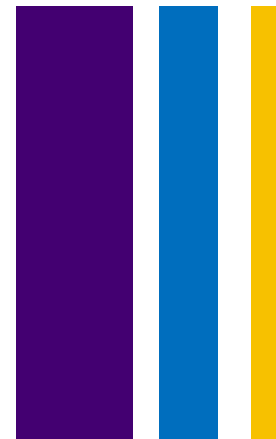




EPSRC, UKRI and Combustion Engineering

Combustion SIG meeting, Cambridge

5th November 2018



EPSRC Strategic Plan & Delivery Plan 2016-2020

EPSRC
Investing in research for
discovery and innovation

STRATEGIC PLAN 2015

RESEARCH.DISCOVER.INNOVATE.
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RESEARCH.DISCOVER.INNOVATE.

Engineering and Physical Sciences
Research Council

EPSRC
Pioneering research
and skills

Engineering and Physical Sciences
Research Council

EPSRC
Investing in research for
discovery and innovation

EPSRC Delivery Plan 2016/17-2019/20 Science for a Successful Nation

PRODUCTIVE



CONNECTED



RESILIENT



HEALTHY



1

OUR VISION

Our vision is for the UK to be the best place in the world to research, discover and innovate

2

OUR GOALS

Our vision is supported by two goals:

**Research and
Discover**

**Research and
Innovate**

3

OUR STRATEGIES

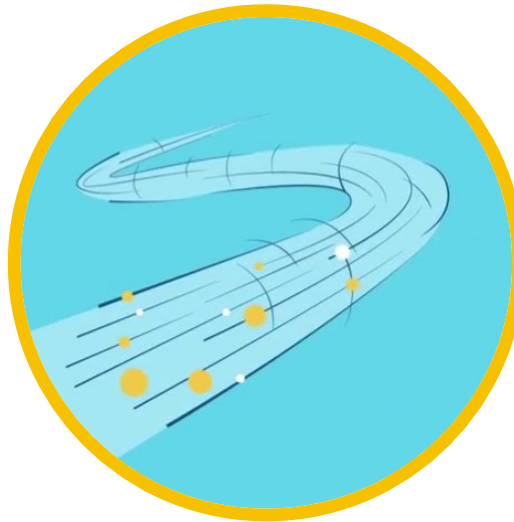
To achieve our goals we will use three strategies:

