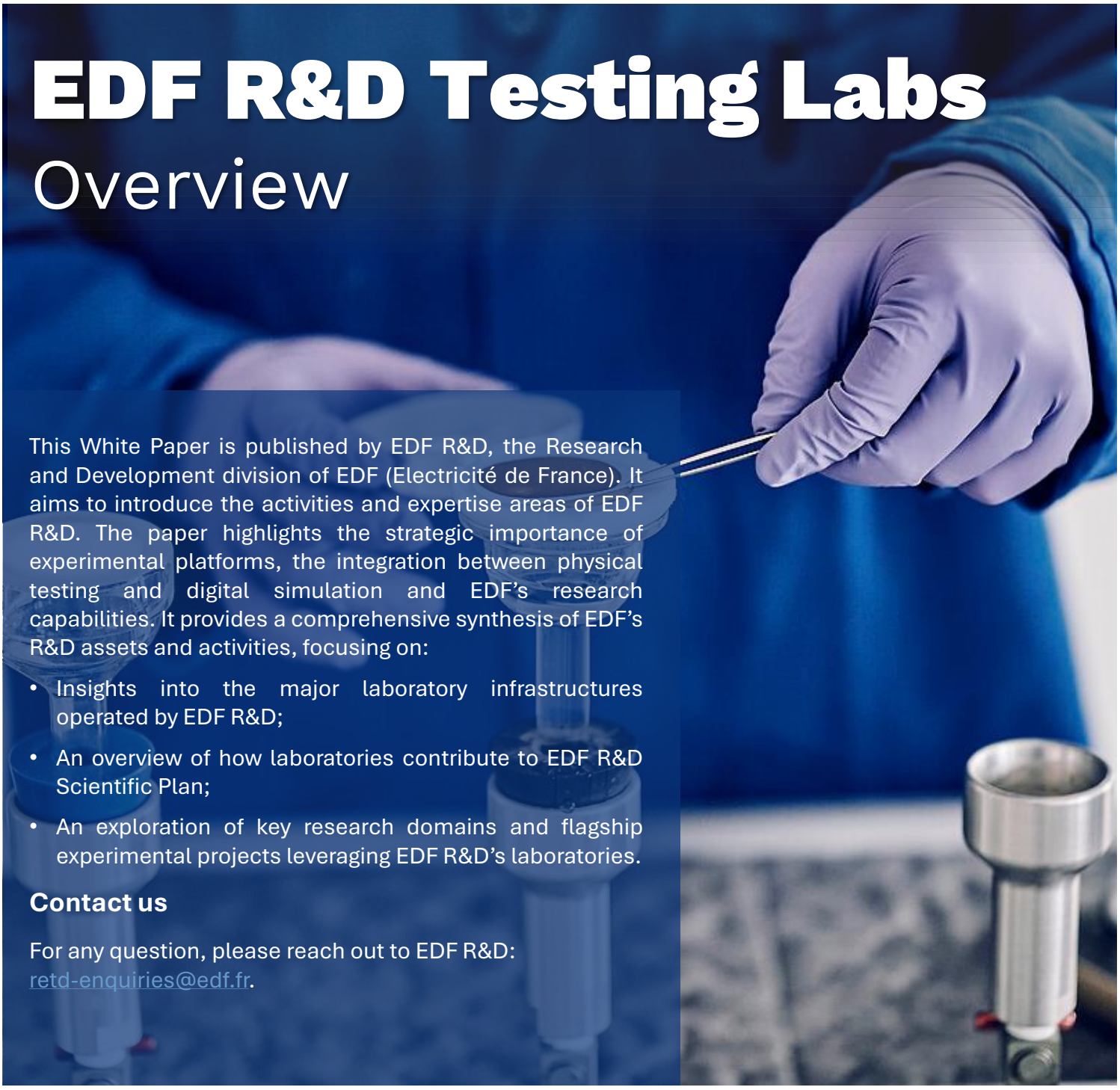
July 2026

R&D WHITE PAPER

EDF R&D Testing Labs
Overview

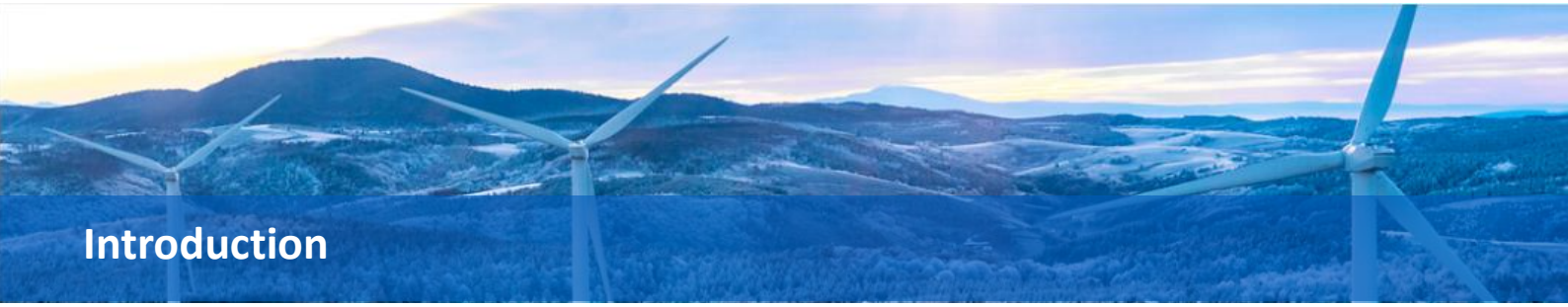


This White Paper is published by EDF R&D, the Research and Development division of EDF (Electricité de France). It aims to introduce the activities and expertise areas of EDF R&D. The paper highlights the strategic importance of experimental platforms, the integration between physical testing and digital simulation and EDF's research capabilities. It provides a comprehensive synthesis of EDF's R&D assets and activities, focusing on:

- Insights into the major laboratory infrastructures operated by EDF R&D;
- An overview of how laboratories contribute to EDF R&D Scientific Plan;
- An exploration of key research domains and flagship experimental projects leveraging EDF R&D's laboratories.

Contact us

For any question, please reach out to EDF R&D: retd-enquiries@edf.fr.



Introduction

Introduction to EDF R&D testing facilities

This White Paper aims to provide an overview of EDF international R&D activities and labs, emphasising the strategic importance of EDF global research initiatives.

