[redacted] Transforming Net Zero with Ultrawide Bandgap Semiconductor Device Technology (REWIRE)

# Check application

**Status:** SUCCESSFUL

**Application**

Application reference
[redacted]
Application name
Transforming Net Zero with Ultrawide Bandgap Semiconductor Device Technology (REWIRE)
Applicant
Martin Kuball
Organisation
University of Bristol
Application status
Successful

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Application status:
Successful

# Transforming Net Zero with Ultrawide Bandgap Semiconductor Device Technology (REWIRE)

## 1. Details

### Summary

**Co-created and delivered with industry, REWIRE will accelerate the UK's ambition for net zero by transforming the next generation of**

**high voltage electronic devices using wide/ultra-wide bandgap (WBG/UWBG) compound semiconductors**. Our application-driven, collaborative research programme and training will advance the next generation of semiconductor power device technologies to commercialisation and enhance the security of the UK's semiconductor supply-chain.

Power devices are at the centre of all power electronic systems. WBG/UWBG compound semiconductor devices pave the way for more efficient and compact power electronic systems, reducing energy loss at the power systems level. The UK National Semiconductor Strategy recognises advances in these technologies and the technical skills required for their development and manufacture as essential to supporting the growing net zero economy.

REWIRE's philosophy is centred on cycles of **use cases** co-created with industry and stakeholders, meeting market needs for devices with increased voltage ranges, maturity and reliability. **We will develop multiple technologies in parallel from a range of initial TRL to commercialisation.**

Initial work will focus on three use cases co-developed with industry, for transformative next generation WBG/UWBG semiconductor power electronic devices: **(1) Wind energy, HVDC networks (>10 kV)** – increased range high voltage devices as the basis for enabling more efficient power conversion and more compact power converters; **(2) High temperature applications, device and packaging** – greatly expanded application ranges for power electronics; **(3) Tools for design, yield and reliability** – improving the efficiency of semiconductor device manufacture.

These use cases will: improve higher TRL Silicon Carbide (SiC) 1-2kV technology towards higher voltages; advance low TRL devices such as Gallium Oxide ($Ga_2O_3$) and Aluminium Gallium Nitride (AlGaN), diamond and cubic Boron Nitride (c-BN) towards demonstration and ultimately commercialisation; and develop novel heterogenous integration techniques, either within a semiconductor chip or within a package, for enhanced functionality. Use cases will have an academic and industry lead, fostering academia-industry co-development across different work packages.

These initial, transformative REWIRE technologies will have wide-ranging applications. They will enhance the efficient conversion of electricity to and from High Voltage Direct Current (HVDC) for long-

distance transfer, enabling a sustainable national grid with benefits including more reliable and secure communication systems. New technologies will also bring competitive advantage to the UK's strategically important electric vehicle and battery sectors, through optimised efficiency in charging, performance, energy conversion and management.

**New use cases will be co-developed throughout REWIRE, with our >30 industrial and policy partners who span the full semiconductor device supply chain, to meet stakeholder priorities.**

Through engagement with suppliers, manufacturers, and policymakers, REWIRE will pioneer advances in semiconductor supply chain management, **developing supply chain tools for stakeholders to improve understanding of the dynamics of international trade, potential supply disruptions, and pricing volatilities.** These tools and our Supply Chain Resilience Guide will support the commercialisation of technologies from use cases, enabling users to make informed decisions to enhance resilience, sustainability, and inclusion.

**Equity, Diversity, and Inclusivity (EDI) are integral to REWIRE's ambitions.** Through extensive collaboration across the academic and industrial partners, we will build the diverse, skilled workforce needed to accelerate innovation in academia and industry, creating resilient UK businesses and supply chains.

**Start date**

[redacted]

**Duration**

[redacted]

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## 2. Core team

| Name | Role | Organisation |
|---|---|---|
| Martin Kuball | Project lead | [redacted] |
| Bernard Stark | Project co-lead (UK) | [redacted] |
| James Pomeroy | Project co-lead (UK) | [redacted] |
| Matthew Smith | Project co-lead (UK) | [redacted] |

| Name | Role | Organisation |
|---|---|---|
| Minhao Zhang | Project co-lead (UK) | [redacted] |
| Nikolaos Stylos | Project co-lead (UK) | [redacted] |
| Palie Smart | Project co-lead (UK) | [redacted] |
| Philip Mellor | Project co-lead (UK) | [redacted] |
| Saeed Jahdi | Project co-lead (UK) | [redacted] |
| [redacted] | | |
| Florin Udrea | Project co-lead (UK) | [redacted] |
| Rachel A Oliver | Project co-lead (UK) | [redacted] |
| Teng Long | Project co-lead (UK) | [redacted] |
| Marina Antoniou | Project co-lead (UK) | [redacted] |
| Olayiwola Alatise | Project co-lead (UK) | [redacted] |
| Peter Gammon | Project co-lead (UK) | [redacted] |
| Phil Mawby | Project co-lead (UK) | [redacted] |
| Vishal Shah | Project co-lead (UK) | [redacted] |

