

Harvest, Storage, and Transportation of Biomass

A cost-effective system for the harvest, storage, and transportation (HST) of biomass is essential to the success of transitioning from petroleum-based liquid fuels to biobased liquid fuels. The value chain for the production of biobased liquid fuels begins with germplasm development and ends with a variety of processing techniques. There are many companies that focus on germplasm and processing as their business models. The middle—the harvest, storage, and transportation of the biomass—however, is lacking an industry sector to drive its development. Iowa State University is forming an industry consortium to address these issues. The research will primarily be conducted at the New Century Farm, a facility being constructed to integrate the production and processing of biomass.

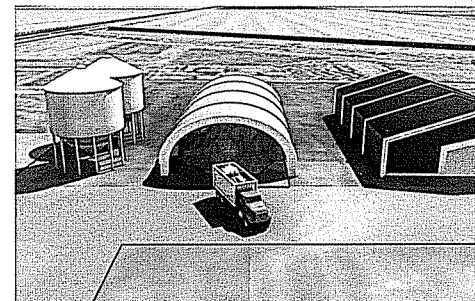
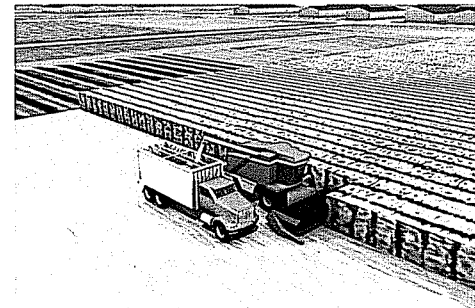
Iowa State University is bringing together industries across the value chain to support research in harvest, storage, and transportation of biomass.

The starting point of the consortium is the harvesting biomass composed of cellulose, hemicellulose, and lignin derived from ag residues of grain crops, dedicated energy crops, and woody/herbaceous crops. The ending point is delivery of a feedstock to a processing plant that is suitable for either thermochemical or biochemical processing. Research will include field trials on harvest, experimental investigations of storage options, and technical and economic analysis of HST issues.

Examples of potential projects include, but are not limited to:

- Preprocessing of biomass to improve transportation and storage
- Producer attitudes about growing and harvesting biomass
- Impact of HST on communities
- Impact of biomass transportation on roads and bridges
- Innovative storage solutions

Annual consortium dues are \$100,000 per company, starting in calendar year 2008. Research priorities will be driven by the member companies, with Iowa State faculty invited to submit proposals to address these priorities. Consortium members will then select research projects for funding.



Artist renderings credit: Trevor Brown

The HST consortium will bring together industries across the value chain.

Bioeconomy Institute

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If you are interested in joining the HST consortium, please contact Jill Euken, jeuken@iastate.edu.

New Century Farm

An Integrated Biomass Production and Processing Center

The New Century Farm at Iowa State University is planned to be the first integrated, sustainable biofuel feedstock demonstration farm in the United States. The New Century Farm will serve as a model for American biorenewable energy and bioproducts production and demonstrate the transformation of agriculture to become feedstock ready.

The emerging bioeconomy and the emphasis on renewable fuels produced from plants presents our nation—and especially rural areas—with an opportunity to develop new industries and to diversify its agriculture. Key to the success in attracting the development of biorefineries will be the ability of producers to grow the kind and quantities of feedstocks needed by the industry. It is widely recognized that the renewable fuels economy cannot be supported by corn grain alone — that a variety of annual and perennial cellulosic crops must be grown to complement corn and soybean production. If carefully designed and implemented, a transformed agriculture will

- serve the bioeconomy, as well as provide food and feed
- conserve soil, water, and other natural resources
- strengthen rural communities and improve the quality of life for those who produce and supply biomass materials

Achieving this vision of sustainable bioenergy and bioproducts production will require new crops and new cropping systems. It will require the integration of disciplines in the agronomic and biological sciences, social sciences, and engineering into teams focused on biofuels and bioproducts. It will require, at all stages of the research and development process, input from producers, industry representatives, and policymakers.

Fulfilling the Vision

The New Century Farm—the first integrated and sustainable biofuel feedstock production system of its kind—will play a critical role in fulfilling this vision. It will serve as a living laboratory for developing and testing sustainable biomass systems through rigorous integration of agronomic, environmental, and socio-economic research. It will be directly linked to molecular and traditional plant sciences as well as to advanced processing research. Basic and applied research will be conducted to achieve short-term and long-term advances in biorenewable fuels and biobased products. The New Century Farm also will provide a needed venue for education and training.