EDF R&D is a world leader in energy research, investing €551 million (2025) across multiple domains of the energy transition. The R&D division operates 9 labs worldwide: 3 sites in France and 6 internationally, and an R&D office in Brussels.

This global collaborations with the energy, industrial and scientific sectors serve as key drivers for identifying emerging innovations and strengthening partnerships. All of EDF's experimental R&D activities are organized around its **scientific plan**, which is structured across five key areas as shown below.

To meet these challenges, EDF's R&D division draws on a unique set of **70 laboratories and testing facilities**, spread across its three major centers in France and several international sites.

Thanks to the diversity of these facilities, EDF is able to investigate all physical phenomena that underpin the energy value chain, allowing EDF to test innovative technologies in realistic conditions towards their operational implementation.

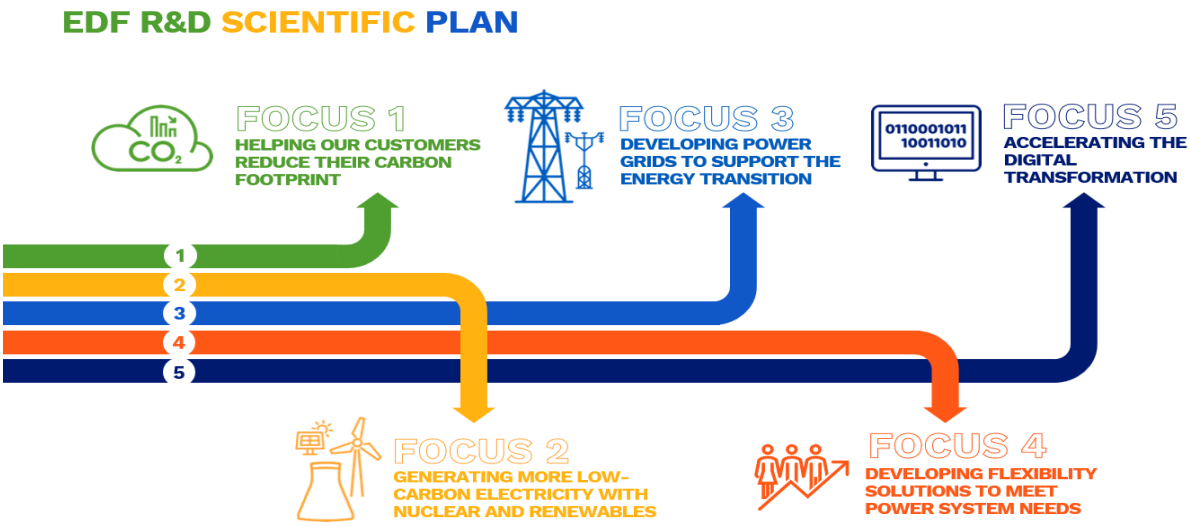
These experimental capabilities play a central role in the strategy aimed at achieving **carbon neutrality by 2050**. By combining experimental research and large-scale testing, EDF R&D supports the deployment of low-carbon technologies, enhances infrastructure resilience and provides the technical validation

