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Partner Country Case Study: Malaysia

Final Evaluation of The Newton Fund

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Disclaimer

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Abbreviations

AIM	Malaysian Innovation Agency
AHRC	Arts and Humanities Research Council
ASEAN	Association of Southeast Asian Nations
ASM	Academy of Sciences Malaysia
BBSRC	Biotechnology and Biological Sciences Research Council, UK
DARA	Development in Africa with Radio Astronomy
DOST	Department of Science and Technology, the Philippines
DP	Delivery Partner
EPSRC	Engineering and Physical Sciences Research Council, UK
ESRC	Economic and Social Research Council, UK
EU	European Union
GCRF	Global Challenges Research Fund
GCSM	Global Conference on Sustainable Manufacturing
GDC	Green Data Centres
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on Research and Development
GNI	Gross National Income
HSSE	Health, Safety, Security and Environment
ICT	In-Country Team
IP	Intellectual Property
ISF	Indonesia Science Fund
LIF	Leaders in Innovation Fellowships Programme
MEL	Monitoring, Evaluation and Learning
MetMalaysia	Malaysian Meteorological Department
MCR	Medical Research Council

MIGHT	The Malaysian Industry-Government Group for High Technology
MOHE	Ministry of Higher Education, Malaysia
MOSTI	Ministry of Science, Technology and Innovation
MRC	Medical Research Council, UK
MTR	Mid-Term Review
MYR	Malaysian Ringgit
NADMA	National Disaster Management Agency Malaysia
NAHRIM	National Hydraulic Research Institute of Malaysia
NARIT	National Astronomical Research Institute of Thailand
NCDs	Non-Communicable Diseases
NERC	Natural Environment Research Council, UK
NF	Newton Fund
NPSTI	National Policy on Science, Technology and Innovation
NUOF	Newton Ungku Omar Fund
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OSCC	Squamous Cell Carcinoma-type cancer
PI	Principal Investigator
PMO	The Prime Minister's Office of Malaysia
Ristekdikti	Ministry of Research Technology and Higher Education Republic of Indonesia
R&D	Research & Development
R&I	Research and Innovation
RCUK	Research Council United Kingdom
S&I	Science & Innovation
SATREPS	Science and Technology Research Partnership for Sustainable Development Programme
SDG	Sustainable Development Goal

STFC	Science and Technology Facilities Council, UK
STI	Science, Technology and Innovation
TÜBITAK	The Scientific and Technological Research Council of Turkey
TRF	Thailand Research Fund
UK	United Kingdom
UKRI	UK Research and Innovation
USAID	United States Development Agency
UTM	University Teknologi Malaysia
WCSSP	Weather and Climate Science for Service Partnership

Executive Summary

Newton-Ungku Omar Fund (NUOF) at a glance

- Established in 2014, the overarching priority for NUOF is climate change mitigation and sustainable urbanisation. NUOF strives to build partnerships between research and innovation funders, organisations and institutes, as well as between individual researchers from the UK and Malaysia.
- It spans five research areas: i) health and life sciences; ii) environmental resilience and energy security; iii) future cities; iv) agri-technology and v) digital innovation and creativity.
- The central coordinating body in Malaysia is the Malaysian Industry-Government Group for High Technology, MIGHT, which acts as both a facilitator and Delivery Partner for the NUOF.
- In Malaysia, NUOF Delivery Partners (DPs) consist of eight government ministries and agencies. UK Delivery Partners include the Research Councils, the UK's four national academies, the British Council, Innovate UK and Met Office.
- The UK and Malaysian governments jointly committed £8m annual funding to NUOF.

The case study

Tetra Tech International Development produced this Partner Country Case Study in Malaysia to inform the Final Evaluation Report of the Newton Fund.¹ It is one of 11 country case studies that investigates the Fund's implementation and its results. It serves as a deep dive into the development, relevance, additionality, and results of (a) the programme activities; and (b) their success factors and barriers that affected their implementation.

The case study sampled three calls under the Newton-Ungku Omar Fund, and from each a project was selected for in-depth analysis:

- **Research and Innovation Bridges:** under this call, **the Next Generation Green Data Centres for Environmental and Business Sustainability** collaboration aimed to achieve lower CO2 emissions from data centres by integrating the Malaysian Green Data Centre (GDC)'s Submersify liquid cooling technology and the UK's Dearman Engine zero-emission cooling and power generation technology. The combined technology, known as KoolKUBES, was found to have the potential to reduce energy consumption and was further developed by the Malaysian Principal Investigator (PI) following the end of the collaboration, leading to the Community Data Centres spin-off product.
- **Joint call for small scale research and networking activities with south-east Asia, including Malaysia:** under this call, the **Micro Bubble Aeration System** project tested the

¹ In this report, 'the Newton-Ungku Omar Fund' refers to the joint UK-Malaysia initiative through which funding calls were issued. 'The Newton Fund' refers to the broader UK programme financing activities in 17 countries, including Malaysia. The Newton-Ungku Omar Fund was financed both by Newton Fund contributions and those from Malaysian funding partners.

potential of adapting microbubble aeration technologies to shrimp aquaculture. The project sought to harness efficient new technologies and reduce the cost and environmental impact of shrimp farming to make the industry more sustainable from both an economic and environmental perspective. The project achieved all its stated objectives and led to researchers preparing applications for further funding opportunities.

- **The UK-Malaysia Joint Health Research Call in Non-Communicable Diseases:** under this call, the **Identification of Genetic Vulnerabilities In Head And Neck Cancers For The Development Of Novel Therapies** project was implemented. The project was designed to tackle cancer of the oral cavity (Squamous Cell Carcinoma-type cancer (OSCC)-type cancer), which is seen as one of the most significant public health issues in Malaysia and Asia generally, and has led to important research results.

The research for this report included desk-based review of project- and fund-level documents, and remote interviews with 21 Malaysian and UK stakeholders, including Delivery Partners in both countries, Award Holders (AHs), senior staff from partner organisations as well as the programme team and UK High Commission staff. The research was conducted between July and August 2020.