# 3. Vision and Approach

**Application question**

**What are you hoping to achieve with and how are you going to deliver your proposed work?**

**For the Vision, explain how your proposed work:**

- is of excellent quality and importance within or beyond the field(s) or area(s)

- has the potential to advance current understanding, generates new knowledge, thinking or discovery within or beyond the field or area
- is timely given current trends, context and needs
- impacts world-leading research, society, the economy or the environment

Within the Vision section we also expect you to:

- identify the potential for its outcomes to have a transformative effect on the UK's semiconductor landscape

**For the Approach, explain how you have designed your approach so that it:**

- is effective and appropriate to achieve your objectives
- is feasible, and comprehensively identifies any risks to delivery and how they will be managed
- if applicable, uses a clear and transparent methodology
- if applicable, summarises the previous work and describes how this will be built upon and progressed
- will maximise translation of outputs into outcomes and impacts
- describes how your, and if applicable your team's, research environment (in terms of the place, its location, and relevance to the project) will contribute to the success of the work

Within the Approach section we also expect you to:

- describe the governance plan and the structures that you will have in place, how they will support the team and provide oversight
- demonstrate access to the appropriate services, facilities, infrastructure, or equipment to deliver the proposal
- provide a detailed and comprehensive project plan including milestones and timelines in the form of a Gantt chart or similar (additional 2-pages of A4)

Upload the vision and approach as a single PDF document, see details in the file upload guidance. In the text box simple entre 'attachment provided'.

## Vision and Approach

[redacted] [redacted]

# 4. Co-created research and innovation programme

**Application question**

**How have you designed your research and innovation programme to maximise the impact of the IKC activity?**

**What the assessors are looking for in your response**

Using the text box, explain how you have designed your research and innovation programme so that it:

- Has been co-created and co-delivered with businesses, industry and end users.
- identifies an appropriate strategy and plan to push fundamental research towards proof-of-concept, concept, commercialisation, and exploitation.
- evidence of a mechanism to engage key industrial partners and businesses.
- details of how the IKC will manage the outputs of the project, including any intellectual assets and intellectual property
- given that the majority of fabrication and manufacture is based overseas, how will you ensure that outcomes of the research are anchored to the UK and add value to the UK sector
- details of your plans for the additional Pump-prime industrial engagement and commercialisation funding from Innovate UK.

This section should cover how you will build links with businesses and enable them to exploit research outcomes, as well as discussing how the design of your research and innovation programme will be co-created with business and users, as appropriate. In addition, you should cover how you will use the Innovate UK “pump-priming” funding. You should also have a section on your specific "Exploitation Strategy", how you will handle IP and ensure research outcomes and value are anchored to the UK, recognising that a lot of the manufacture is overseas.

**Embedded images guidance for the Funding Service**
In this section you can include embedded images. Guidance and principles below.

You must:
use images sparingly and only to convey important information that cannot easily be put into words
insert each new image onto a new line
provide a descriptive legend for each image immediately underneath it (this counts towards your word limit)

Files must be:
in JPEG, JPG, JPE, JFI, JIF, JFIF, PNG, GIF, BMP or WEBP format
smaller than 8MB

**Co-creation of REWIRE with industry:** [redacted]

[redacted]

[redacted]

**Co-creation will continue through:**

[redacted]

[redacted]

[redacted]

