The Opportunity:

The natural resource-based industries of Alabama and the nation possess tremendous unrealized potential for the production of multiple, high value-added products from biomass resources. The products range from bulk and fine chemicals through polymers, fiber composites and pharmaceuticals to energy, liquid fuels and hydrogen. The process of separating the biomass constituents and converting them to high value products is called biorefining and is the basis upon which a new and prosperous natural resource-based economy can be built in Alabama. Economic development based on biorefining makes sense for Alabama because technologies and business models are emerging which can help reinvigorate Alabama’s established industries while creating new product streams, satisfying state and national needs while moving Alabama toward sustainable development.

The Core Technologies:

The realization of the enormous potential of biorefining depends on the further advancement of certain core technologies dealing with the separation, purification, and conversion of the basic biomass components to a range of products. The chemical, biological, and thermochemical pathways from the biomass constituents to commercial chemicals, polymers, and fuels are well established, but further research, development, and demonstration are needed to improve process efficiency and economics to the point where these technologies become viable commercial options. The technologies include chemical and biological processes to convert biomass to sugars and then to products, thermochemical conversion of biobased feedstock to syngas and then to fuels, and direct biomass fractionation technologies to separate biomass into pure chemical components.

The Partnership Concept:

The Alabama Biorefining Initiative (ABI) is based on partnerships linking Auburn University and other major research universities with Alabama’s forest products, agricultural, and energy industries. Additional partnerships with state and federal agencies as well as biotechnology and biomass-to-fuels/energy companies are also part of the mix to ensure seamless pathways from fundamental research through to demonstration, deployment and commercialization of new technologies.

Currently active funding partners include: The Alabama Department of Agriculture and Industries, Masada Resources, Alabama River Pulp, National Science Foundation and the U.S. Department of Energy. Major technology partners include: PureVision Technology, Masada Resources, Gas Technology Institute, NeoSource International and Thermo Chem Recovery International.
The Program Structure:

The structure of ABI consists of four major thrust areas. These four research thrust areas are: biotechnology, energy, advanced materials and sustainability. Technological advances at the leading edge of each of these areas are required to insure the success of the initiative.

In the area of biotechnology and bioresources the key research must focus on separation of the biomass into its basic chemical constituents. Advanced chemical reaction engineering principles then need to be applied to the efficient biological, chemical and thermochemical processing and conversion of the biomass constituents to commercial materials and fuels satisfying both economic and environmental constraints.

Concerning advanced energy resources and systems the program has two main focal points. The first concentrates on conversion of biomass carbohydrates (hemicellulose and cellulose) to component sugars by either thermochemical (steam/acid) pretreatment or biological (enzymatic) conversion to liquid fuel such as ethanol. The second focuses on thermal gasification of biomass feedstock to produce synthesis gas which can be catalytically converted to liquid fuels or further to hydrogen.

Recent advances in materials science and nanotechnology provide tremendous potential for the development of a range of high value-added products from biomass resources. These include polymers, adhesives, films and a range of materials currently produced from non-renewable resources.

Finally, the ABI affords the real opportunity to re-invent the State’s existing natural resource-based industry as a new world class enterprise based soundly on the principles of sustainable engineering and green chemistry. The biorefineries of the future will be the ultimate in low/zero impact manufacturing producing environmentally desirable products from renewable resources. The program undertaken by the ABI will be conducted with sustainability as a necessary outcome.

Focus Areas:

- Production of Fuels and Chemicals from Renewable Resources
- Leveraging of Federal Funding
- Facilitation of Public-Private Partnerships
- Demonstration, Deployment and Commercialization of Technologies
Key Technologies:

- Biochemical Processing of Biomass for Production of Ethanol and Higher Alcohols
- Thermochemical Processing of Biomass for Production of Liquid Fuels and Hydrogen
- Fractionation of Biomass into Pure Feedstocks for Fuels and Energy Production

Strategic Outcomes:

- Cooperative R&D Programs Producing Commercializable Results
- Management and Coordination of Research and Pilot Facilities
- Partnership Formation for Commercial Demonstration

Specific Projects:

A number of commercial demonstration projects have already been identified as candidates for acceleration under the framework of ABI. These are, in approximate order of priority according to the criterion of readiness to proceed:

1. A Pulp Mill Sludge to Ethanol Commercial Plant
2. A Pulp Mill Biomass Gasification to Liquid Fuels Demonstration
3. Supercritical Water Processing of Pulp Mill Waste To Fuels
4. A Municipal Solid Waste (MSW)/Pulp Mill Sludge to Ethanol Pilot Plant
5. A Pulp Mill Booster Black Liquor Gasification Demonstration
6. A Pulp Mill Hemicellulose Extraction and Conversion to Ethanol Demonstration
7. Conversion of a Pulp Mill to an Ultimate Biorefinery

Additional projects will be identified as ABI proceeds.
**Management:**

The Alabama Center for Paper and Bioresource Engineering (AC-PABE) is responsible for management of ABI and is uniquely suited to lead the program in collaboration with Auburn University’s Department of Chemical Engineering (AU-CHEN). AC-PABE and AU-CHEN possess core competencies in biomass process optimization, fractionation technologies, biochemical process engineering, and gas-to-liquid technologies. Expertise in additional crucial areas of biorefining research, e.g. characterization of biomass resources along with gasification of biomass and spent liquors, can be provided by a number of AU-CHEN and AC-PABE collaborators. AC-PABE enables contact with all major players in biorefining research as well as the industries where these technologies will be implemented.

To support the commercial demonstration projects listed above, AC-PABE plans to issue a series of tightly focused solicitations for targeted research in the focus areas, also listed above. These RFP’s will be directed to research communities, both at Auburn University and at other major research universities in Alabama and elsewhere. The intention is to assemble the best possible research teams with clear focus on specific research objectives to support the planned commercial demonstration projects.

**Impact:**

Full penetration of just those technologies listed above specific to the Alabama pulp and paper sector would result in net incremental annual industry income of more then $1.5 billion, clearly providing a much needed revitalization to a major, yet beleaguered, industry. Thousands of well-paying new jobs would be created, and local and state tax revenue would be greatly enhanced.