Shaping the future: renewable fuels and chemicals from solar energy for a climate-neutral Europe

Joint roadmapping workshop on future milestones by SUNERGY, EIC and DG RTD

What? A strategic roadmapping workshop on the future of solar fuels and chemicals, jointly organised by SUNERGY (within the framework of the EU SUNER-C CSA), EIC and DG RTD.

When? 14/15 June 2022

Where? Academy of Science, Brussels. The event will take place at 'Salle de Duve', meals and coffee breaks will be on the patio.

Concept in a nutshell:

- **Meet and discuss with the principal stakeholders along the whole solar fuels value chain**
- **Bring together diverse realities**: make scientists understand today's industrial reality - and industrials the breakthrough innovations of tomorrow and their impact on future business models;
- 2-day workshop in Brussels to elaborate an all-agreed roadmap;
- Mix of high-level overview presentations by leaders in the respective field and roadmapping exercises in the specific working groups.

Funded by the European Union, Grant Agreement No. 101058481

Day 1:
From a centralised to a decentralised system: dream or near future reality?

9:30 - 10:00	**Welcome Coffee & Registration**
10:00-10:15	**Welcome by the SUNERGY coordinators** Prof. Bert Weckhuysen, Utrecht University Dr. Frédéric Chandezon, CEA
10:15-10:35	**SUNERGY Strategic R&I Agenda** Prof. Joanna Kargul, University of Warsaw Dr. Carina Faber, ENGIE
10:35-10:45	**Solar fuels for the near future of sustainable Europe** Dr. Francesco Matteucci, European Innovation Council
10:45-11:00	**Opening talk** **Chair: Prof. Joanna Kargul** ● Why the carbon neutral energy transition will imply the use of lots of carbon? Dr. Jan Mertens, ENGIE
11:00-11:15	**Coffee Break**
11:15-12:15	**Keynote Talks** **Chair: Prof. Ann Magnuson** ● E-fuels for the energy transition? A system level vision Dr. Falko Ueckerdt, Potsdam Institute for Climate Impact Research (PIK) ● Artificial Photosynthesis Prof. Huub de Groot, University of Leiden ● International cooperation for Renewable Fuels: Mission innovation case study Dr. Philippe Schild, EC, DG RTD ● Kromatix. From the lab to reality. The needed awakening Mr. Rafic Hanbali, Kromatix

12:15-12:45	**Industrial Pitch Session** **Chair: Dr. Francesco Matteucci** ● Biogas to hydrogen production via solar chemical looping Dr. Pere Margalef Valldeperez, Snam SPA ● ReUze: sustainable aviation fuel Mr. Gaëtan Deckers, ENGIE Thermal Europe ● Haru Oni hydrogen plant Prof. Maximilian Fleischer, Siemens Energy ● Green hydrogen to Sustainable Aviation Fuel demonstrator plant Dr. Moritz Schreiber, TotalEnergies ● Steelanol project Dr. Kristof Verbeeck, ArcelorMittal	
12:45-14:00	**Lunch Break**	
14:00-14:15	**Keynote Talk** **Chair: Dr. Carina Faber** ● Energy-Technology-Economy nexus: from observation of the past to forecasts of the global energy transition Dr. Hervé Bercegol, CEA	
14:15-15:00	**ROUNDTABLE** From a centralised to a decentralised system: dream or future reality? **Moderators:** **Prof. Joanna Kargul** **Dr. Joachim John**	Prof. Maximilian Fleischer (Siemens Energy) Dr. Isabel François (WaterstofNet) Prof. Huub De Groot (ULeiden) Dr. Hervé Bercegol (CEA) Dr. Falko Ueckerdt (PIK) Dr. Jan Mertens (ENGIE) Dr. Kristof Verbeeck (ArcelorMittal) Dr. Philippe Schild (EC) Mr. Rafic Hanbali (Kromatix) Dr. Pere Margalef Valldeperez (Snam)
15:00-16:00	**LICROX Symposium** **Chair: Prof. Antoni Llobet** *How to engage with society to predict future costs and environmental impact? The importance of standardised assessment.* ● Current status of techno-economic assessment methodology and its importance for industry and EU R&I projects Dr. Miet Van Dael, VITO ● Involving the public in technology assessment Mr. Lars Klüver (Danish Board of Technology)	

