Animal &
Plant Health
Agency

Science Strategy 2021-26

Expertise with Impact

» Foreword

Our Science Strategy 2021-26 underpins our APHA Mission Statement: **Safeguarding animal and plant health for the benefit of people, the environment and the economy**. It builds on our Science Strategy 2015-2020 'Expertise with Impact'. Since we launched our 2015 strategy, there have been significant changes, notably the decision to leave the European Union, the confirmed funding for the redevelopment of our science headquarters in Weybridge, Surrey and the global pandemic of COVID-19.

Whilst our mission and vision for the agency has remained the same, these significant changes strengthen our ambition to have a global scientific influence with world class facilities to support and retain our internationally recognised expertise. For example, in response to SARS CoV-2, we have built upon our ability to provide an agile and flexible One Health approach, utilising our laboratory facilities and scientific expertise and will extend this to provide and support a national response for incidents and disease outbreaks.

Science continues to be fundamental to everything APHA does and we are committed to high quality science-based evidence for decision making and policy development. We will deliver this strategy over the next five years.

Kath Webster
Director of Science

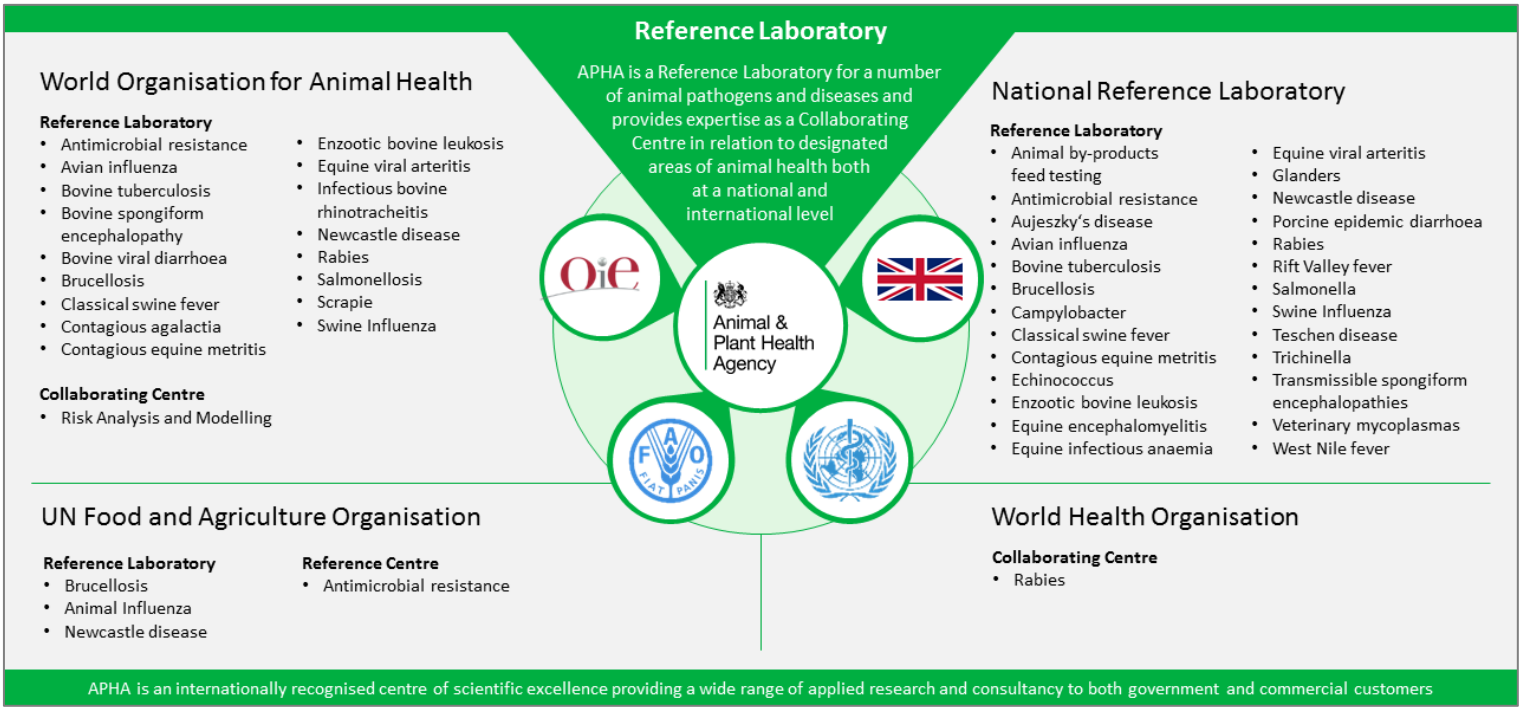
» Strategic Context

APHA as an Executive Agency of the Department for Environment, Food and Rural Affairs (Defra) is responsible for responding to **biosecurity threats** to the UK from endemic or exotic animal diseases (including zoonotic diseases), pests and diseases of plants and bees, and invasive non-native species. These biosecurity threats can occur in three ways: deliberate, accidental or natural. Around 60% of all human diseases and 75% of all new and emerging infectious diseases are zoonotic diseases – that is, naturally transmitted from animals to people[1].

> Our laboratory testing portfolio is extensive and includes over 600 assays across a very broad range. Annually we perform more than 800,000 tests.

We provide high containment laboratory and animal facilities, scientific expertise in a range of microbiological and analytical disciplines, research and test development functions to diagnose known diseases and develop tests and reagents to detect new diseases and support outbreak control measures. Our laboratory testing portfolio is extensive and includes over 600 assays across a very broad range, annually we perform more than 800,000 tests.

APHA is one of the world's leading research centres in the field of animal and veterinary public health. APHA hosts 17 of the 25 International Reference facilities located in the UK, which are designated by the World Organisation for Animal Health (OIE); World Health Organisation (WHO) and Food and Agriculture Organisation of the United Nations (FAO). Our scientists hold these expert roles by operating at the cutting edge of knowledge, modern technology and the forefront of