SUBJECT PORTFOLIO

## Research and innovation at ENGIE, inventing the energy of the future

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**engie** 

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## **Our convictions** On the road to carbon neutrality

Energy is at the heart of the economy, of technology, health and creativity.

Throughout the world, pollution and greenhouse gas emissions are having an increasingly negative impact on the climate and the environment. We must not remain indifferent to this impact.

Our collective awareness of this situation has prompted

us to rethink our models of production and consumption.

At ENGIE, we are convinced that energy companies must be at the forefront of this transformation.

This is the greatest challenge that we have ever faced. It is also our duty, and an unprecedented opportunity, to reinvent our energy model.

# **Inventing the energy of the future**





Click here to read Shankar Krishnamoorthy's article

### **Key figures** An international R&D and innovation ecosystem



# A few figures on innovation:



## **Expert opinions**

#### excerpts from Michael Webber

#### **Research Is Necessary to Accelerate Our Transition to a Carbon Neutral World**



"Our civilization depends upon access to energy. Energy brings us light, heat, clean water, abundant food, mobility, information, and much more.

How can we obtain all the benefits of energy without the downside impacts of pollution, price volatility and geopolitical risks? The answer is to recognize that each fuel and technology has its upside benefits and downside risks. There are no universal, immediate solutions. We need a suite of solutions that are suitable for each geographical area.

One of the future challenges will be to step up financial support for the world's research ecosystem of industrial facilities, national labs and universities, so as to accelerate the pace of innovation. We must collaborate across sectors, academic disciplines, and borders.

The fastest, cheapest and most reliable way to reach carbon neutral energy includes a varied mix of low-carbon electricity and low-carbon fuels. We need new, cleaner forms of energy and, at the same time, we need to reduce emissions from conventional forms of energy.

There are many areas where we can take action quickly: low-carbon power generation from wind, solar, and geothermal energy, low-carbon gases, hydrogen, carbon capture, smart and efficient uses of energy including energy storage, smart appliances, and user education to change our behaviors and habits.

ENGIE's corporate research program is organized around these themes. Adopting a cleaner suite of solutions while increasing energy access and closing down our high-pollution facilities is the path we must take for our future.

Change is positive, but change happens slowly. It is definitely time to get started. This is where research is needed most: to accelerate the transition."

A video

on R&D at ENGIE



Source: special edition – Pour La Science – April 2020

Gaz ou électricité ? Quelles solutions pour un avenir énergétique zéro carbone ?

#### **Emerging sustainable technologies**



**Dr. Jan Mertens,** Chief Science Officer



Dr. Elodie Le Cadre Lead Science Advisor, ENGIE

At ENGIE, we are convinced that technological progress will be part of the solution.

It is difficult to accurately predict the next technological breakthroughs, but we are working in some of the most promising fields so as to make a positive impact on this transition. We are therefore monitoring trends in these technologies carefully.

Investments must be made to develop these new sustainable



technologies, and public and private organizations have to work together. Leaving aside environmental and economic considerations, public support is crucial. Social acceptance and the resulting adoption of new technologies will together determine whether a technology will make a breakthrough. The energy transition will therefore be a question of "AND", in two ways.

First of all, we will need a large number of emerging, sustainable technologies; one technology will not be enough to meet the challenge alone. It is too great a challenge. As individuals, as a company, and as a sector, we will have to work together.

# ENGIE Solutions

On the road to a carbon neutral energy future

By 2021, ENGIE will have added 9 gigawatts of renewable energy to its energy mix. Meeting this objective will require many different projects and innovation programs which aim to make the production, storage, distribution and sale of green energy more efficient, intelligent and digital.

All the energy transition scenarios include a reduction in energy volumes and the decarbonization of energy.

To make progress towards carbon neutrality, we will have to use less energy and at the same time produce greener, more accessible energy. The challenge is to ensure that these cleaner forms of energy are as readily available and flexible as fossil fuels.

