Written Evidence Submitted by the University of the West of Scotland (UWS) (RFA0096)

Executive Summary
The ARPA style approach could enrich the existing research and innovation ecosystem in the following way:

- Focusing on regionally competing project missions that will cement UK's position at the forefront of globally impactful developments;
- Providing funding for high-risk, early stage projects tackling major planetary challenges with globally competitive scalability of funding for projects that have the highest potentials (i.e. longitudinal approach) by drawing from visioning and talent regionally;
- Working as a resilient, distributed organisation to attract talent regionally, contribute to regional economic prosperity and supported by a core management team.

1. Introduction
University of the West of Scotland (UWS) is classified as one of the new Universities that has been granted a University status in 1992 (i.e. Paisley College of Technology was granted the title University of Paisley). Following the merger of the University of Paisley with Bell College (Hamilton), in November 2007, the Privy Council approved the name University of the West of Scotland for the merged institution. More information about the University is available at: https://www.uws.ac.uk/about-uws/.
We are submitting evidence to reinforce the need for support of extraordinarily talented teams achieving extraordinary results regardless of where they are.

2. What gaps in the current UK research and development system might be addressed by an ARPA style approach?
The research funding landscape in the UK is rich although a disruptive innovative force – ARPA – could pivot the focus of research funding to global challenges, economic prosperity, and country-scale industry funding. InnovateUK is a great example of such a focus, providing a valuable lesson for any new approach. In order to successfully drive change, the agency would require significant funding and autonomy. Inadequate levels of funding often translate into projects that are narrow in scope, risk-averse and consequently they do not lead to globally impactful outcomes at scale sufficiently frequently (e.g. future space missions, global technology companies arising from such projects). There is also a need to significantly boost doctoral training outside of the UKRI umbrella. Many modern universities have excellent relationships with industry but due to UKRI limitations, severely restricted access to funding high-risk, industry-led doctoral research, which demonstrably attracts talent.
Some of UWS research where extraordinarily talented teams delivered extraordinary results and can serve as examples of what is possible, believing that through ARPA they would be able to achieve far more include:

- Institute for Biomedical and Environmental Health Research: [After 13 years of painstaking research supported by the University, Professor Fiona Henriquez and her team developed and patented the first of its kind single-step Acanthamoeba keratitis (AK) treatment https://www.opticianonline.net/news/preventative-ak-treatment-developed-by-uws-researchers]
- BEYOND 5G HUB: http://beyond5ghub.uws.ac.uk [With no track record in 5G technologies, we created a highly-effective team of academics with complementary expertise in 2015 with a strategic University support to establish world-class 5G capabilities, leading to winning two consecutive H2020 projects with technical leadership capabilities: SELFNET (https://selfnet-5g.eu) and SLICENET (https://slicenet.eu)];

- Institute of Thin Films, Sensors and Imaging (TFSI; https://www.itfsi.com) has been established in 2014 by bringing together talent from industry (Prof Des Gibson) and academia, which has over the years resulted in 17 patents, spin-outs (Novosound, Converge Challenge winner 2017; Albasense, shortlisted Converge Challenge 2017) and 7 worldwide deployed products. The latest developments include a partnership with Glenrothes-based semi-conductor foundry Semefab in response to COVID-19 pandemic to develop non-contact thermometers with more than 12 million orders worldwide (https://www.universities-scotland.ac.uk/uws-works-to-prevent-spread-of-covid-19/).

3. What are the implications of the new funding agency for existing funding bodies and their approach?

The focus really is on unlocking transformative technologies through a longer (10-15 year) period and being complementary to the existing funding mechanisms so they are not spread too thinly by constantly attempting to fund the full range of challenge-based projects. ARPA needs to support the emergence of regional technology visioning with extraordinary talented teams delivering on a particular technology vision (i.e. scalable technological solutions suitable for one geographical region adopted by other similar regions worldwide). The medium-term implications may include a profound shift of the existing funding bodies to develop new focused approaches in order to establish connection and complementarities with ARPA projects as they unfold, and enable funding of the best research and individuals regardless of where they are (across the funding landscape). Having said that, ARPA funding is to address the stated gap and should thus be separate and on top of the existing funding rather than being a replacement.

