Rebuilding a Resilient Britain: Evidence Gaps and Knowledge Exchange opportunities

Synthesised by:

Kathryn Oliver, Government Office for Science

Annette Boaz, Government Office for Science

Giulia Cuccato, Government Office for Science

Cameron Dashwood, Government Office for Science

February 2021

ari.comment@go-science.gov.uk

List of acronyms

AI: Artificial Intelligence
ARI: Area of Research Interest
AHRC: Arts and Humanities Research Council
BAME: Black, Asian and Minority Ethnic
BBSRC: Biotechnology and Biological Sciences Research Council
BEIS: Department for Business, Energy and Industrial Strategy
CBI: Confederation of British Industry
CJS: Criminal Justice System
CO: Cabinet Office
COVID-19: Coronavirus Disease 19
CSA: Chief Scientific Advisor
DCMS: Department for Digital, Culture, Media and Sport
Defra: Department for Environment, Food and Rural Affairs
DfE: Department for Education
DfT: Department for Transport
DH: Department of Health
DHSC: Department of Health and Social Care
DIT: Department for International Trade
DWP: Department for Work and Pensions
EPSRC: Engineering and Physical Sciences Research Council
ESRC: Economic and Social Research Council
FCDO: Foreign, Commonwealth and Development Office
FSA: Food Standards Agency
GCSA: Government Chief Scientific Advisor
GOS: Government Office for Science
HMRC: Her Majesty's Revenue and Customs
HMT: Her Majesty's Treasury
HO: Home Office
HSE: Health and Safety Executive
MHCLG: Ministry of Housing, Communities and Local Government
MoD: Ministry of Defence
MoJ: Ministry for Justice
MRC: Medical Research Council
NERC: Natural Environment Research Council
NGO: Non-Governmental Organisations
NICE: The National Institute for Health and Care Excellence
ONS: Office for National Statistics
PHE: Public Health England
R&D: Research and Development
SAGE: Scientific Advisory Group for Emergencies
SME: Small and Medium-sized Enterprises
STEM: Science, Technology, Engineering, and Mathematics
STFC: Science and Technology Facilities Council
UKRI: UK Research and Innovation

Table of Contents

This paper should be cited as:

Oliver K, Boaz A, Cuccato G, Dashwood C. (2021) Rebuilding a Resilient Britain: Evidence Gaps and Knowledge Exchange Opportunities. ARI Report. [online] https://www.gov.uk/government/publications/evidence-gaps-and-knowledge-exchange-opportunities.

1. Aim

The aim of this paper is to indicate future research likely to be most useful for government in developing the response to COVID-19 over the medium to long term. These evidence gaps and knowledge exchange opportunities were identified through the *Rebuilding a Resilient Britain* programme, the academic-policy engagement process hosted by the Government Office for Science (GOS) and facilitated by the Economic and Social Research Council (ESRC)/GOS Areas of Research Interest Fellows. Working Groups comprising government officials, funders and researchers discussed cross-cutting topics considered critical to the government response; assembled the evidence base, and identified gaps for future research and knowledge exchange. Nine reports were produced by these working groups, which can be found at https://www.upen.ac.uk/go_science.

2. Who is this paper for?

Funders in United Kingdom Research and Innovation (UKRI) and beyond may wish to review these identified evidence themes and gaps when planning strategic or routine investments in these areas. Funders may also wish to select proposals which are sufficiently well-specified (see those in Annex 1) for direct commissioning and/or to shape strategic investments. In addition, funders wishing to support interdisciplinary research programmes may find these useful, as all the evidence gaps and research projects described below are the result of facilitated discussions between government officials and multi-disciplinary groups of researchers.

Researchers planning proposals: Researchers may wish to use this paper to develop research proposals, as the gaps identified in this paper speak directly to priorities developed through a process of co-design between policymakers, funders and researchers.

Government officials: May wish to inform strategic planning around research commissioning, calls, and collaborations, and may find this paper useful when preparing future Areas of Research Interest (ARIs), or to gather ideas for their own research commissioning and activities.

Teams supporting cross-departmental research initiatives or commissioning may find the proposed cross-cutting research gaps useful to scope research collaborations across government. In addition, the sections on policy dialogues represent opportunities to bring together government departments to discuss critical topics of relevance to more than one department.

3. How these evidence gaps were identified

This paper offers an overview of the key gaps and themes identified by our Rebuilding a Resilient Britain programme, which assessed the key research priorities for government departments as identified by the Chief Scientific Advisers. In 2019, two Fellows were appointed jointly by ESRC and GOS to promote academic-policy engagement around Areas of Research Interest, which are statements of priority research areas identified by government departments.

Between April-November 2020, the Fellows ran the Rebuilding a Resilient Britain programme, which sought to identify evidence relevant to sets of cross-cutting ARIs identified as critical to supporting the government response to COVID-19 in the mid- to long-term. Nine working groups brought together over 250 researchers, policy officials and funders to identify existing evidence, key messages for decision-makers arising from this evidence, and gaps in the current research evidence base. Working groups were given between 4-31 ARIs to consider. In some cases, no evidence was identified due to lack of specific expertise within the group (for a complete list of unanswered ARIs, see Annex 2). It is therefore possible that relevant evidence may be identified with a more targeted

and resourced search and synthesis process. In this paper, we address the specific and higher-level evidence gaps and research ideas proposed by working groups.

4. How this paper is organised

We summarise three types of evidence gaps or knowledge exchange opportunities in this paper.

- Research themes and projects**:** We asked working groups to identify possible next steps based on unanswered ARIs, including proposed research projects and programmes, relating to their ARIs. Discussion within each working group acted as a stimulus for conversation about potential future research projects and knowledge gaps both responding to the ARIs and moving beyond them. For each project we have indicated the working group of origin for ease of follow up.
- Knowledge Exchange opportunities: Working groups were also asked to identify practical next steps. In this section we summarise areas where working groups identified a mature evidence base relevant to the ARIs, implying an opportunity for further dissemination and implementation projects to ensure that evidence is reaching decision-makers rather than new research.
- Cross-departmental dialogue opportunities**:** Finally, groups indicated areas where there is limited evidence, but a strong policy pull which could be of interest to many departments. Here we identify opportunities for cross-government discussion and working.

To facilitate follow up we have indicated the original working group(s) who identified the themes, and we would recommend that the original reports are used in discussion with relevant Chairs, members and facilitators if any of these themes are to be taken forward to gain detailed insights into the state of the evidence base and potential avenues for research development. Please contact the Government Office for Science to help in facilitating these connections, by emailing ARI.Comment@go-science.gov.uk.

5. Research themes and projects

Working groups were asked to propose ideas for research projects and programmes where there were clear gaps in the evidence base. Most working groups through their discussions also co-created research ideas which did not directly address the ARIs. These ideas vary from clearly defined research projects to higher-level suggestions and ideas. For ease of use, we have grouped these by research theme. Six main themes were identified:

1. Net zero and economic growth
2. Regional, national and international trade and work
3. Effect of COVID-19 on social and health inequalities
4. Delivery and support of more effective public services
5. Data infrastructure, access and investment
6. Evidence use in policy and practice

Each theme is summarised briefly in text. A full list of the specific projects relating to each theme can be found in .

Annex 1: List of Research Projects arranged by Theme.

5.1 Net zero and economic growth

Several groups highlighted the opportunity for, and tensions between addressing the need to rebuild the economy post-COVID-19 and the UK's commitment to net zero and other climate targets. Noting the lack of evidence about the options available to government in navigating this challenge, the groups identified research relevant to a greener recovery, land use, skills and training, decarbonisation and changing travel technologies. These research gaps and projects focused on addressing the need to reduce our carbon emissions while protecting economic growth and productivity, including how land can be better utilised; changing travel and work patterns; interventions to promote (greener) productivity and mitigate against inequalities caused by the pandemic; and decarbonisation.

5.1.1 Sustainable green economic recovery

Groups highlighted the opportunity to explore the potential social, environmental and economic impacts of shifting to greener recovery through investment in employment and consumption behaviours. COVID-19 is likely to affect our dependence on fossil fuels, energy consumption patterns, and consumer behaviour in general. However, there is little empirical evidence about what constitutes 'green' or 'clean' jobs and growth (WG5), or how to support and balance greener investment and growth within and across regions (WG8).

5.1.2 Space, place, and people

Land is a key asset for the UK on which competing demands are made. Balancing transport, agricultural, and housing functions with the need to provide public spaces and meet climate and biodiversity commitments is a significant and complex policy challenge. Current key questions include how to integrate food production with other key land use demands (renewable energy, agro-forestry, housing) (WG6); the impact of COVID-19 on supply chains; consumption and donation behaviour patterns; and how to design our cities and urban spaces to be healthier places to live and work in (WG8), which could include everything from research into innovative transport solutions to greater evaluation of existing urban infrastructure and cultural or economic stimulus packages. Working groups also identified the need for multidisciplinary research in this area, such as developing new approaches to the psychology of people in space and their interactions as a complete multidisciplinary concept (WG7).