	• Life cycle assessment as a tool to evaluate emerging technologies Dr. Ivan Muñoz, 2.0 LCA consultants • Techno-economic assessment of sustainable proteins production from carbon dioxide and green electricity Dr. Justine Sauvage, Young Fellow of the Belgian Royal Academy of Science, UGhent	
16:00-16:15	**Keynote Talk** **Chair: Dr. Carina Faber** • Bridging the scales - from solar conversion at the nanolevel to the full device with computational material science Prof. Gian-Marco Rignanese (UCLouvain)	
16:15-16:45	**Coffee Break**	
16:45-18:30	**Breakout session: roadmapping exercises in the dedicated working groups**	**Working groups**: - The future of electrochemical conversion - Direct Conversion: PC & PEC approaches - Direct Conversion: Bio-based approaches - Solar-thermal conversion - Sustainable CO_2 sourcing - Think tank: Novel business models - Think tank: Societal acceptability and the societal contract **Ask me anything**: Computational Materials Science accelerating renewable fuels and chemicals development
18:30-20:00	**Walking Dinner**	

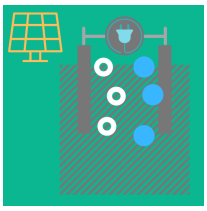
Day 2:

Finding the sweet spot: early scope of exploitation of solar conversion technologies

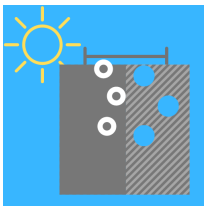
9:00 - 9:30	**Welcome Coffee**
9:30-10:45	**Keynote Talks** **Chair: Prof. Huub de Groot** ● IPCC report: The role of Carbon Capture and Utilisation Dr. Célia Sapart, CO2 Value Europe ● European R&D innovation goals on Renewable Fuels Mr. Thomas Schleker, EC, DG RTD ● The future of electrolyzer for the novel energy system: the importance of integration Prof. Maximilian Fleischer, Siemens Energy ● Sustainable aviation fuels Dr. Clyde Hutchinson, General Partner, Team ABC
10:45-11:00	**Coffee Break**
11:00-11:30	**Innovation Pitch Session** **Chair: Dr. Francesco Matteucci** From breakthrough innovation to novel business models ● CO_2 utilisation success stories Prof. Pelayo García de Arquer, ICFO ● A-LEAF Prof. José R. Galán-Mascarós, ICIQ ● SoFIA Dr. Indraneel Sen, Uppsala University ● IMPOWER2X Dr. Samantha Michaux, INERATEC GmbH ● FUTUROLEAF Prof. Tekla Tammelin, VTT ● SUNCOCHEM Prof. Simelys Hernandez, Politecnico di Torino

11:30-13:00	**Breakout session: roadmapping exercises in the dedicated working groups**	**Working groups**: - The future of electrochemical conversion - Direct Conversion: PC & PEC approaches - Direct Conversion: Bio-based approaches - Solar-thermal conversion - Sustainable CO_2 sourcing - Think tank: Novel business models - Think tank: Societal acceptability and the societal contract **Ask me anything**: Computational Materials Science accelerating renewable fuels and chemicals development
13:00-14:00	**Lunch Break**	
14:00-15:00	**Keynote Talks** **Chair: Dr. Hervé Bercegol** ● A critical view on photoelectrochemical conversion Prof. Vincent Artero, CEA ● The beauty of biologically-driven approaches for solar-to-chemicals conversion Prof. Eva-Mari Aro, Turku University ● Sustainable carbon capture: challenges and perspectives Prof. Patricia Luis Alconero, UCLouvain ● E-refineries for solar conversion into chemicals: challenges and opportunities Prof. Gabriele Centi, UMessina, ERIC	
15:00-16:00	**ROUNDTABLE** Finding the sweet spot: early scope of exploitation of solar conversion technologies Moderators: Prof. Huub de Groot Dr. Ann Magnuson	Ms. Babette Pettersen (Lanzatech) Dr. Clyde Hutchinson (Team ABC) Prof. Gabriele Centi (UMessina) Prof. Vincent Artero (CEA) Prof. Eva-Mari Aro (UTurku) Dr. Jan Vaes (VITO) Mr. Thomas Schleker (EC) Dr. Célia Sapart (CVE) Prof. Patricia Luis Alconero (UCLouvain)
16:00-16:30	**Belgian Waffles Coffee Break: A Vincent's special**	
16:30-17:30	**Summary of the working groups**	Working group leaders
17:30-18:00	**Coffee Goodbye**	