their fields. We are the UK designated laboratory for over 35 diseases, with the majority having National Reference Laboratory (NRL) status and we continue to expand this capability. Jointly with the Centre for Environment, Fisheries and Aquaculture Science (Cefas) and the Veterinary Medicines Directorate (VMD) we are also now recognised by the FAO as the Reference Centre for Antimicrobial resistance (AMR), and the OIE Collaborating Centre for Risk Analysis and Modelling jointly with the Royal Veterinary College (RVC).



> Over the last five years APHA has been involved in responding to over 800 suspected exotic notifiable animal disease threats of which many have a human health impact.

APHA undertakes surveillance for new, re-emerging, endemic, exotic animal and plant diseases and pests. Surveillance is achieved through a combination of approaches including statutory reporting; targeted surveillance; local intelligence; horizon scanning and risk analysis including monitoring and tracking developments and changes around the world through our wider networks (national and international), as well as analysis and assessment of disease data arising from material submitted for diagnostic purposes.

Our work in these high-profile areas is critical to the economy, society and the environment. APHA provide specialist expertise to the UK's Veterinary Risk Group (VRG). This group's remit is to identify and assess how to manage new and re-emerging animal health and welfare threats in the UK. The risks associated with animal diseases, particularly those that can be transmitted naturally between animals and humans (zoonoses) feature highly on the UK Governments' radar, which has been further highlighted following the global pandemic of COVID-19. In the UK by early January 2021, SARS-CoV-2 has infected more than two million individuals[2], caused more than eighty thousand[3] deaths and GDP fell by 9.9% in 2020, the largest annual fall on record.[4]

The loss of biodiversity and increasing human wildlife interactions contributes to increased risk of new zoonotic diseases. The **National Risk Register** features animal diseases as a high risk which would have a detrimental effect on our environment and economy. Many of these risks need a **One Health** approach; in achieving optimal health outcomes we recognise the interactions between people, animals, plants, and their shared environment/ecosystems. Over the last five years APHA has been involved in responding to over 800[5] suspected exotic notifiable animal disease threats of which many have a human health impact. APHA scientists are members of the human animal infections and risk surveillance (HAIRS) group, this group is a multi-agency cross-government horizon scanning and risk assessment group. They identify and discuss infections with potential for interspecies transfer (particularly zoonotic infections) which may pose a threat to UK public health. The multidisciplinary nature of the HAIRS group enables it to assess horizon scanning reports in an objective and scientific manner.