5.1.3 Skills, training, and education to support net-zero

Research on provision of training and skills, including re-skilling, was identified as a key contribution to creating a greener economic environment. Several groups identified opportunities for research into educational and training interventions to support such a shift, including roles for universities (WG5), and local community-led organisations (WG6) in supporting local, sustainable economic growth.

5.1.4 Changing travel technologies and behaviours

Groups identified commuting and other travel behaviours as key opportunities to influence carbon emissions. A holistic approach to understanding travel needs and practices will assist future investment decisions. Research into key sources of carbon emissions (multi-mode transport hubs, charging infrastructure via renewable energy sources such as hydrogen and subsidy schemes, and new techno-economic and environmental policies to implement new decarbonising transportation) could be used to inform future intervention (WG5 and WG7).

5.1.5 Decarbonisation

Finally, decarbonisation was identified as an important way to address net zero commitments. Suggestions for future research included exploring urbanistic solutions to free up urban land for green space; further research into the electrification of transport, charging infrastructure, batteries and aviation; examining behaviours around changing work and consumption patterns and their effects on transport systems within cities; and studying the most efficient ways to decarbonise existing housing stock, improving construction practices, and/or incentivising uptake of new and emerging technologies amongst householders and businesses (WG5).

5.2 Regional, national and international trade and work

Several working groups considered ARIs relating to regional disparities in terms of economic productivity, growth, and impact of COVID-19 on trade, employment, and labour market participation. Groups recognised the huge economic impact of COVID-19 on countries and populations, and have raised important questions from provision of public goods and services during pandemics, supply chain management, international trade agreements and blocs (WG9), to the potential role of employers and educational and training providers in mitigating effects on particularly the more vulnerable populations (WG1,7,8). Overall, groups felt there was scope for significant coordination of research in this area, examining and synthesising existing research as well as investing in the gaps below. High-level programmes are proposed to explore the structural causes and drivers of low productivity and economic growth. This should include: i) Labour market: creating the demand for skills and education; quality of work, pay and productivity; demographic change; inequality and inclusivity, particularly gender equality; ii) Institutions: what role do institutions national, regional and local play in supporting productivity and growth; and (iii) Role of public sector (including education and health), non-governmental organisations (NGOs), civic, voluntary, community (WG8). This should also include data collection on the post- COVID-19 recovery of high-streets in towns compared to large cities (WG8).

5.2.1 Place-based inequalities and the labour market

It was widely recognised that COVID-19 was likely to disrupt the labour market for some time, and that the impact of these disruptions would be felt differently by different regions, countries, and groups. Groups recommended research into these impacts, and into potential regulatory and legislative interventions to mitigate them. Local government was recognised as a key actor with the ability to influence local outcomes. Groups called for research into the role of local government effective social care which delivers improved outcomes, including how to better share resources across agencies, and how to deploy public servants more flexibly in crises (WG2); and whether collaborations with local universities and research centres could aid in solving local problems such as homelessness.

5.2.2 Human-animal interaction and the illegal wildlife trade

The zoonotic nature of COVID-19 and investigation into suppression of zoonotic transfer are considered by Science Advisory Group for Emergencies (SAGE), not by this programme of work. However, several ARIs relating to the illegal wildlife trade stimulated discussion around the connections between human-animal interactions and the potential role of wildlife trade regulation in minimising future threats. Illegal wildlife trade is often carried out by networks engaged in other forms of crime including environmental crime, and the crime, security and biosecurity implications should be investigated (WG9).

5.2.3 Interventions to promote regional economic growth and productivity

Working groups recognised that current economic models of how regional economies contribute to macroeconomic outcomes are not well-developed (WG8). The theoretical paucity in this area means that understanding of how macroeconomy influences regional economic issues is limited. This can be seen, for instance, in our limited grasp on questions such as how supply chains are structured geographically to encourage economic diversity locally and regionally, and questions of equity/distribution (WG5). It also means that there is a knowledge gap when designing evaluations or impact assessments on the effect of the pandemic on the economies and productivity of cities and regions, coastal/rural and "deprived" areas (WG2). This gap will also affect further analysis on how to mitigate these effects and prioritise these communities, by, e.g., resourcing capabilities from local authorities or unlocking investment that prioritises vulnerable communities and green recovery (WG5). There was a recognition of the need to consider questions of poverty and inclusion in the push for innovations and planning for transition (WG5). Specific proposals include reviewing UK and international programmes that encourage enhanced productivity (e.g. through the adoption of new technologies or improved management practices) (WG8).

5.2.4 The impact of COVID-19 on working patterns

Groups recognised that COVID-19 had disrupted normal working patterns, labour market trends and impacts on employees, both nationally and internationally. The main evidence gap was around employers lacking robust evidence on how best to support employees. Large-scale research programmes into the development of systemic, ambitious policy solutions that draw out and connect the future of work trends (such as shorter working weeks, universal income, labour market initiatives, automation) (WG8) and establishment of criteria for labour market progress beyond pay, particularly focusing on vulnerable groups (those with caring responsibilities or health issues; black and minority ethnic groups; women; young people; older workers; and those on Universal Credit (WG7)) may be particularly valuable. Evaluative research into access to, and effects of, adjustments for flexible working for those with reduced access to flexible working (lower-skilled, self-employed) should be considered. (WG7)

5.2.5 Health and education employment interventions to mitigate the effects of COVID-19

Several groups called for research into how the pandemic could be best mitigated in the workplace, particularly focusing on employer provision of support and health and safety issues. Educational and skills-based training are valuable avenues to support reduction in inequalities, stimulate regional economic growth, and protect communities from the effects of COVID-19.

5.3 Effect of COVID-19 on social and health inequalities

The social and health impact of COVID-19 in the short term is beginning to be well-characterised, but how the economic and societal changes will affect the longer-term effects on the social determinants of health is less clear. Groups proposed interventions and investigations into the impacts of COVID-19 on inequalities, noted key vulnerable groups, and identified data-related needs. A program to consider the systemic impacts of COVID-19 on interrelated facets of human development, social and policy responses was recommended by several groups. Discussions of inequalities – focusing primarily on the health and social disparities, although as noted above several groups also noted the links to economic and productivity inequities – included assessment of current and potential use of data, impact on specific groups and interventions to mitigate this, and social cohesion.

5.3.1 Data and assessment of impact on inequalities

Several groups called for better data collection in general for vulnerable/minority populations (WG1,7, and 2), particularly more fine-grained recording of ethnicity data (e.g. in death registrations, benefit support applications) and linkage to other factors such as age, occupation, housing (WG1) and the impacts of COVID-19 on socioeconomic inequalities on the wider determinants of health and their impacts on health outcomes during the pandemic. Some research is being commissioned by the Health Foundation (WG2).

5.3.2 Impact on vulnerable groups, and interventions to mitigate these effects

Groups recognised that COVID-19 was likely to disproportionately affect the most vulnerable in society, in multiple ways. Children and young people are likely to be negatively affected. Research into the impact of COVID-19 and school closures on childhood development, including cognitive, social and emotional development in the short- and long-terms was considered important (WG2), as was study of the long-term impact of COVID-19 on the job prospects of young people, including the most disadvantaged (WG8). WG4 identified a set of projects looking at vulnerability and crime, including changing offender profiles, and the direct and indirect impacts of COVID-19 on crime particularly focusing on financial stress, inequality, relationship breakdowns, changing technology use, and the disproportionate impacts on vulnerable, minority and disadvantaged groups. Proposed intervention research included those aiming to reduce homelessness (WG1), occupational health reform (WG7), and investigation of mechanisms to reduce spatial and social inequalities in terms of land use (WG6).

5.3.3 Social cohesion

Groups recognised that trust and social cohesion were important aspects of managing the pandemic, affecting adherence to rules and underpinning effectiveness of communication from government and authorities. Groups recommended research into which groups are mobilising to create and amplify social division (WG1), into the role of misinformation (WG4) and interventions to mitigate against these activities were considered particularly important.

5.4 Delivery and support of more effective public services

COVID-19 has created unprecedented demand for public services while hindering their easy delivery and support. Groups raised questions about effectiveness of services and the impact on populations, the ways in which services are adapting including greater use of technology, the impact on workforce and recruitment, and on potential for partnership working with the private and voluntary sectors and the public. Several groups noted that the effectiveness of public services had been diminished or changed by the pandemic and highlighted the need for an assessment of these impacts; that services were adapting to the pandemic including by adopting online and technology-enabled service delivery modes; and that partnership working between public and private/voluntary sector organisations and the public required more investigation to optimise.