**Balancing
Capability**

**Building
Leadership**

**Accelerating
Impact**

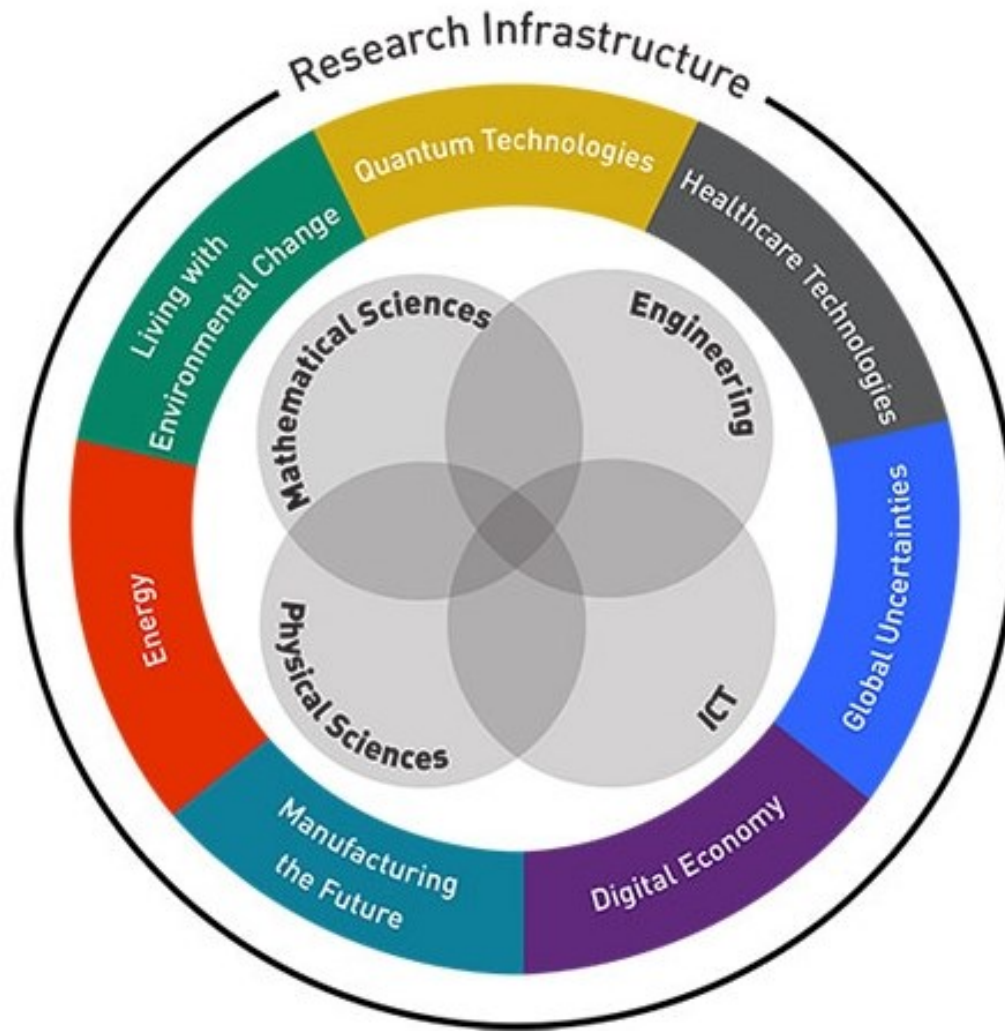
**STRATEGIC
VISION**



**THE OUTCOMES
FRAMEWORK**



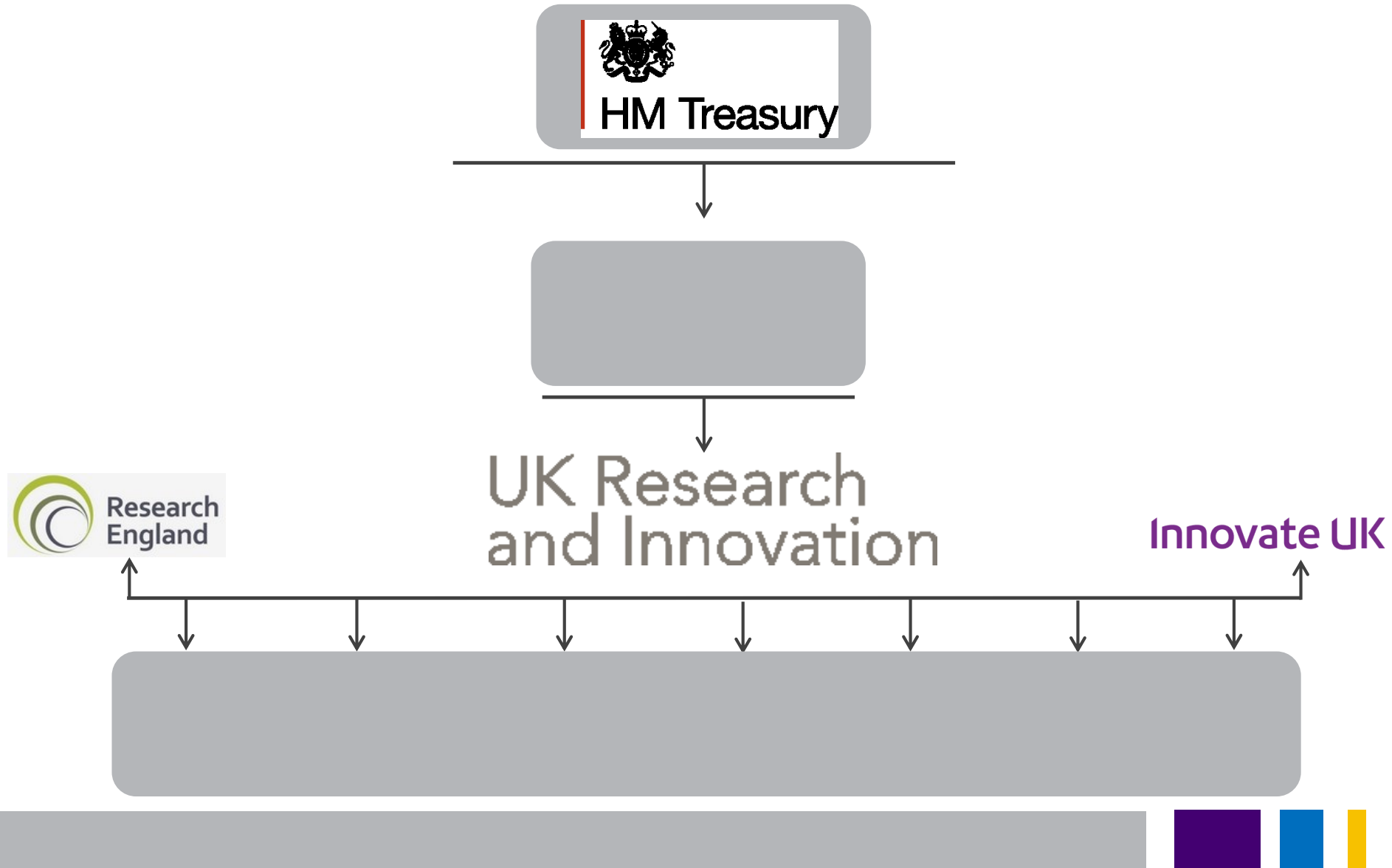
EPSRC Theme Structure 2016-2020



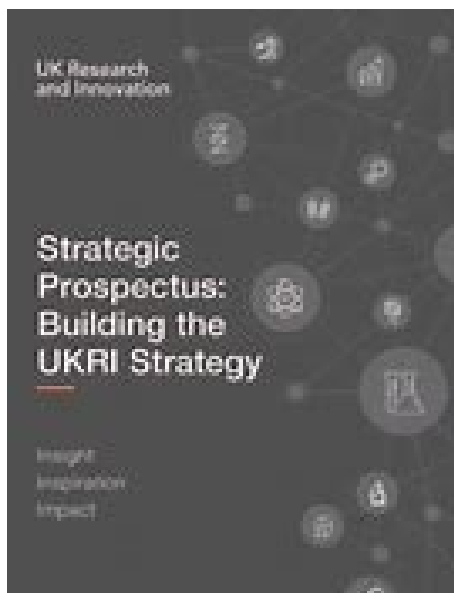
Engineering's approach to the delivery plan



The changing landscape



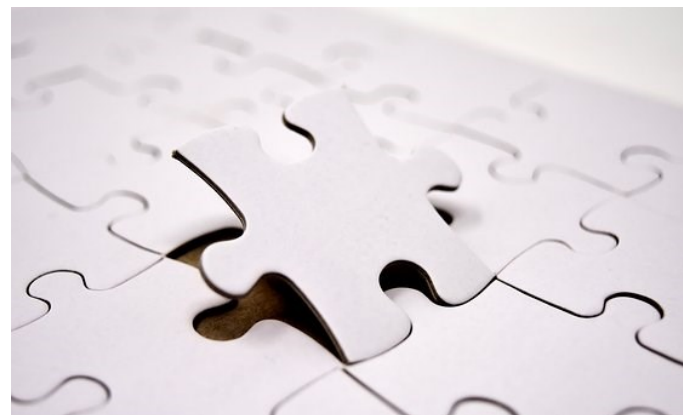
UK Research and Innovation Mission



Strategic Delivery Plans (SDPs)

One year after the Strategic Prospectus, SDPs from each Council are due to be published in the Spring 2019.