Endemic animal diseases such as **bovine Tuberculosis (bTB),** cost the UK taxpayer in excess of £150million[6] per year with additional costs falling to industry. These diseases can have severe impacts on the health and welfare of the wider rural economy. Within APHA, over 500 staff are involved in combatting bTB. Left unchecked, bTB poses an increasing threat to animal health and welfare, to the agricultural economy and to public health.

Following the Godfray review (strategy for achieving bTB free status for England), several of the recommendations were agreed as the government's top priorities including: accelerating work to develop a deployable cattle bTB vaccine; improving diagnostic testing, surveillance and deployment of epidemiological tools to better understand disease sources and enable better targeted disease control policies.

Antimicrobial resistance (AMR) is recognised on the National Risk Register as a serious longer-term issue; the number of resistant infections is expected to increase markedly over the next 20 years. AMR is a global problem and the UK government is working with international partners on action at a global level. In the UK, the national action plan on AMR promotes actions to reduce infection and responsible use of antibiotics. For example, by improving our understanding of the routes of transmission of resistance including the impact of the environment and food, by raising the health status of farmed animals and improving rapid diagnostics we will significantly reduce the need to use antibiotics.

The **UK Plant Health Risk Register** identifies in excess of 1,100 plant pests and diseases that could seriously damage crops and plants in the UK. By maintaining and promoting a high plant health status, we can reduce this biosecurity threat and help protect the £9 billion annual value of our crops, horticulture and trees, which deliver benefits to our economy and society. Through a contract with Defra, Fera Science Ltd deliver the plant health laboratory capability working in partnership with APHA.

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There are nearly 2,000 non-native species established in GB with numbers increasing each year. Most are harmless but about 10 to 15% become invasive - causing harmful impacts on the environment, economy and our way of life. They cost the British economy over £1.8 billion[7] a year, are one of the key drivers of global biodiversity loss and some can even pose a risk to human health. Our work helps to reduce the future impact of **invasive non-native species** by preventing more species being introduced and becoming established, and by better managing existing problem species. A recommendation from the Environmental Audit Committee in 2019 called for significant strengthening of our capability to improve biosecurity against invasive non-native species.

Defra's strategic goal to increase the UK's international influence after leaving the EU in the areas of animal health and welfare, plant and bee health, aligns with APHA's cross cutting **International Development** work. It adds value to core capability and links the agency's activities through international appointments, partnerships, funding sources and supporting the development of International Trade. For example, Official Development Assistance (ODA) in One Health aims to increase the capabilities of priority ODA eligible countries and regional institutions to meet international commitments and delivery ambitions by strengthening preparedness and response to zoonotic threats, emergencies and potential pandemics and enhancing animal and plant health.

The invasive Asian Hornet that poses a risk to the UK's bee and pollinators population

» Our Disciplines

Discipline specific excellence is vital for our multidisciplinary approach and **'discipline champions'** are appointed to lead on the capability implementation plans in these key areas. Following the most recent capability review, we identified a need for both greater breadth and to strengthen our cross-cutting expertise. We have therefore appointed Data Sciences (replacing Biomathematics) and Vector-Borne Diseases (to strengthen awareness and understanding of the potential impact of the climate emergency) discipline champions. For other capabilities where we do not have the in-house expertise, we use specific partnerships to provide this. Scientific work continues to be delivered via a portfolio of projects, which are led by Lead Scientists. The overview of portfolio and discipline strategies is contained in the strategy annex.