Source : EDF R&D CO2 lab Chatou – Daste Adrien

These facilities offer **unique multi-physics testing capabilities**, complemented by advanced modelling and digital twins. Some of our testing facilities are open to industrial and academic partners, willing to test their equipment relying on EDF deep expertise in this domain.

EDF R&D is recognized for its cutting-edge expertise within EDF and at European and international levels, working towards a resilient and sustainable future.

Discover our offers: EDF R&D at the service of your challenges.



Helping our consumers reduce their carbon footprint

Enabling low-carbon uses

Reducing consumers' carbon footprint is a cornerstone of the energy transition. The building sector, transport and everyday electricity consumption represent a significant part of global CO_2 emissions. Electrification, improvements in energy efficiency and the integration of local renewable energy generation are key drivers for decarbonizing these areas, whilst maintaining comfort, affordability and reliability.

EDF's R&D laboratories enable the development, testing and validation of low-carbon solutions for housing, commercial buildings, industry, electric mobility and local energy systems under realistic operating conditions.

Climatron, low-carbon heating

Source: EDF Lab R&D Les Renardières – Pellerin Lucille

Climatron is a large-scale climate testing facility dedicated to evaluating thermal equipment used in residential and commercial buildings, such as heat pumps, electric water heaters and heating systems.

It enables performance to be assessed under controlled temperature and humidity conditions, reproducing a wide range of climatic scenarios, from extreme cold to heatwaves.

Research carried out with industrial partners contributes to the development of low-carbon equipment capable of reducing energy consumption while ensuring reliable performance throughout the year.

Low-Carbon Connected Home

Source: EDF Lab R&D Les Renardières – Pellerin Lucille

The Low-Carbon Smart Home is a full-scale experimental home designed to test innovative energy solutions in new constructions. It combines a high-performance building envelope, low-carbon technologies, local renewable energy production and smart connected devices. This platform provides valuable insights into how future homes can actively contribute to decarbonization while improving comfort and empowering consumers to manage their energy consumption. Find out more about Low Carbon Connected Home.

Smart Home Laboratory

Italy

Source: Smart Home – NicoElNino / Shutterstock

Based at the Officine Edison Milano, within the Politecnico di Milano's innovation ecosystem, the Smart Home Laboratory is dedicated to developing and testing digital and IoT solutions for residential energy management.

It explores technologies that enable consumption monitoring, control of connected devices and optimization of self-consumption for customers equipped with photovoltaic panels and battery storage systems.

Electric Mobility & Smart Charging

Source: EDF Lab R&D Les Renardières – Pellerin Lucille

The rapid growth of electric vehicles represents a major opportunity for decarbonizing transportation, but also raises challenges for electricity networks and consumers.

EDF's R&D laboratories and demonstration sites are investigating smart charging strategies, "vehicle-to-home" (V2H) and "vehicle-to-grid" (V2G) solutions, enabling electric vehicles to become flexible assets rather than simple electric loads. Find out more : EDF and electric mobility.

Ultra Fast Charging

Source: EDF Lab R&D Les Renardières – Daste Adrien

EDF R&D has invested in a new high-power EV charging platform:

- Innovative EV Charging Area designed for vehicles with a rated power up to 350 kVA.
- A platform rated 1.6 MVA for testing several cars charging simultaneously, thanks to an energy buffer (battery).

