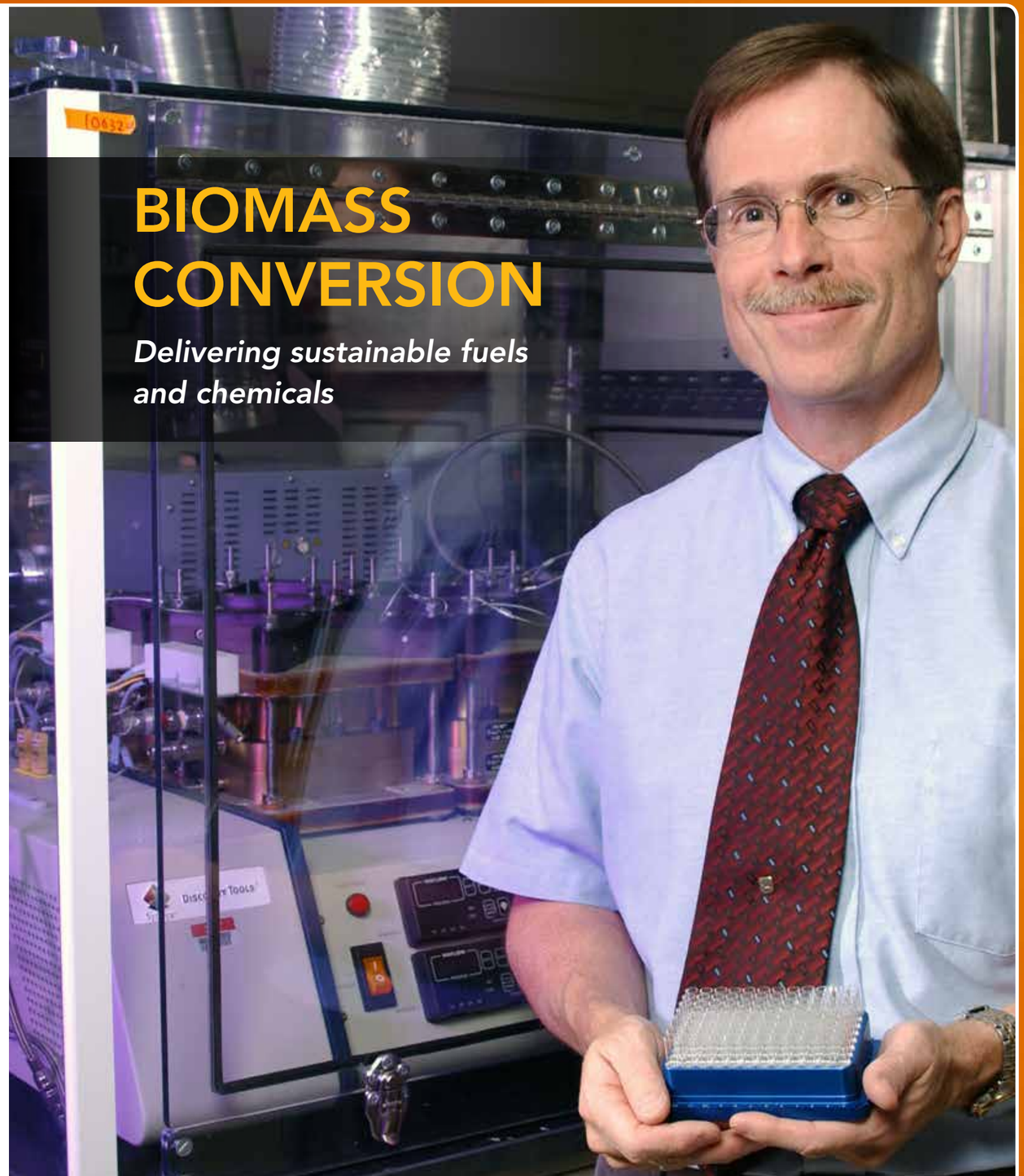


BIOMASS CONVERSION

Delivering sustainable fuels and chemicals

...a recognized leader in biomass conversion with over 40 U.S. patents, numerous scientific awards and contribution to a Nobel Peace Prize.

Pacific Northwest National Laboratory (PNNL) is helping drive technological advancements that reduce the nation's carbon footprint and dependence on petroleum by providing renewable options for fuel and chemical production. We are focused on developing the most efficient, economically viable and sustainable processes for converting biomass into fuels and products that can be immediately delivered to the market via the existing infrastructure.

BIOFUELS

Our researchers are using biotechnical and catalytic processes to develop the next generation of hydrocarbon fuels for use in gasoline, diesel and jet engines. These advanced biofuels, derived from sustainable, non-food-crop sources, will help reduce U.S. dependence on imported oil.

