![EDF logo]

Research and Development

at EDF UK

Delivering Research and Innovation to Help Britain Achieve Net Zero

75+
Researchers spread over 4 main research groups

20+
PhD students supervised by EDF UK R&D researchers

25+
Different nationalities represented at EDF UK R&D

12+
Millions of Pounds of research budget managed

3+
Millions of Pounds of research funded by the UK government or by Horizon Europe

30+
Collaborations with strategic partners (academic or national labs)

5
Main locations across the UK: London, Manchester, Gloucester, Exeter & Hove

Research and Innovation
are at the Heart of EDF UK to Help Britain Achieve Net Zero

By coupling the advances in science and engineering with the emergence of new digital innovations, EDF R&D UK is delivering research and innovation to our internal business units, policymakers, partners and customers to help Britain achieve Net Zero.

Established in 2012 and part of EDF UK Strategy and Corporate Affairs division, EDF UK R&D provides support to all business lines and subsidiaries of EDF in the UK and prepares the future for new business.

Researchers of EDF UK R&D are driven by two goals: improving performance in all EDF UK current activities and preparing for the energy future by exploring breakthrough technologies or business opportunities.

As of today, our 75-strong fully international team is engaged in R&D projects across all energy aspects including Nuclear, Climate Change, Offshore Wind, Energy Systems, Flexibility & Storage, Zero Emissions Heat and Mobility, Low Carbon Hydrogen and Advanced Digital Technologies.

Since 2020, EDF UK R&D is also coordinating and organizing innovation related activities across business units and subsidiaries in the UK to develop synergies, foster a culture of innovation and leverage the new EDF innovation division and the UK ecosystem of Innovation.

Our Board of Directors

A wholly owned subsidiary of EDF Energy, EDF UK R&D is supported by long-standing mentors and experienced experts in the energy sector as members of its board :

- **Richard BRADFIELD** – Chief Technical Officer at Nuclear Operations, EDF UK
- **Pascal CHARLES** – Director for Engineering and Generation R&D Programs at EDF R&D
- **Dan HOPCROFT** – Director of Zero Carbon Heat, Customers, EDF UK
- **Carmen MUNOZ DORMOY** – Director for Sales & Marketing, Renewable Energies, Energy Management and Networks R&D Programs at EDF R&D
- **Jacques SACRESTE** – Director for International & Finances at EDF R&D
- **Paul SPENCE** – Director of Strategy & Corporate Affairs, EDF UK

Our R&D activities and projects, serving a wide panel of internal clients in the UK and abroad

In line with our Raison d'Etre and our strategy, EDF UK R&D teams have acquired cutting-edge expertise to support our business units, policymakers, partners and customers in order to help Britain achieve Net Zero.

The structure of EDF UK R&D is defined, apart from administrative staff units and our innovation function, by four R&D teams all represented in the R&D Leadership Team.

The Nuclear R&D department, led by Richard Jones and based in Manchester, Gloucester and London manages and delivers a portfolio of programmes supporting the safety, performance and life extension operation of the existing nuclear fleet in the UK; the preparation of its decommissioning plan; and the development of new build projects and new reactor technologies.

The Renewables R&D department, led by Marie Renner and based in London, supports EDF R&D, EDF Renewables UK and worldwide in Offshore Wind where the team is leading the R&D activities for the entire EDF Group.

The Future Energy Systems department, led by Rebecca Rosling and based in London undertakes research in the fields of new market and system design, such as system flexibility and storage, decarbonisation of heat, transport and industry and H2 production, storage and end use.

The Digital Innovation department, led by Jordan Murkin and based in Hove is leading research into cutting-edge digital technologies with a focus on Artificial Intelligence and Data Science to accelerate the digital transformation of EDF UK.

Our clients

EDF UK R&D serves all EDF UK's business entities, such as Nuclear Operations, Nuclear Services, Customers (WMS, EBS, B2C), Hinkley Point C, Sizewell C, EDF Renewables UK & Ireland and Dalkia UK but also Group Business entities such as EDF R&D, EDF Commerce, ENEDIS and EDF Renouvelables as well as external clients in the UK (DESNZ and Innovate UK) and abroad (Horizon Europe).

Testimony

"With the acceleration of Net Zero ambitions in the UK, EDF UK R&D will continue to bring huge benefits internally and externally and will have a critical role in innovating to meet the challenges to help Britain Achieve Net Zero"

Paul SPENCE - Director of Strategy and Corporate Affairs and member of the Executive Team of EDF UK.

Our R&D activities and projects, backed by the UK Government

EDF to demonstrate four long duration energy storage technologies in UK

EDF INNOVATES TO HELP CUSTOMERS MOVE TO HEAT PUMPS

More funding to progress UK nuclear-generated hydrogen project

British Steel gets funding for hydrogen fuel study

Hanson tries hydrogen for asphalt sites

Part of R&D's role is to secure sponsorship from the UK Government and other public sector bodies to support some of our innovative projects.