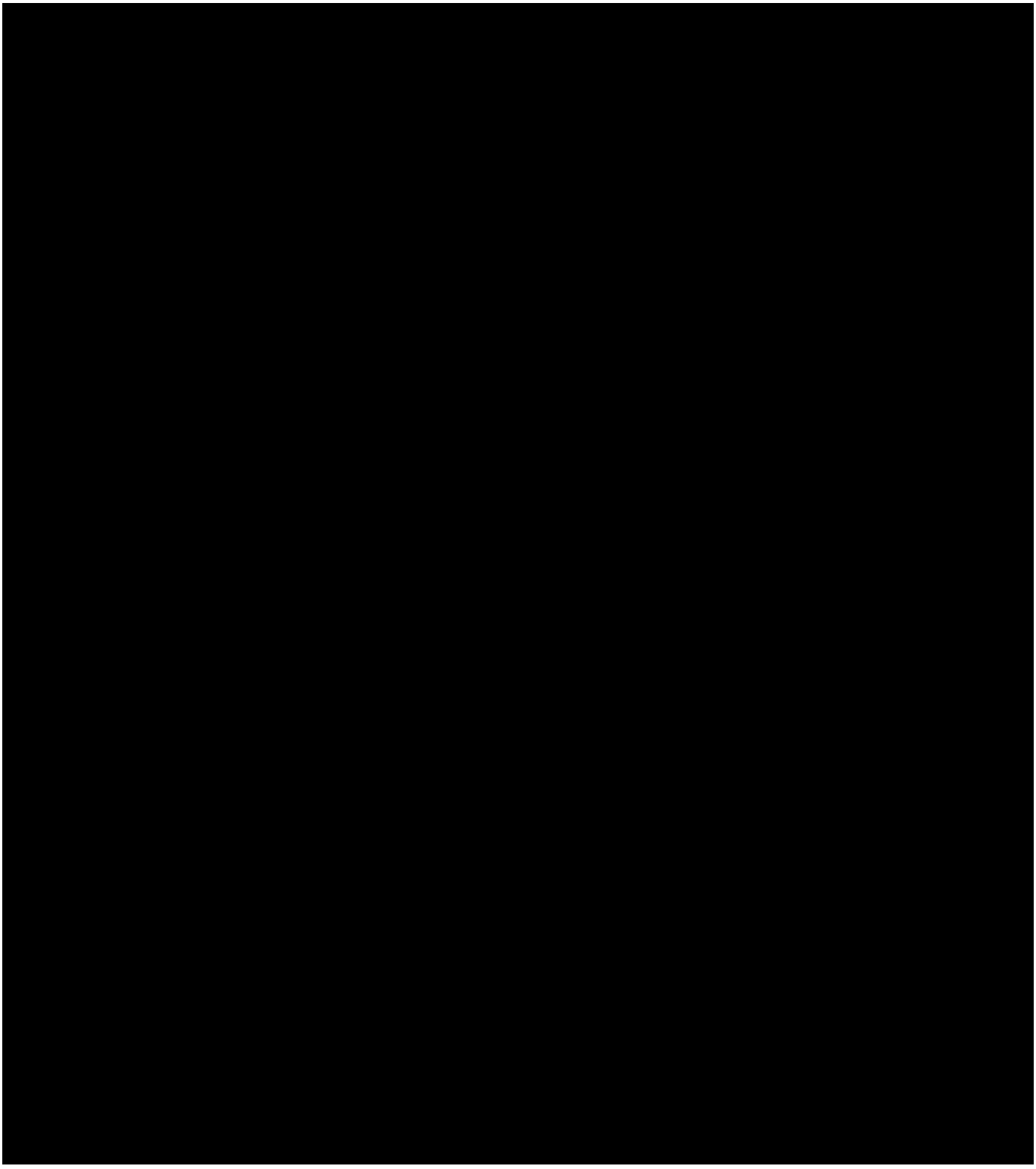
[redacted]

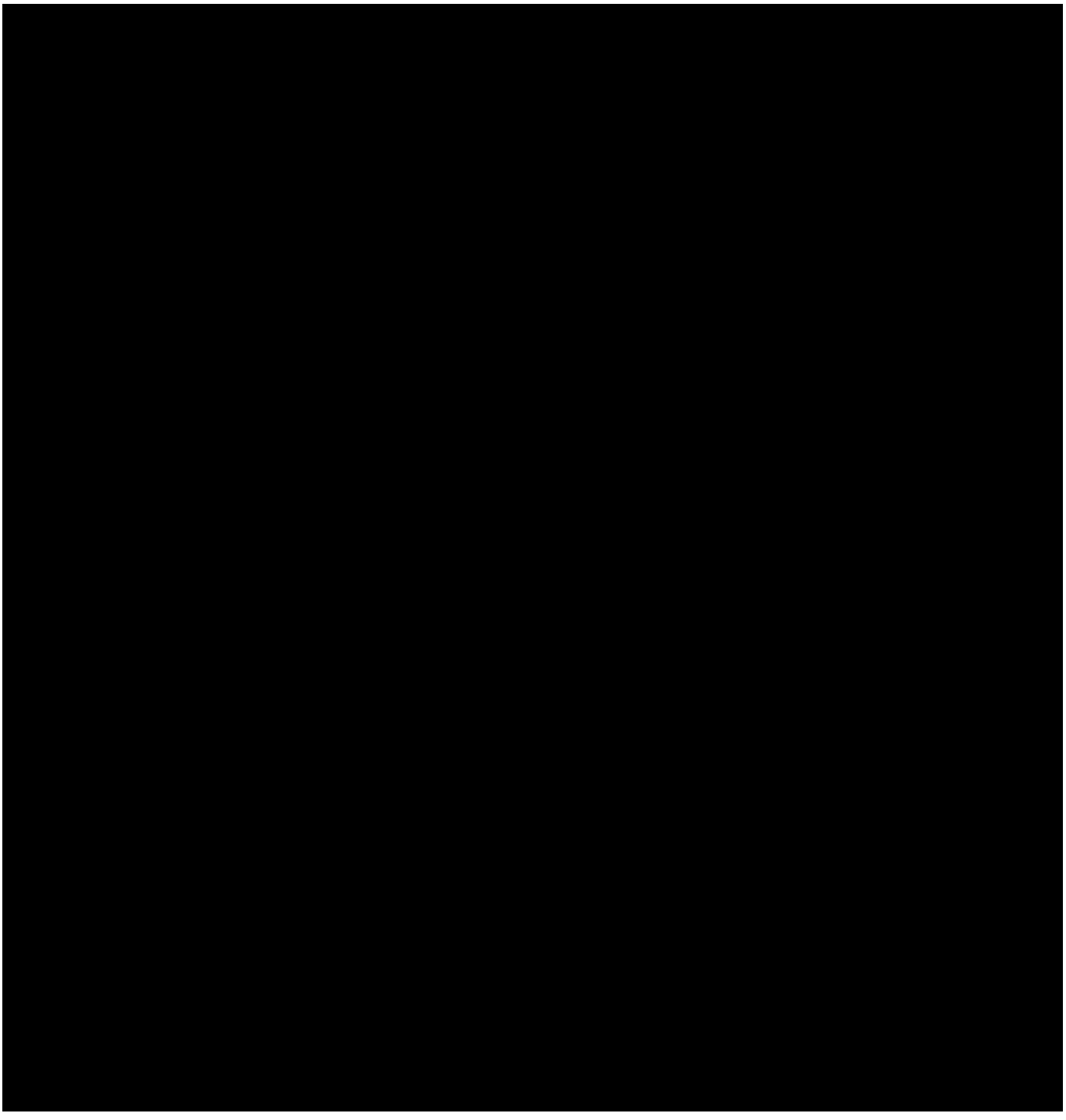
**Exploitation Plan (see also Gantt Chart, Vision and Approach, p.10):**