Generating more low-carbon electricity with nuclear and renewables

Scaling low-carbon generation

To meet future demand for electricity whilst achieving carbon neutrality, there is a need for a massive expansion of low-carbon power generation. This requires both the optimization of existing nuclear facilities and the accelerated roll-out of renewable energy technologies, such as solar and wind power.

EDF R&D supports this transition through state-of-the-art laboratories and experimental platforms dedicated to improving performance, extending the lifespan of facilities and developing next-generation solutions.

These facilities enable the study of materials, systems and integration challenges throughout the lifecycle of low-carbon generation technologies.

Offshore Wind & Renewable Integration

Source: Saint-Nazaire offshore wind farm – Bernard Gaëtan

EDF R&D works closely with industrial and academic partners to optimize offshore wind technologies, one of the fastest-growing sources of low-carbon electricity. Research focuses on turbine performance, structural behavior, maintenance optimization and integration into electricity grids.

These activities also address challenges related to variability, grid connection and hybrid systems combining wind, solar and storage, thereby ensuring renewable generation. Find out more: The integration of renewables at EDF

Nuclear materials and ageing on long time operations (LTO)

EDF R&D is actively preparing for the next generation of nuclear technologies, especially advanced modular reactors (AMRs). The research combines experimental testing with advanced digital simulation and modelling tools to optimize reactors.

Source: EDF Les Renardières VeRCoRS – Jobard Rodolphe

VERCORS (Realistic Containment Verification), a 1/3-scale model of the double-walled containment vessel of a nuclear reactor, studies ageing and structural behavior, as well as investigating evolutions of air leakage rates over time. Finally, it is equipped with a digital twin for continuous monitoring and predictive modelling.

Vercors is then a key asset for discussions with nuclear safety authorities targeting long term operations, and therefore improved economic performance.

Agri-PV Platform

Source: EDF Lab R&D Les Renardières – Daste Adrien

The Agri-PV platform explores the integration of photovoltaic systems into agricultural activities, enabling dual land use for both food production and low-carbon electricity generation. The aim is to develop solutions that optimize the balance between agricultural yield and energy production, whilst minimizing land-use conflicts. By enabling local production and, potentially, self-consumption, Agri-PV helps to reduce end-users' carbon footprint whilst supporting sustainable agricultural practices and energy resilience.

ConnexLab

Source: EDF R&D Paris-Saclay ConnexLab– Pellerin Lucile

Dedicated to digital innovation for the nuclear sector (augmented reality, virtual reality, chatbots, digital twins, artificial intelligence), this laboratory is used to develop models and prototypes for the design, operation and maintenance of nuclear power plants. Find out more: ConnexLab

CO2 Lab

Source: EDF R&D CO2 Lab Chatou – Pellerin Lucile

The CO_2 Lab is designed to evaluate advanced carbon capture technologies. It investigates chemical absorption for the capture of CO_2 from the flue gases of gas-fired power stations, as well as adsorption and membrane gas separation processes.

The platform combines bespoke laboratory testing of low-concentration flue gas with numerical simulation and process optimization tools.

Developing power grids to support the energy transition

Grids of tomorrow

Climate change will inevitably transform the operating conditions of electricity networks.

Source: EDF Espiers-Guilleville – Dupont Cyrille

The increase in extreme weather events is already placing growing pressure on transmission and distribution infrastructures. Furthermore, the massive expansion of renewable energy, the growth of electric mobility and the rise in electrified applications are profoundly transforming electricity networks.

- Validate solutions on a real network, risk-free.
- Test under high-voltage and high-current conditions.
- Secure network equipment and connections.

Several R&D laboratories are dedicated specifically to T&D grids and equipment.

Concept Grid

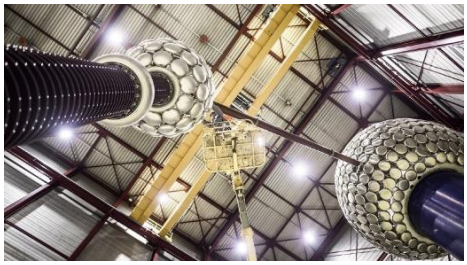
Source: R&D EDF Concept Grid – Pellerin Lucille

This platform enables the integration of innovative equipment (inverters, batteries, sensors, protection or communication systems...) in MV-LV distribution grids. The intermittency of renewable energy sources can be simulated, as well as advanced control strategies (flexibility, demand response, collective self-consumption).