» Our Partnerships

Partnerships are vital to the delivery of our science, increasing the pool of professional knowledge, raising the impact and quality and providing efficiencies, which are especially important during these economically challenging times. We already collaborate with many scientific institutions nationally and internationally and will strengthen our key partnerships. They present an indispensable mechanism for both developing existing expertise, embracing opportunities to exploit science innovation, acquire new skills or additional elements to a project outside of direct scientific remit. These include partnerships with other government agencies (e.g. PHE and DSTL), research institutes (e.g. Moredun and Pirbright) academia (e.g. RVC) and industry.

We have diversified income streams in order to increase efficiency, resilience and improve our ability to maintain vibrant capability and critical mass, for example **APHA Scientific** (the commercial brand of APHA) provides an interface between commercial customers and our scientific project leaders. Our specialist scientific and veterinary expertise, containment laboratories and animal accommodation facilities present a unique opportunity for collaborative partnerships worldwide.

Substantial funding has been allocated by the government to support the development of a new **National Science Centre for Animal Health** (NSCAH) at Weybridge. This investment directly supports several of our strategic goals (international science centre, global influencer and a great place to work) and enhances the site's global reputation as a centre of excellence.

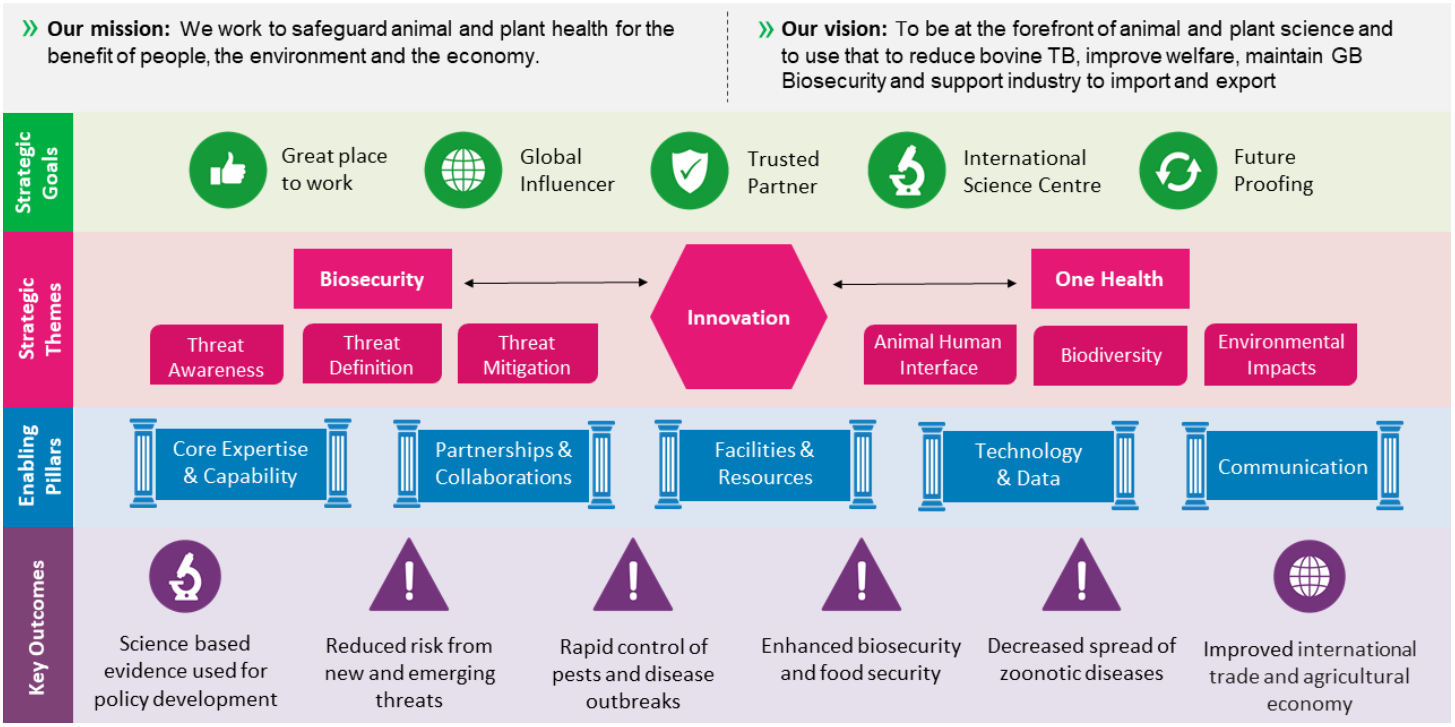
The APHA Science Advisory Board provides the assurance through effective challenge on the quality, value for money and appropriateness of APHA's science and research capability.

