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Photofuel - Biocatalytic solar fuels for sustainable mobility in Europe

Deliverable D2.4

**Comparison of various biocatalytic strains
and recommendation which strain should
be collaboratively optimised –Milestone 2**



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Editorial	
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Publishable Summary

Within the Photofuel consortium, three research groups have engineered various photosynthetic microorganisms to secrete a range of hydrocarbons with potential as liquid fuel substrates. Within the first 30 months of the project, significant advances in strain engineering have been achieved in three different organisms. The research teams have developed secretion of 1-butanol, isobutanol, free fatty acids, and sesquiterpene hydrocarbons from cyanobacteria and a eukaryotic microalga. Of the systems, yields of 1-butanol have been achieved approaching the gram/ litre scale, while free fatty acid secretion combines high-yields with ease of product separation from the algal culture. Significant advances in sesquiterpene production from the eukaryotic microalgal host have also been demonstrated. All systems were amenable to scale-up in outdoor conditions, and members of research groups in other work packages have demonstrated scale-up and modelling of separation technologies for each product. The greater consortium made a thorough discussion of all properties of each production host, as well as the potential for downstream processing at pilot scale, and individual fuel properties with input from all partners. The consortium has decided to dedicate the last 18 months of the Photofuel project to the development of free fatty acid secretion from cyanobacteria, which will be subject to pilot-scale cultivations and downstream processing by consortium partners. Additionally, a 1-butanol secreting cyanobacterium, *Synechocystis* 6803 will be cultivated at pilot scale, and attempts to generate samples of products including iso-butanol, bisabolene, other alkenes, and 1-octanol will be undertaken at various scales in order to demonstrate photosynthetic production of different fuel products.

Table 1: Overview of biocatalyst ratings.

Product and biocatalyst strain	Productivity	Cultivation	Separation	Fuel properties
1-butanol, <i>Syn</i> 6803	++	+	--	+
Iso-butanol, <i>Syn</i> 6803	+	+	--	+
Bisabolene, <i>C. reinhardtii</i>	-	+	+	-
Free fatty acids, <i>Syn</i> 7002	+	++	++	++
Free fatty acids, <i>Syn</i> 6803	+	+	++	++
Alkenes, <i>Syn</i> 6803	+	+	--	+
1-octanol, <i>Syn</i> 6803	--	--	--	+

Strains: *Syn* 6803-*Synechocystis* PCC 6803; *Syn* 7002-*Synechococcus* PCC 7002; *Chlamydomonas reinhardtii*.