5.4.1 Assessing the effectiveness of public services

Evaluation and replication studies into the effectiveness of public services was recommended by several groups. Specific interventions which groups identified priorities included homelessness reduction (WG1), those targeting vulnerable populations, particularly looked-after children and refugees (WG1) and those at risk of (re-)offending (WG4).

5.4.2 How services have adapted to COVID-19

There is a need to evaluate how services have adapted to the COVID-19 crisis. Co-ordinated evaluation across services and interventions would enable commissioners and decision-makers to assess the

impact of COVID-related adaptation on children and services users. Research should investigate the journeys of service users from identification to referral and support; analysis of how service delivery for specific vulnerable groups has changed during this pandemic (WG1), the role of local government in developing, delivering and evaluating an integrated and holistic service offer to (different groups of) vulnerable people (WG2), and the operational aspects and short- and long-term outcomes associated with colocation of multiple services (WG8). An holistic evaluation would also include development of a common tool for high-quality data for assessing local system delivery and shared outcomes and outcome frameworks to assess impact.

5.4.3 Technology-enabled service delivery

As public services have become affected by COVID-19, there has been an acceleration of the trend towards digitalised and technology-enabled services, from online learning in schools to intervention delivery to prevent crime. Groups recommended research to better understand the positives, negatives and potential for widening inequalities around the use of tech-enabled and digital service delivery. For example, researching how to keep young people involved with digital services (WG1), and the impact of the changes on access to, and quality of, adapted/digital and hybrid provision of services to children and families (focussing especially on the complex and interacting web of support offered) (WG2).

5.4.4 Public service workforce development and recruitment

The COVID-19 pandemic has exacerbated existing workforce challenges such as under-recruitment into key sectors and workforce gaps due to sickness absences. Research is needed into how to better recruit and retain staff into critical roles, particularly around the role of training. In addition, groups recognised that there was an opportunity to improve collaboration and inter-agency response / service delivery. Research may identify characteristics of a specific recruitment strategy within an integrated approach to social care reform, recognising the need for a sustainable migration strategy, and identify exemplars of best practice to inform a template/toolkit of shared resources for service partners (WG2).

5.4.5 Partnership working to develop and deliver services

Partnership working with the private and voluntary sectors was highlighted by groups as a potential mechanism to cover gaps in provision by the public sector. Several groups noted that co-design and co-delivery of services with local communities may be a way to improve service effectiveness. Attention should also be given to how best to empower local communities, focussing on strengthening community networks, allowing service users to develop their own solutions, and the necessary changes to local government and providers (WG1,2).

5.5 Data infrastructure, access and investment

Many funders, researchers and officials are engaged in thinking through how to optimise collection and use of data. Data platforms, sharing and ethics are concerns for many organisations currently, reflected in the very broad set of ARIs and research proposals relating to data. For a broader and more detailed summary of the ARIs relating to data and evaluation please see our summary paper[1]. Here, we summarise the research proposals pertaining to data infrastructure, access and investment which were identified solely through the Rebuilding a Resilient Britain programme.

[1] Boaz A, Oliver K, Cuccato G, Dashwood C. (2021) Rebuilding a Resilient Britain: Data and Evaluation Areas of Research Interest across Government: ARI Report. https://www.gov.uk/government/publications/data-and-evaluation-areas-of-research-interest-across-government

5.5.1 Access to data and data platforms

Several groups identified provision of more accessible and open data platforms as a key facilitator of improved services, policies, and research. Improved data sharing through platforms, and other collaborative tools and working practices should be a priority. For example, developing systems to enable better data sharing across local and national government, social care and healthcare providers, and researchers would facilitate collaboration. This could be through creation of open data platforms, secure facilities, or safe havens (e.g. ADR-UK) to reduce the time spent in data collection, cleaning, and storage phases of projects, and they allow for easier entry for topic expert (WG4). To maximise exploitation of existing evidence and data, creating a structured way for academia/industry to engage, extend current knowledge, and work jointly toward a concrete outcome. Data hubs distributed across the country, for example, could work with local authorities, reduce duplication and increase national synergies (WG4).

5.5.2 Strategic investment into new data collection and analytical technologies

Several groups recommended development of a protocol / ethical framework around collection of new data and data infrastructure creation. WG5 pointed out that the creation of new data infrastructures carries a carbon cost, so a conservative approach to minimise carbon emissions and maximise efficiencies should be taken. Investments should be made with the overall aim of improving data quality, and by careful characterisation of where new data is required. Groups identified the need for better data collection which minimises bias, improves consistency and detail for data collection around vulnerable populations and better enable policy delivery, design and evaluation. Poor data collection especially around vulnerable population means it is difficult to design effective interventions. Understanding the sources of bias in existing datasets will require both domain experts who know how data is collected and data scientist. Reducing these biases will require research into the sources of these biases, and development of ethical methods to reduce them, as well as improved longitudinal data systems and infrastructure (WG1, 4).

5.6 Evidence use in policy and practice

Finally, all groups highlighted ways in which the COVID-19 crisis had illuminated opportunities to improve how evidence is made and used for policy and practice. This included direct opportunities to evaluate and learn more effectively about current policies and interventions, learning about the science advisory system and the research-policy interface more directly, and the potential for applying systems approaches for research and policy development.

5.6.1 Using data, research and evaluation to develop and support services and policies

Improving use of data and evidence in service and policy development and delivery should be a key area for future research. Key principles were highlighted by groups around research practices which would support evidence use: co-designing research, improved evaluation, and evidence synthesis and implementation research. Co-designing research enquiries with a diverse set of stakeholders, in order to respond to the needs of frontline practitioners, service providers, parents and communities, and work together to address the most pressing concerns, and bring this research to bear on policymaking and service design (WG2). Evaluation, replication, scale up and roll out should all be considered as a standard part of new intervention funding (WG4), particularly considering how interventions may interact with one another (WG8). Evidence synthesis and implementation research to mobilise robust evidence about interventions should also be funded, in order to translate evidence into practice (WG4).

In addition, there was recognition of the missed opportunity to develop data-informed services, by more effectively exploiting existing datasets and databases. Across several groups was the recommendation to improved use of data to design and evaluate interventions, policies and services. A more strategic approach to designing and collecting data was recommended, to move from asking "what can we do with existing data" to "what data do we need to do what we want" (WG4). In order to do this, the quality and robustness of data and infrastructure needs to be improved (see section on Data).

5.6.2 Strengthening the research-policy system and interfaces

Key research gaps in this area include exploring how different disciplinary thinking can contribute to policy development and science advice (WG3,8,5). Investigations could also include comparison of disciplinary diversity in government science advice systems, focusing on how evidence is found and applied within science advice systems, and how this relates to the policy use of such evidence and advice. This may help understand how science advisory systems can be more effective through increased understanding of how public and media frame narratives and use evidence (WG3). There is also a role for traditional research evaluation research, such as understanding how research (including review work) is commissioned, published, communicated, and evaluated/synthesised (WG3).

5.6.3 Systems approaches for research and policy development

Groups identified a particular opportunity to explore the value of systems thinking in policy development and evidence use. By taking a systems lens, and understanding the system dynamics, time delays and feedback loops to identify high-impact points of leverage or influence, groups felt it may be possible to do more creative and effective policy delivery (WG2). Similarly, a study on the possibilities presented using systems approaches in policy formation, in particular how systems approaches can usefully add to the evidence base (including the type of evidence, alongside other approaches such as longitudinal studies and case studies) would support the continuous improvement of the quality, diversity and relevance of evidence. It would also provide a valuable reflection on the interconnections between different sources of expertise and policy (WG3).

6. Knowledge Exchange opportunities

Groups identified mature and coherent evidence bases relevant to ARIs or groups of ARIs. These are noted here as potential opportunities for implementation, dissemination, or knowledge-sharing opportunities such as workshops, roundtables, or other dialogues. These include:

- Ensuring relevant departments are aware of the UKRI report on three crime areas where investment is vital (WG4)
- Collating an overview of current funding (from UKRI, the Industrial Strategy Challenge Fund, HSE COVID-19 Competition of Ideas) around strategic areas for open access
- To maximise exploitation of existing evidence and data, creating a structured way for academia/industry to engage, extend current knowledge, and work jointly toward a concrete outcome. Data hubs distributed across the country, for example, could work with local authorities, reduce duplication and increase national synergies
- Open data platforms to support knowledge sharing (e.g., data, methods, policies) across stakeholders, as well as provide for real-time monitoring and evaluation, and crime prediction
- Publication of usage data of electric car charging infrastructure to enable better roll-out
- Investing in 'Test Beds': Initiatives designed to aid in data/AI innovation adoption for Industry, such as the IROR programme with the Hartree Centre and IBM Research have helped develop

reusable digital assets and software to solve a range of industry challenges from life science to aerospace boosting productivity and could be developed with further investment into aiding co-development of AI solutions focused on Industry need. Test beds may also play a key role in helping innovators and adopters understand and evaluate case uses for specific sectors such as Health and social care.

