

# Proteins for Next-Generation Bioenergy

*A new generation of renewable energy will progressively substitute fossil fuels. Protéus is committed to moving beyond reliance on petroleum toward a bio-based economy. We envision a future in which white biotechnology processes result into sustainable production of clean energy.*

Proteus creates bio-based solutions to efficiently convert biomass into energy with dramatically lower energy inputs and net carbon emissions. We aim at improving and accelerating the conversion of biomass from a variety of origins, including lignocellulosic feedstock from industrial by-products, agricultural waste, municipal waste, or activated sludge into bioenergy.

Because of the biomass recalcitrance to hydrolysis, enhancing and accelerating the conversion of these raw materials into fermentable material is the core challenge for sustainable production of clean energy. Proteus (i) improves the productivity of existing bio-based processes by improving the performance of the enzymes involved in biomass cracking into fermentable material and, (ii) creates and fine-tunes competitive natural or engineered biological cocktails that fit the specific composition of the renewable feedstock available and the characteristics of the energy-producing processes of our clients.

SECOND  
GENERATION  
BIOFUEL  
PRODUCTION  
FOR CLEAN  
AND RENEWABLE  
ENERGY

**WE HELP MEETING  
TODAY'S INDUSTRIAL,  
ENERGETIC  
AND ENVIRONMENTAL  
CHALLENGES**

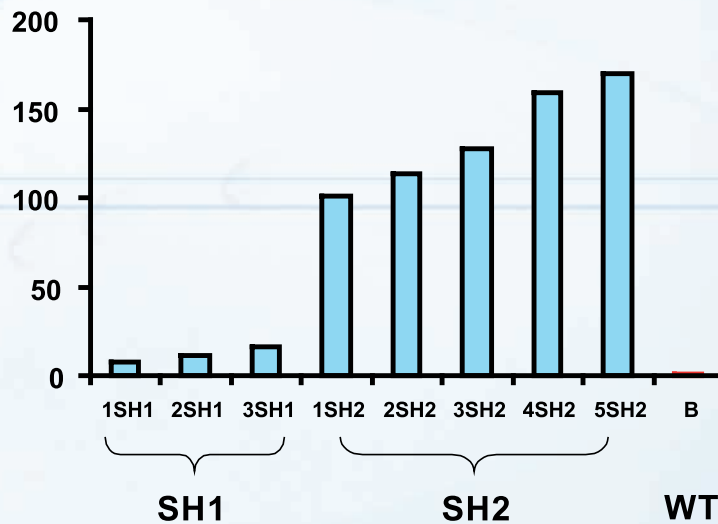
For instance, Protéus develops bespoke enzymes for SHF (Separate Enzymatic Hydrolysis and Fermentation), SSF (Simultaneous Saccharification and Fermentation) and for engineering CBP-enabling microorganisms (Consolidated BioProcessing). For biogas production, Protéus optimizes the enzymatic hydrolysis of the biomass in order to increase the process productivity.

Proteus has embarked upon collaborative R&D program with industry global players to accelerate the development of competitive and sustainable bio-energy production from biomass. Protéus is also part of the PNRB French governmental program on bioenergies.

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To develop new high performance enzymes, we discover new genes and new enzymatic activities of interest by screening our vast and unique collection of microbial biodiversity, including probably the broadest collection worldwide of microorganisms originating from extreme environments. Additionally, using our cutting-edge proprietary technology platform for protein engineering - including gene shuffling, gene expression and high throughput screening - we create optimized enzymes to prepare enzymatic cocktails (e.g. high-performance cellulolytic enzymes) for next-generation energy producing bioprocesses that scale up sustainably and efficiently.

## CASE STUDY : OPTIMIZATION OF AN ENZYME FOR USE IN BIOETHANOL PRODUCTION



Biological degradation of lignocellulosic renewable feedstock, such as straw, to produce fermentable sugars requires the use of enzymatic cocktail. Proteus and its partner have identified a key limiting activity. Starting from a wild type natural enzyme (WT), Proteus achieved quantum improvements of the activity after two rounds of enzyme evolution (SH1 and SH2, respectively). The best performing new enzyme (5SH2) had a 230-fold increased specific activity when compared with the natural one, hence dramatically improving the process productivity when used under industrial conditions.

## CASE STUDY

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