Our key outcomes align with Defra's 25 year environment plan for enhancing biosecurity and compliment:

- Wales Animal Health and Welfare Framework
- Scotland's Animal Health and Welfare Framework
- Defra's Safeguarding our animals and plants
- UK Biological Security Strategy

Our strategy takes account of our role in mitigating these risks on behalf of the UK Government and well as protecting the wider population as an international partner.

» Strategic Framework



Strategic Goals

1. **Great place to work**: we want to retain and develop specialist skills and expertise, where staff are highly engaged within a culture of innovation, inclusion, equality and diversity.
2. **Global influencer**: we want to grow and maintain our world class animal, plant and invasive species expertise and international networks to influence disease and risk control at a global level and help to reduce the risk and consequences of their entry into the UK.
3. **Trusted Partner**: we want to build on and strengthen our reputation of being the partner of choice for delivering high quality, objective, fit for purpose assured science for animal and plant health advice, knowledge exchange and outbreak control.
4. **International Science Centre**: we want to continue to be recognised nationally and internationally as an international centre of excellence for science innovation within a context of disease control.
5. **Future Proofing**: we want to ensure we have an operational framework that allows for flexibility, including changing priorities, future threats and opportunities.

Strategic Themes

1. Biosecurity

Natural and accidental threats associated with either animal or zoonotic diseases, plant diseases and pests or invasive non-native species, have the potential to cause devastating effects on the nation's health, security and economy. The UK's approach to biosecurity is internationally recognised for delivering the highest standards of protection from pests, disease and invasive non-native species.

- **Threat awareness:** An understanding and awareness of the threats that are likely to impact animal, plant and public health in the UK, both now and in the future. Maintaining surveillance mechanisms including networks (nationally and internationally; e.g. OIE, FAO and WHO) to ensure we have the expertise to be aware of threats to the UK and respond to any outbreaks. Awareness and understanding of the climate emergency and the impact this has on animal and plant diseases and pests including the new drivers for understanding the emergence of zoonoses, working at international scale.
- **Threat definition:** Characterisation of the threat and assessment of the level of threat it presents. A multi-disciplinary approach is imperative to understand causation and the nature of the threat, assessment of pathways of entry into the country, as well as the likelihood of establishment in the country, assessment of the impact and to determine the mechanism of transmission and speed of spread.
- **Threat mitigation:** Systematic reduction in the extent of exposure to either the threat and /or likelihood of its occurrence. Through prevention where possible, for example vaccination, enhancing biosecurity, border controls or influencing behaviour. If prevention is not possible, working in partnership to develop effective response plans.

2. One Health

Recognise that human, animal and environmental health are tightly connected and studies the hazards that may cross species and environmental barriers to move between compartments.

- **Animal Human Interface:** A greater understanding of the interfaces, potential barriers and pathogen-host interactions is required to create and implement effective preventative measures and management interventions.
- **Biodiversity:** Major drivers of biodiversity loss include climate change, over-exploitation, habitat loss and microbial ecosystems. Unforeseen consequences of such ecological shifts can result in hidden problems that are not readily observed until there is a spill-over event with great human, plant or animal health impacts. A greater understanding of the drivers and subsequent micro and macro effects of biodiversity loss, and reversal, will give better foresight to institute targeted monitoring for potential threats.