ENGIE is exploring a wide variety of technological solutions, at each stage of the value chain, from production to end-use.

The emerging technologies that are making an impact on energy today will also have a direct or indirect impact on energy in the future.

### Innovation and green gases, an environmental necessity

Biogas is an eco-friendly natural gas solution, which is not only local and renewable, but is also a component in the circular economy. Biogas is produced by the breakdown of organic matter through a process of anaerobic digestion. ENGIE researchers are working on sev-

eral projects that aim to reduce production costs and proceed to industrial-scale production.

Biogas can also be produced through the gasification of dry biomass, waste and refuse-derived fuels.

Once carbon dioxide and trace gases have been eliminated from the biogas (purification process), it is then transformed into



renewable methane - biomethane - which is a substitute for natural gas that can be injected into the distribution network. Green hydrogen, produced from renewable resources, is also one of the most promising options to provide clean energy to the industrial and mobility sectors, and also to store and transport renewable energy.



### **H2SITE**

ENGIE New Ventures has invested in H2SITE, which aims to market a system that is capable of producing on-site, high-quality hydrogen from methane and in particular from biomethane. Based in Bilbao, Spain, H2SITE is a spin-off created by the Tecnalia European Research and Technology Centre and Eindhoven University of Technology.

The H2SITE technological platform serves customers' needs in terms of decentralized production, transport and storage of hydrogen. This disruptive innovation was identified and evaluated by ENGIE in the context of various collaborative research projects. H2SITE has two goals: to help its customers save money and to pave the way for green mobility, an essential component of our future world. Both of these goals involve the production of high-quality hydrogen on-site. Producing green hydrogen onsite using biogas, bioethanol or biomethanol eliminates transport costs and also prevents energy loss due to compression and decompression, or due to leakage. This solution, which previously seemed like science fiction, is now a reality thanks to the technology developed by H2SITE and a leading-edge SMR (steam-methane reforming) reactor.



# Gaya, biogas on an industrial scale



With its GAYA platform in Saint-Fons (Rhône, France), ENGIE is playing a pioneering role and showing that it is possible to produce biogas on an industrial scale. ENGIE is now producing green gas from forest residues, which is then used instead of natural gas for transport and distribution networks, and for natural gas vehicles. This is the first European platform to cover the whole process of producing green gas from dry biomass. The next challenge is to produce green gas from waste.



### An Australian city sets its sights on carbon neutrality

In Springfield, Australia, ENGIE has signed a strategic alliance to jointly create a 21<sup>st</sup> century model city where development will focus on clean energy and hydrogen, giving rise to the first positive-energy conurbation. The abundance of sunshine, wind and open spaces in Australia make it particularly suitable for renewable energy projects. The country has positioned itself as a key producer in the hydrogen economy, which could be set to take over as a new vector for green energy worldwide. By participating in this collaborative research project which will extend over the next fifty years, ENGIE is taking part in this transition and offering practical solutions that pave the way towards carbon neutrality.





Sunlight and wind are clean, readily accessible, unlimited energy resources. The sharp decrease in the cost of operating photovoltaic technologies enables us to create more decentralized solutions that make the most of sunlight to produce electricity, which in turn allows us to produce energy on-site and convert almost all types of facilities into power plants.

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# Kathu, the town with 384,000 mirrors



ENGIE's solar farm in Kathu, South Africa, is one of the largest renewable energy projects in the country, with 100 MW of installed capacity. It is a concentrated solar power (CSP) plant that is fitted with parabolic trough technology and equipped with a molten salt heat storage system that provides 4.5 hours of autonomy to reliably supply electricity when there is no sunlight and during periods of peak demand. The Kathu site covers around 4.5 km<sup>2</sup>, and comprises 384,000 photovoltaic mirrors.