All nine will sit together to form a coherent set that describes UKRI's long-term strategic vision and short term deliverables.



Guiding principles set by UKRI Board:

- UKRI strategy to be enduring, holistic, and starting point for Councils' plans
- For SDPs, ensure sufficient time for engagement with both community and new Councils
- For SDPs, likely to be up-dates to current Delivery Plan at high level with forward look into next Spending Review period

Providing the foundation for UKRI

- Foundation for excellent research and innovation



Trusted and
diverse system

EQUALITY, DIVERSITY AND INCLUSION

We are committed to attracting and retaining our brightest and best researchers from a diverse population



Leading talent

PEOPLE AND SKILLS

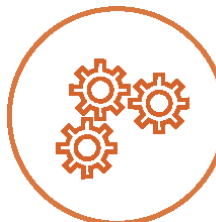
We invest in the people and skills required to deliver world-leading research and innovation



Global Britain

PLACE

We invest in excellence wherever it arises, attracting research leaders and industrial leverage to deliver regional and global impact beyond the point of investment



Infrastructure

RESEARCH INFRASTRUCTURE

We invest in the National Research Facilities, state-of-the-art equipment, large scale strategic equipment and e-infrastructure that is critical to the success of the research and innovation landscape



Providing the foundation for UKRI

- Human knowledge and understanding



Push frontiers
of human
knowledge
and
understanding

BALANCING CAPABILITY

We maintain the UK's leading position in EPS and maximises opportunities to advance new and emerging research areas through evidence based decisions

BIG IDEAS

We are pushing the boundaries of research and innovation by helping to shape and evolve the next new, exciting and visionary idea

CENTRES OF EXCELLENCE

We are recognised for our ability to bring together large numbers of partners around a single vision, creating the environment that enables world class discovery science to flourish

PROVIDING THE FOUNDATION FOR UKRI

- Economic, social and cultural impact



Deliver
economic
impact

DELIVERING ECONOMIC IMPACT AND SOCIAL PROSPERITY

We invest in the fundamental and application driven research and skills - providing a platform for future UK prosperity by contributing to a Productive, Connected, Healthy and Resilient nation

VALUE THROUGH PARTNERSHIPS

We have a proactive partnerships model that is highly valued by universities and business - delivering key investments, impact and policies in areas such as skills, E,D&I, international and industrial strategy



Create
social and
cultural
impact

ACCELERATING IMPACT

We develop policies and approaches that increase the likelihood of academic, societal and economic impact occurring - decreasing the time between discovery and impact of knowledge

PUBLIC ENGAGEMENT

We encourage the development of a research culture that inspires the public, attracts people to STEM careers, and values interaction with publics in all stages of the research process



Critical to meeting the 2.4% ambition

- Maximising opportunities

National Productivity Investment Fund (NPIF)

Investment of £23 billion

Additional £4.7 billion for R&D

Strategic Priorities Fund

To support
research across
disciplines

Talent and Skills

To support world-
class research
and innovation
talent

Industrial Strategy Challenge Fund

To tackle the big
societal and
industrial
challenges of today

Fund for International Collaboration

To enhance the
UK's excellence in
research and
innovation through
global engagement

Strength in Places Fund

To support areas
across the UK to
build on their
science and
innovation
strengths

Critical to meeting the 2.4% ambition

- Maximising opportunities

EPSRC has won over £300M total additional investment through NPIF, and rising

Strategic
Priorities Fund

£89M awaiting ministerial
approval

Talent and
Skills

£4.5M for 80
Innovation
Fellowships

£60M for 650
doctoral places

£39M for Research Talent

ISCF

£42M for RAI
in extreme
environments

£78M for
Faraday Battery
Challenge

£36M for
Transforming
Construction

£12M for Prospering
from the Energy
Revolution

What is Balancing Capability?