CHEMICAL PRODUCTS

We began developing the capability to convert biomass and its components to bio-based chemical products more than a decade ago. Since then, our conversion technologies have produced intermediate "building block" chemicals used in everyday products. From an economic perspective, our work is helping to maximize the types of products that can be produced in a biorefinery, providing flexibility and the potential for higher financial rates of return.

DISTINCTIVE CAPABILITIES

Catalytic and Thermal Processing

PNNL has been a leader in thermochemical conversion processes for more than 25 years, developing technologies to produce fuels and products from biomass. Our expertise includes pyrolysis, liquefaction and gasification processes that convert biomass into liquid and gas intermediates. We develop new catalysts used to upgrade these intermediates to finished fuels.

Biotechnology and Bioprocessing

PNNL scientists are developing new processes to convert cellulosic biomass to building blocks, primarily with research focused on translating genomic information into metabolic models, and then applying these models in conjunction with cell biology and proteomics methods to developing strains relevant to industry.

Our research programs focus on using filamentous fungi to convert complex terrestrial biomass to enzymes, chemicals and fuels. Our fermentation facility allows development and scale-up of those proven processes. We are also using systems biology tools to improve algal species, while simultaneously developing cultivation tools to assess algal growth in open ponds, simulating light and water temperature anywhere in the country at any time of year.

PNNL scientists are active in the U.S. Department of Energy (DOE) Office of Science's Joint Genome Institute and Joint BioEnergy Institute (JBEI) to provide a basic biological foundation upon which biotechnological advances may be built for advancing the DOE mission in renewable biofuels production.

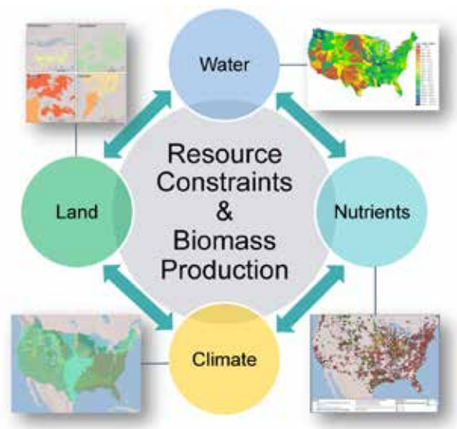
Hybrid Processes

A distinguishing characteristic of our work is developing hybrid approaches that combine biotechnology and catalysis, to create new processes. For example, there are opportunities to utilize biotechnology to convert biomass to distinct intermediates that are amenable for downstream processing via catalysis for the production of valuable fuels and chemicals.

Advanced Analysis

PNNL techno-economics capabilities are comprehensive, as evidenced by our ability to provide quick estimates and screening to determine a project's viability. We also address complex tasks, such as detailed heat and material balances and discounted cash flow economic analysis.

We use process economics to help focus our research and development efforts on the areas that have the greatest impact on reducing cost. During the R&D process, the models are constantly updated and provided to our industrial partners to provide estimates of capital and operating costs.



The Biomass Assessment Tool utilizes high resolution geographical information systems and physical models to address resource constraints for water, land, nutrients and climate.

The Propylene Glycol from Renewable Sources Process, winner of 2010 R&D 100 and 2011 Federal Laboratory Consortium Awards, is an example of PNNL's ability to help move laboratory concepts to commercial deployment. The process is used in a new Archer Daniels Midland processing facility in Illinois, providing an environmentally friendly, cost competitive alternative to petroleum for producing propylene glycol, a chemical widely used in consumer products.

Process models also provide information needed for life-cycle analysis. Our focus is to couple process economics with life-cycle analysis for process optimization.

PNNL is also actively involved in developing geographic information systems (GIS) to combine with physical-based models, creating a Biomass Assessment Tool (BAT). The BAT provides high resolution information about the land, sun, water, and nutrient inputs required to produce biomass.

Sustainability

Using biomass resources to produce fuels and chemicals requires sustainable practices for managing carbon emissions and water use. Our carbon management programs include advanced techniques for sequestering carbon dioxide, and global climate modeling that integrates the interplay between humans, climate technology, and economics.

PNNL's biomass program is housed in the recently constructed Bioproducts, Sciences, and Engineering Laboratory (BSEL) on the campus of Washington State University Tri-Cities.

The Environmental Molecular Sciences Laboratory (EMSL) is a DOE national scientific user facility located at PNNL that provides integrated experimental and computational resources for discovery and technological innovation.

The Biological Sciences Facility provides biological systems science focused on gaining a fundamental understanding of biological systems that are needed to more effectively use micro-organisms for renewable bioenergy.