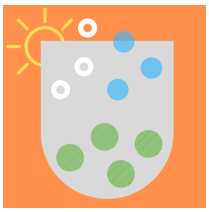
Working groups



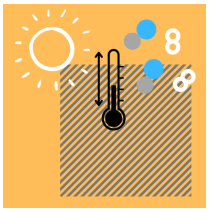
The future of electrochemical conversion
Water electrolysis & thermochemical upgrading
Direct CO_2 reduction
Bioelectrosynthesis
Electrocatalytic transformation of biomass-based feedstock



Direct Conversion: PC & PEC approaches
Photoelectrochemical cells
Photocatalytic approaches
Bio-hybrid technologies



Direct Conversion: Bio-based approaches
Microbial cell factories
Gas fermentation

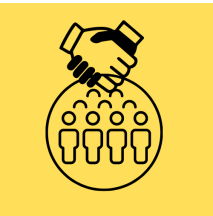


Solar-thermal conversion
Direct solar-thermochemical conversion of water and CO_2

Sustainable CO_2 sourcing
Industrial point source capture
Direct air capture
Direct air capture and conversion

Think tanks

Societal acceptability and the societal contract



We will be working with the SUNERGY roadmap and use a set of pre-defined criteria to let the participants discuss topics for strategic foresight and agility in roadmapping. The participants will be asked to consider when during a roadmap it makes sense to have certain considerations within e.g., ethics, equality, fairness, risk, NIMBY, transition speed, also reflecting on the nature of these considerations. The think tank will develop a range of recommendations of things

to consider when developing an agile roadmap for solar fuels and energy technologies. The think tank will delve into primary topics on the first day and follow on the second day with a summary of the previous discussion in order to discuss more detailed and difficult topics.

Novel business models

Solar conversion technologies offer the possibility to shift from a centralised to a decentralised energy and production system, inducing a paradigm change from consumers to prosumers. Industry has to prepare for such kinds of novel business models - and address them already in the near future since enormous structural changes are required. In this think tank, we will start to approach this vast topic step by step, starting around the following questions:

- What would such a novel decentralised system look like and what would the different roles be for the traditional players?

- How to help the research players to bring these technologies to industrial deployment?

- What are early market opportunities to deploy these technologies (e.g. downstream uptake of simple carbon-based products) ? What products to select (high-value/low-volume or low-value/high-volume) ?

- How to define proper viability targets? What is the role of socio-techno-economic assessment?

Ask me anything:
Computational Materials Science accelerating renewable fuels and chemicals development

Novel materials will allow cost-competitive, efficient and durable solutions across the proposed technological SUNERGY approaches. Computational materials modelling can guide experiments, avoiding tedious sequences of trial and error in the lab, and thus significantly speeding up the innovation process. To this end, a close dialogue between the different communities has to be established, ensuring that theory meets the expectations and needs of material and device developers. A crucial element in this context is the standardised and straight-forward exchange of theoretical and experimental results.

In this “Ask me anything” session, you will have the possibility to communicate your needs and ask our experts everything you want to know on machine learning, high-throughput computing, ab-initio and multiscale modelling, …

Why SUNERGY Roadmapping?

SUNERGY provides an inclusive innovation ecosystem with the vision to co-create an all-agreed on vision and roadmap for solar fuels and chemicals.

Bridging industry & academia
Bridging innovators with policy makers
Bridging innovators with society

SUNERGY stands for a smooth transition to a novel energy & production system.

Bridge mature electricity-based technologies with the direct conversion of solar energy to shift from centralized to decentralized energy and chemical production systems.

Please..
Not another lengthy roadmap!

Co-create a future based on renewable energy and fossil-free feedstock with us!

What outcome to expect?

Create credible & influential ambassadors
Provide foresight in emerging domain
Foster alignment & collaboration

Participant-specific material
A thorough basis to build individual, internal strategies & to enable concrete implementation

Please..
Not another lengthy roadmap!

Co-create a future based on renewable energy and fossil-fend feedstock with us!

First SUNERGY vision & roadmapping workshop

EU large-scale initiatives

Leading universities, research centers and research and technology organizations

Steel, Cement, Energy, O&G, Chemical Industry

Start-Ups

Multi-step conversion routes
Direct solar conversion routes

Social & environmental impact
Economic impact

Hydrogen
Ammonia
Carbon-based products
CO2 from the atmosphere
Industrial CO2

Policy makers
Funding bodies

Material science
Catalysis

Meet the community!

Brussels, 14/15th of June!

The main goal of this first workshop is to bring diverse realities together.
We will develop a **common language** to define major objectives and **milestones**.
These will be **accessible** in a **living** document, widely published and open for review!