In recent years we have won multiple bids across such diverse areas as Advanced Modular Reactors, Heat Pumps and Hydrogen storage. Public support allows us to prepare the future by developing ideas, tools and technologies that are not yet ready to commercialise.
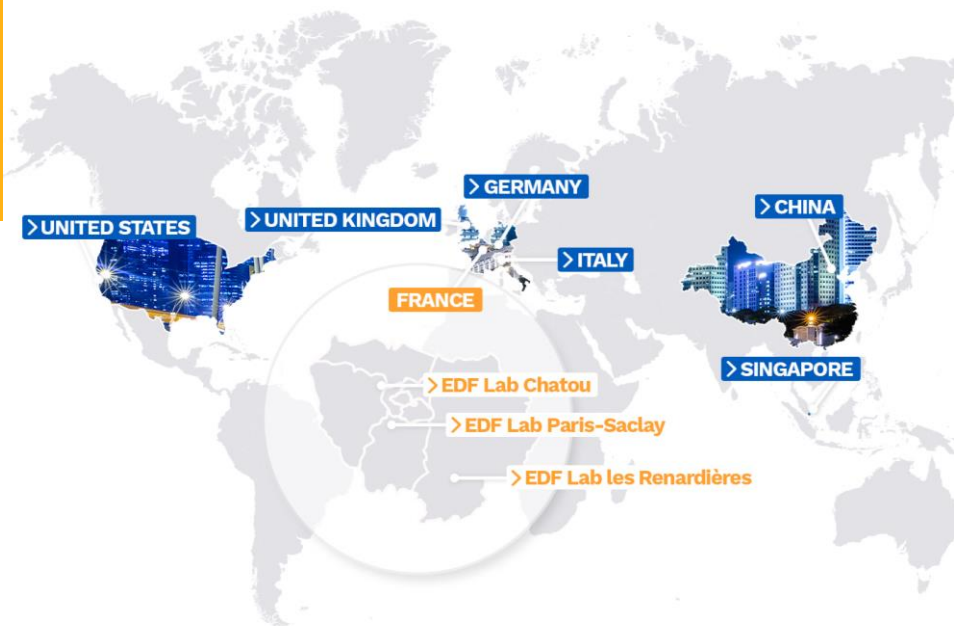
Our technical teams are supported in developing bids and delivering projects by a small and dedicated Commercial team, lead by Redwan Choudhury who provide expert advice and project management across the portfolio.

EDF UK R&D : a well-established R&D Centre part of EDF Group R&D and Innovation wider community

As one of six International R&D Centres, EDF UK R&D is an integral part of the EDF R&D international network, bringing the UK perspective to international collaborations. EDF UK R&D is creating a docking point to enhance synergies between EDF UK and EDF Group in the field of R&D.

EDF Group R&D : the World's most advanced Energy Group Research & Development division

Thanks to the expertise of its researchers, its testing facilities and its digital capabilities, EDF's R&D division is in a position to prepare for the future and open up possibilities in the world of energy.

EDF Group R&D division draws on daily support from EDF's business lines and subsidiaries and has two main goals:

- Improve the EDF Group's performance in its current ventures and enable customers to benefit
- Preparing for the future of energy by working on disruptive technologies.

EDF Group R&D covers all business lines and activities across the energy sector. In line with EDF's Purpose Statement, it focuses its research on four key areas:

- Using electricity to decarbonise users' activities
- Bolstering the performance of production resources
- Inventing the electricity solutions of the future
- Speeding up the digital transformation

EDF Group R&D Key Figures

€649 million investment in R&D in 2022

More than **1800** employees in France,

6 R&D centres outside of France, **225** employees internationally

40 nationalities represented

Nearly **160 PhD** students

70 testing, measuring and simulation platforms operating in all areas of the energy sector

20 laboratories set up with our partners

2100 patents in France and abroad

Testimony

"EDF UK R&D has always been well positioned on new and important topics for EDF UK and EDF Group. From early stage research, EDF UK R&D has rapidly moved to impactful projects and innovations close to the market or deployed in the business."

Bernard SALHA
EDF R&D director and Chief Technical Officer of EDF Group

Strategic Partnerships

With over **40 strategic collaborations** with **academic institutions**, **national labs**, and **institutes**, through PhDs, government funded projects or direct commissioned work for the business units, EDF UK R&D is the main connection of EDF to the ecosystem of research and innovation in the UK, leveraging the local ecosystem to access government funding, promote EDF UK's views and help EDF's reputation in the UK.

University of Manchester

The research partnership between EDF and The University of Manchester has developed over several years, incorporating a long-term collaboration in the field of computational fluid dynamics, extended later to research and development within the University's Materials Performance Centre and also the establishment of the Modelling and Simulation Centre (MaSC) in 2011, broadening the collaboration in solid mechanics with the joint appointment of a Professor and a Research Fellow. The collaboration focuses mainly on Nuclear technologies such as AMR HTGR's (High Temperature Gas Reactors) as well as SZB Lifetime, and new build projects such as HPC and SZC.

University of Bristol

Bristol University represents EDF R&D UK's largest academic partner. EDF collaborates with Bristol on a wide range of core scientific and engineering research subjects which include, Graphite, Structural Integrity, and Chemistry, supporting the UK's nuclear energy strategy and EDF's current fleet of nuclear power stations. Other collaborations include nuclear decommissioning, digital innovation and future energy systems.

ORE Catapult

OREC is the UK's leading technology innovation and research centre for offshore renewable energy. OREC has unique facilities and research and engineering capabilities and is a key partner of both EDF UK R&D and EDF Renewables UK & Ireland.