[redacted]

[redacted]

[redacted]





# 5. Applicant and team capability to deliver

**Application question**

**Why are you the right individual or team to successfully deliver the proposed work?**

Evidence of how you, and if relevant your team, have:

- the relevant experience (appropriate to career stage) to deliver the proposed work
- the right balance of skills and expertise to cover the proposed work
- the appropriate leadership and management skills to deliver the work and your approach to develop others
- contributed to developing a positive research environment and wider community

**Contextual guidance**: for this opportunity also please consider the right mix of non-academic staff to enable business engagement, development and assistance – enabling the push of emergent technology and services towards market.

The word count for this section is 1,500 words, 1,000 words to be used for R4RI modules and, if necessary, a further 500 words for Additions.

Use the Résumé for Research and Innovation (R4RI) format to showcase the range of relevant skills you, and if relevant your team (investigators, researchers, other (technical) staff for example research software engineers, data scientists and so on, and partners), have and how this will help to deliver the proposed work. You can include individuals' specific achievements but only choose past contributions that best evidence their ability to deliver this work.

Complete this section using the R4RI module headings listed below. You should use each heading once and include a response for the whole team, see the UKRI guidance on R4RI (https://www.ukri.org/apply-for-funding/before-you-apply/resume-for-research-and-innovation-r4ri-guidance/#:~:text=UKRI%20committed%20to%20adopting%20a,UKRI%20throughout%202022%20and%202023.). You can enter N/A for any you think irrelevant, and will not be penalised for doing so, but it is recommended that you carefully consider the breadth of your experience:

- Contributions to the generation of new ideas, tools, methodologies, or knowledge

- The development of others and maintenance of effective working relationships
- Contributions to the wider research and innovation community
- Contributions to broader research or innovation users and audiences and towards wider societal benefit

**Additions**

Provide any further details relevant to your application. This section is optional and can be up to 500 words. You should not use it to describe additional skills, experiences, or outputs, but you can use it to describe any factors that provide context for the rest of your R4RI (for example, details of career breaks if you wish to disclose them).

Complete this as a narrative. Do not format it like a CV.

