

# EDF Energy – Nuclear R&D Programme

*Current activities and future opportunities*

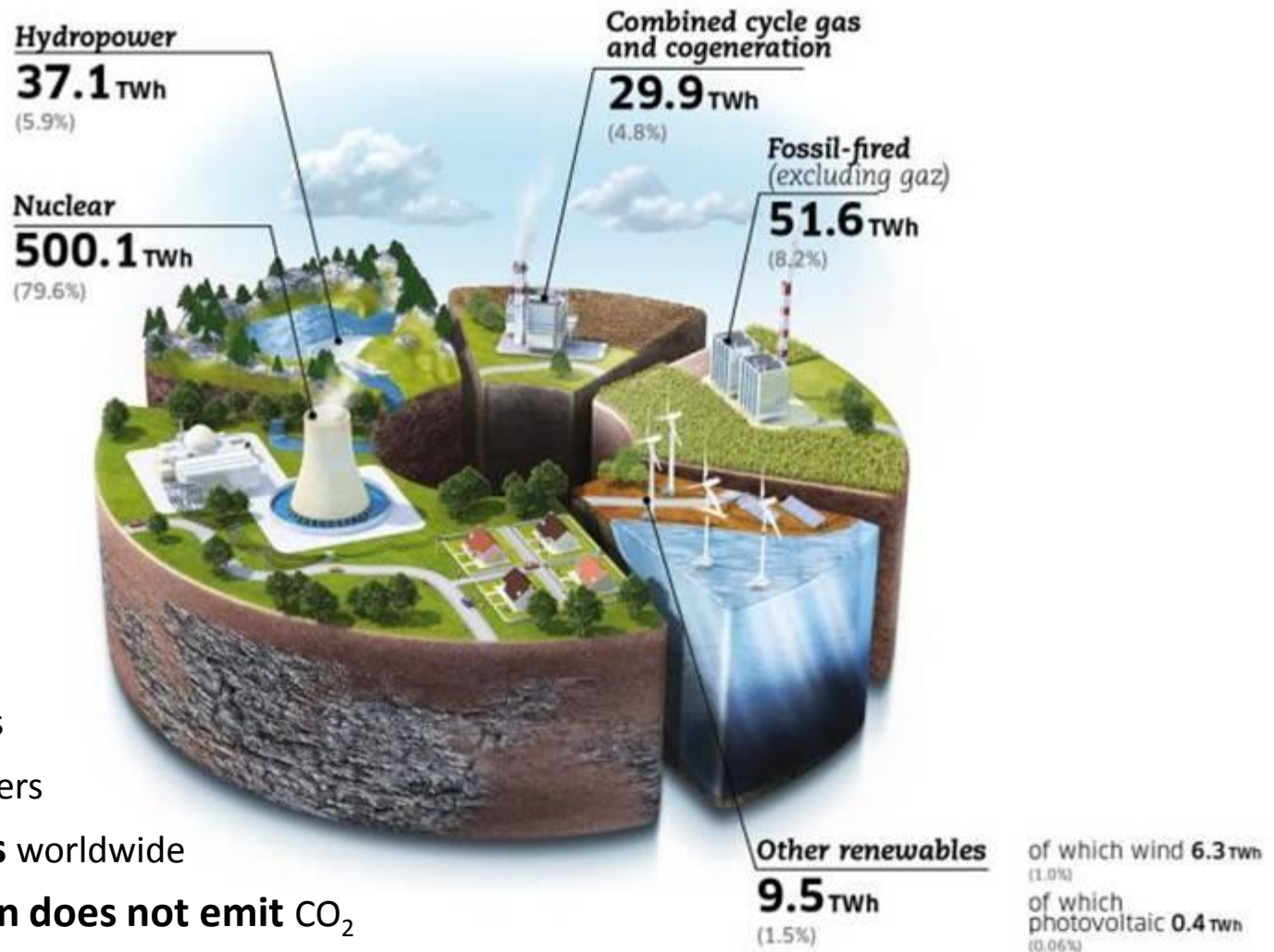
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**Erwan Galenne**

