



# Biomass Program

## Sugars R&D

### Development of New Sugar Hydrolysis Enzymes: Novozymes Biotech, Inc.

The cost of cellulase enzymes for enzymatic cellulose hydrolysis remains a significant technical barrier to the conversion of lignocellulosic biomass to fuels and chemicals. Enzyme cost primarily depends on the direct cost of enzyme preparation (\$/kg enzyme protein) and the enzyme loading required to achieve the target level of cellulose hydrolysis (gram enzyme protein/ gram cellulose).

The near-term goal is to reduce cellulase enzyme costs to approximately \$0.10/gallon of ethanol. At this level, enzyme costs will significantly reduce the corresponding enzymatic cellulose hydrolysis technical barrier associated with commercializing biomass conversion processes for bioenergy and bioproducts.

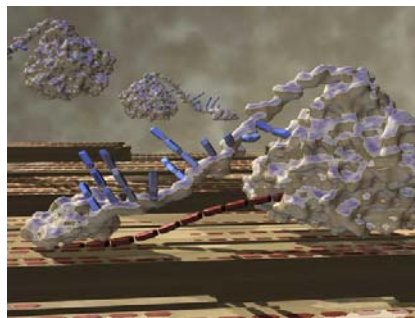
#### R&D Pathway

Although the exact cellulase enzyme cost reduction strategy taken by Novozymes is proprietary, possible approaches may include:

- Reducing substrate or other operational costs
- Increasing the productivity and/or yield of the enzyme manufacturing process

- Increasing the enzyme effectiveness (per gram enzyme)

NREL's role is to facilitate the enzyme cost reduction research and to validate the results. As part of this effort, NREL and Novozymes are collaborating to improve applicability and scalability of the resulting enzyme product.



Digital drawing of cellulase enzyme (gray) attached to cellulose (red).

#### Benefits

- Improved enzymes for economic biomass conversion to sugars and ethanol

#### Applications

Improved cellulase enzyme systems will boost the viability of converting biomass to bioenergy and bioproducts. The new performance assay methods will enable more efficient (and less costly) enzyme development efforts, benefiting other developers of enzyme-based biomass conversion technologies.

#### Project Partners

National Renewable Energy Laboratory  
Novozymes Biotech, Inc.

#### Project Period

FY 2000 – FY 2004

#### For more information contact:

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