



## DHI PROJECT

# ENSURING SUSTAINABLE CELLULOSIC BIOETHANOL PRODUCTION

Using detailed process analysis to identify ways to reduce water consumption

To address the world's growing energy needs, some companies are developing new sources of renewable energy, such as cellulosic ethanol production. This method of energy production uses wood, grasses, and other inedible plant parts to produce biofuel. It relies heavily on water, which raises additional questions and concerns about the quantity of water consumed during the production process.

Novozymes is a world leading biotechnology company and one of the frontrunners in transforming the energy field from fossil-based to bio-based. Cellulosic ethanol is now starting to be produced on a large scale. As such, Novozymes commissioned a study to establish how much water cellulosic ethanol production consumes.

Using a detailed process analysis, we examined water consumption in cellulosic ethanol production. We utilised design data for the water circuit and unit operations of two commercial cellulosic ethanol production processes in the planning and construction phase.

Our initial analysis showed that the ethanol conversion process itself is not a significant water consumer. Instead, utility operations are the most water intensive processes, with cooling tower evaporation responsible for 90-95% of water use. Through further analysis, we identified a range of water saving measures that could lower cellulosic ethanol production's water consumption. These measures include:

- extended water recycling
- changing the cooling technology

## SUMMARY

### CLIENT

Novozymes A/S

### PROJECT PERIOD

June 2011 - December 2012

### CONTRACT VALUE

DKK 500,000

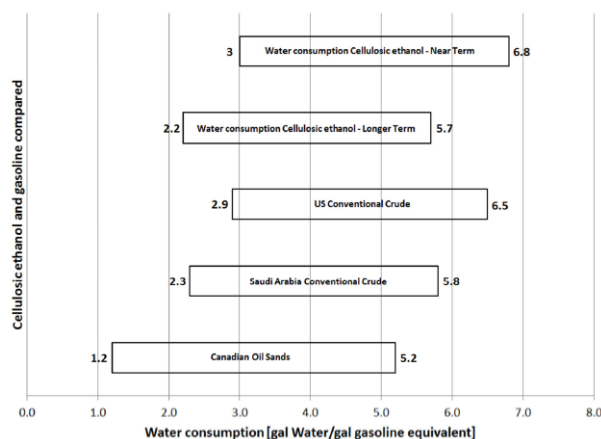
### LOCATION /COUNTRY

Bagsværd, Denmark

### CLIENT TESTIMONIAL

*"We are very satisfied with the work DHI has done and with the high level of technical knowledge provided. We now have a well-documented study as a basis for the debate on water consumption for biomass-based bioethanol production."*

*Per Henning Nielsen  
Senior Manager, Novozymes A/S*



*We compared near- and long-term water consumption estimates for cellulosic ethanol production with current accepted figures of water consumption in gasoline production. In the long-term water consumption in cellulosic ethanol production is comparable to or lower than conventional gasoline production. © Chemtex Italia S.R.I.*