- Workshops on preventing zoonotic disease transmission, bringing together experts in animal studies such as philosophers, political theorists, human geographers and sociologists with key stakeholders such as farmers, wildlife traders, wildlife consumers, health professionals, food justice activists and climate change activists (WG9)
- Creation of a platform to bring together stakeholders, is required for incubating and sustaining transition of the kind suggested by groups where all stakeholders in Modern Methods of Construction (MMC) can effectively interact and exchange good practice. It will take a concerted effort to encourage uptake of new and innovative technology by UK construction firms despite the obvious benefits of doing so. Market conditions and demands for MMC housing coupled with incentives and cultural shifts for this to happen.

7. Cross-departmental dialogue opportunities

Several groups identified opportunities for departments to work more effectively together on a shared problem or policy area, by bringing together stakeholders across research, funding and policy organisations to create dialogue around these topics. Further examples may be identified in the original reports. Examples of dialogue topics suggested by the groups include:

7.1 Transport and work (BEIS, DWP, DfT, WG7, WG8)

Work, commuting and health are linked in multiple ways. DfT, DWP and BEIS policy teams are considering how to redesign public transport systems with the aims of reducing carbon emissions, enabling flexible working, and supporting social distancing. This was also seen as an opportunity to address disability needs, and to address national priorities around healthy ageing and work (employment, markets, innovations and retirement).

7.2 Economy, biodiversity and carbon emissions (Defra, DIT, BEIS; WG5, WG6, WG9)

There is an opportunity to link ongoing discussions about 'green recovery', energy transitions, multi-functional land use, and biodiversity. COVID-19 and COP26 offer a chance to reframe standard policy narratives around what 'recovery' means – for example in terms of how economies function, how investment might shift as what constitutes an 'asset' is recalibrated, and in relation to changing power dynamics between different sectors and regions of the economy. Alongside the need for economic rejuvenation and levelling-up, discussions about how to increase UK self-sufficiency in food in the context of Brexit, the possibilities of delivering 'biodiversity net gain', and balancing a clean and fair energy transition are ongoing.

7.3 Changing international agreements (FCDO, DIT, Defra; WG5, WG9)

Brexit, COVID-19 and the withdrawal of the US from international agreements are sources of tension for discussions around ambitious climate and biodiversity action, the availability of international finance, and new business and legal regulatory frameworks arising. There may be opportunities to align discussions and reframe policy narratives.

7.4 Preventing crime (BEIS, DCMS, DfE, HO; WG1,2,4)

Several departments contribute to crime-prevention policies. By linking these discussions, there is an opportunity to create a cross-departmental approach to limiting criminal opportunity in priority areas.

7.5 Decarbonisation (DfT, MCHGL; WG5, WG8)

Reaching a holistic approach to policy formulation for successful decarbonisation of UK housing stock. This will require combining policy mixes contextualised in local specificities or under different scenarios. How these policies may combine and under which scenario to deliver quality lower-carbon housing must be examined and fed back into policy formulation.

8. Annex 1: List of Research Projects arranged by Theme

1. Net zero and economic growth	
Sustainable green economic recovery	• Development of an international system for tracking migration (legal and illegal, intra- and inter-national) using different country's Boarder Force data, satellite data, and AI to quantify and assess the impact of COVID-19 on fossil-fuel demand and supply and the transition to renewable energy sources (WG9). • A systematic mapping of the nature and consequences of different forms of 'green recovery' (and which kinds of recovery and what forms of green are involved) would be useful in understanding how far these are likely to drive more ambitions for or conflicts between climate and biodiversity goals (WG5). • Further investigation should be undertaken into which areas attract cross-sector investments (e.g. across food, energy, and water nexus), the challenges / implications of these investments, and what this means for policy coordination and industrial and infrastructural planning (WG5). • The impact of COVID-19 on oil, and its implications for the energy transition are yet to be quantified and assessed. It is proposed that a multidisciplinary network is established (across the fields of law, business, science and engineering) in order to address the above issues and identify the lessons which the energy sector/governments/regulators/stakeholders can draw from the current situation. The network should conduct joint research and communicate their findings/recommendations via academic publications, impact studies or reports (WG9). • A review of the evidence concerning the availability of international/multilateral finance for climate action and how this is changing in the light of COVID-19 (WG5) • An interdisciplinary research program to investigate: How can the international trade regime and UK trade policy be designed to support efforts to decarbonise the global economy and protect vital ecosystems (WG9) • Evaluation of the impact of 'Public realm' investments (e.g. Towns Fund and Future High Street Fund) and interventions designed to improve the desirability of places to residents or businesses. Evidence of the impact of such interventions on local outcomes – from attracting more affluent residents, workers and shoppers, to improving outcomes for existing residents - is extremely limited. These evaluations should be undertaken in collaboration local decision-making to ensure impacts of interest to them are captured (WG8) • Analysis of the impacts of COVID-10 on affordability of energy and importance of energy efficient homes when we are spending more time at home; and, more importantly, taking into account the distribution of ecological goods in homes, buildings and neighbourhoods. (WG5)
Space, place, and people	• An interdisciplinary research program into how multinational corporations can be taxed and regulated at international level, through domestic law and regulation, or through public purchasing policies to ensure conformity with international and domestic environmental, human rights and labour protection goals; Exploring how human rights could provide a framework for thinking about responding to poverty, inequality and the climate emergency post-COVID (WG9) • A systematic mapping of (a) how far the commitments made by Parties to the United Nations Framework Convention on Climate Change in their Nationally Determined Contributions (NDCs) might be affected by COVID-19 and its economic effects (e.g. on the coal sector or on key economic sectors where 'foot dragging' on previous commitments is emerging); (b) how far commitments being made for a (green) recovery could either support or limit the stated ambitions of NDCs; and additional analysis of shifts in domestic economic and environmental priorities and potential realignments of commitments towards climate action (WG5)

	• A systematic overview of how new models of land ownership, governance and investment can be developed which support forms of land-use which are able to generate multi-functional outcomes (e.g. provide housing and ecosystem services; generate electricity and enable recreation (WG5) • Evaluation of investment in cultural events and cultural infrastructure such as new museums, and their impact on economic outcomes. Cultural events and infrastructure are funded to deliver a wide range of social benefits, but there is limited evidence about their local *economic* benefits is limited. As local areas decide which types of investment will deliver economic recovery and growth, this evidence will be essential (WG8) • Evaluating the impact of transport infrastructure projects (e.g. congestion-easing road projects) on regional inequalities. As the government looks to invest more in 'levelling up', it will be increasingly important to understand whether such projects do deliver growth (WG8) • Investigation of the role of newly proposed planning reforms and their alignment with new design guidance and proposed regulatory measures under the Environment Bill, and methods to ensure growth areas are not bypassing a duty to green space provision in cities and its health and wellbeing-links to economic productivity. Research in this area should aim to ensure a consistency of policy focus, avoiding short term policy measure or experimental initiatives' short term and growing trust and stability in the business community – especially SMEs. (WG5)
Skills, training and education to support net-zero	• A programme of research investigating which aspects of the economy are most exposed to the processes of decarbonisation, including: increased / decreased demand of skills, sector differences (degree of exposure not sufficiently explored), shift to clean energy jobs (WG5) • Investigation into re- and re-skilling particularly around the role of university apprenticeship schemes and vocational education, identifying priorities for technical education and vocational apprenticeships, and linking innovation zones to investment in re- and up-skilling. (WG5)
Changing travel technologies and behaviours	• Identify key sources of carbon emissions (multi-mode transport hubs, charging infrastructure via renewable energy sources such as hydrogen) to inform future intervention such as new techno-economic or environmental policies (WG5) • Use of AI to identify and design candidate low-carbon technologies enabling quicker adoption of low carbon technologies. (WG5) • Assessing the impact of COVID-19 on travel and commuting to enable social distancing. This may include rethinking the design of public spaces (particularly offices and transport) to enable lower occupancy and reduce the risk of COVID-19 transmission. This might include assessment of low-carbon forms of transport (e.g. e-scooters) (WG7)
Decarbonisation	• A programme of research investigating which aspects of the economy are most exposed to the processes of decarbonisation. Some resource-intensive forms of economic activities may no longer be viable, in the wake of re-occurring COVID-19 related restrictions on the movement of people, goods and services. Should we recognise a Schumpeterian opportunity for 'creative destruction' and support those affected to transition to something new and better, which will need a spending-led recovery that incentivises business/industries to let go and build something better? Again, such an approach requires an equity-centred orientation considering existing structural inequalities between the North and South (England), and between industry sectors most likely to be affected by shifts to a 'cleaner' economy. In particular, investigation would be required into: Increased / decreased demand of skills, sector differences (degree of exposure not sufficiently explored), this shift in jobs in dirty energy to clean energy jobs
2. Regional, national and international trade and work	
Place-based inequalities and	• Research into the regional disparities in demand for labour, and consequently how to reduce youth unemployment in a labour market which is persistently weak and only has few job opportunities (WG8)