EPSRC's **Balancing Capability strategy** enables us to:

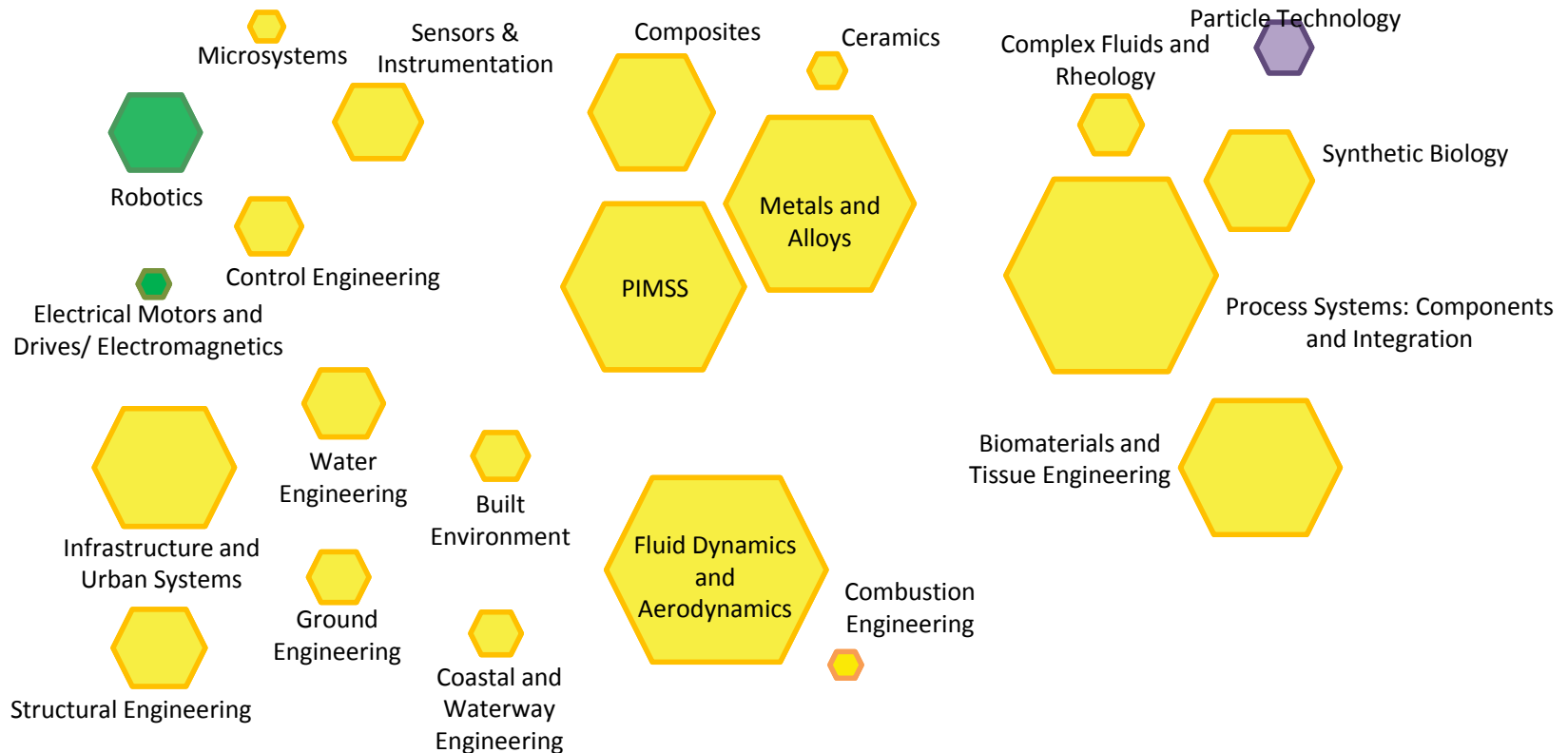
- Set **strategic priorities aligned to UK strength and national importance**
- **Maintain and develop** the **UK's world leading position** in engineering and physical science research within a finite budget.