- **Environmental impacts:** The environment may be seen as the cradle for pathogen-interfaces and biodiversity. Changes in the environment can be drivers to change in the other two pillars of the One Health triad. Understanding how the environment is changing and the adaptions that are made as a consequence is necessary to further our understanding and work within pathogen-interfaces and biodiversity.

For example, the COVID-19 pandemic caused by SARS-CoV-2 has 'shone a light' on zoonotic diseases illustrating the impact of global health security on every sector of the economy, and in particular, highlighting weaknesses in preparedness (early warning and detection) and response. SARS CoV-2 has emphasised the importance of a One Health Approach:

- ✓ Collaborative multisector/ transdisciplinary international working.
- ✓ Efficiencies and economic benefits accrued from jointly developed systems and disease control strategies.
- ✓ Combined service delivery, shared logistics and infrastructure across international institutions to better prevent, detect and respond to emerging zoonoses.
- ✓ Other threats leading to foodborne illnesses, food insecurity and public health.

3. Innovation

Using modern technology and infrastructure to be efficient, flexible and responsive. Utilising APHA science to develop solutions to challenges in disease threat, definition and control through applying cutting edge innovative approaches to genomics, surveillance, diagnosis and vaccine research.

- The most far reaching and impactful solutions to the above goals can be achieved by the exploitation of 'Big Data'. Supercomputer technologies will combine bioinformatics with machine-based-learning in utilising powerful digital management systems for handling complex data. These developing technologies will be applied to the rapid detection of new threats, referred to as 'Disease X' and will provide timely and cost-effective insights into broadening our understanding of complex pathogen-host interactions. For example, unlocking the potential of pathogen biology through Whole Genome Sequencing (WGS) allows rapid identification and characterisation of threats for either plants or animals, rapid detection of AMR risks; as well as detailed epidemiology of outbreaks or epidemics through molecular technologies.
- The development and facilitation of field or remote non-laboratory based 'penside' diagnostics for disease surveillance will provide early detection systems for new and emerging pathogens. Data will be linked to automated laboratory-based systems for rapid data flow and reporting, thereby reducing the overall costs while maintaining quality assurance systems. These non-laboratory-based surveillance systems will also make use of innovative technological solutions including drone technologies by monitoring environmental changes and habitat fragmentation, the incursion of emerging infectious pathogens and pest threats, thereby enriching the capability of disease surveillance. For example, monitoring for potato virus or animal populations e.g. wild boar using drones and routine use of onsite diagnostics at border control posts, e.g. Genie® LAMP (Loop mediated isothermal amplification) machines for the detection of animal pathogens and plant pests.
- The detection of both endemic and exotic pathogens will be enhanced by utilising diagnostic tools that differentiate between infected from vaccinated animals (DIVA). These DIVA tests will enable vaccine deployment to prevent disease incursion and spread using automated and computerised outputs in support of disease preparedness and emergency response.
- Use of alternative methodologies for animal models addressing reduction, refinement and replacement by application of synthetic production systems. Vaccine design will be improved with the development of multivalent vaccines against disease syndromes in animals. This approach will be assessed in animal models and by developing in vitro models to replace the use of animals. These developments will be complemented by utilising advancements in immunology that strengthen research at the pathogen-host interface.
- Validate and utilise our innovative platforms for investigating exotic disease and pathogen emergence through our international preparedness programmes to ascertain international hot spots.

- Apply and embed our innovative platforms and solutions for enhanced pre- and postgraduate training of veterinary para-professionals and scientists ensuring a multi-disciplinary approach.