EDF Power Networks Lab

Test your XXL equipment under extreme conditions.

Dialectric Laboratory



Source: R&D EDF Lab Les Renardières – Daste Adrien

The EDF Dielectric Laboratory is a testing facility dedicated to evaluating the electrical insulation performance of power network equipment, from low to very high voltage levels (up to 420 kV). It conducts a wide range of dielectric tests such as impulse, AC/DC voltage, and partial discharge measurements to ensure equipment reliability under stress. The lab is equipped with large testing halls, high-voltage generators, and specialized environments, enabling certification in compliance with international standards.

High Power Testing Station

Source: R&D EDF Lab Les Renardières – Daste Adrien

The EDF High Power testing station is a large-scale facility designed to test electrical equipment under extreme current and voltage conditions. Connected to the local 400 kV grid, it enables short-circuits, switching operations, and fault simulations to assess the performance and reliability of components. With a testing capacity of up to 3300 MVA, the station can reproduce real network, including high currents up to 130 kA and complex electrical phenomena.

Climatic Laboratory

Source: R&D EDF Les Renardières – Daste Adiern

This large chamber has climatic-controlled facilities able to stimulate the environmental constraints, with temperatures ranging from -40°C to +60°C, humidity of up to 95%, solar radiation and ice. Its purpose is to test the resistance of equipment, materials or facilities and ensure that their integrity is maintained for as long as possible. Find out more: Climatic room

Electromagnetic Compatibility of Digital Networks

Source: R&D EDF ECM laboratory – Beaucardet William

The proliferation of electronic equipment (inverters, charging stations, storage systems, smart automation systems) is radically transforming the electromagnetic environment of T&D networks. EDF R&D's EMC laboratory studies electromagnetic emissions and equipment immunity to ensure their proper behavior and interoperability.

Developing flexibility solutions to meet power system needs

Unlocking system flexibility

Developing a reliable, flexible and decarbonized power system is a key challenge of the energy transition. The increasing share of variable renewable energy, the electrification of uses and the decentralization of production require new approaches to balance supply and demand across multiple time scales.

In the electric power system, flexibility refers to the ability of generators and consumers to adjust their electricity generation or consumption in real time to ensure a balance between supply & demand on the grid.

Electrolyzer Testing Platform

Source: EDF R&D Hydrogen Platform site – Pellerin Lucile

EDF's electrolyzer testing facilities enable advanced electrochemical analysis and the long-term operation of hydrogen production systems. They aim to identify degradation mechanisms, detect failures *in situ* and develop specialized algorithms to monitor performance, optimize operating conditions and predict remaining service life with high accuracy. Find out more: Assessing your electrolysis

Battery and Storage Laboratories

Source: R&D EDF Les Renardières – Daste Adrien

Energy storage is a key enabler for renewable energy integration. EDF's battery laboratories provide end-to-end characterization of electrochemical storage systems, from cell to full system level, through extensive testing of electrochemical performance, thermal behavior and ageing mechanisms (cyclic & calendar ageing). Dedicated test benches (up to 1000V-320kW-800A), large-scale climatic chambers and abusive testing facilities enable realistic electrical, thermal and safety stress conditions, including failure modes such as thermal runaway. Find out more: Battery laboratory

Multi-Energy Platform

Singapore

The initial aim was to roll out a commercial offering of affordable, high-performance microgrids for remote areas in South-East Asia.

The MASERA platform combines several technologies: a 50 kW photovoltaic production with bifacial panels, hybrid storage systems (lithium-ion battery), as well as an electric vehicle equipped with a V2G device allowing energy to be injected into the network.

Since then, the laboratory has expanded to include other functionalities: EV Smart Charging, EMS integration, testing of H2 electrolyzers, etc. Discover MASERA

Numerical Control Platform

EDF's R&D department uses its expertise, methods and tools to offer digital control engineering for substations covering needs up to the design of a complete unit. To this end, it has set up a control-command testing platform, which plays a key role in qualification and integration tests. Find out more: Numerical Control Platform

EIFER/ICT LAB

European Institute for Energy Research by EDF and KIT

The EIFER research activities on H_2 collaborate with the Institute for Chemical Technologies (ICT H_2 Lab, Fraunhofer). It covers the electrochemical testing of core components and lifetime assessment of high temperature solid oxide based-technologies (SOC). The lab includes cells and small-sized stacks (kW-scale) monitored under various operational conditions and profiles (co-electrolysis, fuel cell).