National Labs / Institutes

Academics
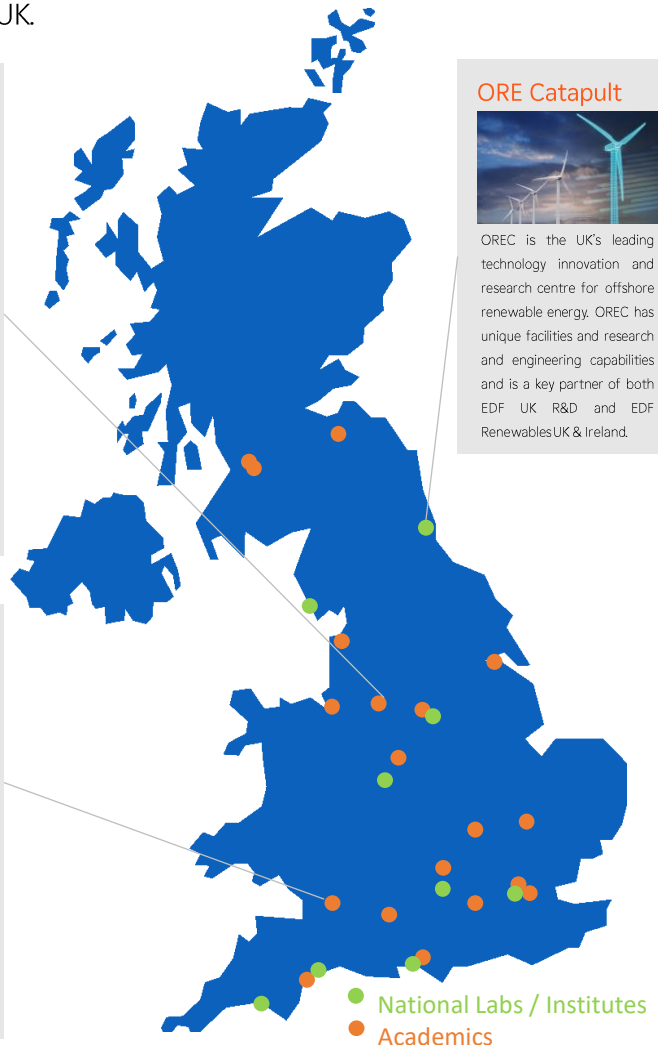
Our people are key to our success
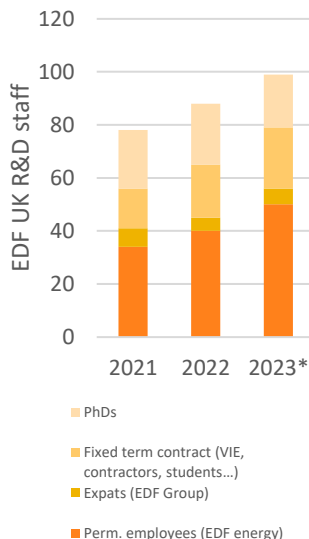
Everyone's Welcome

Starting with a very small team of a few expatriates, EDF UK R&D is today a very diverse R&D team of more than 100 talented admin staff, PhDs and researchers of various backgrounds, experiences and origins with multiple skills.

At EDF UK R&D, we are proud to support EDF's "Everybody's Welcome" ethos, aiming to create a supportive environment where people can get the most from their work and their workplace.

The team of EDF UK R&D have diverse
- **Career paths** - coming from academia, EDF UK business units, EDF Group, other industries, or starting their careers.
- **Skills** - including engineering, digital, commercial innovation and modelling.
- **Gender balance** – currently around a third of our team are female, and we are working towards a fully balanced team.
- **Nationalities and ethnicities,** with 30 different nationalities currently represented, with around 26% of our staff being from an ethnic minority group.

We support our team in developing themselves within R&D and, when they're ready to move on, to explore roles in the wider EDF group. Many of our 400+ alumni since the creation of EDF UK R&D in 2012 have taken roles elsewhere in EDF UK or EDF Group.

EDF UK R&D staff

Chart showing stacked bar data for 2021, 2022, 2023* with y-axis from 0 to 120.

Legend:
- PhDs
- Fixed term contract (VIE, contractors, students…)
- Expats (EDF Group)
- Perm. employees (EDF energy)

How do people describe their time in R&D?

MOTIVATING
Collaboration
Thrilling
Amazing
DIVERSITY
Supportiv
Openspace
richness
Kindness
Tooshort
Confidence
INNOVATION
Eurostar
Curiosity
Carteblanche
multiculture

Contact us

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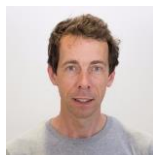
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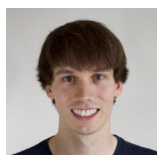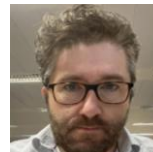
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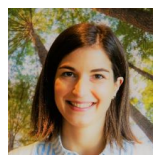
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More info

Interested to find out more? Visit our website:-

https://www.edfenergy.com/about/innovation
https://www.edf.fr/en/the-edf-group/inventing-the-future-of-energy/r-d-global-expertise
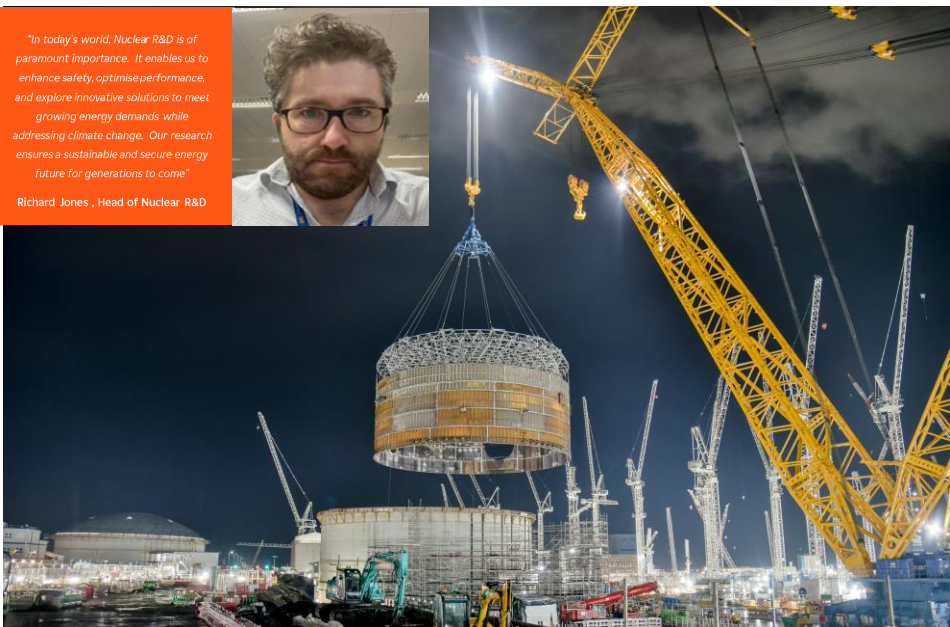
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The **Nuclear R&D** Department
of EDF UK R&D

Leading the way in nuclear research and development, in support of new build, safe, long-term operations and end of life.

Our mission

We support continued AGR operation and transition to end of life; SZB Lifetime and HPC/SZC build and future nuclear ventures as part of Net Zero Development.