Enabling Pillars

1. **Core expertise and capability:** competent and skilled people, retained, valued and engaged
2. **Partnerships and collaborations:** key collaborations and partnerships to enable us to deliver in a One Health approach; achieving efficiencies, multidisciplinary and innovative outcomes
3. **Facilities and resources:** flexible future proofed facilities that are fit for purpose and deployed to improve animal and One Health outcomes
4. **Technology and data:** accessing modern technology and using data effectively
5. **Communication:** using appropriate channels to facilitate and promote knowledge exchange

Key Outcomes

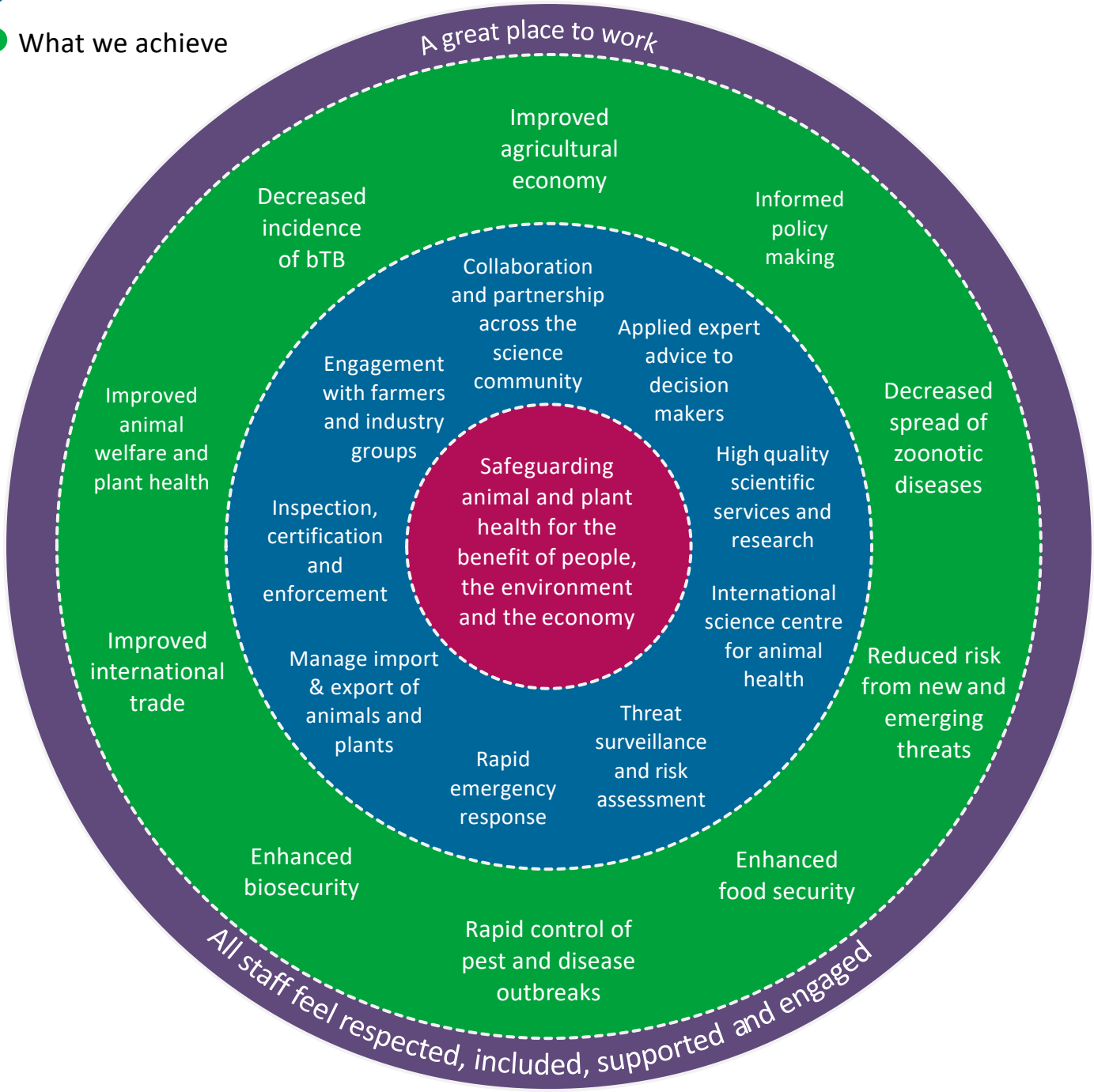
These are:

