PHOTOFUEL
Biocatalytic solar fuels for sustainable mobility in Europe

MOTIVATION AND OBJECTIVES
The motivation is to promote the development of high quality, low impact transportation fuels. The challenge is to advance the base technology of microalgal cultivation in closed bioreactors by enabling phototrophic algae or cyanobacterial microorganisms to produce alkanes and alcohols, which are excreted to the culture broth for direct separation without cell harvesting. This thereby turns the microbial cells into self-reproducing biocatalysts allowing the process to directly convert solar energy, water and CO₂ into engine-ready fuel instead of being used to form biomass, as shown in the figure. Objectives are:

- Development of advanced biocatalysts for the direct production of solar fuels.
- Upscaling of cultivation volume and raw fuel production.
- Upgrading/purification to fuel for blending and engine tests.
- Analysis of risks, economics and environmental impact of the pathway.

PROJECT PLAN, MILESTONES AND DELIVERABLES
The final goal is to advance the solar fuel technology towards highly sustainable production of drop-in fuels on arid or marginal land. Economically and environmentally sustainable large-scale systems for geographically independent conversion of solar radiation into chemical energy would support rural communities and substitute significant shares of fossil energy for the benefit of Europe and many other regions.

TECHNICAL APPROACH
WP2 Biocatalyst development on base of two cyanobacterial strains and one microalga. Targeted fuel compounds are butanol, medium chain alcohols and alkane, sesquiterpenes. The best performing strain(s) are selected by the PHOTOFUEL consortium and jointly improved in the last 18 months of the project.

WP3 up scales cultivation volumes and assesses the biocatalyst. The final volume is 5m³ for outdoor production of fuel compounds. A control strategy and fuel separation process is developed. Options to recycle water, nutrients and energy as well as sanitation are studied.

WP4 analyses and upgrades the crude biocatalyst products from WP 3. These are blended with fossil fuels and other biofuels to on-spec, engine-ready solar diesel and gasoline fuels.

WP5 studies the engine performance of solar fuel blends, prepared in WP 4 according to expectations of both WP on the composition of fuels in the future. Tests are performed in gasoline- and diesel engines of the EURO6 norm, representing passenger vehicles and trucks.

WP6 assesses the techno-economic risks, economical performance and environmental impacts of the PHOTOFUEL pathway for comparison to other existing or developing processes for the production of fossil and renewable fuels.

WP7 summarises the project results for the preparation of a business development plan.

WP1 disseminates the project results in press, on conferences and workshops and includes project management and administration.

ACHIEVEMENTS
A biocatalytic pathway to solar transportation fuels ready for pilot scale application.

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