Head of Low Carbon Generation  
EDF Energy R&D UK Centre



# EDF - A Global Leader in Low-Carbon Electricity



**€72.7 billion** in sales

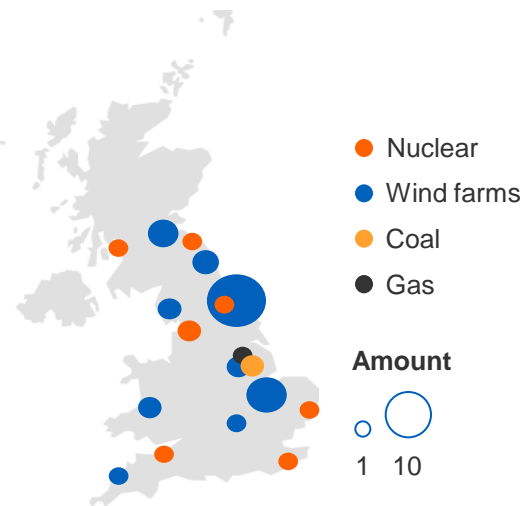
**39.3 million** customers

**159,740 employees** worldwide

**84.7% of generation does not emit CO<sub>2</sub>**

# EDF Energy in the UK

## Generation



**8**  
nuclear power  
stations  
(14 AGRs, 1 PWR)

**31**  
wind farms  
(including  
1 off-shore)

**2 + 1**  
coal gas  
powered stations

**2**  
EPRs  
in project at  
Hinkley Point

**Sales &  
marketing**



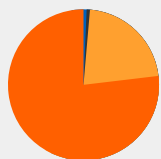
**52.8 TWh**  
electricity sold



**25.7 TWh**  
gas sold

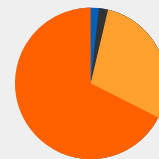
**5.8 million**  
customers

## Generation 72.5 TWh



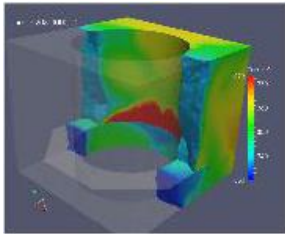
● Nuclear **77%**  
● Coal **22.5%**  
● Combined cycle gas and cogeneration **0.2%**  
● Other renewables **0.3%**

## Installed capacity 13 GWe



● Nuclear **67.6%**  
● Coal **31%**  
● Gas **0.7%**  
● Other renewables **0.7%**

# EDF Energy R&D in the UK



*Existing Nuclear*



*People, Processes & Buildings*



*Energy Systems*

## *Local delivery of Global Value*

100 people (FTE)

40 PhD

£40m of investment in R&D



*Digital Innovation*



*Open Innovation*



*Part of EDF Group International R&D Centres  
(500m€ investment per annum, 2100 people)*



*Renewables*



*Environment and  
Natural Hazards*

# Nuclear R&D Programmes - France

A **200m€** R&D programme to support performance of Group businesses and to anticipate and prepare for the future

## R&D Roadmap Themes

- Safety
- Performance
- Lifetime Extension
- Fuel and core
- New reactors
- Modelling and Simulation

## R&D programme supported by:

- State-of-the art experimental facilities
- Codes and modelling tools
- National and international collaborations



VERCORS mock-up:  
containment building at scale  
1:3



Ultra-high resolution TITAN  
microscope

# Nuclear R&D Programme in the UK – a changing context

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- Mature AGR Fleet and one operational PWR where R&D is a key part of underpinning:
  - Safety of our Plant
  - Our Operational Performance Today
  - Our Plant Life Extension (PLEX) commitments
- Challenging generating market where achieving financial value in R&D is important
- Increasingly diverse R&D needs:
  - AGR Technology
  - Waste and Decommissioning challenges
  - New LWR Technology in various forms
  - Growing application and use of digital technology



