SUNtoLIQUIDII

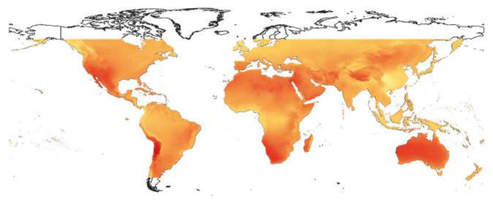
FUELS FROM CONCENTRATED SUNLIGHT

SUNlight-to-LIQUID

Efficient solar thermochemical synthesis of liquid hydrocarbon fuels using tailored porous-structured materials and heat recuperation

Context

The European Green Deal aims at a 90% reduction in transport-related greenhouse gas (GHG) emissions by 2050 which requires large volumes of renewable liquid fuels especially for aviation. SUN-to-LIQUID II addresses this challenge by developing an integrated solar thermochemical pathway for sustainable and cost effective fuel production at the scale of future demand directly from sunlight, water and CO_2.



DNI – the solar resource. Less than 1% of the arid land is sufficient to meet the global fuel demand

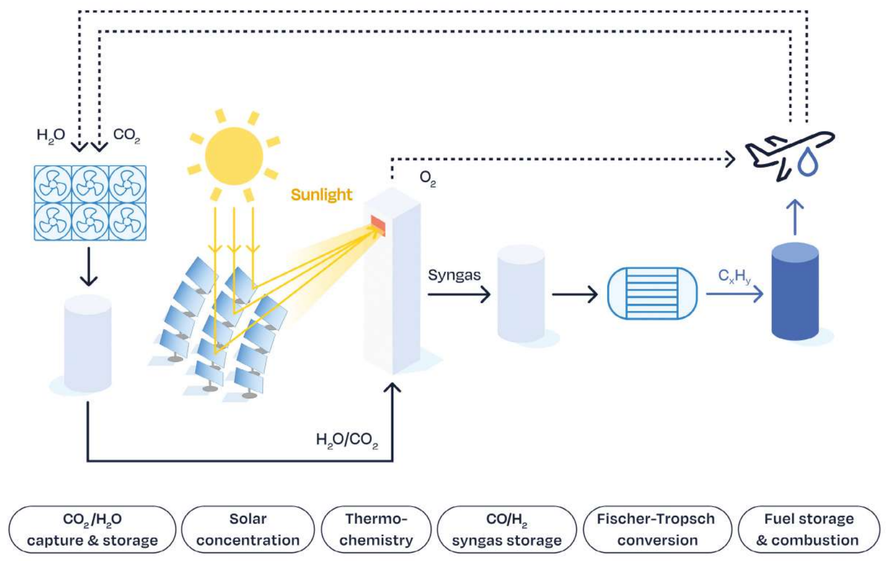
Objectives

SUN-to-LIQUID II develops a robust and sustainable conversion pathway to produce high-quality and fully decarbonized renewable liquid fuel from the untapped inexhaustible potential of solar energy.

The primary objective of SUN-to-LIQUID II is **to increase the solar reactor energy efficiency up** to record-high efficiency **> 15 % to be demonstrated in the field at 50 kW power.**

Improving the effective radiative absorption using 3D printed redox materials with **optimized structure and reducing sensible heat losses** during the temperature swing redox process by introducing heat recovery.

SUN-to-LIQUID II will provide evidence for cost-effective **> 80 % GHG emission reduction** with production potentials beyond projected future fuel demand.



Innovations

Solar radiation is the most scalable form of renewable energy. SUN-to-LIQUID II will develop a set of versatile technologies for solar fuel production from CO_2 and H_2O, including:

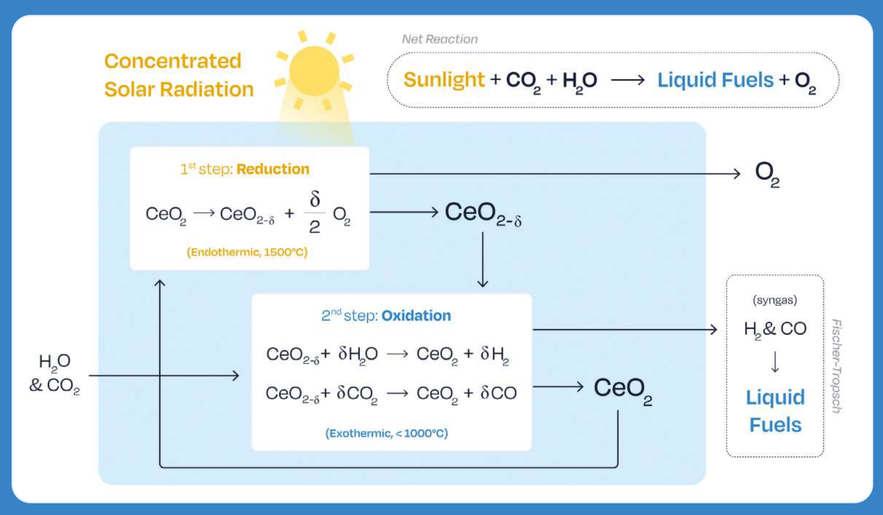
- An improved high-flux solar concentration system for applications using high-temperature process heat
- The development of efficient solar thermochemical fuel conversion using novel 3D printed redox materials
- Heat recuperation concepts to further improve the efficiency of high-temperature energy technologies and appropriate downstream integration with gas-to-liquid conversion plant

The combination of these technologies will enable efficient solar synthesis gas production in the long-term, ranging from solar H_2 generation, over solar syngas at adjustable H_2:CO ratio, to pure CO_2 splitting. SUN-to-LIQUID II will specifically focus on a synthesis gas with H_2:CO ratio of about 2 that is suitable for solar jet fuel production via Fischer-Tropsch synthesis.

1. Enhancement of high-flux solar concentrator
2. Development of tailored porous redox materials
3. Receiver-reactor with sensible heat recuperation
4. Gas-to-liquid plant
5. System analyses and business case study

Methodology

The SUN-to-LIQUID II concept stores **concentrated solar energy in liquid hydrocarbon fuels produced from H_2O and CO_2.** This reversal of combustion is accomplished via a methodology known as two-step high-temperature thermochemical cycle which is schematically shown in the figure below.



Consortium

Bauhaus Luftfahrt – The Aviation Think Tank

IMDEA Energy Institute

DLR Deutsches Zentrum für Luft- und Raumfahrt – German Aerospace Center

HYGEAR – The Global Hydrogen Source

LUP

Synhelion – solar fuels

Project acronym & title

SUN-to-LIQUID II

SUNlight-to-LIQUID - Efficient solar thermochemical synthesis of liquid hydrocarbon fuels using tailored porous-structured materials and heat recuperation

Starting date **01/11/2023**

Duration **48 months**

6 partners

5 European countries

Project Coordination

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Grant from SERI Swiss State Secretariat for Education, Research and Innovation **0.84 M€**

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