The case study is a self-contained investigation and its findings are not intended to be generalised to the entire Newton Fund in country. Case studies were limited to three projects per case study, which were conducted remotely owing to the Covid pandemic. In some projects, the added logistical challenge of remote research limited the number and range of stakeholders consulted. The case study findings reflect the data provided by each project and available information online. The volume of documentation provided varied by project, thus limiting the possibility of triangulating findings. In terms of total Newton Fund expenditure, the projects selected represent a very small fraction of all expenditure across 5,400 projects. The case study is therefore not representative of all Newton Fund activities. Whereas it provides valuable depth and illustration of Newton Fund activities, the case study alone does not provide generalisable evidence.

Key Findings

Effectiveness

- **NUOF has been an effective programme.** The activities undertaken by the sampled projects have resulted in the creation of rewarding research collaborations and have generated follow-up funding, research papers, patent applications and successful commercial spin-offs. For example, the Head and Neck Cancer Research Project has been awarded an extension through the Newton Fund Impact Scheme; the Green Data Centres Project was instrumental in creating a viable product of ‘community data centres’ that service internet traffic in residential neighbourhoods in Malaysia, and the Shrimp Aquaculture Project has resulted in a patent application for a nozzle producing reduced-size microbubbles. All the sampled projects have produced at least two research papers and further accounts of outputs through conferences and dissemination events.
- **For some projects, activities are expected to carry on into the future.** Part of the success and effectiveness of the Fund’s work stems from the existence of long-standing research collaborations and people-to-people links between Malaysia and the UK, as well as from the strength and length of bi-lateral relations between the two countries. Two out of

three projects sampled for this case study were initiated through pre-existing links between researchers.

- **There is a sense of ownership of NUOF by Malaysian stakeholders.** The Malaysian government has been active in disseminating Newton calls and in seeking high-skilled researchers. There is also potential to translate project research outputs into broader poverty alleviation initiatives in the future, within and beyond Malaysia. There is evidence of improved capacity among UK and Malaysian researchers, and there has been a range of follow-up project activities stemming from NUOF collaborations.
- **There is evidence of additionality**, i.e. NUOF projects sampled for this case study would not have happened without Newton Fund support through a partnership funding model.

Emerging impacts

- **The NUOF has resulted in high-calibre research and has raised the UK's profile as the research and innovation (R&I) partner of choice for Malaysia.** The support provided by the UK in the R&I sphere is responsive to Malaysian needs and reflective of the strong relationship between the two countries. NUOF benefited from an already-strong partnership between the UK and Malaysia.
- **Across the three sampled projects, there is evidence of achievement of all interim outcomes of the Theory of Change.** Effective collaboration between the UK and Malaysia has been established, resulting in peer-reviewed research publications for all three sampled projects. However, more can be done to ensure that these partnerships are multidisciplinary.
- **Research, innovation, and translation capacities have all improved during the Fund's implementation in Malaysia**, building on pre-existing conditions and networks. Socially inclusive solutions and commercial spin-offs are being tested, and products are being developed through collaborative research. There are also clear signs that the UK continues as a preferred partner of choice for Malaysia in R&I collaborations.

Sustainability

- **Further collaborations beyond NUOF largely depend on the ability to secure follow-up funding**, either via the Newton Impact Scheme² or other UK-funded opportunities, as most of the research undertaken through the Fund in the three sampled projects can be categorised as fundamental research.
- **Projects where the research collaboration or technology pre-dated the Newton Fund itself have matured, and two out of three sampled cases have either attracted follow-up funding or generated commercial spin-offs.** Projects designed purely in response to Newton Fund funding calls could be more challenging to sustain. For example, research on shrimp aquaculture methods using air microbubbles has not secured an extension or follow-up funding.
- **Overall, the Malaysian government is fully supportive of the Newton Fund and sees a wide range of benefits from it and has expressed a desire to continue collaborating.** The sustainability of the results brought about by the NUOF will depend on the nature of the

² The Newton Impact Fund is a funding scheme for current and previously funded Newton Fund grantees that aims to maximise impact from Newton Fund activities and through which the collaboration between UK and partner countries can build upon the original partnership. Malaysian applicants were eligible for the scheme in 2019.

relationship in the future, and the availability of additional funding. There are strong indications that if the Fund continues, the sustainability of research solutions and the potential to take them to scale would be higher.

Complementarity and Coordination

- **NUOF and GCRF are well-coordinated and work with a spirit of complementarity.** There is no competition or overlap between the Newton Fund and other funds: management teams coordinate their funding decisions, discuss any relevant points ahead of time and maintain effective communication channels. NUOF is regarded as being able to disburse funds rapidly and target immediate research priorities.

Lessons Learned

- **The Newton Fund can work particularly well where research networks, common research culture and mutual understanding are already established between the UK and the partner country.** These pre-established research networks shorten the time needed to prepare winning research proposals. Many researchers would have collaborated with each other via PhD studies and are aware of each other's interests and strengths. Having pre-existing networks reduces initial difficulties in cross-cultural communication that can be experienced in research projects. However, the Newton Fund still brought an element of additionality to these pre-existing collaborations, as it generated additional research activity, outputs and outcomes in an already fertile research landscape.
- **NUOF's success is supported by high levels of buy-in from the Malaysian government to the matched-funding model.** NUOF stakeholders and funders on the Malaysian side of the partnership communicate funding opportunities effectively, using multiple channels and existing networks. Malaysian stakeholders highly value the cooperation with the UK which has been made possible through the Fund.
- **Networking activities have a critical role in the success of the Fund's projects and collaborations.** Where there were no pre-existing research links, the networking events organised by the British High Commission in Kuala Lumpur or the Newton-wide events held in London started new conversations about collaboration opportunities. Some cases, such as the Green Data Centres project, resulted in actual projects being undertaken. Facilitating people-to-people relations and face-to-face discussions was a critical success factor for the Fund as a whole.
- **The operational efficiency and the quality of the in-country team (ICT) was essential for the Fund's success.** During the Malaysia case study research, the Newton Fund ICT team received widespread praise from stakeholders on the Malaysian and UK sides of the collaboration. The team's ability to advertise funding opportunities quickly and effectively and facilitate networking among stakeholders attracted high-quality applications for a wide array of projects and resulted in tangible research outputs. A quality ICT is an effective vehicle to realise the Newton Fund's potential benefits: without it, the cooperation would have been less streamlined and less effective.

