Masshylia project
Producing green hydrogen from 100% renewable energy

The Masshylia project aims to produce green hydrogen from solar photovoltaic energy to initially supply the TotalEnergies biorefinery in La Mède. This is the first large-scale project in France aiming to decarbonize the industry and avoid CO2 emissions.

Starting date of the project	September 2020 (feasibility study)
Project Localisation Places of implementation of the project at this stage and targeted geography if replicable.	Refinery in Mède, Châteauneuf-les-Martigues, Bouches du Rhône.
Project objectives Type of climate innovation of the project with a description of the problem/issue addressed	The aim of the MASSHYLIA project is to develop a complete value chain for the production of renewable energy (from photovoltaic solar panels) and decarbonized hydrogen, mainly for industrial uses and, in particular, for TotalEnergies' biorefinery in La Mède.
Detailed project description	The energy transition and climate change adaptation are long-term challenges that must be addressed. To this end, the European Union has set ambitious targets for achieving net-zero emissions by 2050. TotalEnergies' La Mède industrial site is part of this plan: in 2019, TotalEnergies transformed the refinery into a world-class biorefinery. This transformation represents the first step towards achieving global carbon neutrality. In addition to this transformation, the hydrogen consumed at the site is now being replaced with green hydrogen. This involves substituting carbon-based hydrogen for hydrogen produced from renewable energy. So, it is only natural that TotalEnergies has joined forces with Engie, two world-class champions working together to develop this ambitious project; a global first on an industrial scale. Initially, this project aims to supply the La Mède site and then to develop a hydrogen ecosystem to facilitate its use for mobility, industrial and energy purposes. The 100% Integrated (Renewable/Storage/Hydrogen Production) architecture represents the cutting-edge in design. It reflects the scale of the challenges that must be overcome to decarbonize industrial hydrogen supply needs while managing the intermittency of renewable energies. The consumption of green hydrogen at the TotalEnergies biorefinery, in the first instance, is a key benefit of the MASSHYLIA project. It enables supply to a customer, an industrial development, at a renowned site, to facilitate the subsequent deployment of this process on a large scale. This project is in keeping with the roadmap of the South Hydrogen Region and the Regional Urban Planning Scheme for Sustainable Development and Equality of Territories. Photovoltaic panels with an approximate capacity of 110 MW will be installed near the site and will supply a 40 MW electrolyzer. Initially, all of the hydrogen produced will be consumed by the Biorefinery site as a substitute for the gray hydrogen produced through steam-methane reforming (without capturing or storing the CO_2 emitted) which is currently being consumed. In a later phase, depending on local demand (transport/heating/electricity), this electrolyzer's use could be maximized to supply local needs, or even be connected to a H_2 transport network. The electrolyzer will be installed on an industrial site and will comply with industrial standards while offering a local environmental benefit. In addition, the project aims to create and support a Safety Center of Excellence based on local and international expertise. This Center of Excellence will work on four key areas: • Providing training and instruction on H_2 safety and security issues, • Developing platform testing to validate scenarios and equipment for example, • Bringing together national and international expertise to support/challenge projects and standardization issues, • Supporting R&D projects based on the development of specific safety models

This project is characterized by the following dimensions:

- The capacity to develop a hydrogen project which is 100% supplied by a regional renewable energy source without grid electricity and with geographical and temporal correlation. This design choice is cutting-edge and reflects the challenges that must be overcome in order to meet and decarbonize the industrial need for the most constant supply of hydrogen possible, while managing the intermittency of renewable energy sources. The location of the TotalEnergies' biorefinery in La Mède is a key benefit of the MASSHYLIA project to ensure the exploitation of this green hydrogen, which must be used to validate its subsequent deployment on an industrial-scale.
- The dimensioning of the value chain is set up to enable the coupling of renewable energies, hydrogen production and industrial processes. Numerous electrolyzer projects have been announced in recent years, but, to date, few have been successful because they are not competitive with current hydrogen sources (especially those of similar size, use and complexity to the MASSHYLIA project). The project will be implemented provided that financial support mechanisms and the preliminary authorizations from the competent competition authorities have been obtained. Requests for subsidies from the French (AMI) and European (IPCEI, Innovation Fund) authorities.
- The opportunity to form a skills and expertise hub: the MASSHYLIA project is of an unprecedented scale in France and will **bring together a variety of players** (partners, subcontractors and stakeholders) **from the sector** with the aim of developing a predominantly French and European value chain that can be **replicated** across other French sites, as well as internationally. The wide-scale deployment of this value chain will reduce costs and accelerate the development of renewable hydrogen uses in France.
- The availability of renewable electricity through the installation of photovoltaic solar panels exclusively for the hydrogen facility and of sufficient capacity to ensure its energy autonomy, combined with hydrogen storage solutions, is a key factor in the project's success.

As a result, this platform will become a real hub for green energies and a place to improve skills and expertise in the rapidly developing, future field of decarbonization of our industry and the energy mix in general.