- To lead the way in nuclear research and development, with a focus on safety, sustainability, and innovation. We are committed to advancing the state of the art in nuclear science and technology, and to creating a brighter, cleaner, and more secure future for the UK.

- We work to advance nuclear science and technology for the betterment of internal business units, policymakers, partners and customers in order to help Britain achieve Net Zero. We strive to explore new frontiers, push the boundaries of what's possible, and find innovative solutions to nuclear challenges.

- Through coordination, management and delivery of cutting-edge R&D and innovation, we aim to deliver positive business impact on behalf of all EDF UK licensees, in support of New Build, Operation and Decommissioning of Plant.

• Working with UK Academia (Bristol, Manchester, Imperial, etc.). UK Supply Chain (Jacobs, Atkins, Frazer-Nash, etc.) and NNL, UKAEA, DESNZ, NIRAB, NIRO and beyond.

The Nuclear R&D Team

+20 staff located across the UK, PhD students, Interns and Group Expats. Cross-cutting networks into UK Universities, EDF Group and beyond. Core skills in Materials Modelling, Chemistry & Corrosion, Hazards & Climate, Reactor Physics & Decommissioning & Defueling.

Our Stakeholders

Nuclear Operations
Nuclear Services
Advanced Gas Reactors fleet inc. operations and defueling
Sizewell B and Long Term Operation
Hinkley Point C
Sizewell C
Decommissioning & Defueling
EDF Renewables
Group R&D

Testimony

## Testimony

Our skills and our expertise

Advanced Reactors and Structural Integrity

A key goal of the ARSI Team is to **develop and validate structural integrity assessment tools** to support the EDF business. This includes **structural modelling, assessment methods and computational fluid dynamics simulation**, all of which are fundamental to underpin the structural integrity case for nuclear assets. The team directly **supports the operating AGR nuclear fleet, the AGR decommissioning & defueling Programme, PWR plant in the UK (Sizewell B and EPR)** and the growing area of **advanced reactor technology**, including high temperature Advanced Modular Reactors (AMRs), PWR Small Modular Reactors (SMR) and fusion technology.

Natural Hazards and Climate Change

The Team works to increase the **reliability and operational performance** of current, future build, and to be decommissioned, nuclear fleet and renewables against natural hazards and climate change impacts. The team **employs data analysis, extreme statistics, numerical modelling and remote sensing techniques** to holistically understand extreme weather, coastal flooding and erosion, space weather, marine ingress, climate change (where applicable) and hazards' combination.
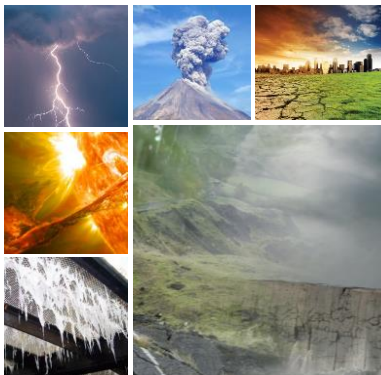
Decommissioning and Deconstruction

The Decommissioning R&D Programme team are responsible for **supporting station defueling, waste management and future deconstruction strategies and activities**. The team delivers value directly into the business, working closely with decommissioning business leaders, engineering experts and station management to ensure that the best in state-of-the-art technology, methods and processes are used in driving forward an effective and efficient decommissioning process.

Chemistry and Corrosion

The Chemistry and Corrosion Team focuses on understanding the **chemical interactions and corrosion processes in nuclear systems**, with the aim of **enhancing reactor safety and increasing the longevity of nuclear infrastructure.** Through applied research, effective corrosion mitigation strategies and advanced chemistry control measures can be adopted to the benefit of the buisiness.

Reactor Physics and Fuel

Reactor physics and fuel nuclear research involves **studying the behaviour and characteristics of nuclear reactors and their fuel.** This research focuses on **optimising reactor designs, improving fuel performance and efficiency, enhancing safety measures, and exploring advanced fuel cycles.** The goal is to maximise power output, extend fuel lifetimes, minimise waste generation, and ensure safe and reliable operation of nuclear power plants.

Some of our Nuclear R&D projects

AGRs Life Extension: Hartlepool and Heysham 1

AGR Lifetime is linked to safety cases associated with key irreplicable components, notably the Graphite Core and Boilers. As a result, these two components have seen the largest areas of support from the NG R&D programme for decades.

The latest lifetime extension is only the most recent example of how R&D has supported plant operation. Providing confidence that a robust materials data and assessment methodology is available to support an extended safety cases, for both graphite and boilers.

This has only been possible due to long term R&D programmes constantly developing materials data, methodology and possibly most importantly, the skilled workforce to accelerate solutions when plant issues emerge.

Over the history 40-year history of HYA/HRA, there are numerous examples of the R&D programme providing solutions to help keep HYA/HRA operating.

Potential of AMR technologies : Hartlepool Heat Hub project

The UK government has identified Advanced Modular Reactors or AMRs (in particular HTGRs) as a key technology to produce high temperature heat and thus decarbonise industrial processes. With its experience in gas-cooled reactors, graphite and high-temperature materials, its sites and its operational experience, EDF UK is eager to support the UK's ambition for AMRs. Rather than being positioned in a developer or operator role, EDF UK wanted to take a bottom-up approach, starting from the heat/steam needs of the end users (industrial) at a given site (Hartlepool) and then identifying the most suitable type of AMR.

EDF UK R&D, in collaboration with Nuclear Generation and Atkins, has won (and completed) a project called the "Hartlepool Heat Hub" concept as part of the BEIS AMR Research, Development & Demonstration Programme: Phase A. This positions EDF UK as a key player in the Phase B programme and strengthens our links to GBN and DESNZ.

## Natural Hazards and Climate Change
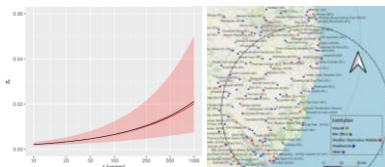
To investigate the effects of climate change, we rely on climate projections provided by global climate models (GCMs). R&D has developed and applied statistical methods for parameters such as air temperature and rainfall.