Considerations and recommendations for the Newton-Ungku Omar Fund

- **It is recommended that the relationships built or cultivated through the NUOF continue, either via the Newton Fund or through a similar mechanism.** The Fund was successful in building on the existing science and research networks, and in some cases,

making them stronger or forging new relationships through the existing institutional links. There is evident value-added by the Newton Fund in solidifying these research links and enhancing the UK's status as a partner of choice for research and innovation in Malaysia.

- **The Newton Fund's centralised monitoring, evaluation, and learning (MEL) processes could be improved, as noted in the Newton Fund Final Evaluation Report.**³ An improved monitoring function would support project implementation and further strengthen the standing and visibility of the NUOF, allowing for better evidencing of outcomes, impacts and demonstration of VfM at the end of the Fund's life cycle
- **While projects implemented under the NUOF have generally run well, some minor operational adjustments could be considered for the future.** The project delivery process could have been more flexible in allowing for modification of project parameters, expected outputs, stakeholders and research topics. Although other initiatives exist in the UK research investment portfolio to support short-term response research, a higher degree of flexibility and adaptive management embedded in the Newton Fund could make projects even more relevant and productive.
- **There are indications that the NUOF could be further tailored to the Malaysian context, considering its specific strengths and challenges.** To reduce the perception that some research proposals may not be sufficiently focused on the Malaysian context, project proposals could be more closely aligned with Malaysian socio-economic conditions and aspirations. Consideration of certain geographic and climatic factors could also make proposals more context specific. This could be achieved by altering guidance at the proposal stage. More attention should be given to Malaysia's specific strengths and how these can benefit from collaboration between the two countries.

³ Improving MEL processes is the focus of one of the recommendations from the broader, Fund-level evaluation.

1 Introduction

1.1 Aim and purpose of the case study

This report presents our findings for our country case study of Newton Fund activities under the Newton-Ungku Omar Fund in Malaysia. While these findings will inform the Newton Fund's final evaluation, they are specific to the country under investigation and not to be generalised to the broader Fund. The strength of evidence (Section 1.5) for this case study should guide the reading of the results set out in Sections 3- 6. Remote research in Malaysia was carried out in **July and August 2020**.

The purpose of the case study is to examine:

- the relevance of the country-level work to Newton Fund's theory of change, including the ways in which funded projects have supported the Newton Fund to achieve its stated outputs and outcomes.
- the effects of Newton funding in terms of the scale and type of results delivered by the sampled projects, and their potential impact on the socio-economic challenges identified in the country and more widely.
- the likely sustainability of the activities and results of the sampled projects and by the Newton Fund.

We also aim to better understand the overarching significance and impact of Newton-Ungku Omar Fund in Malaysia, such as on the internationalisation of research institutions, the relationship between the partner country and the UK, and in the sharing of best practice between the two countries.

1.2 Research scope

This country case study focussed on the activities under the Newton-Ungku Omar Fund. Specifically, it assessed the following:

- the **development of each activity** – examining its origins, how engagement with the Newton Fund occurred, and an overview of the process of securing Newton funding.
- the **relevance of each activity** to Malaysia's development needs and to Newton Fund and Official Development Assistance (ODA) goals.
- the **additionality of each activity**.⁴
- the **results of each activity** in terms of the outputs, outcomes and impacts generated to strengthen the science and knowledge base, innovation capacity and policy influence in Malaysia and beyond.

⁴ In the context of the Newton Fund, additionality aims to assess whether a given call or project could have happened in the absence of the Newton Fund (for example, through funding for similar activities provided by other programmes).

- the **success factors (and barriers) which affected each activity**, as well as the potential benefits from each activity that might be expected to arise in the future.

The case study included a mix of ongoing and completed activities. When assessing these activities' results, we considered their ambitions as well as early signs of achieving impacts, recognising that impacts of research and innovation take time.

To understand how sustainable solutions to economic development and poverty reduction have emerged from Newton Fund activities, our enquiry focussed on the factors that facilitate specific research activities, increase the quality of research outputs, enhance international collaboration for higher-level education and translate research into innovative practices.

1.3 Case study selection

As part of our sampling methodology for the Newton Fund country case studies, we shortlisted case study calls for each country based on three measures: size, pillar, and sector (see Annex 2 for details). Project selection considered thematic areas of focus, aiming to include priority areas for the Newton Fund in each country. We also sought to achieve a spread of Delivery Partners (DPs) and activity types across the countries in our sample. Following consultations with in-country teams (ICTs), DPs and the Newton Fund Central Team, we selected **three calls per country**. This selection allowed us to include a call under each of the Newton Fund's core activity pillars: People, Research, and Translation.

The next step to the case study selection is the sampling of one specific project from each of these three calls to ensure as broad geographical and partner coverage within the country case study's short timeframe. We also considered the relevance of their specific research areas to the Newton Fund's priorities in Malaysia when the projects were selected.

In Malaysia, the sampled calls and projects analysed in depth in this report are:

Calls	Projects
Research and Innovation Bridges	The Next Generation Green Data Centre for Environmental and Business Sustainability
Joint call for small scale research and networking activities with south-east Asia, including Malaysia	The microbubble aeration system for nursery pond of shrimp aquaculture in Malaysia under energy, water quality and biofloc circulation constraints
The UK-Malaysia Joint Health Research Call in Non-Communicable Diseases	The identification of genetic vulnerabilities in head and neck cancers for the development of novel therapies

1.4 Methodology

The research for the country case studies included desk-based review documentation and remote key informant interviews (see Annex 1). For the Malaysia case study, we consulted 21 respondents (British High Commission officials, inclusive of the High Commissioner, the ICT Team, the Prosperity Fund managers, the UK and Malaysian Delivery Partners, including

research council staff and ministry- level staff in Malaysia, Principal Investigators, Award Holders, Call Funders and private sector implementors). This was combined with consultations with UK-based partners and researchers involved in the actions included in the study.

