



## Link Resources: BioFuel Experience

Real-World Operational Solutions for BioFuel Stakeholders, Investors, and Government

Link's experience in biofuels began in 1999, when we were selected to assist Masada Resource Group in its efforts to develop and construct the first commercialized cellulose to ethanol plant. Example subsequent experience included:

- Identification and analyses of current biofuel technologies, focusing heavily on their near-term commercialization
- Investigation and conclusions regarding optimal biodiesel technologies
- Assistance in EPC, commissioning, and operations of a plant in Australia using a novel continuous transesterification technology and processing low-quality oil feedstock
- Consulting and advisement project to import the Australian technology to North America for the construction and operation of a fleet of biodiesel plants using primarily beef tallow, chicken fat, and/or used cooking oil
- Joint investment in a biodiesel plant development company to construct a large biodiesel facility in St Louis
- Consultation projects with DOE to review and analyze solicitations from biorefinery technology companies proposing to construct pilot or demonstration plants (using DOE grants) that could be commercially viable in the short term.

KEY EXPERIENCE	EXAMPLE PROJECT SUMMARY
<p><b>Cellulosic Ethanol from MSW</b></p>	<p>In 1999 Link was awarded a project to assist Masada Resource Group in the development and planning of a large cellulose-to-ethanol project using a strong-acid approach on Municipal Solid Waste feedstock. Link was also awarded EPC oversight (including pilot projects for particularly troublesome sub-systems), commissioning and long-term operations contracts for the yet-to-be-constructed plant in Middletown, NY. The complex plant included MSW sorting, drying, hydrolyzation and cellulose conversion, acid recovery, fermentation, and distillation. The plant utilized dried sewage sludge converted to steam via a fluidized bed boiler, and had several profitable byproducts such as typical MSW rejects (e.g. aluminum), CO2, soil treatment, and green fuel. Link's assignments during the project period included oversight of the prime EPC contractor, Kvaerner, during engineering and procurement; Link's prime focus was the constructability and the operability of the processes and systems. Link also, in joint effort with Kvaerner, developed all O&amp;M policies and procedures for plant equipment and systems. The first facility has not yet been constructed due to difficulties in obtaining investors in the \$400M plant.</p>
<p><b>Review of Biofuel Technology</b></p>	<p>Tadanac Energy, Inc. engaged Link to review available biofuel technologies with respect to their overall commercial viability, project capital cost, energy balance, environmental attributes, constructability, and operability. The project included an assessment of feedstock availability, future feedstock risk, optimal U.S. locations, and plant sizing, staffing, and O&amp;M costs. Our conclusion was that technology able to handle up to 15% FFA beef-tallow-based feedstock was optimal, with caveats.</p>
<p><b>Biodiesel Fleet Infrastructure</b></p>	<p>Australian Biodiesel Group (ABG), a subsidiary of Transfield, initially utilized Link in the startup and commissioning of its 40 mgpy continuous transesterification facility in Queensland. Link's contract expanded into creating the turn-key administrative process, financial, and administrative infrastructure for the fleet of biodiesel facilities they intended to build in the U.S. This infrastructure included plans and schedules for EPC/commissioning/operations, draft specifications and contracts for EPC, all personnel and organizational policies/procedures, O&amp;M policies and procedures, staffing and compensation plans, and the Operating Plan.</p>
<p><b>Biodiesel Plant Development and Construction</b></p>	<p>Within a Joint Venture with Tadanac BioEnergy LLC, Link played the primary role in developing and acquiring the rights to the ABG biodiesel technology in North America, developing a brownfield site on the Mississippi in East St. Louis, developing plans and schedules, negotiating feedstock supply contracts as well as EPC contracts, obtaining permits, preparing for the commissioning and operations of the 50 mgpy biodiesel plant based on a beef-tallow feedstock from the Missouri River basin. Tadanac is awaiting financing for this profitable facility.</p>



## BioFuel Grant Allocation for DOE

Link was awarded a contract with DOE (EERE) to assist in the evaluation of solicitations from biofuel technology companies interest in receiving Federal grants for the Demonstration of Integrated Biorefinery facilities that could be commercially viable in the short term. A sample of the technologies/projects evaluated by Link included:

- **Ethanol Generation from Waste Sugars:** using immobilized microbe bioreactor technology, including waste water treatment and recycling of waste carbon sources.
- **Conversion of Agricultural residue to Ethanol and Ethyl Acrylate:** included pretreatment of feedstock (corn stover and other lignocellulose biomass) into pellets and subsequent hydrolyzation of cellulosic and hemi-cellulosic fractions, as well as other subsequent and other chemical treatments.
- **Production of Cellulosic Ethanol from Corn Stover:** using patented yeast technology for the fermentation of both five and six carbon sugars while simultaneously co-producing high value co-products such as the cellulases, hemicellulases, or other important industrial enzymes.
- **Fuel Ethanol from Barley:** producing parasitic electricity and thermal energy from available biomass (waste wood and other plant based products); recovering CO<sub>2</sub> from the ethanol fermentation process to produce commercial grade liquid CO<sub>2</sub> for the production of dry ice and to use in the on-site greenhouses. Utilizing waste process heat, available water, available land and CO<sub>2</sub> in on-site greenhouses.
- **Cellulose to Ethanol Conversion using Enzymes:** implementation of 2nd generation technologies to improve the overall performance of existing cellulose to ethanol conversion using enzymes. Feedstocks investigated included bagasse, energy cane, high biomass, sorghum, wood, switch grass, corn stover, and miscanthus.
- **“Drop-In” Biorefinery:** improving harvest operations and maximizing the ethanol yield/acre of fermentation of sweet sorghum, and establishing small commercially viable “drop in place” bio-refineries, combined with a decentralized network of fueling stations where the ethanol would be blended “at the pump”.
- **Re-purposing of a Corn-based Ethanol Facility:** the concept was to re-purpose a corn-based ethanol facility to turn wheat straw into ethanol using a patented pre-treatment process and subsequent enzymatic conversion.

It should be noted that Link’s added value lay not in the ability to evaluate the chemistry, but rather the viability of the development, construction, operations, energy balance, and environmental impact.