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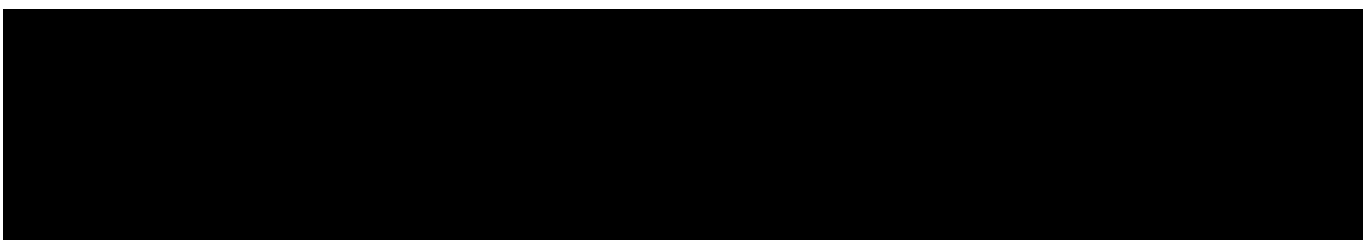
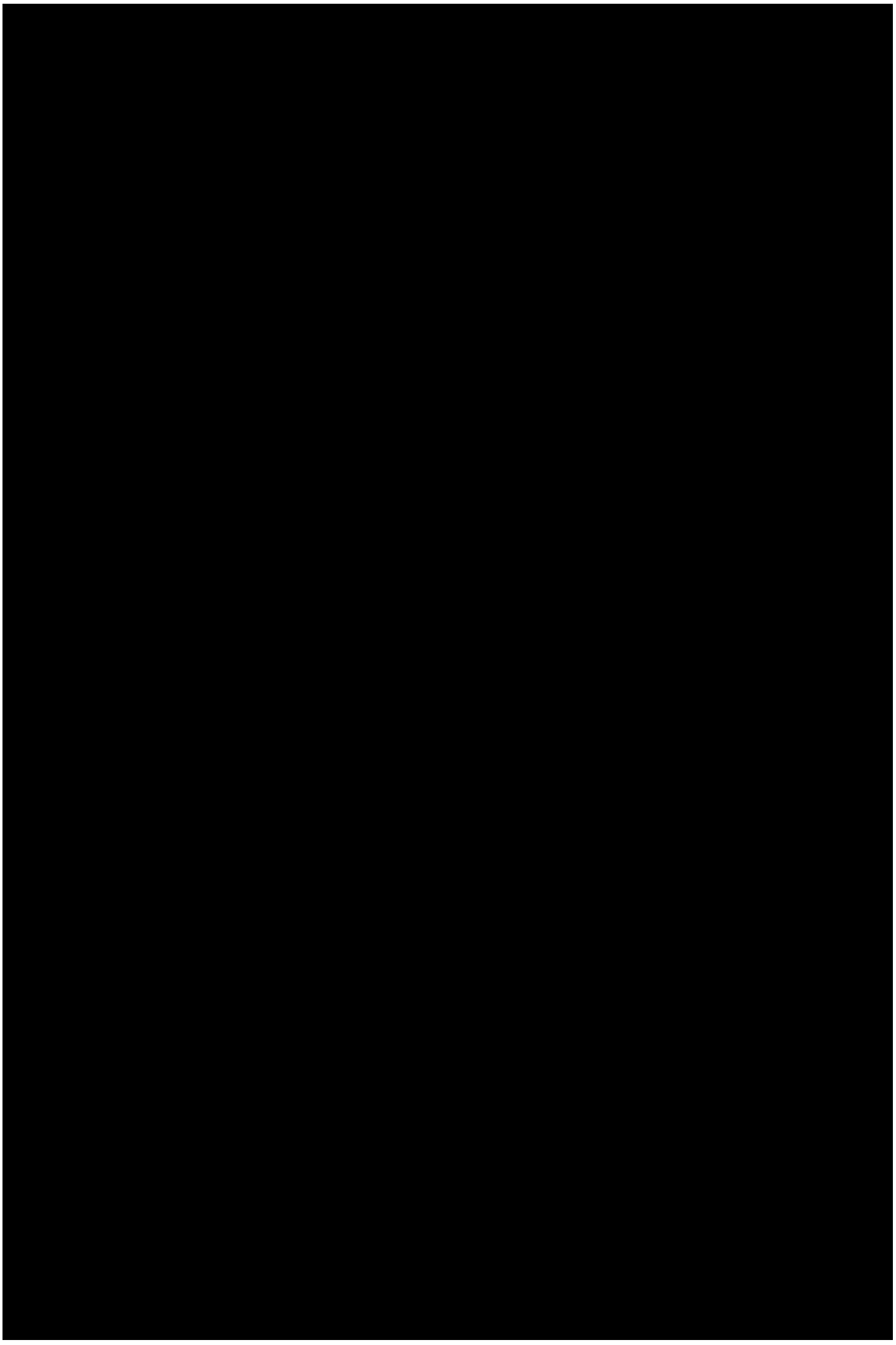




[redacted]

[redacted]

## 6. Project partners: contributions

**Application question**

**Provide details about any project partners' contributions using the template provided.**

If you do not have any project partners, simply add 'N/A' into the text box, mark this section as complete and move to the next section.

If you do have project partners, download and complete the project partner contributions template (DOCX, 52KB) [redacted]

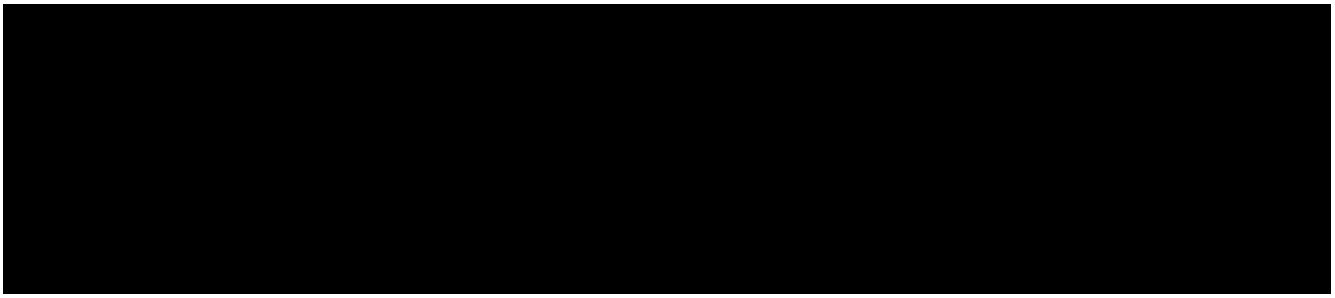
[redacted] then copy and paste **only** the table within it into the text box below.