One of these is the Cumulative Density Function Transformation (CDFt). It is a statistical downscaling method that allows EDF to project/simulate hazards at a local site scale, for the present and future climate, based on observations and large spatial scale climate data.

The project provides an opportunity for the EDF UK R&D Natural Hazards & Environment team to better understand the temporal and spatial gradient of sea surface temperature at the English Channel and the North Sea.

Decommissioning and Defueling
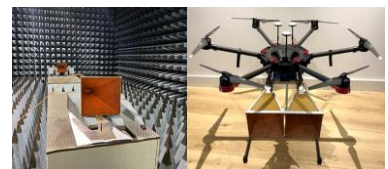
In 2022 the decommissioning R&D programme collaborated with Telespazio to provide 3 case studies to the business, demonstrating how data, obtained from satellites could be used to remotely monitor nuclear sensitive sites during the long periods of care & maintenance. The case studies, centred around HPB, DNB & HAR demonstrated strong value in utilising this data for structural health monitoring of buildings and coastal flood defences.

The value offered to both decommissioning site safety, as well as reducing the baseline liability of decommissioning, meant that the business won £680K investment in two projects with Imperial College London to further develop and perfect this technology.

Contact us
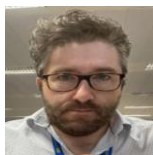
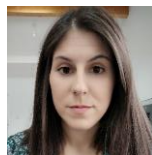**Richard Jones**
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More info

Interested to find out more? Visit our website:-
https://www.edfenergy.com/about/innovation
https://www.edfenergy.com/about/nuclear

⁂ eDF

The **Renewables R&D** Department
of EDF UK R&D

Delivering Research and Innovation to
make the most of offshore wind and
support ambitious decarbonisation
targets

Our mission

By 2030, offshore wind (OW) capacity is expected to reach 290 MW, 5% floating (+21%/y). Fixed OW is quite mature; our R&D focuses on optimizing O&M. Among the many challenges of floating R&D, we focus on the C&I and O&M phases to tackle the specific issues of Main Component Replacement and accessibility. In addition, we have developed a transverse expertise in cost-modelling and work to provide accurate and reliable meteocean data.

EDF Renewables is an international key player in OW, with a portfolio of 23 GW (2.4 GW in operation end of 2023). Offshore wind is highly competitive, and still not mature for floating. To ensure the success of EDF R, we bring our expertise in a large variety of topics, with a focus on Meteocean site conditions, C&I and marine operations and Operation and Maintenance. We are knowledgeable and have expertise in cost-modelling. We support the business with high-level cost-modelling tools enabling to provide site / project ranking and competitor analysis during pre-FID estimates, and we provide high fundamental understanding of cost trajectories by analyzing of the impact of innovations on OW costs.

Thanks to the UK flourishing offshore wind context (14 GW OW installed vs 16 GW EU-27 end of 2022) and ecosystem, we are positioned on the most relevant OW topics for EDF Group.

We rely on our expertise and excellent academic partnerships - E.g. SuperGen, ORE Catapult, IDCORE - to support locally EDF R UK, as 1/4 of EDF R offshore wind portfolio is in the UK which targets 50 GW of offshore in 2030. And we leverage on UK capabilities and knowledge for EDF Group's benefits.

The Renewables R&D Team

EDF UK R&D coordinate offshore wind R&D activities for EDF Group and host part of the R&D project teams.
We have 15 members dedicated to Offshore Wind, with various backgrounds, origins and type of contracts.

Our clients

The Renewables R&D department serves mainly EDF Renewables business entities (UK, France, North America, and new countries where EDF R is expanding its portfolio], the Strategy Division of EDF Group and EDF R&D.

Our skills and our expertise

Project integration

EDF UK R&D have been coordinating offshore wind R&D activities for EDF Group for more than 10 years. We have thus acquired a strong OW field knowledge about market fundamentals (economical, technical, regulatory, etc.), trends and challenges. Our aim is to be able to identify weak signals or strong market OW trends, to provide a global overview of offshore wind challenges and a strategic vision (orientation of partnerships, research projects...), and to be facilitator of data and knowledge sharing.

To achieve these goals, we build on our strong collaboration with the Offshore Asset operators of EDF existing wind farms (Blyth, Teesside) and strengthen new ones (NnG, PGL, Saint Nazaire, French Tenders, USA, China, etc.), we rely on strong links with academics (Strathclyde, Edinburg, Plymouth, DTU...), and leverage on consortium of experts (ORE Catapult, Supergen, Orca Hub...) and collaborative projects (FEM, H2020...)
.

Marine operations & O&M

EDF UK R&D two main goals are:
- Helping EDF R to achieve safer maritime operations, accurate installation planning and optimal OWF construction,
- Providing safer and better performing assets by removing the human elements as much as possible through better use of the data and remote operations.

Our team has developed a **technical expertise** related to:
- **the analysis and hydro-modelling of operations (port infrastructures:** data basis and strategies, Major Component Replacement),
- Robotics Autonomous System for operations (capabilities, on-site trials on use-case of interest, computer vision),
- **C&I and O&M operational data expertise**
- Optimized O&M strategies

We work closely with EDF R and EDF R&D in France, Orca Hub and techno-providers.

Cost modelling

Thanks to Cost Modelling (CM) R&D activities, we analyze the impact of innovations on OW costs and provide high fundamental understanding of cost trajectories.

We have developed R&D tools to model the cost of offshore wind farms. These tools were built to evaluate sites quickly, providing the costs and LCOE for a wind farm in a matter of seconds. These high-level tools that can use to predict the comparative costs of pipeline projects in a certain context. This capability supports activities such as project ranking, competitor analyses, and site selection for leasing auctions

The cost-modelling team also support EDF Strategy Group (DSG) through the CHypSE exercise by assessing the long-term market projections for offshore wind up to 2060.

