



Integrated Biorefinery Project

Cooperative Research and Development Final Report

CRADA Number: CRD-10-390

NREL Technical Contacts: Alex Chapeaux and
Daniel Schell

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In accordance with Requirements set forth in Article XI.A(3) of the CRADA document, this document is the final CRADA report, including a list of Subject Inventions, to be forwarded to the Office of Science and Technical Information as part of the commitment to the public to demonstrate results of federally funded research.

CRADA Number: CRD-10-390

CRADA Title: Integrated Biorefinery Project

Parties to the Agreement: Amyris Biotechnologies

Joint Work Statement Funding Table showing DOE commitment:

Estimated Costs	NREL Shared Resources
Year 1	\$ 129,321.00
Year 2	\$ 472,757.00
Year 3	\$ 65,513.00
TOTALS	\$ 658,591.00

Abstract of CRADA work:

The Amyris-NREL CRADA is a sub-project of Amyris's DOE-funded pilot-scale Integrated Biorefinery (IBR). The primary product of the Amyris IBR is Amyris Renewable Diesel. Secondary products will include lubricants, polymers and other petro-chemical substitutes. Amyris and its project partners will execute on a rapid project to integrate and leverage their collective expertise to enable the conversion of high-impact biomass feedstocks to these advanced, infrastructure-compatible products. The scope of the Amyris-NREL CRADA includes the laboratory development and pilot scale-up of bagasse pretreatment and enzymatic saccharification conditions by NREL for subsequent conversion of lignocellulosic sugar streams to Amyris Diesel and chemical products by Amyris. The CRADA scope also includes a techno-economic analysis of the overall production process of Amyris products from high-impact biomass feedstocks.

Summary of Research Results: The partnership between Amyris and NREL was one portion of the entire Amyris's DOE-funded integrated biorefinery project. NREL's role in this project consisted of performing four tasks: chemical analysis of bagasse samples and intermediate process streams, bench-scale pretreatment studies, pilot-scale work to produce concentrated sugar streams, and techno-economic analysis. The techno-economic analysis portion of this project was ultimately performed by Amyris after initial model development by NREL.

Various operating conditions were screened during the bench-scale pretreatment studies using dilute acid or hydrothermal treatment to find conditions that worked best for the Amyris process. The goal was to also identify appropriate operating conditions for pilot-scale production work. Overall performance was assessed by examining pretreatment yields and enzymatic digestibility of resulting pretreated solids. The sugar stream (hemicellulosic and cellulosic sugars) produced after enzymatic hydrolysis was concentrated

and supplied to Amyris for testing in their laboratories. They identified the best pretreatment conditions for the pilot-scale production studies.

Six pilot-scale campaigns were performed over a period of eight months to produce larger quantities of sugars for scaled up fermentation work in Amyris's laboratories. The bagasse was pretreated in NREL's 40 dry kg/h continuous horizontal pretreatment reactor at several different operating conditions and enzymatic hydrolysis was performed in a 4000-L paddle-type reactor. The resulting sugar streams were concentrated and shipped to Amyris.

Subject Inventions Listing: None

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Responsible Technical Contact at Alliance/NREL: Alex Chapeaux/Daniel Schell

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