the labour market	• How to develop an effective approach to place-based working, to learn the lessons about more effective central-local joint working for future pandemics. In particular, research may focus on what improvements place-based working and commissioning may bring in terms of cost-effectiveness, and what oversight and accountability mechanisms and outcome measures are best suited to place-based working (WG2) • Improved understanding of the impacts of economic shocks and public health restrictions on global supply chains, including those that provide goods to UK consumers. Impacts are likely to be felt on workers, gender inequities, wealth inequity, UK firms, and UK consumers. There is an urgent need to better understand these multi-faceted and interlocking impacts, and how they are repatterning global supply chains and trade (WG9) • There is a need to understand and compare (e.g. across county, industry, portion of the supply chain, and type of worker) how COVID-19 is impacting the patterns of modern slavery and child labour within supply chains providing goods to UK consumers. Has the pandemic, and government and company responses to it, altered patterns of demand for forced labour in supply chains? How do producer government responses (e.g. lockdown, stimulus spending) impact workers, suppliers, and the status of production (including sustainability and stability of supply to the UK)? Is the effectiveness of supply chain governance (e.g. ethical auditing, certification, due diligence legislation like the UK Modern Slavery Act) being transformed amidst the pandemic (WG9) • A 2-3-year research project to track the actions taken by companies, including SMEs, to the pandemic, in relation to their national and international supply chains. This could be viewed in relation to sectors, geographic locations, and conflict issues in their supply chains. Innovative practice can be examined to gauge how companies are responding to the crisis, and whether such innovations might map well onto the post-COVID-19 commercial landscape (see https://www.nottingham.ac.uk/research/groups/commercial-law-centre/COVID-19-research.aspx). (WG9) • Research assessing the viability and potential of EU policies for confronting the crisis (e.g. green deal, etc.); analysing the political reactions to EU/eurozone responses including research on domestic politics and public opinion in different member states; research on potential 'disintegration' of EU in view of this latest crisis; considering the position of the EU/eurozone in broader geopolitical context. (WG9) • A research project (1-2 years) to analyse the impact on companies of legislation and practices by UK and other comparable governments in their regulatory responses to the pandemic. This would include empirical research of corporate responses to these changes and compare the UK position to that in other jurisdictions and international standards. This comparative and international research would investigate the application of any new legislation, case law, treaty or other regime that will emerge post-Brexit and identify gaps and areas for improvement. (WG9) • A 2-3-year research project to track the impact of the pandemic on the volume and nature of corporate insolvencies in the UK. It will collect and analyse data on corporate insolvencies available through the Companies House Beta Service. Reports filed with the service will assist in determining the extent to which the new insolvency/rescue measures are being used and their effectiveness in the short and medium term. Sectoral impact can be illustrated, as can the extent to which employment is lost as a result of corporate insolvencies. Further, such research can examine how insolvency professionals use existing insolvency strategies and the COVID-19-generated government initiatives during the pandemic, and to what effect. Innovative practices can be examined to gauge how practitioners are responding to the crisis, and whether such innovations might map well onto the post- COVID-19 commercial landscape (see https://www.nottingham.ac.uk/research/groups/commercial-law-centre/COVID-19-research.aspx). (WG9) • Research in cross-border insolvency would investigate the application of any new law, treaty or other regime that will emerge post Brexit to replace the EU insolvency

	regulation, to identify gaps and areas for improvement against the backdrop of the global regime and the new model laws. (WG9) • Investigation into the compatibility of COVID-19 related restrictions with human rights law obligations or with other obligations under international law. A 2-year project could track the cases in the UK and elsewhere to consider what human rights issues are raised and the response of courts, governments and business to these cases. This will include a consideration of different human rights affected, the claimants, respondents, and the court decisions. It will also track the impact of these decisions. This will assist in gauging the likely effect of human rights issues, especially when raised in courts, on COVID-19 restrictions, and policies going forward (see https://www.nottingham.ac.uk/hrlc/abouthrlc/introduction.aspx) (WG9)
Human-animal interaction and the illegal wildlife trade	• Research collaborations bringing together researchers focused on public health, traditional Asian medicine and wildlife trade to understand the nuances of demand for wildlife products for medicinal use, and in particular whether COVID-19 has prompted a turn away from traditional medicines, increased demand or triggered a switch away from certain animal products but towards others, focusing on: the different profiles of consumer demand in Asia and Asian diasporas; the differences between and within countries; drivers of successes in changing consumer behaviour (WG9) • A multidisciplinary research programme to develop understandings of government responses and public attitudes to illegal wildlife trade, as well as legal wildlife trade since the two are bound together, in particular to: Seek the perspectives of relevant stakeholders e.g. animal welfare campaigners, conservation NGOs, wildlife traders, transport and shipping companies, government ministries et; Differentiate between attitudes to health and to economic impacts; differentiate between countries and regions (WG9) • Assessment of the actual and potential social and ecological justice implications of shifts in attitudes of governments and publics to the illegal wildlife trade, co-produced with wildlife dependent communities. These questions are central to the concerns of political ecologists. The rapid development of new regulations, including bans on wildlife trade could be undermining the food security of marginalised communities in the global South (especially Sub-Saharan Africa). How are such new regulations and bans implemented? Are they accompanied (especially in Africa) with militarisation, enhanced forms of law enforcement that could lead to human rights abuses (as evidenced in other conservation enforcement initiatives)? Is there any weight to claims that the collapse in tourism as a result of COVID-19 has led to increased poaching rates? (WG9) • Expert panels and research programmes that draw on the expertise of critical criminology, law geography, politics, and international relations to investigate how COVID-19 and the illegal wildlife trade intersects with wider forms of environmental crime. What are the crime, security and biosecurity implications? (WG9) • Interdisciplinary research into the social, political, and ethical dimensions of increasing reliance on surveillance technology and artificial intelligence for tracking, intercepting and monitoring illegal wildlife trade (WG9)
Interventions to promote regional economic growth and productivity	• A comprehensive review of Business Basics Programme (BEIS) (piloting innovative ways of encouraging firms to improve their productivity and use interventions aiming at technology adoption and improving management practices) (WG8) • The role of universities in supporting local regeneration through place-based industrial strategies, such as through Local Enterprise Partnerships. (WG8) • Replication studies and/or randomised controlled trial of productivity interventions to assess benefits among larger business communities. (WG8) • A 'living laboratory initiative' (shaped to the need of specific sectors), to aid entrepreneurs and innovators to co-design and evaluate in real life plug-and-play environments and scale innovation that is being asked for from specific regions. These interfaces could be supported by adopting cluster models to support and de-risk collaboration by convening partners (WG8) • An evaluation of the recent Enterprise Zones and freeport models would be both possible and particularly informative if the relevant data could be made available. (WG8.