# Nuclear R&D Programmes in the UK

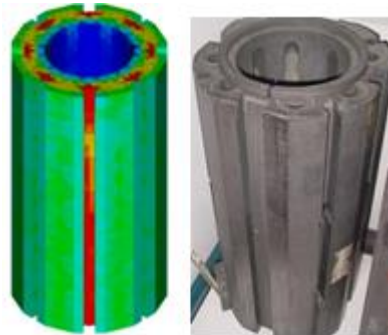
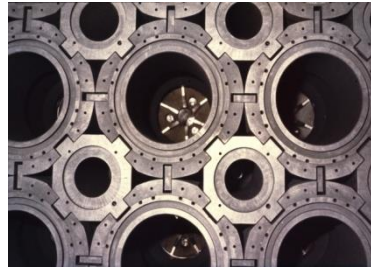
A **£30m** R&D programme with a specific focus on **Plant Life Extension** for AGRs

## R&D Roadmap Themes

- Improve Plant Performance
- Understand Plant Condition
- Improved Modelling
- Skills

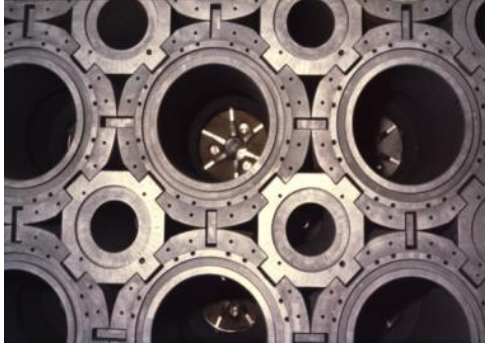
## R&D Scope

- Graphite (30% of the budget)
- High temperature Materials (25% of the budget)
- Chemistry
- Plant Engineering, nuclear technology, fuel handling
- Environment

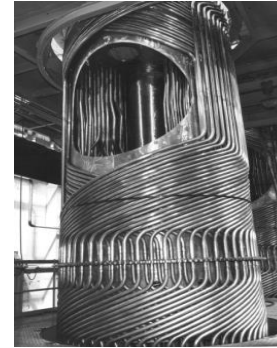


# AGR Lifetime Challenges

## Graphite core



## Boilers



### Fundamental Requirements

- Neutron moderator
- Mechanical stability (fuel configuration, control rods) and passage of primary coolant
- Thermal inertia (important aspect of reactor fault studies)

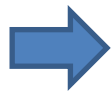
**PLEX Challenges :** ageing and degradation due to both temperature and irradiation effects (weight loss, shrinkage)

### Fundamental Requirements

- Provide the primary heat sink for cooling the reactor
- Allow steam production
- Part of confinement barrier

**PLEX Challenges :** gas-side oxidation and water/steam-side corrosion coupled with ageing and degradation

**Replacement or repair of the graphite cores and boilers is not feasible**



### R&D programme

- > Improve knowledge of actual state by **inspection and monitoring**.
- > Improve understanding of ageing and **degradation mechanisms**:
- > Assess and mitigate the impacts of ageing and degradation mechanisms
- > Maintain key skills needed by the development of AGRs exclusively in the UK.

