
Research and development case study



National Audit Office

Energy research



November 2017

Introduction



This case study on **energy research** is one of a series that we have developed to support and complement our published report on research and development.

Our examination of energy research focused on arrangements to coordinate the funding of research into traditional and renewable energy sources to improve energy efficiency and identify storage solutions.

Other case studies focus on research relating to:

- advanced materials;
- animal and plant health;
- climate;
- human health; and
- robotics and autonomous systems.

If you would like to know more about the National Audit Office's work on science and research, please contact:

Sian Jones

Director for value for money audit work on business, skills, science and industry

✉ sian.jones@nao.gsi.gov.uk

☎ 0191 269 1889

Heather Thompson

Audit manager

✉ heather.thompson@nao.gsi.gov.uk

☎ 020 7798 7690

If you are interested in the NAO's work and support for Parliament more widely, please contact:

✉ Parliament@nao.gsi.gov.uk

☎ 020 7798 7665

The National Audit Office (NAO) scrutinises public spending for Parliament and is independent of government. The Comptroller and Auditor General (C&AG), Sir Amyas Morse KCB, is an Officer of the House of Commons and leads the NAO. The C&AG certifies the accounts of all government departments and many other public sector bodies. He has statutory authority to examine and report to Parliament on whether departments and the bodies they fund have used their resources efficiently, effectively, and with economy. Our studies evaluate the value for money of public spending, nationally and locally. Our recommendations and reports on good practice help government improve public services, and our work led to audited savings of £1.21 billion in 2015.

Summary



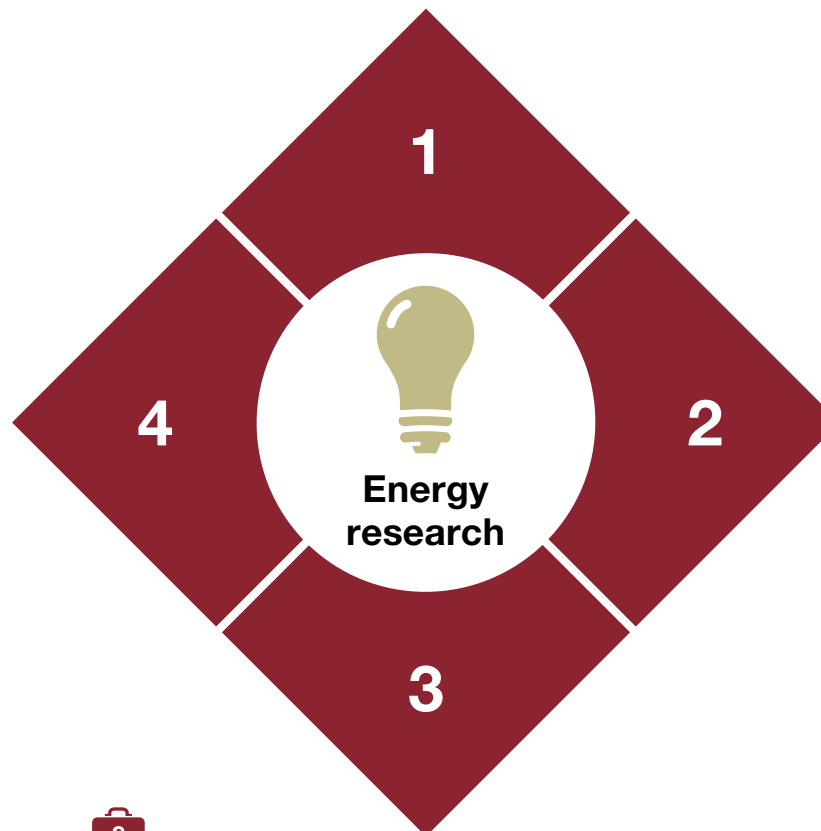
4 What did we find?

- There is a broad consensus on the need for coordination and leadership; mechanisms for setting strategy and sharing information are being developed
- Some individual funders have developed systematic approaches to evaluate their own investments



1 Who is involved?

Funders, coordinators, researchers, influencers



3 How much is spent?

We estimate that government spent around £377 million in 2014 on energy research



2 What happens?

Stages of research activity

Video ▶

[The real world view:
The energy challenge](#)

1 Who is involved?



The funders

- UK government departments (including the Department for Business, Energy & Industrial Strategy (BEIS) and the Department for International Development (DFID))
- Research councils (including the Engineering and Physical Sciences Research Council (EPSRC))
- Innovate UK
- Industry (including automotive and utilities sectors)
- European Union



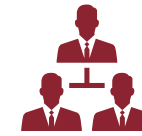
The co-ordinators

- Energy Innovation Board
- Research Council UK's energy programme
- Nuclear Innovation Research Advisory Board
- Catapults – specifically Energy Systems and Offshore Renewable Energy
- Energy Technologies Institute



The researchers

- Research institutes
- Universities
- Industry
- International



The influencers

- Policymakers and parliamentarians
- Learned societies
- Energy regulators
- Charities

2 What happens?



Stages of research activity

Description of research	Basic	Applied	Translational
Purpose of research	Knowledge expansion – asks questions about energy. Research is approached as a scientific study rather than to address specific needs	Solutions-focused – research is concerned with finding a solution in response to a specific question or problem	Product development – takes the findings from basic or applied research and uses them to develop new products and treatments
What is involved?	Experiments by academics and researchers at university laboratories or research institutions	Testing and observation at demonstrator site facilities	Development of new products at demonstrator site facilities
Funders include	Research councils; government departments; higher education funding councils	Innovate UK; Energy Technologies Institute; industry; European Union; government departments	Innovate UK; Energy Technologies Institute; industry; government departments