The cost-modelling team works closely with EDF R - to support comparative analysis for early-phase projects and to maintain its CM tools -, with DSG (Chypse) and EIFER (Lower-C). The CM team contributes to the European projects Hiperwind and Marewind, and has strong partnerships with IDCORE and ORE-Catapult.

Meteocean

Our R&D activities aims at providing accurate and reliable meteorological and oceanic data to EDFR, in order to reduce uncertainties on AEP and EYA, get a better design and reduce financial risk & cost of financing

Our team has developed an area of expertise in measurement technologies (calibration and assessment) and turbine power curve verification, and work on large variety of topics: wind & ocean measurement and modelling, extreme events, sea states, Floating offshore wind AEP and climate change impacts.

We work closely with EDF R&D France and EDF R, and have several partnerships among which: DTU, FEM, CEREA, ORE-Catapult and Carbon Trust.

Some of our Renewables R&D projects

Underwater Robotic Systems for Offshore Wind Farms O&M

The use of robotic and autonomous systems to support offshore wind farm O&M could be a game changer in the future. In partnership with the National Robotarium, EDF UK R&D deployed in 09/2021 a unique underwater drone to carry out first ever autonomous robotic inspection of wind farm foundations. The ROV was modified to include cutting-edge robotic technologies for autonomous inspection capabilities and carried out visual inspections of the gravity-based foundations of three offshore turbines (Blyth OW Farm). The images have been used to create a 3D reconstruction model of parts of the underwater assets, which is a major improvement for data post-processing, as the condition of the foundations can be assessed at a glance! In addition, it can be used to monitor biofouling and effectively study its evolution between two inspections. This promising result will pave the way for the establishment of standardized mission profiles using autonomous technologies for the inspection of the foundations of EDF Group's offshore wind farms worldwide. We have now started to work on data analysis and computer vision (to automatically detect defaults) to identify the most promising use cases.

Correcting Wave Hindcast Data using Machine learning
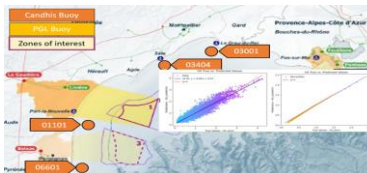
Providing accurate and reliable meteorological and oceanic data is key to reduce uncertainties on Annual Energy Production an Energy Yield Assessment, and then define a better design and reduce the financial risks and cost of financing. In 2023, we assessed how machine learning can be used to correct wave model hindcast predictions when given in-situ measurement data. We developed a tool to predict wave height and wave period given hindcast data with very effective results that pave the way for further developments and researches.

Major Component Replacement technical assessment

Major Components can fail (e.g. a blade) and need to be Replaced (MCR). The emergence of floating wind turbines brings additional challenges to MCR. Indeed, in deep waters, traditional jack-up vessels cannot be used.

In 2022, to support EDF Group's informed strategic choices, we have assessed and ranked the main MCR solutions proposed by industry. 14 technologies coming to market were assessed against specific parameters and a scoring matrix was produced. A variety of scenarios were assessed permuting floater type, lift type and turbine size, to underline which MCR solution was the most appropriate option.

We are now going further by challenging the reliability and performance of MCR solutions. For the most promising MCR technologies, numerical hydro-modelling simulations have been / will be carried out using in-house modeling software. So as to reinforce our understanding and confidence in the performance of the solutions looked at, we are also providing support to prepare wave tank tests.

Cost modelling contribution to EDF R's success in the 1st Irish OW auction

For the first ever offshore wind auction in Ireland (ORESS 1), the cost-modelling team provided its support to EDF R, for the Codling project (1.3 GW, owned and developed by a 50/50 JV of Fred. Olsen Seawind and EDF R). In particular, a set of estimates for competitor analysis in relative terms was provided. We provided early-stage estimates within limited timeframes and EDF R UK&I was given the opportunity to iterate inputs and receive multiple batches of simulations. R&D provided accordingly with support to queries regarding assumptions behind the estimates. In addition, R&D shared its expertise on auction and uncertainty modelling for competitor bidding strategies. The quick and insightful responses were hugely appreciated. In May 2023, Ireland has selected 4 projects (3,1 GW), including Codling.

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More info

Please have a look to the below links:

https://www.edfenergy.com/about/innovation

https://www.edf-re.uk/what-we-do/offshore-wind/

The Digital Innovation Department
of EDF UK R&D

Delivering Research and Innovation
to Help Britain Achieve Net Zero

Our mission

"Lead digital change within EDF and be the trusted experts in emerging digital technology"

Digital Innovation sits at the forefront of our digital transformation, providing end-to-end delivery of digital solutions to address challenges across our business.

Within EDF UK R&D, the Digital Innovation department is leading the company's research into cutting-edge digital technologies. The team operates like a start-up, with the aim to explore, for example, how digital can improve the operational safety and efficiency of EDF's fleet of power stations and transform the way customers use energy.

A constant focus is the use of technology to enable the sustainable use of energy. Current priorities include artificial intelligence, quantum computing and blockchain. The members of the Digital Innovation team spend part of their time embedded in the relevant function within the Business Unit to ensure a close working relationship and ensure the understanding of business needs and requirements.

Team members also work closely with colleagues in EDF R&D to share knowledge and develop synergies. The team contributes to the scientific excellence and reputation of EDF UK R&D by collaborating and interacting with academia and the broader UK energy R&D landscape.

The digital innovation team

Members: 14 + 2 PhDs
Location: Hove (Portland Road)
Structure: Digital Innovation is comprised of a **development team** - focusing on software engineering challenges - and a **data team** - exploring data science challenges - that work together to develop complete digital solutions

Our clients

The Digital Innovation team works with business units throughout EDF Group developing digital solutions and helping support digital transformation.

Our skills and our expertise

Computer Vision

Computer vision is a well-established field of **artificial intelligence** that seeks to enable computers to interpret and understand visual information from the world, such as images and videos, to extract meaningful insights and make informed decisions.