Due to COVID-19-related travel restrictions, we had to switch to a purely remote approach. We assured the quality of our interviews by building rapport with stakeholders by email prior to the interviews, reviewing documents thoroughly to identify the most important gaps to keep the sessions brief amongst other steps. Details of the limitations of this approach and our mitigation actions are set out further in Annex 1.

1.5 Strength of evidence assessment

Tetra Tech used a traffic light system to assess the case study’s strength of evidence (see figure 1 below). The rating assesses the evidence supporting the conclusions reached given the methodological limitations outlined in Annex 1. Table 1 details the main sources of evidence used for this case study and the rating assigned to it.

Tetra Tech used a traffic light system to assess the case study’s strength of evidence (see figure 1 below).⁵ The rating assesses the evidence supporting the conclusions reached given the methodological limitations outlined in Annex 1. Table 1 details the main sources of evidence used for this case study and the rating assigned to it.

Figure 1: Strength of evidence ratings

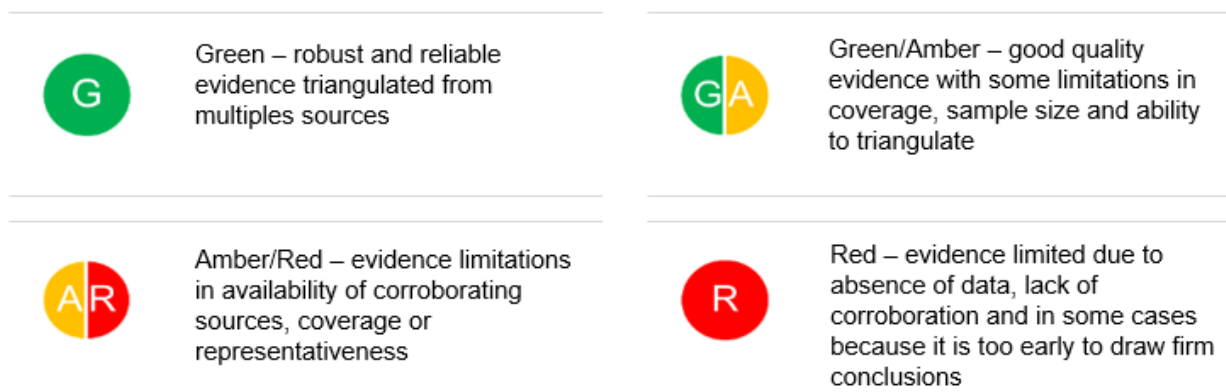


Table 1: Strength of Evidence for the Newton-Ungku Omar Fund case study

Strength of Evidence	
Green/ Amber 	There are gaps in the evidence, which limited the assessment of relevance, effectiveness, emerging signs of impact and sustainability. This is due to the relatively small sample of interviews conducted which limits the extent to which it is possible to assess if the Newton-Ungku Omar Fund has produced results and benefited its intended recipients. In addition, the extent, type and structure of

⁵ Our aim was to achieve a sufficient degree of confidence about the extent to which outcomes have occurred, Newton Fund’s level of contribution to the outcomes and our theory about how the Newton Fund has contributed or failed to contribute. Confidence is affected by the extent of triangulation across sources and the position, knowledge, analytical capacity, and potential biases of primary informants. The ratings are not designed to be a rigid framework, but rather a way to ensure evaluative judgements were made systematically across the Evaluation Questions.

	monitoring data and documentation varied across DPs, limiting the extent to which outputs and outcomes can be reviewed and triangulated.
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1.6 Report structure

The report is structured as follows:

- **Section 2** introduces the context of Malaysia, including political and economic developments and trends in the R&I landscape.
- **Section 3** discusses high-level emerging results of the Newton Fund in Malaysia based on findings from the three sampled projects and broader consultations undertaken with the programme team.
- **Sections 4 to 6** analyse three specific projects more in-depth, providing an assessment of the relevance, effectiveness, emerging impact, and sustainability of the sampled activities.

2 Malaysia in Context

2.1 Context and evolution of the economic and research landscape in Malaysia

Malaysia has seen strong economic growth and important political changes in the past few years.

Malaysia has recently undergone a period of political change unprecedented in its recent history. With two changes in Prime Minister in the past two years (Mr Najib Razak to Mr Mahathir Mohamad in 2018, replaced by Mr Muhyiddin Yassin in March 2020), the country saw the return to power of the United Malays National Organisation. This party dominated Malaysian politics for over 60 years before 2018.⁶ The current prime minister, Mr Muhyiddin Yassin, heads a coalition government of six parties, united under the banner of the *Perikatan Nasional* (National Alliance).

Malaysia is one of the world's most open economies. Its trade to Gross Domestic Product (GDP) ratio averaged over 130% since 2010.⁷ According to the Malaysia Economic Monitor Reports published by the World Bank twice a year, since 2014, Malaysia's economy has been growing, albeit unevenly.⁸ In 2017, the country experienced a significant acceleration in growth due to a confluence of domestic and external factors.⁹ Economic growth slowed in 2018¹⁰ along with global trends¹¹, but expansion resumed in 2019.¹² According to the OECD Economic Survey published in 2019, Malaysia's economic performance has been very successful in recent years, with a rapid catching-up towards living standards prevailing in OECD countries.¹³

In 2020, COVID-19 triggered a severe regional and global economic downturn, including in Malaysia. Malaysian GDP growth in 2020 is expected to fall by 3.1%, reflecting the impact of domestic lockdown measures, reduced tourism, and disruption to the trade and manufacturing sectors as a result of factory closures. More optimistically, according to the World Bank's Economic Prospects published in June 2020, the COVID-19 outbreak appears to have largely subsided in Malaysia, and the government began a gradual easing of lockdown measures by allowing more economic sectors to operate.¹⁴

⁶ BBC News (2020) 'Malaysia gets new PM, Muhyiddin Yassin, after week of turmoil'. Available at: <https://www.bbc.co.uk/news/world-asia-51695463>

⁷ The World Bank (2021). 'The World Bank In Malaysia'. Available at: <https://www.worldbank.org/en/country/malaysia/overview>

⁸ World Bank (2014) 'Towards a Middle-Class Society', Malaysia Economic Monitor (December), World Bank, Washington, DC.