Ensure you have obtained prior agreement from project partners that, should you be offered funding, they will support your project as indicated in the template.

| **Project partner name** | **Project partner address**<br>Postal address | **Country**<br>Linked to the postal address of the business/<br>organisation | **Direct contribution**<br>Describe the contribution in 10 words or less | **Direct contribution value**<br>Provide the value in £s (use format £10,000 not £10k) | **In-kind contribution**<br>Describe the contribution in 10 words or less | **In-kind contribution value**<br>Provide the estimated value in £s | **Name of contact*** | **Job title** | **Department** |
|---|---|---|---|---|---|---|---|---|---|

[redacted]

[redacted]



## 7. Project Partners: letters (or emails) of support

**Application question**

**Upload a single PDF containing the letters or emails of support from each partner you named in the table in the previous 'contributions' section.**

If you do not have any project partners, simply add 'N/A' into the text box, mark this section as complete and move to the next section.

If you have named project partners in the previous 'contributions' section, enter the words 'attachment supplied' in the text box below.

Each letter or email you provide should:

- confirm the partner's commitment to the project
- clearly explain the value, relevance and possible benefits of the work to them
- describe any additional value that they bring to the project
- please refer to EPSRC's guide for more guidance.

Please do not provide letters of support from host and Co-Investigator's research organisations.

Unless specifically requested, please do not include any personal data within the attachment.

Upload details are provided within the service on the actual application.

For audit purposes, UKRI requires formal collaboration agreements to be put in place if an award is made.

Letters of Support

[redacted] [redacted]

## 8. References

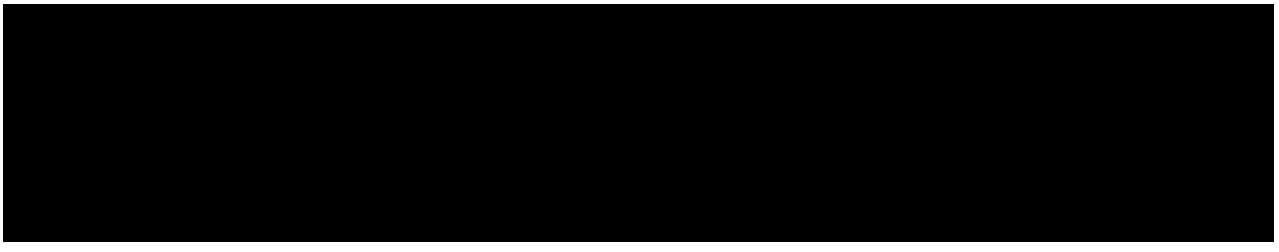
**Application question**

**List the references you've use to support your application.**

Ensure your application is a self-contained description. You can provide hyperlinks to relevant publications or online resources. However, assessors are not obliged to access the information they lead to or consider it in their assessment of your application.

You must not include links to web resources in order to extend your application. If linking to web resources, to ensure the information's integrity is maintained include, where possible, persistent identifiers such as digital object identifiers.

[redacted]



## 9. Facilities

**Application question**

**Does your proposed research require the support and use of a facility?**

If not, enter N/A into the text box, mark this section as complete and move on to the next section.

If you will need to use a facility, you should follow your proposed facility's normal access request procedures. Where prior agreement is required, ensure you obtain their agreement that, should you be offered funding, they will support the use of their facility on your project.

In the text box below, for each requested facility you should provide:

- the name of facility, copied and pasted from this list [redacted]
- the proposed usage or costs, or costs per unit where indicted on that list
- confirmation you have their agreement where required

Do not put the facility contact details in your response.

[redacted]

## 10. Resources and Cost

**Total full economic costs (fEC)**

[redacted]

**Total contribution from applying organisation(s)**

[redacted]

**Total funding applied for**

[redacted]

## Directly allocated

### Cost categories

| Category | Applied for |
| --- | --- |
| Staff | [redacted] |

| Category | Applied for |
| --- | --- |
| Estates | [redacted] |
| Other | [redacted] |

### Staff breakdown

| Name | Role | %FTE |
| --- | --- | --- |
| [redacted] | | |

## Directly incurred

### Cost categories

| Category | Applied for |
| --- | --- |
| Staff | [redacted] |
| Equipment | [redacted] |
| Travel and subsistence | [redacted] |
| Other | [redacted] |