The Digital Innovation team has been exploring the field of computer vision for more than five years. Through our work we have identified this as a **key technology for EDF, allowing us to streamline and optimise our monitoring and maintenance activities** and improve quality assurance coverage without additional human intervention. This area of work continues to grow as we identify more applications for this technology across our business, from providing onsite automated smart meter installation quality assurance to identifying defects in wind turbine blades, solar panels and concrete structures.

Natural Language Processing

Natural Language Processing (NLP) focuses on the **interaction between computers and human language.** It involves developing algorithms and models that enable computers to **understand, interpret, and generate human language,** enabling applications like language translation, sentiment analysis, and chatbots.

Our work on this topic started with our first project to create chatbots as a launch partner for the Amazon Echo in the UK. Since then we have expanded our expertise in this area and used this technology across the business:
- Improving the understanding of energy data by generating simple text summaries of time series data.
- Assisting engineers to search and interpret regulatory data
- Analysing market sentiment in order to understand and anticipate trends in the energy sector.

Recently, our work has further expanded with the increased capabilities of **large language models (LLMs), such as ChatGPT,** and we have began work with business units across the Group to use LLMs to improve access to our large document and data stores.

Web3

Web3 is an emerging vision of the internet that emphasizes **decentralisation, user control, and peer-to-peer interactions.** The realisation of this concept, replaces the current centralised approach with distributed technologies like **blockchai**n, enabling greater transparency, security, and ownership of digital assets and data.

Since 2014, Digital Innovation has been investigating Web3 to understanding the benefits this new approach could bring to EDF and our customers along with the impact it could have on our business. We have developed proofs-of-concepts and hosted events in the UK, US, France, China and the Middle East to explore ideas and build a community across EDF specialised on this topics. In 2023, we took over as **lead of the EDF R&D Babbage project to continue this work, expand into larger scale demonstrations** and explore further areas such as the **integration of AI within Web3**, its cybersecurity implications and the user experience considerations.

Software engineering

Within the Digital Innovation team, software engineering plays a pivotal role in our operations. Our expertise in this area is integral to our success, allowing us to align seamlessly with the evolving needs of the business. We work across all cloud platforms, choosing the most appropriate environment and programming language for each application enabling us to quickly explore new ideas and collaborate effectively throughout EDF Group.

Our capabilities in **software engineering allow us to provide end-to-end project execution, where our data and development teams collaborate together to build solutions.** We can **build data models, deploy them in the cloud, and create user-friendly** applications for customers to interact with them. Moreover, our capabilities extend to bridging the gap between R&D and end users, **translating advanced models into practical applications** that benefit the wider EDF community.

Some of our Digital R&D projects

A.I. for Blade Inspections

Inspection and maintenance of wind turbines is essential to ensure safe and continuous carbon-free energy production. Today, photographic inspections are used to identify blade damage, followed by in-house analysis. In order to gain productivity on this last step, the Digital Innovation team has developed an artificial intelligence-based tool to automate defect detection on wind turbine blade inspection photos.

The tool, based on convolutional neural networks, the knowledge and the feedback of EDF Renewables, allows to automatically identify different types of defects (cracks, erosion...). This automatic solution, under deployment by EDF R, will save the blade engineers 100's of work-hours and allow them focus on important tasks. A future development could be a coupling with the digital blade twin in order to predict the propagation of cracks automatically detected by the tool.

Defueling Config. Control App.

EDF UK is about to enter a phase of defueling and decommissioning for 7 nuclear power stations, each of which requires managing the state changes of nearly 30,000 alarms and signals. This process is requires desk engineers to print out thousands of changes each week to justify each change and record them in the Asset Management System. This process is lengthy, resulting in drawing and document changes taking place weeks or months behind.

The Digital Innovation team has worked alongside colleagues in Generation to develop a Configuration Control application. This application provides engineers with digital management of signals and alarms and allows a view of the current state of the plant in real time ahead of the documentation process. The app improves the efficiency and monitoring of the defueling process, digitising the change management process, supporting safety cases, and can be easily scaled to other systems and stations.

Babbage

Babbage is a multi-year project exploring the business applications of Web3, focused on demonstrating its potential value to EDF business units in the future. In 2023, the Digital Innovation team took over as lead of this project to expand the work into larger scale demonstrations and explore further areas such as the integration of AI within Web3, the cybersecurity implications it introduces and the user experience considerations. In 2023, the project will deliver:

- The Low-carbon Hydrogen Certification Project, led by EIFER, to demonstrate the feasibility of certifying hydrogen production using blockchain.
- ECOTRUST, led by Singapore Lab, ensuring renewable electricity procurement for electric vehicle charging using fractional renewable energy certificates (fRECs)
- Exploration of emerging Web3 areas, developing technical proofs-of-concept, maintaining a market watch, facilitating knowledge sharing, and building connections with startups.

Disaggregation

Disaggregation, also known as Non-Intrusive Load Monitoring, is an area of research that explores separating a household's energy consumption into the individual appliance signals, allowing customers to better understand how the electricity in their home is being used.

This technology has been explored EDF for multiple years, both internally and with various third-parties providing this as a service to our customers. The Digital Innovation team have launched two projects to pursue research in this area. The first intends to build an in-house disaggregation solution for the UK that will be integrated into EnergyHub. The second explores improved models for the French market in collaboration with SEQUOIA and Datanumia.

Contact us
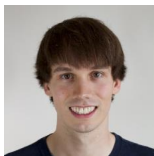
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More info

Please have a look to the below links:

https://www.edfenergy.com/about/innovation

The **Future Energy Systems** Department
of EDF UK R&D

Delivering Research and Innovation
to Help Britain Achieve Net Zero

Our mission

In Future Energy Systems, we take a hands-on approach to developing tools and technologies that will support EDF in helping Britain achieve net zero. We work with partners inside and outside EDF to develop innovative projects across a range of technologies, ranging from desktop studies to large scale real life demonstrators.