⁹ World Bank (2017) 'Turmoil to Transformation', Malaysia Economic Monitor (December), World Bank, Washington, DC.

¹⁰ World Bank (2018) 'Realizing Human Potential', Malaysia Economic Monitor (December), World Bank, Washington, DC.

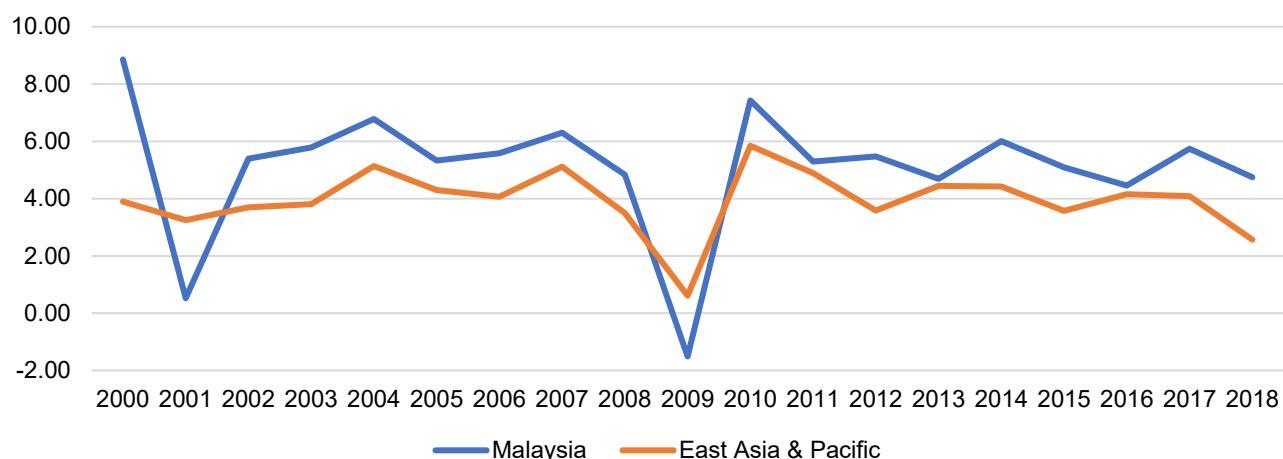
¹¹ International Monetary Fund (2019). 'World Economic Outlook Update'. Available at: <https://www.imf.org/en/Publications/WEO/Issues/2019/01/11/weo-update-january-2019>

¹² World Bank (2019) 'Making Ends Meet', Malaysia Economic Monitor (December), World Bank, Washington, DC.

¹³ OECD (2019) 'OECD Economic Surveys: Malaysia 2019'.

¹⁴ World Bank (2020) 'Global Economic Prospects'.