4. What should be the focus be of the new research funding agency and how should it be structured?

To be effective, the focus needs to be on areas that can reverberate globally by engaging talent throughout the UK regionally but in truly unconventional ways. For example, *The Shockwave Rider* by John Brunner was originally published in 1975[1], predicting many of the challenges internet is facing today (e.g. The Morris Worm) and apart from the name (i.e. worm) gave the John Shoch and other brilliant minds at Xerox Palo Alto Research Centre (PARC) an insight into problems of connected devices where worms may spread from one machine to another without human intervention[2]. "*Harmony between artificial and human intelligence for the improved planetary wellbeing*" is one such mission where the UK can position itself at the forefront of globally impactful developments at a national level. The key idea behind this broad mission is to develop transformational solutions that make AI work for the humanity and our planet. While this may be self-explanatory, a lot of current AI research lacks purposeful exploration. Other challenges to focus on include "*Planetary-scale ocean clean-up system*", "*Space economy and society*" and "*Planetary-scale hypersonic transportation systems*". All of those combined should represent an ecosystem of the funding agency's challenges by recognising that (1) all disciplines are needed to address planetary-scale challenges and (2) future space society may be at odds with its planetary counterpart(s) – science fiction may actually materialise along the lines of the predictions made in John Brunner's books.

The agency should have regional presence by working as a distributed organisation with a very small management team, enabling virtual project-team formations. Funding should be awarded for exploratory research, supporting technology visioning and risk-taking. We believe that the greatest developments arise from collaboration with a strong emphasis on multi-disciplinary, multi-institutional projects. The funding must be longitudinal, in recognition of the exploratory nature where breakthrough developments and technologies often arise through high-risk, emerging fields

[1] Brunner, J. (2014). *The shockwave rider*. Open Road Media.

[2] Chen, T. M. (2003). Trends in viruses and worms. *The Internet Protocol Journal*, *6*(3), 23-33.

with unpredictable outcomes. A short-term funding model would not permit longitudinal excursion and thus stifle this creativity and innovation.

5. What funding should ARPA receive, and how should it distribute this funding to maximise effectiveness?

Separate funding mechanism for ARPA is expected to be in addition to the existing funding mechanisms. As long as the developed solutions are bound by only one simple criterion – they need to work for the humanity and our planet – funding should be open to anything that can drive the mission. Distribution of funding could be along the lines of regional specificities and disparities following a 'locally impactful, globally applicable' paradigm. Each UK region has its own specifics and talent pool, and developing locally impactful solutions with a real potential to be applied in the global context should be considered along with the cross-regional collaboration. High-risk projects need to be appropriately funded and while some early stage projects may start small (e.g. <£100k), the funding arrangements should be sufficiently flexible to allow projects to grow in size in excess of £1bn, should they demonstrate potentials for real breakthroughs in the development of far-reaching transformational solutions.

6. What can be learned from ARPA equivalents in other countries?

There is sufficient and multi-decade evidence of benefits from a singular project-led approach in the USA as well as a competing teams approach in the former Soviet Union. An amalgamation of both approaches into a regionally-competing project missions could be considered. This would include several regional teams working on the same project and some of these projects could be centred around commercial entities (equivalent to SpaceX, for example). Flexibility is key and challenge-led regional funding arrangements are of great importance to develop globally impactful solutions.

7. What benefits might be gained from basing UK ARPA outside of the 'Golden Triangle' (London, Oxford and Cambridge)?

Strong regions significantly support resilience of the national economy. There is no real need to be based in the 'Golden Triangle' if the agency's purpose is funding the best research and individuals wherever they are found, adding to its resilience. Looking back in the history, many Apollo Program research centres were scattered throughout the USA rather than being in close proximity to NASA headquarters in Washington DC[3]. Even some of the largest centres (e.g. Goddard Space Flight Centre in Greenbelt, Maryland; the Jet Propulsion Laboratory in Pasadena, California; the Johnson Space Centre in Houston, Texas; and the Langley Research Centre in Hampton, Virginia) are distributed throughout the United States. This geographic dispersion enabled more straightforward attracting of talent regionally – and this was well before the times of modern communication technologies. In addition to boosting regional economies, having multiple locations is also more secure and safe.

(July 2020)

[3] Beattie, D. A. (2001). *Taking Science to the Moon: Lunar Experiments and the Apollo Program*. JHU Press.