Previously called "Smart Customers", the team now supports many different business units in the UK, such as Customers, Renewables and Nuclear Operations, bringing expertise in a variety of technologies supported by a strong commercial focus.

We are organised across three teams – Zero Carbon Applications, Zero Carbon Systems and Zero Carbon Hubs, with many projects drawing on resources from all three of the teams.

Our projects cover a range of technology readiness levels, with the majority dedicated to near-to-market technologies, like solid oxide electrolysis, or to accelerating uptake of mature technologies like heat pumps. We have a focus on commercializing technologies and overcoming barriers to deployment. We complement this with horizon scanning and a small number of projects dedicated to developing early stage technologies.

We have a number of projects sponsored by government innovation programmes,, often as the lead of a consortium. This is a testament to the quality of our technical delivery and project management,

Our clients

Our clients with EDF UK include the Customers business, Nuclear Operations, Hynamics and EDF Renewables UK. Within the group we work closely with the wider R&D team, particularly the commerce and Renewables and Storage programmes. We deliver many projects on behalf of the Department for Energy Security and Net Zero

Testimony

"R&D is working closely with teams from Customers on a diverse range of topics helping find solutions to challenging issues, from how to install insulation retrospectively in the most complex buildings to developing plans for how, in future, EDF offers customers the ability to flex consumption keeping their bills low and their homes warm in a market reliant upon less predictable generation".

Daniel Hopcroft
Zero Carbon Heat Director

Our skills and our expertise

Zero Carbon Systems

Our Zero Carbon Systems team have **strong optimisation and technical modelling skills. They are experts in power system economics**, able to use their in-house optimisation models to explore key topics like:

- **GB power system analysis**, impact of energy policy changes, system operability as well as flexibility requirements;
- **Commercial proposition of flexibility assets**, ranging from grid scale batteries, to industrial flexibility to domestic flexibility arising from heat pumps and EVs;

The team works closely with stakeholders in the UK and France, including the Wholesale Markets Services team, EDF Renewables and the Energy Management and Renewables & Storage programmes in EDF R&D. Where appropriate the team draw on expertise of partners in academia and in the OSIRIS department in France.

Zero Carbon Applications

Our Zero Carbon Applications team's goal is to **accelerate the elimination of carbon emissions** for energy users in a way that is feasible and commercial.

Their work is focused around 4 key topics:

- **Mobility**
- **Heat**
- **Energy Efficiency and flexibility**
- **Hydrogen applications**

The team have a wide range of skills including **technical topic knowledge, technoo-economic modelling, application development and business models**. The team also have a strong **project management** capability, with experience of running proofs of concept and customer trials.

They are closely aligned to the Customers buisness in EDF UK, with additional support to other EDF entities like EDF Renewables, Urbanomy and Hynamics. With a strong mobility focus they work closely with the Mobility programme in R&D France, working with entities like Pod Point, Dreev and the group mobility department.

Zero Carbon Hubs

The Zero Carbon hubs team was formed in 2021 to lead the **growing topic of energy hubs** – coupling generation and demand through the **development and application** of new and existing technologies in hard to decarbonise sectors. Focus areas include:

- **Hydrogen production**, particularly where coupled to nuclear or other zero Carbon energy sources
- Hydrogen and electricity storage
- Direct air capture of Carbon Dioxide
- Hydrogen derivatives and synthetic fuels
- Heat assisted technologies

Many of the team have an engineering background, with experience in a variety of different industries including chemical, nuclear and steel. This is complemented by a techno-economic modelling capability, industry insight, and an ability to deliver practical demonstrations.

Some of our Future Energy Systems R&D projects

Flexibility Innovation

The pathways to Net Zero require energy systems to be reliable, flexible and sustainable so as to accommodate consumers' future energy needs in a cost-effective way. This means that when and where customers consume energy is likely to be as important as how much they consume. Moreover, in a digitally connected world with large volumes of data, this challenge becomes even more relevant, but also complex.

EDF R&D has acquired extensive experience with identifying, modelling and evaluating the business case for flexibility across multi-energy systems and markets, through a vast number of internal and publicly funded projects.

Mobility Innovation

The future of mobility in the UK is Mulitmodal, Connected, Autonomous and Decarbonised. Transportation and transport manufacturing generated over £109 billion added value for the UK in 2019, 5.5% of the total UK output. Transport also accounted for 27% of the UK's Green House Gas emissions in 2019. Digitalisation, greater connectivity, the journey to net zero, changing customer needs and new ways of getting about and delivering goods are all placing fresh demands on transport.

EDF R&D have extensive technical experience in projects related to mobility, they range from feasibility studies to real life demonstration projects.

Bay Hydrogen Hub

Demand for hydrogen is expected to grow and different production technologies and end uses are constantly being explored and developed. One potential production route is utilising both electricity and steam from a nuclear plant to provide energy to a Solid Oxide Electrolyser (SOE) and produce hydrogen at much higher efficiencies than existing electrolysis technologies.

The Zero Carbon Hubs team worked in partnership with Nuclear Operations Strategic & Commercial Development and Heysham 2 teams investigating this technology as part of a government funded innovation feasibility study. The hydrogen will be compressed and transported to local asphalt sites to replace natural gas or PFO in the asphalt production process.

We are now delivering a world first demonstration in the next phase of the project.

Catalyst

Project Catalyst is part of the government funded Heat Pump Ready Programme, focusing on improving the customer journey, The objective of this project is to deliver a consumer-centric digital platform to streamline the heat pump installation process.
The user friendly platform will consist of three modules:
• High level survey
• Remote technical survey
• Post-installation modelling
This end-to-end digital solution aims to simplify and accelerate the heat pump installation journey by reducing the time, cost and complexity for all parties along the supply chain. EDF R&D as leads are working closely with EDF Customers to deliver an optimum solution that can be used beyond the project. Other partners on the project include Daikin, University of Sheffield and CB Heating.

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More info

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