Figure 2: GDP growth in Malaysia and the East Asia and Pacific region, 2000-2018

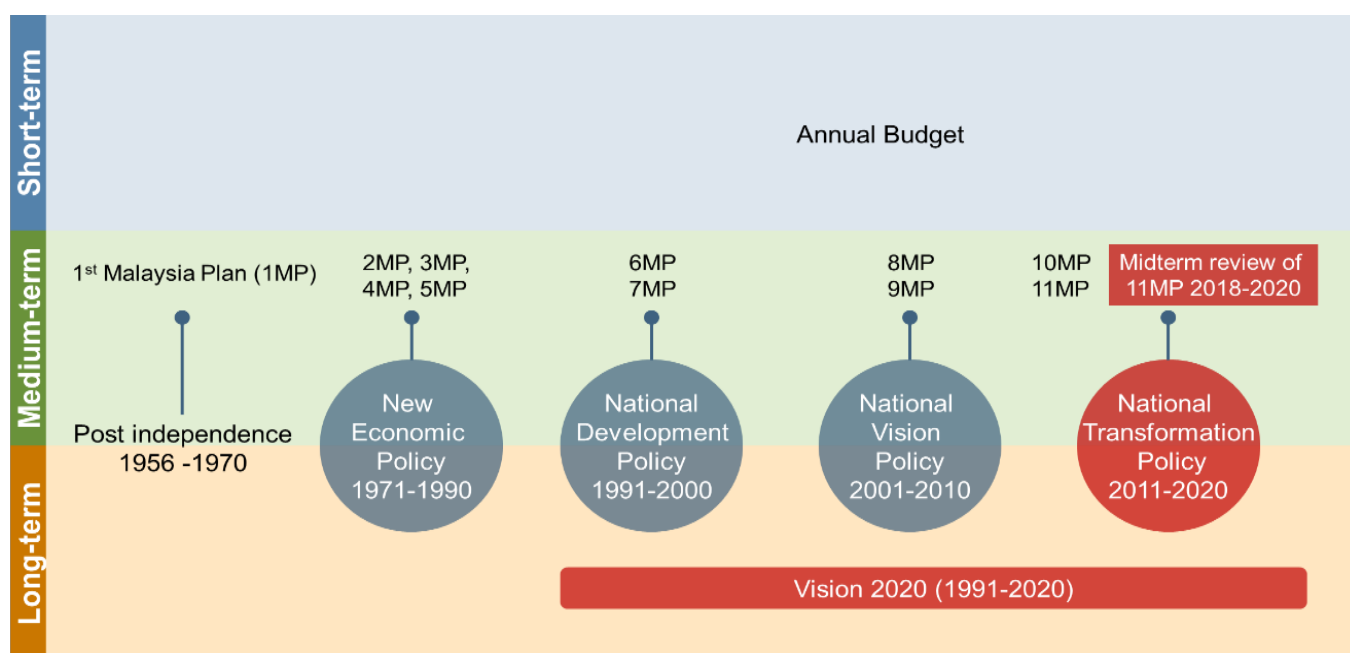


Source: World Bank

Despite recent political changes, Malaysia continues to have a well-defined national development strategy laid out across a range of plans and frameworks, and a stable and mature socio-political system. Malaysia has chosen to invest in science, research and innovation as drivers of economic growth. It has spelt out a range of priority areas (and relevant research) to help it achieve its ambition of becoming a high-income country by 2024. These priority areas are articulated in Malaysia Development Plans, each of which covers five years. The current 11th Malaysian Development Plan covers the 2016 to 2020 time period and has been translated into sectoral and departmental plans at ministerial level. Poverty alleviation is generally seen as achievable through economic growth and the resultant lifting of the population living under the poverty line, as tends to be the trend for middle income and upper-middle-income countries¹⁵.

Socio-economic development planning in Malaysia consists of short-term, medium-term and long-term plans. Malaysia published its first development plan in 1956. As of May 2020, there were a total of 29 development planning documents, including ten Mid-Term Review (MTR) documents. The development plans highlighted in orange in Figure 2 are active as of 2020: Vision 2020 (30 years: long-term), the National Transformation Policy (10 years: medium-term) and the 11th Malaysia plan (five years: medium-term). Only the 11th Malaysia Plan was introduced during the Newton Fund evaluation period.

¹⁵ The general benefits of focusing on economic growth and tackling poverty via is explained neatly in this World Bank blog piece: World Bank, 'How poverty reduction correlates with growth in median incomes' <https://blogs.worldbank.org/opendata/how-poverty-reduction-correlates-growth-median-incomes> (Accessed: 12/02/21)

Figure 3: Overview of development plans in Malaysia


Source: Malaysia's economic planning unit website. (Available at: <https://www.epu.gov.my/en/economic-management/planning-horizon>)

The 11th Malaysia Plan covered 2016 to 2020 and was revised in 2018. Although economic performance in 2016 to 2017 was characterised by modest growth supported by strong domestic demand, the global economic downturn led the Malaysian government to revise its targets. From 2016 to 2017, economic growth was accompanied by increased income, greater employment opportunities, better quality healthcare, more affordable housing, and a safer living environment. Despite this, continuing socioeconomic disparity across states, higher unemployment among young people and the rising cost of living have meant that economic growth benefits have not been enjoyed by all.¹⁶ Table 2 summarises adjustments made to the 2016 to 2020 plan after the 2018 MTR.

Table 2: Comparison between 11th Malaysia Plan and 2018 MTR

	11 th Malaysia plan (published in 2015)	MTR of 11 th Malaysia plan (published in 2018)
Annual GDP growth	5-6%	4.5-5.5%
Labour productivity	RM 92,300 approximately. (£17,000)	RM 88,450 approximately (£16,000)
GNI per capita	RM 54,100 approximately (£10,000)	RM 47,720 (approximately (£9,000))

¹⁶ Ministry of Economic Affairs (2018) 'Mid-term review of the eleventh Malaysia Plan 2016-2020'.

Average monthly household income	RM 10,540 approximately£2,000)	RM 8,960 approximately£1,700)
Compensation of employees to GDP¹⁷	40%	38%
Annual Malaysian wellbeing index	1.7%	1.7%

Source: Ministry of Economic Affairs (2018). Mid-term review of the 11th Malaysia Plan 2016-2020 and Ministry of Economic Affairs (2015)11th Malaysia Plan 2016-2020.

As shown in Table 2, several targets included in the 11th Malaysia Plan were lowered in its MTR, to reflect the 2018 economic downturn. For example, the GDP growth target was revised from an original 5-6% down to 4.5 – 5.5%, bringing it in line with projected world economic growth.¹⁸ According to the Socio-Economic Research Centre in Malaysia, this level of economic growth will be achievable thanks to the continued expansion of domestic demand.¹⁹ Reaching this target would require maintaining the pace of growth seen in recent years, with a focus on productivity gains.²⁰

A 12th Malaysia Plan for 2021 to 2025 is due to be published in early 2021, with a slight delay to the original timeframe due to the pandemic.²¹ The Plan will be aligned with the ‘shared prosperity initiative’ encompassing three dimensions: economic empowerment, social re-engineering²² and environmental sustainability.²³ The plan will also take into account the impacts of COVID-19, which caused an economic downturn in Malaysia and globally.²⁴

Concerning graduation from the OECD Development Assistance Committee (DAC) list of Official Development Assistance (ODA) recipients, Malaysia’s initial plan was to become a high-income country by 2020, a target which was revised to 2024. The World Bank also expects Malaysia to transition from an upper-middle-income to a high-income economy by 2024.²⁵ The likely impact of COVID-19 on the Malaysian economy poses questions on whether this timetable remains realistic.

¹⁷ Compensation of employees to GDP refers to the total gross (pre-tax) wages paid by employers to employees for work done in an accounting period, such as a quarter or a year.

¹⁸ Socio-Economic Research Centre (2018) ‘Mid-term Review of the Eleventh Malaysia Plan, 2016-2020 – New priorities and Emphases: Policies, Challenges and Opportunities’.

¹⁹ Socio-Economic Research Centre (2018) ‘Mid-term Review of the Eleventh Malaysia Plan, 2016-2020 – New priorities and Emphases: Policies, Challenges and Opportunities’.

²⁰ OECD (2019) ‘OECD Economic Survey – Malaysia’.

²¹ Twelfth Malaysia Plan, 2021-2025. Available at: <http://rmke12.epu.gov.my/>

²² The social re-engineering dimension includes enhancing societal values, improving people’s purchasing power, building a resilient *Bumiputera* (native Malaysian) community, strengthening social security networks and improving wellbeing.