Find out more about this project

### **Solar architects**



By investing in the German company Heliatek (6.6% share), which specializes in photovoltaic films for buildings, ENGIE now has the tools to pursue its goal: to become an "energy architect" for buildings. Heliatek has designed the first industrial-quality organic photovoltaic film (OPV) in the world, which enables buildings to achieve zero net energy consumption. The technology uses carbon-based molecules to convert sunlight into energy. This method enables the creation of ultralight, flexible photovoltaic solutions that are 100% eco-friendly.

### Darwin



Thanks to its DARWIN software, ENGIE helps operators collect and analyze real-time data on their renewable energy assets, thus enabling them to increase turnover and optimize costs. Designed by ENGIE Digital, DARWIN collects data from renewable energy plants in 21 countries and hosts this data in the cloud. In total, over 16 GW of power is connected in this way. Today, the platform enables the remote management and security of 100 wind farms and 17 solar farms in France, Belgium, Italy, Germany, Poland, Romania and Holland.



# What is a mini-network?

Mini-networks. also known as mini-grids, are electricity production, storage and distribution solutions that serve the needs of a village. Solar PV panels are installed on the roof of a container. which houses all the required equipment to act as a miniature electrical power plant. The houses, shops and

other electricity consumption points in the village are then connected to the container using smart meters, which calculate their bills according to their actual electricity consumption.



# Storage: innovation is vital

The research team at ENGIE's "Energy Storage" laboratory is focusing on technologies and solutions to make storage - especially batteries - competitive, eco-friendly and suitable for large-scale industry:

- Li-ion batteries that are best suited to each kind of use
- Redox flow batteries (RFB), a new, less mature generation of batteries that are radically different and present many advantages, including a lower levelized cost of storage, no risk of fire or explosion, longer battery life without loss of performance over time, and greater suitability for applications that require several hours of storage capacity, such as switching from one renewable source of energy to another. Our laboratories have already tested numerous RFB technologies, which will be included in the first industrial experimentation projects in 2021.



# EPS, a revolutionary platform

ENGIE EPS is a start-up that ENGIE acquired in 2017. It has since become a technical division of ENGIE that specializes in energy storage systems, micro-grids and e-mobility, to enable the global energy system to make the transition to renewable energy resources and decentralized energy production.

- over 100 people from 15 different nationalities,
- 130 patents filed in 33 countries,
- over 500 trade secrets.

ENGIE EPS products are developed from A to Z on the HyESS platform. This revolutionary, proprietary technology enables all renewable energy resources to be integrated with all energy storage solutions, including electric vehicles. The company has installed storage systems and mini-grids in 23 countries and is about to implement the largest 100% renewable electrification system in the world, on an island.



### Lifou: green energy storage comes to life

Since 2017, ENGIE has been working on the implementation of a project on the island of Lifou (New Caledonia), which produces then stores green energy, and aims to replace the diesel generators at the island's thermal power plant. Energy produced from sunlight and wind is accumulated in a large-scale, centralized storage unit, equipped with an innovative energy management system, which entered its second phase of development in 2019. The system supplies Lifou with 100% green energy for several hours a day, and stores excess energy so that it can be reinjected into the network when it is needed, which reduces diesel consumption.

Find out more: More information about Lifou

## Beyond energy

#### **Our Innovation Awards**



To shine a spotlight on the creative energy of our employees, for over thirty years we have organized the Innovation Awards, an annual in-house competition that rewards our staff, throughout the world, who develop innovations and contribute to the Group's transformation.

Every year, the competition brings together 500 innovative projects, and no less than 2,000 to 3,000 people are involved, who innovate and connect with one another throughout all the ENGIE entities around the world. These enthusiasts want to promote their initiatives and obtain resources to pursue them further, because they are convinced that their innovations will enable us to achieve carbon neutrality.

In 2019, we received over 500 projects from 48 countries and presented 15 awards in fields as diverse as energy storage solutions, green mobility and clean heating systems.

In 2020, we received over 540 projects from 42 countries and presented 19 awards in fields as diverse as energy storage solutions, decentralized energy production and clean heating systems.