EPSRC's **portfolio knowledge is the foundation** of Balancing Capability; intelligence gathered is used to develop our strategic direction

Our portfolio knowledge comes from:

- **Proactive and continuous engagement** with the research community and stakeholders including the academic community, business, charities, and other funders.
- Providing a **transparent route** to input to our evidence and knowledge base

Balancing the Engineering Portfolio



- In November 2016 we shared the Engineering theme's **approach to Balancing Capability** with Engineering Heads of Department.
- February 2017 : **Publication** of the 111 Research Area rationales on the website.
- In March-May 2017 we **disseminated the outcomes** with the broader Engineering community through three Regional Meetings (London, Birmingham and Edinburgh).

Balancing Capability: evolved approach

EPSRC is now delivering Balancing Capability via an evolved approach, focussing on ongoing portfolio **monitoring**, **stakeholder engagement**, **knowledge gathering**, and **evidence** collection.

This will enable:

- **Regular review** and **timely changes** to research area strategies
- A **more agile and responsive strategic approach** in a dynamic and rapidly evolving funding landscape
- Opportunities to **advance new and emerging research areas** that arise from challenge-driven and discovery-led fields
- **Clear routes** for stakeholders to engage with us on a regular basis

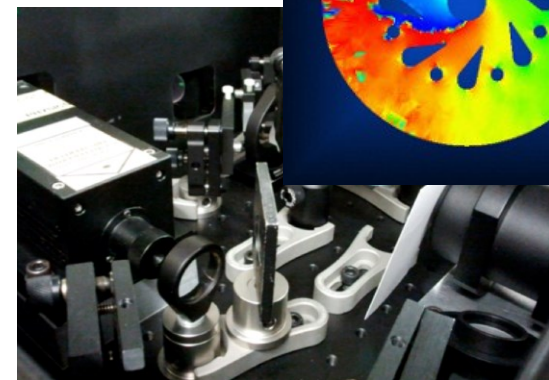
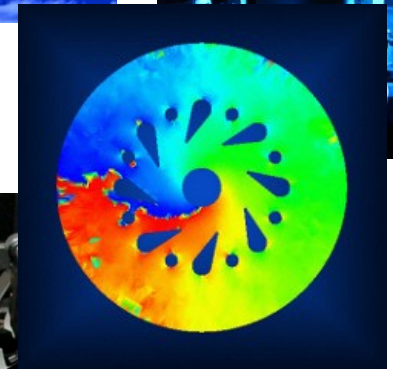
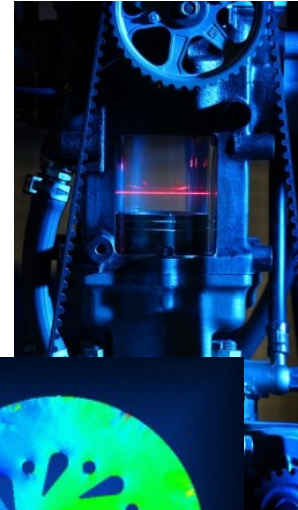
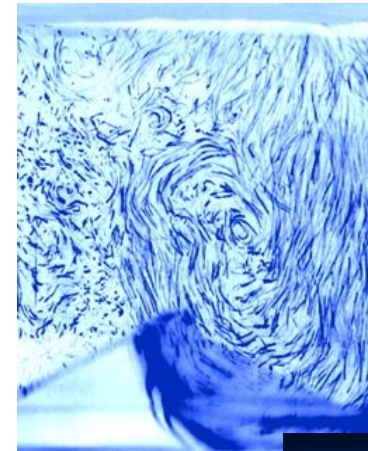
Balancing Capability: Combustion Engineering rationale

The addressing of engineering challenges related to combustion dynamics through both multi-scale modelling and experimental approaches. Activities falling within this research area will contribute to the advanced propulsion systems.