## Staff breakdown

| Name | Role | %FTE |
| --- | --- | --- |
| [redacted] | | |

# Indirect

## Cost categories

| Category | Applied for |
| --- | --- |
| Indirect costs | [redacted] |

## Staff breakdown

No staff for this category

# Exceptions

## Cost categories

| Category | Applied for |
| --- | --- |
| Staff | - |
| Equipment | - |
| Travel and subsistence | - |
| Other | - |

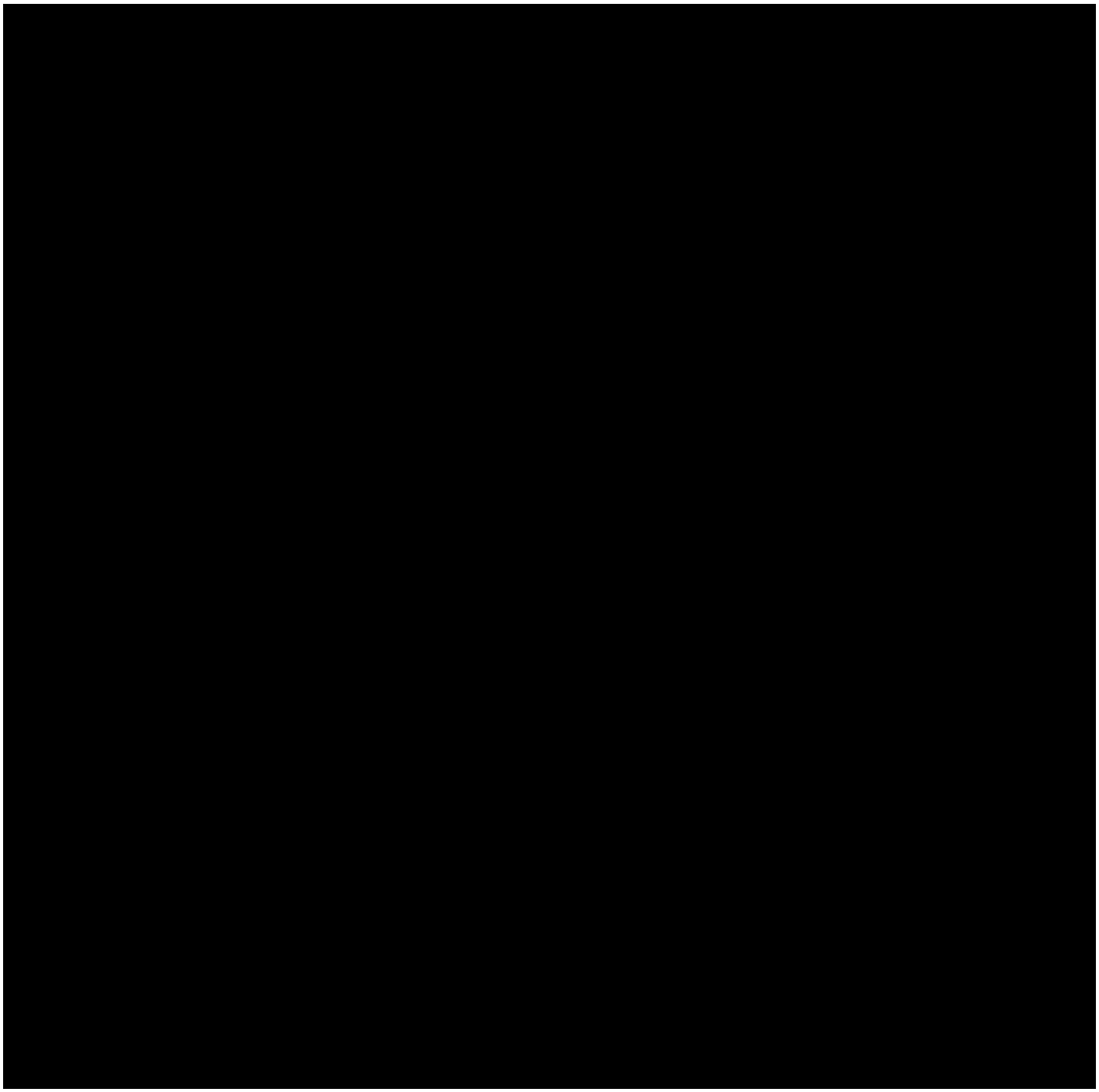
## Staff breakdown

No staff for this category

[redacted]

## Justification of resources

[redacted]



**Financial numbers below are 100% FEC.**

[redacted]

## 11. Ethics and Responsible Research and Innovation (RRI)

**Application question**

**What are the ethical or RRI implications and issues relating to the proposed work? If you do not think that the proposed work raises any ethical or RRI issues, explain why.**

Demonstrate that you have identified and evaluated:

- the relevant ethical or responsible research and innovation considerations
- how you will manage these considerations

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Files must be:

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smaller than 8MB

## 12. Genetic and Biological Risk

**Application question**

**Does your proposed research involve any genetic or biological risk?**

If not, enter ‘N/A’ into the text box, mark this section as complete and move on to the next section.