Configuration of the Masshylia project

Main project's drivers for reducing the greenhouse gas emissions

Enter the information in the appropriate boxes

Reduction levers	Details on the aspects of the project
☐ Energy and resource efficiency (including behaviour)	
☒ Energy Decarbonisation	Decarbonization of hydrogen production
☐ Energy efficiency improvements	
☐ Improving efficiency in non-energy resources	
☐ Emissions absorption: creation of carbon sinks, negative emissions (BECCS, CCU/S, …)	
☐ Financing low-carbon producers or disinvestment from carbon assets	
☐ Reduction of other greenhouse gases emission	

Other/Comments: Decarbonization through the greening of industry, in phase one, and through the development of green hydrogen in other sectors, such as mobility and integration into networks in a later phase. This represents the creation of a green hydrogen hub.

Emission scope(s) on which the project has a significant impact and quantification of GHG emission reductions per emission scope

Indicate the aspects of the project that contribute to the reduction of emissions per category of emissions considered (left-hand column) and the quantification of associated emissions.

Indicate the main hypotheses and calculation steps in the intended section (below the table)

For further details, please refer to the methodology guidelines.

	Aspects of the project contributing to the reduction of emissions by emission category	Quantification of associated GHG emissions by emission category Please follow the quantification methodology used in the Afep guidelines.
Reduction of the company's carbon dependency		
Scope 1 *Direct emissions generated by the company's activity.*		
Scope 2 *Indirect emissions associated with the company's electricity and heat consumption.*		
Scope 3 *Emissions induced (upstream or downstream) by the company's activities, products and/or services in its value chain.*	Green hydrogen production	15 ktCO2/year (1st phase of the project)
Increase of carbon sinks		
Emissions Absorption *Carbon sinks creation, (BECCS, CCU/S, …)*		
GHG emissions avoided by the company at third parties		
Avoided Emissions *Emissions avoided by the activities, products and/or services in charge of the project, or by the financing of emission reduction projects.*		

Clarification on the calculation or other remarks:

In a conventional hydrogen production process (by steam-methane reforming), 1 ton of hydrogen produced generates approximately 9 tCO_2 of emissions. The production of 1660 tH_2 of green H_2 will therefore avoid the emission of 15 $ktCO_2$ per year, in phase one of the project.

On the other hand, the green electricity produced by the photovoltaic panels that will be built by the Masshylia Project, is deemed as zero in terms of CO_2 emissions under the ETS.

Modality of verification of the quantification.

Calculation standard used (ADEME base, GHG protocol, etc.): The conversion factor is based on the ETS benchmark (1 ton of renewable H_2 avoids 8.81 t CO_2)

Verification of the calculation (internal or external): Internal verification

Other environmental and social benefits of the project

If possible, list the impacts and Sustainable Development Objectives concerned

This project targets the following 3 of the 17 sustainable development goals:

- SDG 8 Decent work and economic growth: by developing a Safety Center of Excellence, in collaboration with local partners, based on local and international expertise;
- SDG 9 Industry, innovation and infrastructure and SDG 11 Sustainable cities and human settlements: by promoting sustainable industrialization that benefits everyone and, by 2030, provides opportunities for communities in the region to reduce their environmental impact;
- SDG 12: Responsible consumption and production: by promoting sustainable management and the rational use of natural resources (no over-consumption of drinking water) and by sharing utilities with the existing biorefinery site.

Project maturity level

Tick the corresponding current maturity level

☐ Prototype laboratory test (TRL 7)
☐ Real life testing (TRL 7-8)
☒ Pre-commercial prototype (TRL 9)
☐ Small-scale implementation
☐ Medium to large scale implementation

Remarks:
A pre-feasibility study has already been conducted for the project and its feasibility study was launched in Sept. 2020. The project consists in combining existing but, until now, independently operated technologies with small-scale facilities in order to scale-up production.
The project aims to achieve this on a multi-megawatt scale

- The application of such a combination on an industrial scale and its replicability,
- The development of a massive hydrogen storage block,
- The development of Energy Management System tools to optimize the production of renewable energy to that of hydrogen in real time,
- The development of multi-uses.

Capacity and conditions of the project reproducibility, with associated climate impact mitigation potential	By promoting a form of sustainable industrialization that will benefit everyone, by 2030, this project will offer communities in the region the opportunity to reduce their environmental impact and avoid at least 15 kTCO2 during phase one. By maximizing the use of the electrolyzer, the production of green hydrogen could be increased to 15T/d, with the impact of avoiding 45 kTCO2 in the area. This maximum use will depend on market development.
Amount of investment made (in €)	Not disclosed
Economic profitability of the project (ROI)	☐ ST (0-3 years) ☐ MT (4-10 years) ☒ LT (> 10 years) **Remarks:** click here to enter the information
Engaged partnerships	Currently, the TotalEnergies – ENGIE partnership is considering the option of working with new partners to develop the project (public or private: TSO, Equipment manufacturers). As such, the project has received more than 15 letters of support. The project team is also developing links with ENSOSP to set up a Center of Expertise on an international scale and for the opening of the La Mède hydrogen plant to test new technologies produced by start-ups.
Open comments from the project owner	Integrated project to develop renewable energies and innovative green hydrogen production through its wide-scale deployment and the development of new technological building blocks.
More about the project	
Contact the company carrying the project Please specify an ad hoc e-mail address that will allow the reader to contact the project company directly	Gloria Vendrell: gloria.vendrell@totalenergies.com Olivier Machet: olivier.machet@engie.com
Project URL links	https://www.total.com/energy-expertise/projects/bioenergies/la-mede-a-forward-looking-facility
Illustrations of the project 3 photos/videos minimum (in HD format to be attached)