The New Century Farm's vision will encompass

Research that brings together scientific expertise to address biomass cropping systems, biofuel processing, logistics of biomass supply, and positive environmental effects such as recycling nutrients back to the land

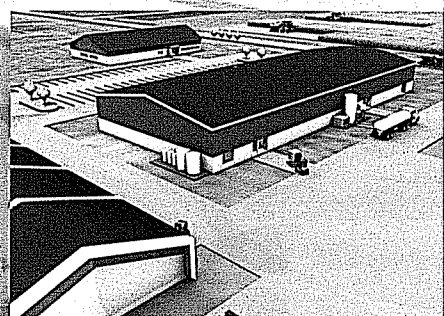
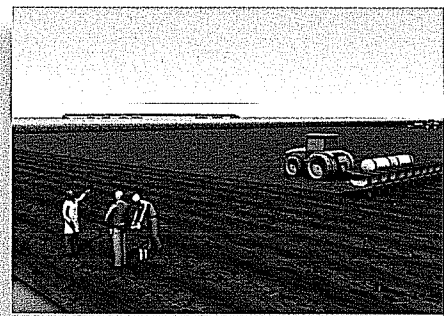
Teaching that serves as a laboratory and resource for training future scientists, producers, and extension experts

Extension that demonstrates economic, social, and environmental viability of biorenewable energy and bioproducts production to producers, policymakers, and the public

Research Questions

Research conducted on the New Century Farm will address some of the most critical questions facing biorenewables, including

- **Crop production:** What are the optimal biomass production systems (species, crop rotations, nutrient and energy inputs, management practices)?
- **Germplasm development:** How can selection and breeding improve conventional and alternative biomass crops (both herbaceous and woody)?

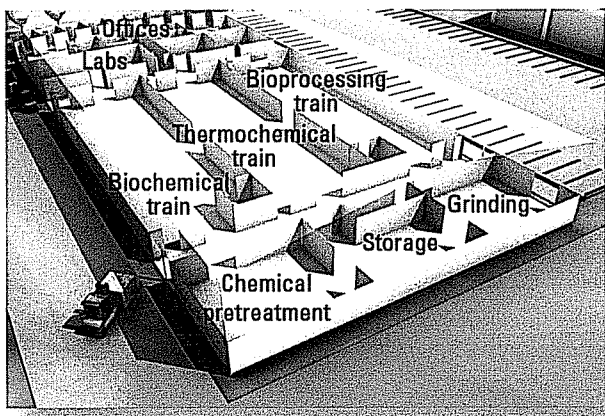


New Century Farm

- **Environmental impact:** How can biomass production improve environmental quality? What practices help ensure that producing and harvesting biomass will not compromise natural resources?
- **Harvest, transport, and storage:** Because biorefineries will require large amounts of bulky materials that need to be collected, stored, and transported, what new equipment and associated technologies will enable this to be accomplished most efficiently and with acceptable environmental tradeoffs?
- **Biomass processing:** In a test facility conducting comprehensive pilot-scale evaluations, how will biochemical, thermochemical, and hybrid technologies that convert biorenewables to fuels and biobased products perform? To what extent can processing byproducts be recycled through the feedstock production system to minimize inputs to the agroecosystem and improve soil?

Request and Justification

Iowa State University is located at the geographical, research, and educational center of the expanding bioeconomy. The university's research accomplishments and expertise in biorenewables date back to the 1970s. Today Iowa State's internationally recognized biorenewables programs offer the only graduate degree program in biorenewables in the nation. Iowa State has close collaborative relations with major agricultural and chemical industries, most of which have major facilities in central Iowa. Iowa State has excellent statewide extension and outreach programs serving agriculture, business, and industry. The New Century Farm promises to be a significant chapter in Iowa State's nearly 150 years of demonstrated innovation and excellence in its mission of research, teaching, and extension.