- **Mature research area, largely supported through collaborations with aerospace and automotive sectors** to deliver efficient combustion modes to address current technological challenges
- EPSRC's role is to support long-term combustion challenges **focused on lowering emissions and improving efficiency within a whole-systems context.**
- In view of the *continuing relevance of combustion-based propulsion*, **we will maintain the level of investment relative to the whole EPSRC portfolio.**
 - ❑ **greater interdisciplinary working** across relevant research areas
 - ❑ **Identify and address combustion research within a whole-systems approach**
 - ❑ Experimental and computational communities to integrate further to **accelerate translation** through to novel propulsion modes
 - ❑ **Ensure appropriate equipment-sharing and access to facilities**

Size of the Portfolio

- Currently **28** active research grants within the Combustion Engineering Portfolio
 - This equates to £7.2m in research grants
 - Overall total value of the portfolio is **£12.25m**, including research and training
- Portfolio has represented 0.33 – 0.35% of the overall EPSRC portfolio between April 2016 and April 2018
 - In October 2018 this dropped to 0.26% partly due to the completion of a large grant (£3m)
- In order to **maintain** the portfolio overall proportion at 0.33%, **please submit more applications!**



Wider Combustion within Engineering

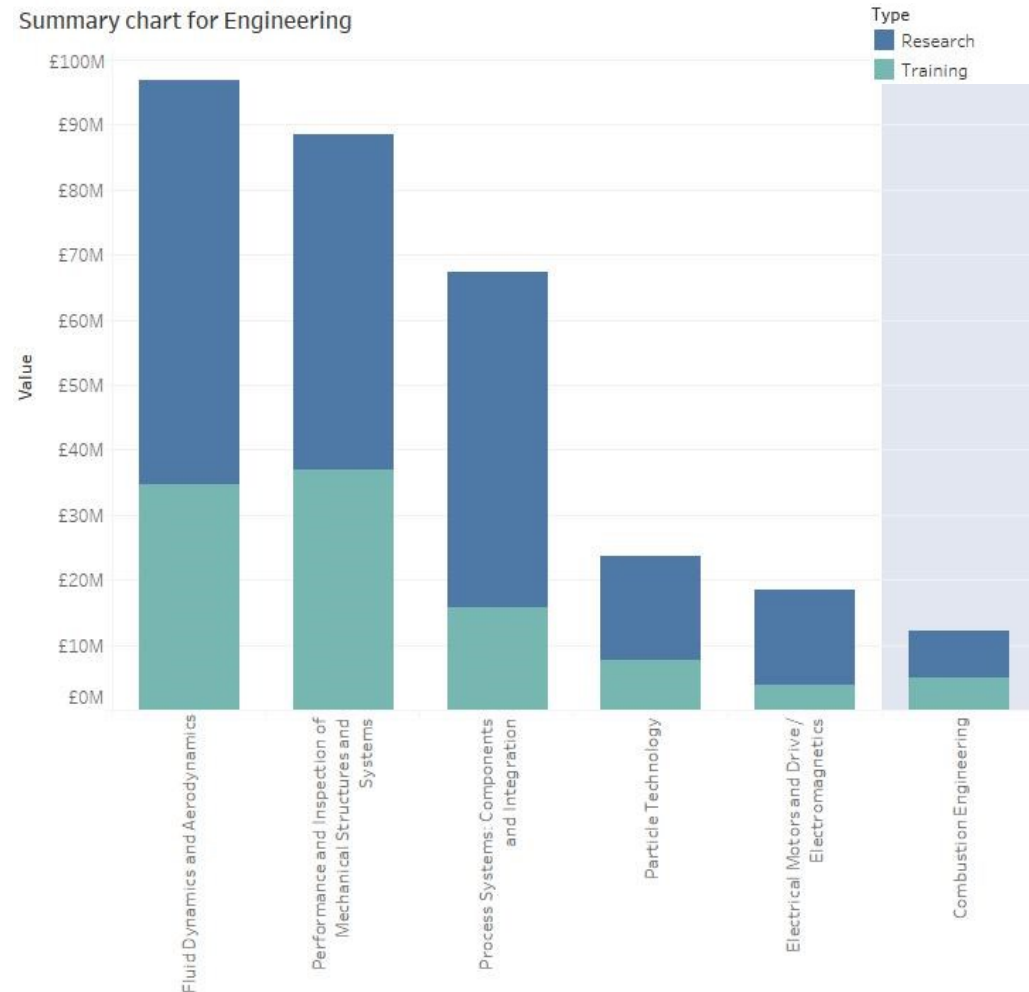
- Combustion Engineering overlaps with a number of other Engineering Research Areas across a number of themes (Energy and Physical Sciences)

