# Partner search

**Date (DD-MM-YY)**

- **(*) Relevant topic in work programme**

  - Call Energy LC-SC3-RES-27-2020 « *Demonstration of advanced biofuels production from aquatic biomass* »
  - But also other calls “Energy and Environment” that address challenges on biofuels, production of chemicals, water treatment, CO2 containing,…

- **Quick description of the project**

**(describe the objectives, activities, partners requested and their skills)**

- **(*) Description of the expertise offered (up to 1000 characters)**

**Expertise of engineering cyanobacteria for the photosynthetic production of terpenes** at CEA/DRF/Joliot/SB2SM/LBBC (http://joliot.cea.fr/drf/joliot/Pages/Entites_de_recherche/I2BC_saclay/SB2SM/lbbc.aspx)

Terpenes are high-value chemicals that can serve to produce fuels (many terpenes have a high energy density & low temperature viscosity), disinfectants (they are cytotoxic) and perfumes (many terpenes have good odours), etc

Why using cyanobacteria for terpene production?
- Cyanobacteria are robust photosynthetic organisms that colonize our Planet
- They capture solar energy at high efficiencies (about 3-9%; i.e. > plants 0.5-3% )
- They fix a huge amount of carbon from atmospheric CO2 (25 gigatons annually) into a huge “simple” biomass (no stems, no roots)
- They tolerate high CO2-containing (≥ 50%) industrial gas.
- Cyanobacteria possess the MEP pathway (methylerythritol 4-phosphate) that produces the geranyl-diphosphate (GPP) and farnesyl-diphosphate (FPP) metabolites, which can be transformed in terpenes **providing heterologous (plant) genes encoding terpene synthases are introduced and expressed in cyanobacteria**.
- The biosynthesis of (plant) terpenoids often relies on cytochrome P450 monooxygenases that use NADPH, a cofactor that is abundant in cyanobacteria

Strategy: exploitation of the biodiversity of cyanobacteria for the photoproduction of various terpenes from solar energy, waters (fresh or marine), CO2, and nitrogen (NO3, NH4, N2 or urea). Taking advantage of our replicative & promiscuous expression vectors we engineer metabolically-diverse cyanobacteria (not only the best-studied models) for the production of diverse terpenes, eventually combined to water treatment. We select & thoroughly analyze (omics) good producers to identify bottlenecks that we will eliminate to optimize the production.
Tasks carried out at CEA/DRF/Joliot/SB2SM/LBBC:

- Insert and express coding genes for the terpene synthases.
- Make sure the genetic stability of the producers is maintained.
- Test the influence of growing conditions (light, CO2, nitrogen, etc) on the production of diverse terpenes.
- Improve CO2 fixation.
- Direct the carbon fixed by photosynthesis toward the production of terpenes (not only cells multiplication).
- To improve tolerance to strong lights and high doses of terpenes.

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| CEA/DRF/Joliot/SB2SM/LBBC is involved in a European project « ABACUS » BBI-JU-RIA (https://www.bbi-europe.eu/projects/abacus) |

- **Keywords describing the expertise offered (up to 10 words)**

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| Cyanobacteria; micro-algae; metabolic engineering; photosynthetic production of terpenes; cosmetics; biofuels; $CO_2$ assimilation; responses to stresses; water treatment; |

## Organisation information

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| **Organisation and country: CEA (French Alternative Energies and Atomic Energy Commission) , FRANCE** |
| **Type of organisation:**<br>**☐ Enterprise ☐ SME ☐ Academic ☒ Research institute ☐ Public Body ☐ Other: Association** |
| **Former participation in FP European projects?**<br>**☒ Yes ☐ No** |
| **Web address:** http://www.cea.fr/english<br>http://www.cea.fr/drf/english/Pages/the-DRF.aspx |
| **Description of the organisation:**<br>Through fundamental research in biology, physics and chemistry, the basic research division (DRF or CEA Sciences) strongly contributes to all of CEA research programs in many fields of expertise, including biofuels. |

## (*) Contact details

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**(*) –Mandatory**