**What the assessors are looking for in your response**

In respect of animals, plants or microbes, are you proposing to:

- use genetic modification as an experimental tool, like studying gene function in a genetically modified organism
- release genetically modified organisms
- ultimately develop commercial and industrial genetically modified outcomes?

If yes, provide the name of any required approving body and state if approval is already in place. If it is not, provide an indicative timeframe for obtaining the required approval.

Identify the organism or organisms as a plant, animal or microbe and specify the species and which of the three categories the research relates to.

Identify the genetic and biological risks resulting from the proposed research, their implications and any mitigation you plan on taking. Assessors will want to know you have considered the risks and their

implications to justify that any identified risks do not outweigh any benefits of the proposed research.

N/A

## 13. Research involving the use of animals

**Application question**

**Does your proposed research involve the use of vertebrate animals or other organisms covered by the Animals Scientific Procedures Act?**

If not, enter 'N/A' into the text box, mark this section as complete and do the same for the next question.

If you are proposing research that requires using animals, write 'Yes' in the text box. Then, download and complete this document [redacted] (DOCX, 74KB), which contains all the questions relating to research using vertebrate animals or other Animals (Scientific Procedures) Act 1986 regulated organisms. Then, save it as a PDF.

N/A

## 14. Conducting research with animal overseas

**Application question**

**Will any of the proposed animal research be conducted overseas?**

If not, enter 'N/A' in the text box, mark as complete and move to the next question.

If you are proposing to conduct overseas research, it must be conducted in accordance with welfare standards consistent with those in the UK,

as per Responsibility in the Use of Animals in Bioscience Research (https://www.nc3rs.org.uk/3rs-resources/responsibility-use-animals-bioscience-research), on page 14.

You should also ensure all named applicants in the UK and overseas are aware of this requirement and provide a statement below to confirm that:

- all named applicants are aware of the requirements and have agreed to abide by them
- this overseas research will be conducted in accordance with welfare standards consistent with the principles of UK legislation
- the expectation set out in 'Responsibility in the Use of Animals in Bioscience Research' (https://www.nc3rs.org.uk/responsibility-use-animals-bioscience-research) will be applied and maintained
- appropriate national and institutional approvals are in place.

Overseas studies proposing to use non-human primates, cats, dogs, equines or pigs, will be assessed during NC3Rs review (https://www.nc3rs.org.uk/who-we-are-and-what-we-do#services) of research proposals. The required information should be provided by completing the template from the question 'Research Involving the use of animals'.

For studies involving other species listed below, you should select the relevant checklist or checklists from the list below, complete it and save it as a PDF and use the file upload feature to attach. If you need to complete more than one checklist, you should merge them into a single document and then save it as a PDF before uploading it.

- Additional questions on the use of rodents overseas. (https://nc3rs.org.uk/sites/default/files/documents/Additional%20questions%20on%20the%20use%20of%20rodents%20overseas%20%286%29_0.docx)
- Additional questions on the use of rabbits overseas. (https://nc3rs.org.uk/sites/default/files/documents/Additional%20questions%20on%20the%20use%20of%20rabbits%20overseas.docx)
- Additional questions on the use of sheep overseas. (https://nc3rs.org.uk/sites/default/files/documents/Additional%20questions%20on%20the%20use%20of%20sheep%20overseas.docx)
- Additional questions on the use of goats overseas. (https://nc3rs.org.uk/sites/default/files/documents/Additional%20questions%20on%20the%20use%20of%20goats%20overseas.docx)
- Additional questions on the use of pigs overseas. (https://nc3rs.org.uk/sites/default/files/documents/Additional%20questions%20on%20the%20use%20of%20pigs%20overseas.docx)
- Additional questions on the use of cattle overseas. (https://nc3rs.org.uk/sites/default/files/Additional%20questions%20on%20the%20use%20of%20cattle%20overseas.docx)

- Additional questions on the use of Xenopus laevis and Xenopus tropicalis overseas. (https://nc3rs.org.uk/sites/default/files/Additional%20questions%20on%20the%20use%20of%20Xenopus%20laevis%20%26%20%20Xenopus%20tropicalis%20overseas.docx)

N/A

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## 15. Research involving human participation

**Application question**

**Will the project involve the use of human subjects or their personal information?**

If not, enter 'N/A' into the text box, mark this section as complete and move on to the next section.

If you are proposing research that requires the involvement of humans subjects, provide the name of any required approving body and whether approval is already in place. Then, justify the number and the diversity of the participants involved, as well as any procedures.

Provide details of any areas of substantial or moderate severity of impact.

N/A

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## 16. Research involving human tissues or biological samples

**Application question**

**Does your proposed research involve the use of human tissues, or biological samples?**

If not, enter ‘N/A’ into the text box, mark this section as complete and move on to the next section.

If you’re answering ‘yes’, provide the name of any required approving body and whether approval is already in place.

You should justify the use of human tissue or biological samples specifying the nature and quantity of the material to be used and its source.

N/A