	• A review of the cost-effectiveness of business advice and support interventions approaches, particularly as government looks to support businesses through the post-COVID-19 recovery (WG8). • Evaluation of local procurement policies which prioritise 'retaining' major local spending within a particular area, particularly on economic outcomes (WG8). • Evaluating the displacement effects of many interventions. Understanding whether jobs have been created by an intervention or simply moved from one place to another, for example, is essential for HMG when assessing whether to invest in similar projects in future (WG8). • A research project (2-3 years) can focus on SMEs to ascertain which of the existing and new tools are mostly used by small businesses, and whether such usage leads to optimal outcomes. A comparative analysis would also identify areas where the regime could be enhanced. It will also investigate the UK regime against the backdrop of the forthcoming international standards on micro and small enterprise insolvency (UNCITRAL/World Bank) (WG9). • Monitoring of the effectiveness of government measures to avoid insolvency and support COVID-19 recovery, especially around how the legal regime impacts small businesses (data on corporate insolvencies available through the Companies House Beta Service) (WG9).
The impact of COVID-19 on working patterns	• A comprehensive sense of the access to, and effects of adjustments for flexible working that do get made or evaluations of their success from an employee or employer perspective. Particular groups (lower-skilled, self-employed) have reduced access to flexible working and effects on these groups should be considered. (WG7). • Studying the effects of COVID-19 on working patters in the long-term (currently being done in the short-term through ONS surveys) (WG7). • Research the longer-term impacts of home working, on productivity, health and mental health and team working. This may include assessment of the potential role of occupational health, employers, and vocational support (particularly for vulnerable groups) (WG7). • Evidence on the effects and risks of social distancing on working patterns and practices, including commuting, office layout and travel (WG7).
Health-related employment interventions to mitigate the effects of COVID-19	• Analysis of which practices make the biggest difference to workplace health (WG8). • Research into how workplaces and employers can support those who have no choice but to continue working in poorer health – and ensure that health is not made worse by work they need to finance their living (WG8). • Study into how employers are adapting work for (and supporting the health of) workers with multiple health conditions – and those who may have been impacted by COVID-19 (or are suffering after-effects of the virus); and into how supportive management attitudes and behaviours can be promoted (WG8). • Evidence collation on the interventions employers are currently offering to workers with health conditions (including but not limited to COVID-19) (WG8). • Study into the changing work patterns due to COVID-19 (more gig working, etc.) and the effects on the health and safety of employees. This may include studies of employers' capacity and capabilities of managing remote workers and impact on their health and safety; the challenge of ensuring workers are appropriately skilled and supervised; and workers who change jobs frequently (WG8). • Evaluating the (cost) effectiveness of mental-physical health adjustments that employers make for employees (such as flexible working) (WG7). • Research of experiences of adjustments and accommodations among employees with disabilities and health conditions and more rigorous evaluations of their effectiveness and cost effectiveness with a view to helping overcome barriers to implementation, including long-term trends in health and disabilities (WG7). • Investigation into how universities could meet the skills needs of local employers (e.g. apprenticeships) (WG5) and in terms of supporting regeneration and skills, including degree-level apprenticeships, the involvement of local employers on advisory boards for such schemes (WG8)

	• Evaluation of employment training particularly in meeting youth underemployment challenges, their capacity to take on apprenticeships, and address underemployment locally. This would ideally use multi-arm randomised controlled trials to compare different delivery models (see evidence summary at https://whatworksgrowth.org/policy-reviews/employment-training) (WG8) • Evaluation of the effectiveness of apprenticeships and traineeships in improving youth employment post- COVID-19, looking particularly at employer capacity to offer apprenticeships over the next 24 months, the incentives offered to employers to recruit trainees and apprenticeships and their effectiveness, the willingness of employers to recruit school-leavers and college-leavers compared with older learners, the impact of the labour market crisis on government receipts from the apprenticeship levy, whether the expansion of traineeships reduces entry-level apprenticeships, demand for T-level qualifications from young people, and whether the Kickstart scheme be targeted effectively at the right young people and employers to generate high quality jobs (WG8). • Effectiveness of work coaches. This includes the extent to which advice reflects: i) knowledge of progression opportunities/job security with specific employers ii) awareness of family circumstances, childcare, housing etc. and iii) available support for in-work progression (WG7).
3. Effect of COVID-19 on social and health inequalities	
Data and assessment of impact on inequalities	Data collection was particularly recommended to focus on: • The reasons for disparities in the impacts of COVID-19 on job prospects and security by age/ethnicity/geography/etc. • Older workers (as well as younger workers) at particular risk of job loss. Research is needed to investigate the reasons for this, and to seek the perspectives of older workers about the impact of COVID-19 on their working lives and plans for retirement (WG7). • The effect of new job creation in certain sectors (self-employment, distribution) and losses in others (financial services, construction, public sector) (WG8).
Impact on vulnerable groups, and interventions to mitigate these effects	• Study of the impact of COVID-19 on childhood development, including cognitive, social and emotional development in the short- and long-terms. Specific outcomes of interest include school readiness, particularly the contribution of social and emotional development, executive function and physical health (WG2). • Research the direct and indirect impacts of COVID-19 on crime particularly focusing on financial stress, inequality, relationship breakdowns, changing technology use, and the disproportionate impacts on vulnerable, minority and disadvantaged groups. This may be achieved by: (1) using existing data systems to identify changes in offending and victimisation and their causes; (2) researching the multi-dimensional nature of inequalities and their role in fuelling crime; (3) shifting from a primary emphasis on youth offending to an age-graded appraisal of offender populations, such as aging populations of repeat service users with complex health needs. This work should coordinate with The National Police Chiefs' Council Operation Talla Recovery and Reform programme (WG4). • Analysis of the offender profile and overlaps with other areas of vulnerability (e.g. health and welfare) (WG4). • Review of the changing patterns of crime (temporal and spatial) by crime seriousness (WG4). • Long-term research into the effects of lockdown school closures on educational outcomes (especially for children in low socioeconomic groups) and the best mitigation strategies (WG8). • Study on the long-term impact of COVID-19 on the job prospects of young people, including the most disadvantaged. This could include short-term primary research with BAME, care-leavers, and other vulnerable groups to: Understand how their experience is similar to and unique from the experience of their less-disadvantaged

	peers; Understand the types and scale of support needed by the most disadvantaged and how best it could be delivered; and longer term studies to understand the wider impact of support to groups that have been particularly affected by the crisis and provide insight on the determinants of successful outcomes (WG8). • Better metrics to quantify the prevalence of household food insecurity. The prevalence of HFI is poorly understood and more research and policy analysis are required to understand and measure this, especially in the light of the impacts of COVID-19 on food poverty and the operation of food banks (WG9). Research proposals focusing on interventions to mitigate social inequalities included: • Exploring the effectiveness of interventions to reduce homelessness, particularly cost-effectiveness and long-term interventions (WG1). • Assessing the impact of these and other interventions particularly on BAME and vulnerable groups (WG1 and 2). • Investigation of mechanisms to reduce spatial and social inequalities in terms of land use (WG6). • Investigation of possible routes to occupational health reform to better support people with physical/mental health conditions, focussing on joining up support from employees, local authorities and healthcare providers. • Identifying triage markers and optimum points of 'early intervention' to inform policy expenditure (through an inequalities lens) (WG4).
Social cohesion	• Research into groups mobilising to create and amplify social division (WG1). • Researching interventions to promote social cohesion as a means of addressing crime like human trafficking and violent extremism (WG4). • Systematic examination of anti-disinformation methods, moving beyond studies of what constitutes disinformation, or blind attempts to build algorithms, in order to develop effective counter-interventions (for example, options to counteract anti-vaccination misinformation) (WG4).
4. Delivery and support of more effective public service	
Assessing the effectiveness of public services	• Collection of quantitative evidence on the effectiveness (cost and long-term impact) of interventions to protect and serve vulnerable populations (WG1). • Effectiveness of interventions to reduce homelessness, particularly cost-effectiveness and long-term interventions (WG1). • Evidence on the most effective interventions (e.g. reconnection interventions, family mediation) to support separated families, especially during COVID-19 (WG1). • Extent, quality, and consistency of support for looked after children, young refugees and others who may be dislocated from family support (WG1). • Research into the link between the quality of prison life and reoffending, particularly on whether improving prison environments and services reduce recidivism (WG4). • Researching cost-effectiveness of peer-to-peer interventions to address crime via education methods as a means of intervention delivery (WG4).
How services have adapted to COVID-19	• Mapping journeys of service users from identification to referral and support; analysis of how service delivery for specific vulnerable groups has changed during this pandemic (e.g. those at risk from domestic violence, rough sleeping and homelessness) (WG1). • Assessing the effectiveness of these changes, and how that knowledge can be used to prepare for future crises by developing service delivery in the rebuilding phase, further utilising data and evidence, and the shift to prevention (WG1). • Explore the role of local government in developing and delivering an integrated and holistic service offer to (different groups of) vulnerable people. An holistic evaluation would also include development of a common tool for high-quality data for assessing local system delivery and shared outcomes and outcome frameworks to assess impact. (WG2).