1. **Science based evidence used for policy development**
2. **Reduced risk from new and emerging threats**
3. **Rapid control of pest and disease outbreaks**
4. **Enhanced biosecurity and food safety**
5. **Decreased spread of zoonotic diseases**
6. **Improved international trade and agricultural economy**

» Our Purpose

Our key science outcomes are aligned with the overall APHA purpose:

- Why we do it
- How we do it
- What we achieve



» Challenges and Approaches

- We recognise that many of the challenges require long term investment, whether targeting eradication of specific diseases or maintaining expertise and capability in the face of declining budgets to deal with novel and evolving pathogens and threats. Longer term research programmes that support and develop key skills, disciplines and partnership working (at a national and international level) are an important mechanism to address these challenges.
- Investing in national capability in respect of epidemiology, mathematical modelling and surveillance methodology, including to support links between Public Sector Research Establishment (PSREs) and the academic sector.
- Research funding to support the development of vaccines / disease intervention agents and diagnostic technologies.
- Development and maintenance of bio-informatics and supporting skills, capabilities and infrastructure, for example in respect of utilising Whole-Genome-Sequencing (WGS), data analyses and contextual interpretation and other technologies.
- A common digital backbone across government and partners, including the NHS to facilitate easier transfer of data enabling flexible deployment of capability supporting a One Health approach.
- The redevelopment and investment into Weybridge, due to the complexities and scale increase the risks of maintaining our business-critical activities and ensuring a smooth transition.
- Loss of some EU funding due to the UK leaving the EU, resulting in additional challenge of maintaining the networks and intelligence sharing.

» Measures of Success

Great place to work

- Reward and pay structure for scientists established and implemented.
- Established programme of apprenticeships, post graduate studentships (MSc, PhDs) and science fellowships.
- Improve inclusion, diversity and equality.
- Fit for purpose equipment and facilities.

Global Influencer

- Maintain or exceed annual publication targets and expanded use of other knowledge exchange formats
- Maintain or increase numbers of staff on International committees or working groups.
- Maintain or enlarge our international portfolio including extending our Official Development Assistance (ODA) programme by working with others to develop and submit proposals for funding.
- Extend our international influence on invasive non-native species including in the British Overseas Territories.

Trusted Partner

- Maintain or increase delivery of a broad range of laboratory services (including testing and analysis) and epidemiological activities, in support of bTB control, improved biosecurity and to facilitate international trade. Areas of expertise include: animal and zoonotic diseases (broad range of pathogens), plant and bee health.
- Maintain our quality standards and accreditations.
- Develop key partnerships and utilise strategically.
- Scanning surveillance network expanded, harmonise data for trade assurance and better integrated One Health surveillance.
- Maintain expertise to support work towards achieving negligible BSE status.
- Support the ambitions of HMG response to the Godfray Review (England), the eradication strategy of Wales and continued Officially TB Free status of Scotland.

International Science Centre

- Maintain or extend our National and International Reference Centre designations.
- Science Capability for Animal Health (SCAH) programme of re-development at Weybridge on track.
- Support the UK's 20-year vision and 5-year national action plan on AMR expanding the influence of APHA in this area.

Future Proofing

- Strengthened succession planning for science leadership and specialists.
- Improve diversification of our funding streams to maintain vibrant capability and critical mass.
- Expertise in bioinformatics, genomic technologies, including genomic epidemiology discipline increased.
- Respond flexibly to future animal epizootics and human pandemics, based on the philosophy of Disease X.

1 UK Biological Security Strategy 2018

2 Coronavirus cases in the UK

3 Coronavirus deaths in the UK

4 GDP monthly estimate UK: December 2020

5 Veterinary Exotic Notifiable Diseases Unit (VENDU)

6 A strategy for achieving Bovine Tuberculosis Free Status for England: 2018 review - government response

7 House of Commons Environmental Audit Committee Invasive Species First Report of Session 2019