IPVF

→ EDF, Total, CNRS, Ecole Polytechnique , Air Liquide, Horiba and Riber.

→ Aims at becoming one of the world's leading centers for research, innovation & training in the field of photovoltaic solar energy by bringing together internationally recognized academic research teams and leading industrial photovoltaic organizations.

→ It sets out to improve the performance and competitiveness of photovoltaic cells and to develop new disruptive technologies.

Accelerating the digital transformation

Innovation & Digital

The increasing integration of renewable energy sources, the rise of distributed generation, and the deployment of new digital technologies are profoundly reshaping how electricity systems are operated, monitored and optimized.

At the same time, the multiplication of connected devices, sensors, and automated systems generates massive volumes of data, requiring advanced analytics, cybersecurity and real-time control capabilities. These evolutions are essential to ensure more flexible, resilient and efficient energy systems.

Data Innovation Lab, data science and AI for energy systems

Source: EDF Group – Digital Reactor

The Data Innovation Lab (DIL) is a cross-domain R&D laboratory dedicated to data science and artificial intelligence. It brings together data scientists, engineers and operational teams to experiment with advanced analytics on real use cases.

The lab develops machine learning, deep learning and data visualization solutions to optimize energy consumption, improve forecasting and support decision-making. Its agile approach ("Think Big, Start Small, Fail Fast") allows rapid experimentation and deployment of digital innovations across activities. Find out more on DIL.

Source: EDF Group - R&D and the digitalisation of the nuclear industry

SMACH,
Simulation of energy consumption

SMACH is a digital simulation platform based on multi-agent modelling that enables realistic simulation of electricity consumption at the scale of households, districts or entire countries. It allows the analysis of human behaviors, energy uses and the impact of external factors such as weather, pricing or new technologies.
By generating realistic consumption data and load curves, SMACH helps anticipate future scenarios, optimize energy systems and support the design of new digital services. Find out more on SMACH.

Data Science & AI World

Source: Digital transformation – Allard Denis

This platform brings together expertise in AI, big data and advanced analytics to accelerate digital transformation across all EDF activities. AI is used to improve forecasting, predictive maintenance and optimization of complex energy systems. EDF R&D develops advanced AI models and digital twins to support decision-making and enable smarter, more efficient electricity networks. Find out more on Data Science & IA.

Big Data

EDF R&D's data scientists use these masses of data as raw material to constantly explore solutions by developing mathematical and computer tools and by perfecting ever more complex algorithms.
Find out more on major R&D projects in the era of Big Data.

Digital Reactor project, digital twins for nuclear systems

Source: EDF Group – Digital Reactor

Developed by EDF R&D, the Digital Reactor project aims to create a full digital twin of nuclear reactors. This virtual replica combines multi-physics simulation models, real-time data and advanced visualization tools to reproduce the behavior of a reactor under all operating conditions.

This technology enables ultra-realistic simulations, operator training and optimization of design, operation and maintenance throughout the entire lifecycle of nuclear installations. It represents a key step in the digital transformation of the nuclear industry.

Industrial validation through extensive lab testing

Driving the resilience and performance of future energy systems

A comprehensive approach to complex energy challenges

The transformation of electricity systems is driven by increasingly demanding technical, environmental and operational constraints. From power networks to industrial machines, from storage systems to buildings, infrastructures must operate reliably under more complex and uncertain conditions.

EDF R&D supports this transformation through a unique combination of experimental platforms, advanced simulation tools and real-scale testing facilities.

Source: EDF R&D Chatou Périclès – Pellerin Lucile

From digital innovation to industrial validation

As highlighted throughout this white paper, digital technologies such as artificial intelligence, simulation and digital twins are essential to anticipate system behavior and optimize performance.

Source: EDF R&D Saclay ConnexLab – Pellerin Lucile

This digital capabilities are systematically combined with physical experimentation to ensure that innovations can be validated under real conditions before deployment. This integrated approach bridges simulation, testing and industrial application.