²³ Twelfth Malaysia Plan, 2021-2025. Available at: <http://rmke12.epu.gov.my/about-us>

²⁴ New Straits Times (2020). ‘12th Malaysia Plan to be reviewed, restructured in wake of Covid-19’. Available at: <https://www.nst.com.my/news/government-public-policy/2020/04/587892/12th-malaysia-plan-be-reviewed-restructured-wake-covid>

²⁵ The World Bank (2021). The World Bank In Malaysia. Available at: <https://www.worldbank.org/en/country/malaysia/overview>

2.2 Research and innovation (R&I) landscape

Malaysia has a robust research system and is considered to be on track to become a high-income, knowledge-based economy by the end of the decade.²⁶ Malaysia's level of Gross Domestic Expenditure on Research and Development (GERD) in 2016 (the latest year for which the data is available) was 1.44%, reflecting steady growth from 1.3% in 2015, 1.26% in 2014, and 1.09% in 2013. In 2016, the private sector's proportion of research funding was 57%, whereas the national government carried out 29%, and the rest came from the higher education sector.²⁷ The science, innovation and research remit is shared between the Ministry of Higher Education (MOHE) and the Ministry of Science, Technology and Innovation (MOSTI). MOHE and MOSTI provide most public Research and Development (R&D) grants, covering several research priorities. The Malaysian Science and Technology Information Centre (MASTIC), managed by MOSTI, published three Science, Technology and Innovation (STI) policies relevant for the evaluation period: the National Policy for Science, Technology and Innovation (NPSTI), the National Biotechnology Policy, and the Intellectual Property Commercialisation Policy.²⁸ These policies were published before the evaluation period and have not been updated since then.

Malaysia's active STI-related policies, and priority areas therein, include:

- the **National Biotechnology Policy**, which was published in 2005 to develop nine sectors (agriculture, healthcare, industry, R&D and technology, human capital, financial infrastructure, legislative and regulatory framework, strategic positioning and government commitment) and support growth of the innovation eco-system among scientific, academic and business communities in Malaysia. There are three phases to implement this policy to create at least 20 global Malaysian companies in the field of biotechnology. The government's implementation plan during Phase Three included consolidating strengths and capabilities in technology development, developing expertise and strength in drug discovery, and strengthening innovation and technology licencing.²⁹

Figure 4: National Biotechnology Policy's implementation approach



Source: MASTIC. National Biotechnology Policy.

- the **Intellectual Property Commercialisation Policy**, which was released in 2009 to encourage Malaysia's research and innovation environment. The policy has three objectives: i) to establish a common framework to regulate the ownership and management of

²⁶ Oxford Business Group (2014) 'Malaysia'.

²⁷ Data provided after the UID GERD indicators, accessible in-house at Tetra Tech International Development. There may be some overlap in higher education and government spending, since the latter funds the former in many instances.

²⁸ MASTIC (n.d.) STI Policies. Available at: <https://mastic.mosti.gov.my/sti-policies>

²⁹ MASTIC (2006) 'National Biotechnology Policy'.

intellectual property; ii) to promote and facilitate the protection of intellectual property; and iii) to promote and facilitate the exploitation and commercialisation of intellectual property generated from government-funded projects.

- MASTIC's most recent policy, **National Policy on Science, Technology, and Innovation (NPSTI) 2013 to 2020**, which identified six 'strategic thrusts' to achieve the government's objective of advancing and mainstreaming STI at all levels. The strategic thrusts include advancing scientific and social research, development and commercialisation, developing, harnessing and intensifying talent, energising industries, transforming STI governance, promoting STI, and enhancing Strategic International Alliances. The policy provided the foundations to enhance knowledge generation, create wealth, and promote societal wellbeing. It did so by setting out a well-functioning STI system and integrating policy into all ministries and agencies. The Academy of Sciences Malaysia (ASM) is conducting a performance review of the current NPSTI to identify issues and challenges and inform a new National Policy on Science, Technology and Innovation for 2021 to 2030 (published in December 2020).
- the **Malaysian Higher Education Blueprint (2015 to 2025)**, which provides guidance for industry- and innovation-driven research. The MOHE established this blueprint for knowledge-based activities by focusing on the quadruple helix of academia, industry, government and local communities. The partnerships between these four parties aim to pursue collective ideas on innovation, development and commercialisation that will facilitate new knowledge in strategic areas seen as critical to the nation's economic growth. This approach encourages academia to intensify its role as a provider of skilled research talent and develop knowledge-based enterprises and commercialisation of R&D products.
- the 2018 **MTR of the 11th Malaysia plan**, which outlined new STI priority areas based on six pillars.³⁰ As part of this, 'accelerating innovation and technology adoption' was prioritised under Pillar 6: 'strengthening economic growth'. Malaysia aims to boost the innovation and technology sector by harnessing the fourth industrial revolution, increasing technology adoption, aligning research and innovation, and enhancing capacity building.³¹
- the **National Industry 4.0 Policy Framework for 2018 to 2025**, published by the Ministry of International Trade and Industry. This outlines guidelines to accelerate the adoption of technologies related to Industry 4.0, particularly among SMEs.³²
- the **Shared Prosperity Vision 2030**, which the Ministry of Economic Affairs published in October 2019. Although its purpose is to improve living standards, Vision 2030 also includes some STI-related goals, such as a higher adoption rate of technology in manufacturing and service sectors and creating 30% high-technology companies among Small and Medium-sized Enterprises (SMEs) in the manufacturing and service sectors.³³ Vision 2030 identifies Key Economic Growth Activities (KEGA) in 15 areas seen as driving economic development. Sectors include digital economy, smart and high-value agriculture, green economy and renewable energy, and the creation of an Association of South-East Asian Nations (ASEAN) hub. The Malaysian government launched some policy initiatives to drive progress in its

³⁰ The six pillars are as follows: (i) reforming governance and improving public service delivery; (ii) enhancing inclusive development and wellbeing; (iii) pursuing balanced regional development; (iv) empowering human capital; (v) ensuring environmental sustainability; and (vi) strengthening economic growth.

³¹ Ministry of Economic Affairs (2018) 'Mid-term review of the 11th Malaysia Plan 2016-2020'.