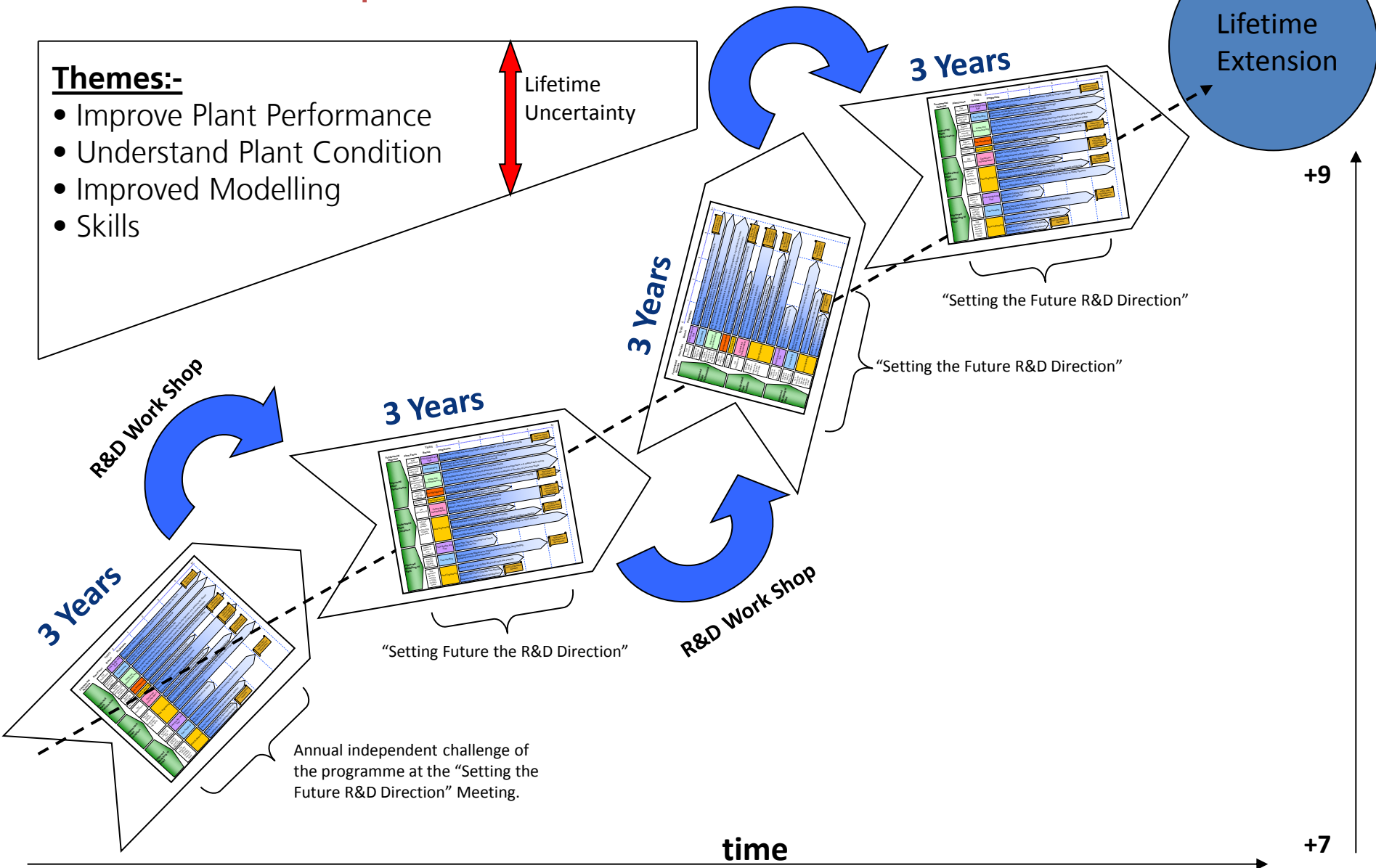


# R&D Road Map – Overview

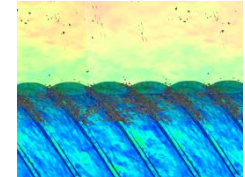
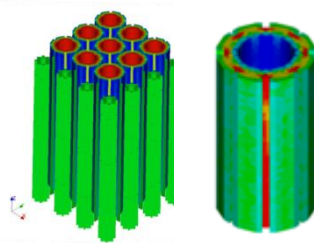
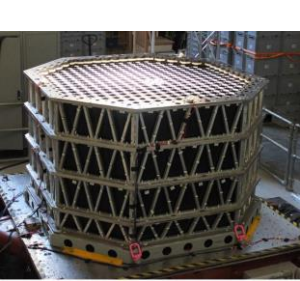
## Themes:-

- Improve Plant Performance
- Understand Plant Condition
- Improved Modelling
- Skills