Artist renderings credit: Trevor Brown

Total funds requested:

Year 1	\$19.0 million (infrastructure development)
Year 2-6	\$2.5 million per year (research and operational expenses)

In year one, funds will be allocated to construction, equipment, and start-up of the bioprocessing facility. Specifically, facilities to be constructed would be a planting, harvesting, and transporting machinery development workshop; a scale-up processing facility capable of research and demonstration of the biochemical (sugar) and thermochemical platforms; a laboratory for on-site biochemical and thermochemical pretreatment and conversion of biomass; and storage buildings for feedstocks and production/harvesting equipment. Funds also will be used to install field equipment to achieve long-term environmental monitoring of soil and water resources.

In years 2 through 6, funds will be used for scientific investigations from the field to the production facility and for operational expenses. The breakdown on annual costs is shown below:

Operations and Maintenance

Custodial and routine maintenance	\$75,000
Utilities	\$300,000
Other (Grounds/Mail/EHS/DPS)	\$55,000
Annual Capital Renewal	\$70,000
TOTAL	\$500,000

Annual Scientific Investigations are estimated at \$2,600,000 and will be generated from external grants and contracts.

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The Sloan Center for the Biobased Products Industry

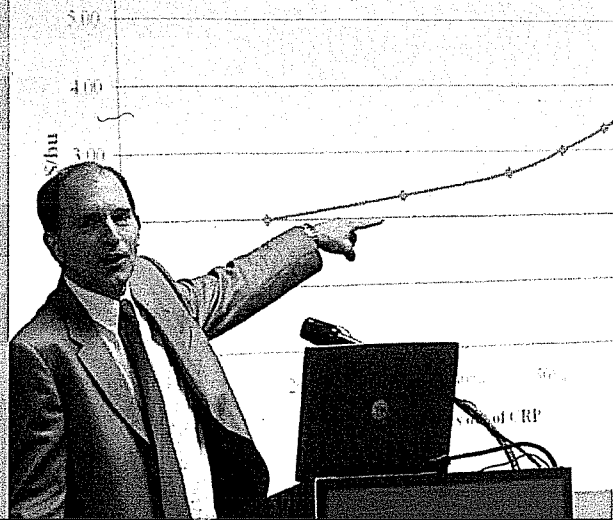
Iowa State President Gregory Geoffroy launched the Bioeconomy Initiative in 2002 by establishing the Office of Biorenewables Programs (OBP) to support interdisciplinary and systems-level research and education in this emerging field. This early commitment to the biobased economy allowed Iowa State to build a powerful network of campuswide programs in biorenewable resources comprising agriculture, business, engineering, liberal arts and sciences, and extension services. The Sloan Biobased Products Industry Center will focus on the industry's rapidly evolving economic and business challenges.

The goal of the Sloan Center at Iowa State is to leverage the intellectual resources of interdisciplinary research and education programs to address critical issues for the biobased products industry.

The Expansion of the Biobased Industry

Biobased industry expansion and growth is not without challenges. Human, industrial, and infrastructural capital investments will be required, and significant risks will be involved. To facilitate expansion of the biobased products industry, new investment, training, and analytical effort is needed. With the partnership of industry leaders, Iowa State will have both the depth and breadth of academic scholarship as well as the resources needed to address these efforts thoroughly and successfully.

The Sloan Center will complement efforts of individual companies and the federal government in developing biobased technologies by conducting research that sheds light on the economics, business, and policy aspects of the biobased products industry and economy. The center will offer analyses that address current issues and focus on practical solutions to challenges.



Potential Research Areas

The Sloan Center's proposed research and analyses projects will require the direct observation of facilities and access to firm-level data from a variety of organizations, including oil and gas companies, farmers' cooperatives, seed companies, and ethanol plant manufacturers. Following are some of the potential areas for research focus.

How Will Economic Shifts Affect the Burgeoning Biobased Industry?

Complex factors combine to affect the growth of the biobased products industry, including petroleum and natural gas prices, feedstock costs, infrastructure limitations, availability of efficient conversion technologies, diversion of agricultural crops from food and feed production to produce biofuels and biobased products, and transportation issues (truck, rail, water, and pipelines). The Sloan Center will evaluate economic, environmental, and related social costs and benefits of manufacturing biobased products. For example, the Sloan Center could perform the following studies:

- What are the effects on the biobased products industry if crude oil prices fall below \$50 per barrel or rise above \$100 per barrel or if natural gas prices increase to \$10/mcf?
- As new technologies are commercialized to convert cellulosic biomass to biofuels and other biobased products, what is the change in scale and location of industry production and the effect on rural communities and the environment?