Supporting the entire energy value chain

EDF R&D laboratories cover a wide spectrum of expertise to address key challenges across the energy industry:

- **Electrical networks and power systems**, combining advanced simulation tools, high-voltage and high-current testing, and full-scale validation platforms, such as Concept Grid.
- **Rotating machines and industrial systems**, through performance monitoring, predictive maintenance and advanced diagnostics.
- **Energy storage systems**, from battery development to system integration and grid services.
- **Structural integrity and seismic risk**, ensuring infrastructure safety under extreme conditions.
- **Building and climatic testing**, enabling the validation of equipment under controlled environmental constraints.

An open and international R&D ecosystem

EDF R&D's network of laboratories covers the full spectrum of energy challenges, offering an integrated visions from equipment design to real-life operation.

Beyond these capabilities, EDF R&D has a distinctive international dimension. It considers global scientific cooperation as a key asset to address tomorrow's decarbonization challenges.

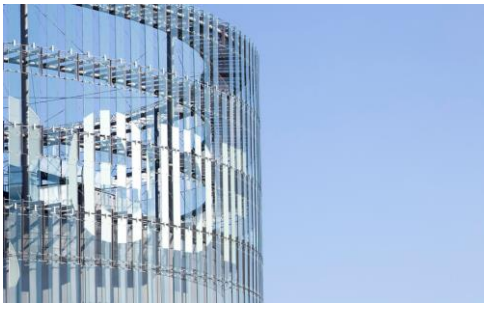
Source: : European Commission - International cooperation

Turning innovation into operational reality

By relying on joint laboratories, academic partnerships and an open ecosystem, EDF R&D has developed a wide range of expertise accessible to external partners, including industrial players, start-ups and research institutions.

EDF R&D is open to industrial collaborations willing to benefit from its extensive set of testing platforms.

This experimental approach complements numerical simulations and digital twins by providing the empirical data necessary for model validation, technology qualification and risk mitigation prior to industrial deployment.



Source: EDF R&S Lab Paris-Saclay– Eranian Philippe


© EDF – Denis Allard

EDF R&D offers a **wide range of services and training courses** for international partners and clients, professionals or scientists.

Several areas of research are open to customers willing to **benefit from EDF R&D analysis, expertise or lab testing**. EDF R&D services span across major domains: **Customers**, **Generation**, **Grids**, **Flexibility**, **and Digital**.

The **Institute for Technology Transfer (ITech)** is a training organization to share practices, expertise, and innovations based on EDF R&D activities.

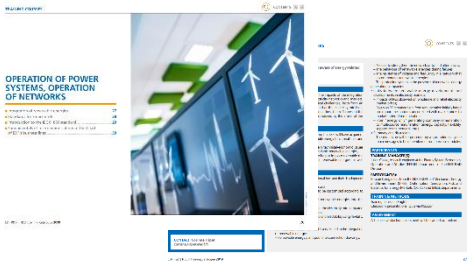
Various training courses are available on **renewable integration, smart grid solutions, microgrids, grid integration, energy storage, energy efficiency, control and communication technologies, etc (see EDF R&D ITECH catalogue).** Training is provided by EDF R&D leading experts in these key domains.

EDF R&D BROCHURE OF SERVICES

Consult the interactive document by clicking on the picture opposite

EDF R&D ITECH CATALOGUE OF TRAINING COURSES

Consult the interactive document by clicking on the picture opposite



R&D SCIENTIFIC PLAN ALIGNED WITH EDF STRATEGY FOR 2035

EDF R&D carries out **research for all EDF Group entities**, helping them improve performance and prepare the future integrating innovative technologies and solutions.

EDF R&D has **three Labs in France, six abroad:** China, Germany, Italy, Singapore, UK, USA and a **R&D representative office in Brussels**.

5 SCIENTIFIC PRIORITIES

1. **HELPING OUR CUSTOMERS REDUCE THEIR CARBON FOOTPRINT**
2. **GENERATING MORE LOW-CARBON ELECTRICITY WITH NUCLEAR AND RENEWABLES**
3. **DEVELOPING POWER GRIDS TO SUPPORT THE ENERGY TRANSITION**
4. **DEVELOPING FLEXIBILITY SOLUTIONS TO MEET POWER SYSTEM NEEDS**
5. **ACCELERATING THE DIGITAL TRANSFORMATION**

EDF Lab's facilities in Saclay, one of EDF R&D research centres.

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