	• Research into the operational aspects and short- and long-term outcomes associated with colocation of multiple services, such as on the effect of the Youth Hubs model on youth employment (WG8).
Technology-enabled service delivery	• Evidence collection on the into the use of technology and digitalisation (e.g. health apps and gamification) to support health and social care services and improved health outcomes, including the impact of the changes on access to, and quality of, adapted/digital and hybrid provision of services to children and families (focussing especially on the complex and interacting web of support offered (WG2). • Research into how to keep young people engaged with interventions (WG1). • Researching interventions which could promote technical resilience (e,.g. security innovations like car alarms and locking systems) (WG4). • Research on how online vs. offline interventions work in under-researched areas like organised crime and terrorism, particularly given that algorithmic methods appear to be fuelling rather than inhibiting extremism (WG4).
Public service workforce development and recruitment	• Examining the impact of the pandemic on the work force, focussing on wellbeing, virtual working, and career development. Research may identify characteristics of a specific recruitment strategy within an integrated approach to social care reform recognising the need for a sustainable migration strategy, and identify exemplars of best practice to inform a template/toolkit of shared resources for service partners (WG2). • Investigating problems in multi-agency response, including what interventions can be put in place, in what circumstances they work and what are the barriers to joint effective working. In particular, what interventions can be implemented to reduce the reoccurrence of problems in joint incidence management (WG2). • Provision and evaluation of interprofessional and interagency training to monitor and support best practice amongst all professionals involved in the support and protection of vulnerable groups (WG2).
Partnership working to develop and deliver services	• Research efforts should take a structured and rigorous approach to identifying and prioritising research needs, and co-designing research enquiries with a diverse set of stakeholders to the needs of frontline practitioners, service providers, parents and communities, and work together to address the most pressing concerns, and bring this research to bear on policymaking and service design. (WG2) (See more below on **Error! Reference source not found.**) • Investigation into how best to empower local communities, focussing on strengthening community networks, allowing service users to develop their own solutions, and the necessary changes to local government and providers. (WG2). This may include locally tailored engagement with BAME communities to identify local solutions to reduce COVID-19 and wider inequalities (WG1). • Research into the resources and structures needed for the voluntary sector to cover gaps in social care (WG1). • Research into how local communities can prevent individuals from becoming vulnerable, e.g. providing opportunities for engagement in the arts (WG1). • Methods to reassure and encourage vulnerable families to access health and education services (WG1).
5. Data infrastructure, access and investment	
Access to data and data platforms	• Exploring the ethical sharing of data across services through the creation of standards and platforms. • Existing data could be repurposed for carbon monitoring, by releasing it from the public sector and elsewhere such as Smart Meters (WG5). • Combine multiple sources of data: Combining data from multiple sources can inform our understanding of emissions, for example, satellite data, on-the-ground measurements, "smart asset" data, and potentially via crowdsourcing (WG5).

	• Build capacity in existing data infrastructures: The UK has established high-quality data repositories, such as the Met Office Informatics Lab, and the JASMIN facility. These can be exploited by researchers collaborating on models alongside curated data (WG5). • Supporting managers and practitioners in children's services to develop better skills around generating and using research and data, to produce better tools and guidance around evidence use (WG2).
Strategic investment into new data collection and analytical technologies	• New data collection into productivity (WG5,8) migration management and how linked to pandemic management (WG9), and enabling easier access and better sharing of emissions data through the creation of common formats and central data repositories (WG5). • Use of AI to identify and design candidate low-carbon technologies enabling quicker adoption of low carbon technologies (WG5). • A programme of work into Cyber-Physical systems, combining physical monitoring and intervention with large-scale intelligent computing, in particular focusing on AI, visualisations, sensor technologies and edge computing, decentralised applications enabled by blockchain, digital twins and quantum computing (WG5). • Aligning diffusion, regulatory expertise, ethics and human rights issues keeps track with technology growth particularly as we edge towards quantum computing (WG8). • Collection of quantitative evidence on the effectiveness (cost and long-term impact) of interventions to protect and serve vulnerable populations (WG1). • More fine-grained recording of ethnicity data (e.g. in death registrations, benefit support applications) and linkage to other factors e.g. age, occupation, housing (WG1). • Better local data infrastructures to enable evaluation of local authority cohesion strategies (WG1). • Development of systems to enable better data sharing by local and national government, social care and healthcare providers and researchers (WG1).
6. Evidence use in policy and practice	
Using data, research and evaluation to develop and support services and policies	• A study of the effects of lockdown (national and local) on the environment (carbon emissions, air/noise/light pollution, ecology) to inform future strategies (WG5) • Identify key sources of carbon emissions (multi-mode transport hubs, charging infrastructure via renewable energy sources such as hydrogen and subsidy schemes, and new techno-economic and environmental policies to implement new decarbonising transportation) to inform future intervention (WG5). • Considering the policy interventions that can be created by bringing together a wealth of ONS data on wellbeing (WG3). • Feasibility, willingness and ability of universities and research centres to directly carry out research which addresses problems in the local area with collaboration with local governments, service providers and other stakeholders. For example, when addressing the issue of homelessness in any area, collaboration between research centres and local government would encourage city specific research on the subject, as well as evidence to inform policy making (WG8). • Development of systems to enable better data sharing across local and national government, social care and healthcare providers, and researchers (WG1). This would require exploring and strengthening how data collation, quality and ethical practice across children's services might be optimised. Research may focus on how data is shared and analysed across statutory and voluntary sectors and the barriers to effective data sharing and how to address these. The Centre for Youth Impact are leading work in this area. • Better local data infrastructures to enable evaluation of policies and interventions, such as local authority cohesion strategies (WG1), informing action on on prevention and safeguarding (WG2), on how shared data can be used to formulate interventions that reduce risk to vulnerable children and adults (WG2).

	• Supporting managers and practitioners in children's services to develop better skills around generating and using research and data, to produce better tools and guidance around evidence use (WG2). • UK government has been putting in place systems to ensure they are able to link to each other's data sets so people only have to "Apply Once ". This is a good way of ensuring comprehensive data, however access to this data for academics can be a problem. Investigate systems to enable linkage of data sets and collaboration between holding government departments (e.g. HO, HMRC) and international counterparts (WG8). • Effect of COVID-19 on international migration. Potential opportunity as lockdowns ease to gain access to other countries data (subject to political constraints). Countries are not in a position to be able to understand the internal migrations patterns occurring or impacts to the migrant workforce. Could be opportunities to explore key research questions and see if other data sources can help e.g. use of satellite data and AI to follow migration patterns. (WG8)
Strengthening the research-policy system and interfaces	• Evaluation, replication, scale up and roll out should all be considered as a standard part of new intervention funding. • Evidence synthesis and implementation research to mobilise robust evidence about interventions should also be funded, in order to translate evidence into practice. • To maximise exploitation of existing evidence and data, creating a structured way for academia/industry to engage, extend current knowledge, and work jointly toward a concrete outcome. Data hubs distributed across the country, for example, could work with local authorities, reduce duplication and increase national synergies. • To move from asking "what can we do with existing data" to "what data do we need to do what we want", research sources of bias and measurement error, innovate to develop methods that reduce these biases, and make such tools resilient to internal and external threats, particularly for real-time data methods. To be effective, this research must ensure domain experts work closely with data scientists. • Creation of open data platforms, secure facilities, or safe havens (e.g. ADR-UK) to reduce the time spent in data collection, cleaning, and storage phases of projects, and they allow for easier entry for topic experts. • Considering the policy interventions that can be created by bringing together a wealth of Office for National Statistics (ONS) data on wellbeing. • Evidence collection on how science advice is being presented by government, how it is being framed in the media, and how the public are making use of scientific advice from official and non-official sources. • Improved understanding of how research (including review work) is commissioned, alternatives to the current scientific publishing system, greater development of good evidence communication methods and portals, and professional training in evidence evaluation. • A programme of crime prevention research should specifically seek to understand the inter-connections between government department levers; how investments and activity in one area can affect or support change in another. There are a number of specific themes which could be used to explore these links, such as tackling disinformation and cyber-bullying (WG4). • Greater investment in the areas of regulatory science and diffusion to keep ahead of our growing technology and data advancements could aid in ensuring UK thought leadership and industry adoption (WG8).
Systems approaches for research and policy development	• Development of systems to enable better data sharing across local and national government, social care and healthcare providers, and researchers. • Taking a systems lens, and understanding the system dynamics, time delays and feedback loops to identify high-impact points of leverage or influence. • A study on the possibilities presented by the use of systems approaches in policy formation, in particular how systems approaches can usefully add to the evidence base (including the type of evidence, alongside other approaches such as longitudinal studies

	and case studies) would support the continuous improvement of the quality, diversity and relevance of evidence. It would also provide a valuable reflection on the interconnections between different sources of expertise and policy. • An international comparison of disciplinary diversity in government science advice systems, focusing on how evidence is found and applied within science advice systems, and how this relates to the policy use of such evidence and advice.