Lifetime  
Uncertainty



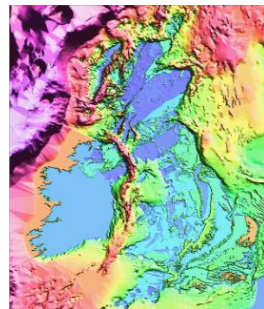
# Some illustrations



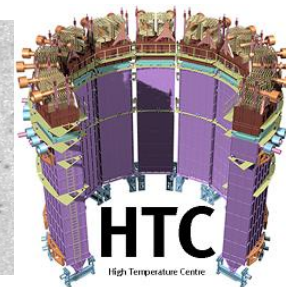
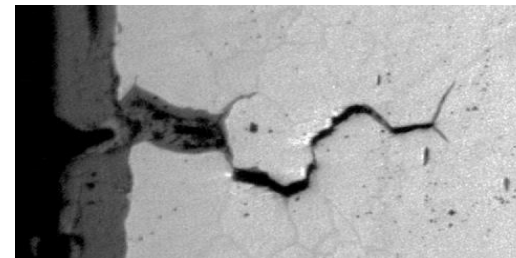
MANCHESTER  
1824  
The University of Manchester

*Shaking table experiment (Bristol) and quarter scale rig (AMEC) of the **graphite core** and modelling at different scales (Oxford, Glasgow, AMEC, Atkins...)*

*Experimental analysis and modelling of fuel pins – **Modelling and Simulation Centre***

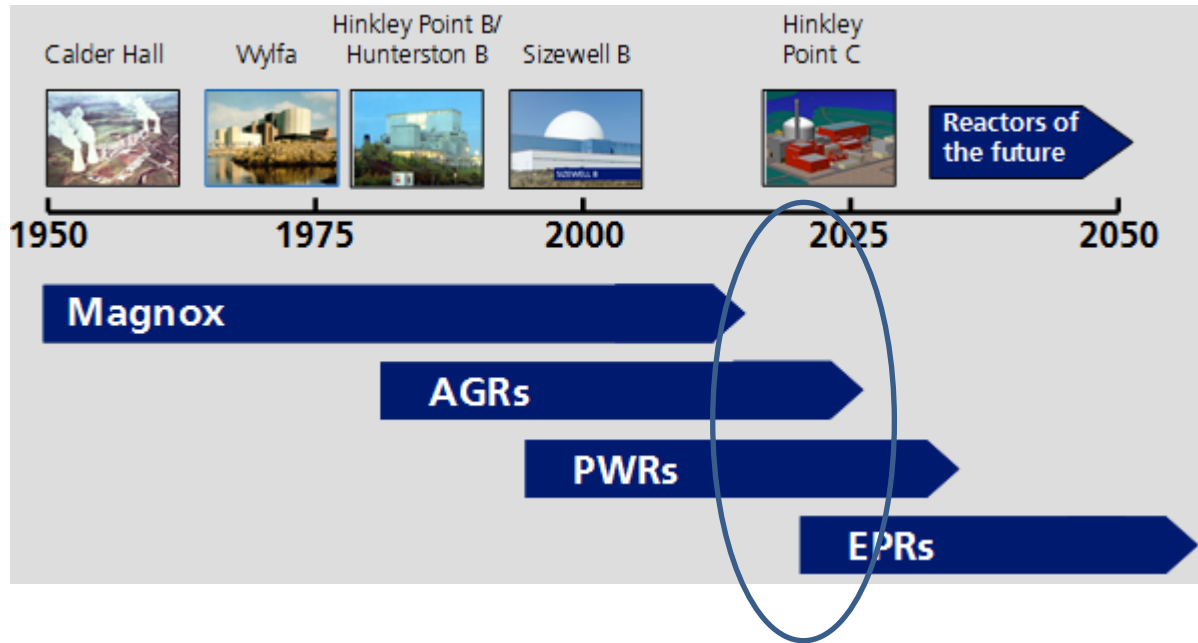


*Evaluation of the impact of solar weather (BGS, National Physical Laboratory, University of Surrey)*



*Creep cracking in carbonised 316H stainless steel – **High Temperature Centre***

# Future opportunities



## Life extension of AGRs and SZB

- Incremental Plant Life Extension Programme
- End-of-Life Value Optimisation

## Decommissioning and Deconstruction

- Characterisation
- Materials and Waste Management
- Handling, Packaging and Storage
- Decontamination and Remediation

## New Build

- Support to EPR projects (HPC, SZC)
- New reactors – including Small Modular Reactors



Thank You!