What Are Effective Integration Strategies for Biobased Businesses?

To perform well in the biobased industry, new business alliances and supply chain tactics must be developed. The center will study methods that integrate technologies from different companies to create biorefineries, optimize efficiencies of scale and plant location, efficiently use coproduct streams from production and manufacturing, and create sustainable supply chains. Potential studies might include

Bruce Babcock, professor of agricultural economics

The Sloan Center

- Analyzing economic discontinuities in food, feed, and fiber industries resulting from increased use of agricultural crops for biobased products.
- Conducting forums for industry leaders to exchange knowledge and discuss integrating their technologies with those of other companies to form high-functioning biorefineries.

How Should Public Policies Keep Pace with the Growing Biobased Industry?

- The biobased industry will create new pressures and dynamics both domestically and internationally. The Sloan Center will perform analyses that elucidate emerging issues (such as the impact of the industry on international trade competition) to develop policy proposals to stimulate necessary public and private investment in infrastructure.

An Opportunity for Partnership

- The proposed Sloan Center for the Biobased Products Industry will be a natural fit with the interests and goals of a range of industries associated with the bioeconomy. Partner companies in the Sloan Center will have a seat on the external advisory board and an opportunity to influence center policies and contribute to determining research directions of this prestigious industry center.
- Industry partners in the Sloan Center agree to provide financial resources to the Center for the first three years, with the opportunity to renew support in subsequent years. With the committed partnership of industry leaders, the Sloan Center will have a substantial impact on the direction, focus, and viability of the growing biobased economy.

Leaders and Partners of the Sloan Center

The Sloan Center for the Biobased Products Industry will be administered under Iowa State's Office of Biorenewables Programs, led by Robert C. Brown. The center will also have external and internal advisory boards, as well as partnerships with industry and governmental organizations.

External Advisory Board

The Sloan Center's external advisory board will be composed of government and industry representatives. This board will meet with the center's leaders and principal investigators to identify and prioritize research areas for the center's initial focus. The board will also meet twice per year to provide advice and guidance regarding issues, challenges, and opportunities of concern and importance to the industry. Additionally, the board will develop the request for proposals, selection process for center research projects, and linkages with additional industry partners for participation in direct observation studies. Industry partners that support the center will be invited to have a representative serve on this board.

Internal Advisory Board

The internal advisory board will be comprised of the provosts for research and extension; the deans of the Colleges of Agriculture and Life Sciences, Business, Engineering, and Liberal Arts and Sciences; and the principal investigators. This board will review and discuss the center's strategic plan, budget, research platforms, facilities, progress, and related issues.

Industry and Government Partners

Twelve biobased companies have already pledged \$50,000 per year, each for three years, to support the center. Several government entities are also supportive of the proposed Sloan Center, including the Iowa Department of Economic Development, the Iowa Legislature, the USDA Office of Energy Policy and New Uses, and the USDA Office of Rural Development.

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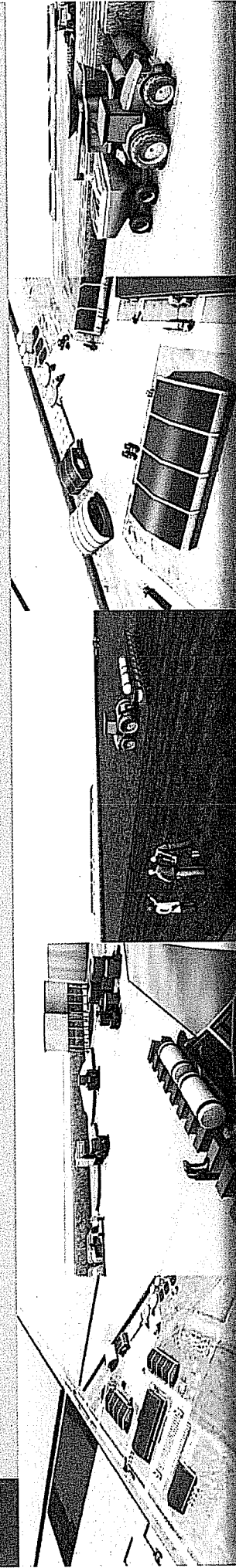
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