9. Annex 2: ARIs for which no evidence was identified by working groups

Working group	Unanswered ARIs
1: Vulnerable communities	• Providing mobility services while protecting vulnerable from COVID-19 • Analysis of the relevance of demographics for the impact COVID-19 has in different parts of the world
2: Supporting Services	• How do we support emergency service? • How can DWP policies, in combination with those of other government departments, facilitate and encourage inter- and intra-generational social mobility? • Potential role of digitalisation and technology-enabled services, looking at inequalities, access and innovative service delivery.
3: Trust in Public Institutions	• Not applicable
4: Crime Prevention	• Enabling sharing of data, evaluation and monitoring to enable better joint working • How do we detect and mitigate threats, crime and smuggling? • Lessons learned from investigation • Analysis of how conflict and terrorist dynamics may change as a direct or indirect result of COVID-19 • Analysis of what new conflicts may arise and where there might be new opportunities to resolve conflict
5: Supporting lower-carbon local economies	• Not applicable

6: Land Use	• How does land use and development serve communities best?
	  ○ How can land use, supply and demand be balanced and optimised between areas of the country?
	  ○ What has been shown to work effectively in shaping Governments' role in land use management to drive sustainable local sustainable growth?
	  ○ How important are amenity, social, health and ecological benefits in ensuring community gains when land use changes?
	  ○ What do communities' value and understand in terms of how land is used and allocated? And to what extent does this change in different geographical areas? What is the most effective way of ensuring these values are recognised and recirculated locally and regionally for the public good?
	  ○ How do you capture the value of an amenity for the benefit of local communities, and which ones create co-benefits? What value gets recirculated on the basis of development gain, and recirculated to whom? How can more value be retained locally to support COVID-19 recovery?
	  ○ What is effective in increasing the transparency, accessibility and availability of data for development on land to community and public bodies through increased digitalisation of the planning process?
	• How do we overcome the uneven development of the UK?
	  ○ What are the key elements of a coherent spatial strategy that balance and optimise land use in different regional contexts and for different types of inequality?
	  ○ How to ensure the maintenance and improvement of a range of economic, ecological and social benefits to land functions when land use changes.
	  ○ How to balance local community needs for land (e.g. recreation, amenity, woodland amenity) with use for other purposes (housing, infrastructure, transport).

	○ Given recognized population and density pressures, what planning principles would underpin a flexible, socially and ecologically equitable approach to development based on key priorities such as net zero place making? ○ How could we regenerate and finance existing city spaces along net zero and active travel neighbourhood principles? ○ What constitutes a sustainable community? And how can in practical ways local communities and neighbourhoods achieve this, especially in terms of relocalisation and ideas such as the 15-minute neighbourhood? ○ How can government, market and civic actions and actors co-produce solutions to foster this process? ○ How can current land uses and occupancy be adjusted to deliver sustainable communities? ○ How could government interventions promote more equitable outcomes to land use policies while meeting public health, climate and biodiversity targets? • How can UK land use change better deliver multiple outcomes for people's health and prosperity to deliver a just transition for all? ○ What roles do green jobs, local employment, renewables, recreation, and thriving biodiversity play in delivering these multiple outcomes? ○ What is most effective in designing nature-based solutions to meet the net zero place making challenge? ○ What can we learn from other countries about how can spatial planning be best used to support design green infrastructure and improve mental and physical health? ○ What are the legislative, sociocultural and regulatory barriers that need to be overcome to transform UK land use towards sustainable production systems and ecosystem services? What are the risks of unintended and inequitable consequences and how can they be mitigated? ○ How will crop, livestock and woodland resilience alter in a changing climate, impacting optimal agricultural, amenity and forestry practices for the UK? 'What works' in terms of increasing resilience in these areas? ○ What is the greenhouse gas emissions reductions potential of different land-based interventions per unit area per year? How does this change over time and what are the timeframes for delivery from implementation? What the potential for both urban, rural and peri-urban interventions? ○ What are the real-world barriers that prevent land-users and owners taking up low/negative carbon measures, and how can these be overcome? How can we improve the estimation and validation of take up for these practices? ○ How can a more integrated and regionally sensitive approach to land use be developed through aligning climate change objectives (adaptation and mitigation) with objectives for biodiversity, social equity and ecosystem services. How can the environmental co-benefits of mitigation actions be identified and quantified? ○ What are the competing pressures, trade-offs and synergies of different land-use in relation to climate change in a post-COVID-world? ○ Can other land-based approaches to greenhouse gas removal such as enhanced weathering and biochar as well as place-based approaches such as local reafforestation help achieve net zero without negative environmental impacts? • Land ownership, governance and finance ○ Financial flows and capital release – how can we ensure equitable and more fluid flows of capital so that land can address climate emergency and social justice? ○ How can land be released for more local community needs (e.g. growing, recreation, amenity, woodland amenity)? ○ Liquidity in land for community benefit – how can we ensure release of land to meet urgent social-ecological objectives of COVID-19 recovery?

	○ Development and green recovery – what mechanisms could ensure that under- used or 'banked' land is released to stimulate an equitable green recovery (for biodiversity, community renewables, community housing, active travel, amenities)? ○ Which new mechanisms for community ownership –grants and support organisations for cooperatives, Community Land Trusts, custom build, cohousing etc – could help the UK achieve its priorities for land use most cost-effectively? ○ What relationships between different scales of ownership: local, national and international – could help ensure a coherent UK spatial plan to avoid overheating, dereliction especially within and between regions? ○ What are the implications for how 'levelling up' subsidy regimes are designed and the levels of in spending per head (e.g. for arts, transport, greenspaces) ○ How can new re-localised and regionalised markets for environmental goods and services be created? ○ Is the allocation of land to different transport types (private vehicle, active travel) optimised to ensure climate, social and health objectives are met? • How can we deliver early warning systems to monitor signals in the environment relevant to public health and other societal outcomes? ○ Monitoring the prevalence of COVID -19 and similar viruses through water systems. ○ Developing environmental surveillance and/or sentinel systems offering early warning signals ○ Better tracking for safety and sustainability of UK food production ○ How can we develop effective early warning systems able to assess and interpret a wide range of signals in local environmental systems (e.g. covering flooding, biodiversity loss, amenity loss, air pollution, soil loss)? ○ How do we use new sensor capability, and combine it with data analytics to deliver predictive capability from near real time to multiyear scenario planning? ○ How can we develop accurate biological sensors throughout the food system to detect changes/ issues in real time combined with decision support tools? • What is the role for UK land in supplying healthy, safe, sustainable and affordable food, and how can innovation boost productivity to transform the UK food and farming system? ○ How to maintain food security and equitable access to a decent diet in the face of challenges such as a rapidly growing population, changing consumption trends, changing climate, globalized markets and black swan events such as COVID-19? ○ How best to develop agritech, robotics and automation to drive change and enable UK food and farming sectors to compete globally? ○ How do the public view the role of the technologies above in the transformation of the UK's agri-food system post-Brexit? ○ How can we prepare for divergent regulatory frameworks (in the USA, European Union and other trading nations) for agricultural inputs such as seeds and livestock? ○ Use of new data science techniques, including AI, to unlock opportunities for improved and more efficient environmental monitoring, regulatory compliance and land management. ○ How to value changes in land use / use of an amenity and the implications for regulation and access. ○ How to incorporate effective local and regional approaches into the development of more resilient food supply chains, processing infrastructures and public sector food procurement processes ○ How to create a growth in shorter- more localised and regionalised food supply chains? How to invest in local urban and regional food processing infrastructures and market innovations?

	○ How to stimulate local and regional food procurement in the public sector (post-COVID-19and Brexit)? ○ How to extend knowledge networks advisory and extension systems and new innovations to landholders and farmers? ○ How can under-utilised urban land be used to support a supply of nutritious affordable food? • How can management of the UK's land use footprint in other countries reduce likelihood of zoonotic disease emergence along with improved sustainability outcomes? ○ How do we deploy science and technology innovations to help deliver a risk-based approach to animal and plant biosecurity, i.e. to move from post-disease/outbreak surveillance to pre-emergence surveillance and mitigation of risks? ○ How will the prevalence and incidence of animal and plant pathogens in domesticated organisms and wildlife adjust to climate change? ○ How can we better join up animal and human health research, capability and digital backbone across government to facilitate agile responses? ○ How to assess and reduce the role of UK imports in driving biodiversity loss, climate change, chemical pollution and the introduction of alien species ○ How do we better understand how the UK land use promotes zoonosis emergence, and environmental transmission and can it be sued to create barriers to spread? ○ How can we build resilience in food systems, recognising that prevention is better than cure? ○ How can we boost productivity on existing agricultural land whilst using less inputs (nitrogen, pesticides, water)? ○ How can UK research and insights support sustainable urban development and SDG11 in the global south in ways that will reduce peri-urban sprawl and the urban encroachment on pristine ecosystems?
7: Making the Future of Work Healthier and More Sustainable	• Not applicable
8: Local to National Growth	• Not applicable
9: Trade and Aid	• Not applicable