- Applications focused on one aspect of the combustion process will most likely be classified as a different Research Area

 - e.g. turbulent flows is within the Fluid Dynamics portfolio, optimising engine performance is within PIMSS

- The value of combustion related research within the EPSRC portfolio is much larger than the Combustion portfolio alone**

Summary chart for Engineering



Political Drivers – Clean Growth



FT Future of the Car Summit 2018
"I think it's important to say that new-generation diesel engines can make a big contribution to reducing our emissions. I would expect the contribution of the higher standards of efficiency and emissions performance of diesel engines to continue to drive improvements in air quality and our greenhouse gas performance".

"There's a place for diesel vehicles and there will be for some time to come,"

Technical Opportunities – Clean Growth

■ The **Electrification** of Vehicles

- (a) 1% of passenger car market now, predicted 10-25% of market in 2030. What about the remaining 75-90%?
- (b) Many limitations with batteries (power density, durability, safety, recycling, materials supply...)
- (c) No convincing fully-electrified options for large commercial vehicles (auto/aero, marine) in near future



■ **Limitations on greenhouse gases, gaseous pollutant and noise emissions**

- (a) No new Diesel cars and vans from 2040; many manufacturers halting production, but Diesel is still the world's most efficient internal combustion engine providing more power and more fuel efficiency than alternatives such as gasoline, compressed natural gas or liquefied natural gas.
- (b) Focus on more innovative and sophisticated technologies for their abatement

Opportunities – Future Propulsion



Opportunities for Combustion Engineering

- ■ ■ Requirement for more efficient, more economical engines
- ■ ■ Need for clean-burning fuels
- ■ ■ Focus on hybridisation and incorporating the combustion engine as part of the whole system
- ■ ■ Need for understanding of fundamental fluid dynamics
- ■ ■ Exploit new infrastructure developments (e.g. NCCAT)
- ■ ■ Incorporate inter-disciplinary research - control engineering, chemical and biological engineering (fuel technologies), systems engineering, materials engineering, structural engineering, sensors, engineering design, manufacturing technologies
- ■ ■ Draw on multi-disciplinary research – economic, social, environmental, medical...
- ■ ■ Explore cross-sectoral opportunities – Automotive, Aerospace, Defence, Marine, Energy, Space, Civil...

Opportunities for the Research Community

The Combustion engineering research community can help to **lead the clean energy revolution by**

- Building on existing strengths of a world-leading research base
- Pioneering new, novel clean technologies to meet global emission targets
- Transforming a traditional area of research by working with other disciplines to address new (and existing) challenges in short, medium and long term
- Taking opportunities to influence stakeholders across a variety of sectors to adopt revolutionary technologies
- Work with EPSRC to help make the case for future investments in this area

- Josie Robinson (josie.robinson@epsrc.ukri.org) - Combustion Engineering Portfolio Manager
- Andy Lawrence (andrew.lawrence@epsrc.ukri.org) – Head of Engineering theme
- Laura Finney (laura.finney@epsrc.ukri.org) – Materials Engineering Portfolio Manager

Thank You!

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