Examples of successes	Marine research – Research Council UK's energy programme investment into marine research has enhanced understanding of marine energy resources and informed the development of technologies that aim to enhance exploitation of marine energy.	New manufacturing approaches to nuclear components and fuels – the New Nuclear Manufacturing programme , part-funded by the EPSRC, has improved and developed existing and new manufacturing technologies in areas such as welding and machining.	Hybrid fuel cell battery systems – research has led to the development of hybrid fuel cell battery systems. A company originating from EPSRC-supported research developed the technology behind the first manned flight of a fuel cell-powered aircraft and a fleet of zero carbon taxis used to transport passengers at the London Olympics.
Examples of current programmes and projects	Carbon capture and storage – research projects to explore how carbon capture would be affected by short term demand changes by modelling what the future energy market might look like, including the kinds of power stations being used and the carbon capture technologies that might be implemented.	Various projects focused on solving challenges, ranging from energy storage, to decarbonisation and fuel poverty. One involves research into how new, low-carbon energy sources can be integrated into the energy grid, and how the grid itself can cope with extreme flows of energy into the system in numerous places and at random times.	Solar cells – researchers are pioneering new ways to convert solar energy into electricity with a new generation of low-cost, flexible organic solar cells that could revolutionise the energy sector.

3 How much is spent?



Who are the principal funders?

As of 2014, government invested around £377 million on energy research.¹

Government-funded energy research programmes include:

- Research Councils UK energy programme which includes a range of energy programmes ranging from wind energy and nuclear fusion, to energy storage.
- BEIS programmes focus on specific challenges in the UK energy system.
- DFID research programmes focus on improving access to clean and affordable energy for those in developing countries.
- Innovate UK funds innovations that will enable sustainable, integrated, resilient and efficient energy systems.

¹ Source: House of Lords Select Committee on Economic Affairs, The Price of Power: Reforming the electricity market, February 2017.

4 What did we find?



A broad consensus on the need to develop leadership and coordination arrangements

The Energy Innovation Board (EIB) was established in 2016. It had met four times by the end of December 2016. Its terms of reference acknowledge that there needs to be a coordinated energy innovation programme.

The EIB's focus is UK-wide. It applies across the whole energy system, including all fuels and technologies and energy demand. Its terms of reference set out its responsibilities.

The EIB's core tasks focus on supporting the government's domestic and international policy priorities which includes:

- advising and supporting public bodies across the energy innovation landscape on the direction of energy innovation activities;
- providing strategic oversight and coordination of energy innovation activity;
- carrying out deep-dives on specific themes across all the technology readiness levels to review and challenge individual programmes and to identify gaps and overlaps;
- commissioning specific activities to support the coordination of energy innovation activity, including on lessons learned, cross-cutting themes, and supporting evidence;
- regular monitoring of emerging opportunities and risks that may help to maximise the impact of government funding for innovation. This will focus on influencing upcoming funding decisions; and
- reviewing funding initiatives and activities as appropriate.

4 What did we find? *continued*



A broad consensus on the need to align priorities

EIB aims to organise the strategic approaches of partner organisations into common priorities and outcomes. It is analysing research activity across **ten thematic areas** to review and challenge individual programmes and to identify gaps and overlaps.

The ten thematic areas are: (1) smart systems, (2) built Environment, (3) nuclear, (4) renewables, (5) industry and carbon capture & storage, (6) transport, (7) cross-cutting issues, (8) international, (9) land use, (10) waste.

Findings from the analysis on smart systems include:

- No single body covers the entire innovation lifecycle. There are four key organisations involved in research activity – BEIS, Ofgem, Innovate UK and Energy Systems Catapult – but around 20 other organisations undertake a broad range of activities from applied research to policy implementation.
- Government has invested more than £450 million in smart systems innovation projects and plans to invest more than £385 million in the next spending cycle.
- More than 110 smart systems innovation projects have been commissioned since 2009 (excludes EPSRC funded projects)
- Industry and academia often scope and deliver projects. Many projects are delivered via collaborations of industry and/or academia
- Nearly all government-sponsored innovation project work is delivered at individual funder level. Each individual funder plays a key role in project scoping, assessment, commissioning, project management or oversight and knowledge capture based on its own view of desired outcomes and drivers.
- Different institutions have different approaches and are at different stages of maturity in terms of innovation activity.

4 What did we find? *continued*



The EPSRC commissioned an independent review of the impact of its investment into the Supergen energy renewables programme to inform decisions on its future investment strategy

The review panel was asked to focus on five key areas including:

- 1 the sector landscape;
- 2 the relevance of the Supergen programme to the landscape;
- 3 the impact that the Supergen programme has had so far;
- 4 the future direction for the programme; and
- 5 possible future modifications to the Supergen programme.

The review found:

- evidence of academic, environmental social and economic impacts;
- additional funding of £94 million secured from other funding sources including industry and overseas (following EPSRC's investment of £150 million); and
- significant progress in bringing researchers together as well as building capacity and growing expertise.

But it was noted that there was still scope to further increase impact and the report recommended that EPSRC should:

- ensure that there is a common repository for outputs that are easily accessible and regularly updated via a common website; and
- Undertake regular horizon scanning to reassess research activities and refocus them.

The Supergen Programme, part of the Research Councils UK Energy Programme, led by EPSRC, aims to contribute to the UK's environmental emissions targets by making the UK's power generation and supply more sustainable.



Design and Production by NAO External Relations
DP Ref: 11452-006 | © National Audit Office 2017