³² Ministry of International Trade and Industry (2018) 'National Industry 4.0 Policy Framework for 2018-2025'.

³³ Ministry of Economic Affairs (2019) 'Shared Prosperity Vision 2030'.

KEGA. The policies and initiatives launched in 2018 include the Industry4Ward (Industry 4.0) policy, the Development of Renewable Energy,³⁴ and the Malaysia Roadmap towards Zero Single-Use Plastics 2018-2030.³⁵

As shown in Table 3, Malaysia’s research output is highly concentrated in agricultural sciences, Information and Communications Technology (ICTs), materials, physics, natural resources and conservation, and social sciences. Malaysia’s specialisation rate in materials is the highest globally, with its rate increasing from 2.38 in 2014 to 4.08 in 2018. Meanwhile, Malaysia’s specialisation rate in biology and biomedical sciences, chemistry, engineering, health services, mathematics, psychology, and geosciences, atmospheric, and ocean sciences sectors was below the global average throughout the evaluation period. The fields which showed an improvement during the evaluation period are materials, physics, psychology, and geosciences, atmospheric, and ocean sciences.

Table 3: Extent of specialisation of articles across selected research fields

	2013	2014	2015	2016	2017	2018
Agricultural Science	1.23	1.21	1.18	1.26	1.22	1.16
Biology and Biomed	0.79	0.68	0.69	0.70	0.67	0.67
Chemistry	1.10	1.09	1.13	1.07	0.95	0.94
Geosciences, atmospheric, and ocean sciences	0.59	0.73	0.48	0.42	0.39	0.40
ICT	2.02	2.03	1.99	1.59	1.74	1.39
Engineering	1.20	1.25	1.32	1.31	0.99	0.98
Health Services	0.48	0.45	0.43	0.43	0.42	0.44
Materials	1.96	2.38	2.10	3.48	3.39	4.08
Maths	0.90	0.74	0.56	0.55	0.41	0.51
Physics	0.92	1.01	1.04	1.01	1.47	1.27

³⁴ The government of Malaysia aims to increase the share of Renewable Energy (excluding large hydro-electric production) in the electricity generation mix from 2% to 20% by 2025.

³⁵ Foreign and Commonwealth Office (2020) ‘UK Science & Innovation Network Country Snapshot: Malaysia’.

Natural Resources and Conservation	1.67	1.74	1.68	1.61	1.65	1.54
Psychology	0.16	0.19	0.38	0.21	0.24	0.23
Social Sciences	1.46	1.34	1.40	1.35	1.36	1.32

Source: Scopus (data sourced from US National Science Foundation).

Note: The figure represents a measure of concentration of a country's publications in a field, by dividing the fraction of publications in a country that are in a certain field by the equivalent global fraction. A score higher than 1 shows that the country is more specialised than the global average, and a score lower than 1 shows that the country is less specialised.

2.3 Overview of Malaysia's research funding structure

There have been no major changes in Malaysia's research funding structure during the evaluation period. The main body administering research funding in Malaysia is MOHE. For NUOF, the main local funder is the Malaysian Industry-Government Group for High Technology (MIGHT), originally attached to the prime minister's office but operating under MOSTI since March 2020. MIGHT is the main counterpart to BEIS for the Newton Fund in the country. Other relevant institutions include MOSTI and the Malaysian Innovation Agency (AIM) (dissolved in 2020).

Funding provided by MIGHT tends to be for theory of concept, long-term research, and supporting researchers to reach a prototype stage in their innovation products.³⁶ The Malaysian government also provides research funding through other organisations such as the Cradle Fund (administered by MOSTI since March 2020), the Malaysian Technology Development Corporation (an agency under MOSTI), and PlatCOM Ventures (the national technology commercialisation platform, a subsidiary of Malaysia's National Innovation Agency) (also dissolved in 2020). These organisations promote the commercialisation of technology by providing funding for start-ups and translational research.

Other Malaysian government bodies provide funding that is open to all researchers, including scientists and engineers, and companies that focus on new product development and commercialisation. These funds (known as TechnoFund, InnoFund, NanoFund and ScienceFund) aim to support research and development projects that can contribute to discovering new ideas and the advancement of knowledge in applied sciences, focusing on high-impact and innovative research. These initiatives are managed and funded separately, rather than through a streamlined approach.

2.4 Monitoring, evaluation and learning (MEL) systems

The Malaysian government uses a range of indicators and surveys for benchmarking of research and innovation activity in the country, including:

- **National Survey of Research and Development:** an annual survey developed following OECD Frascati Manual guidelines to measure organisations' R&D activities. This is used to assess performance against international comparison and government targets.

³⁶ Coffey International Development (2018) 'Thematic Impact Study Report: Malaysia'.

- **National Survey of Innovation:** a survey of services and manufacturing activities, developed under the OECD Oslo Manual guidelines. Up to now, five National Surveys of Innovation have been conducted.
- **Bibliometric Study:** a rich dataset which uses internationally recognised sources such as Web of Science and Scopus, as well as a national database, the Intellectual Property Corporation of Malaysia (MyIPO). This study aims to identify the current status of productivity and production in STI. Five reports³⁷ have been published since 2003.
- **Public Awareness of Science, Technology and Innovation in Malaysia:** a study on citizens' awareness of science, technology and innovation issues.
- **Science, Technology and Innovation Indicators Report:** a series of reports, published since 1994, with the specific aim to benchmark Malaysia in the science and technology field against other countries globally (including ASEAN and OECD countries, as well as China and India).
- **Study on STI Facilities and Equipment:** a survey to collect data on facilities and equipment in STI.
- **Survey of National Commercialisation:** a survey to collect research commercialisation input, activity and outputs for government-funded organisations.

2.5 Malaysia-UK Partnership

Case study research shows that the relationship between Malaysia and the UK is remarkably strong. It is marked by a mutual understanding of each other's strengths and interests, and the ability to derive mutual benefits from trade, cultural, people-to-people, and science collaboration exchanges. Economic relations have been marked by a steady increase in trade volume since 2014.

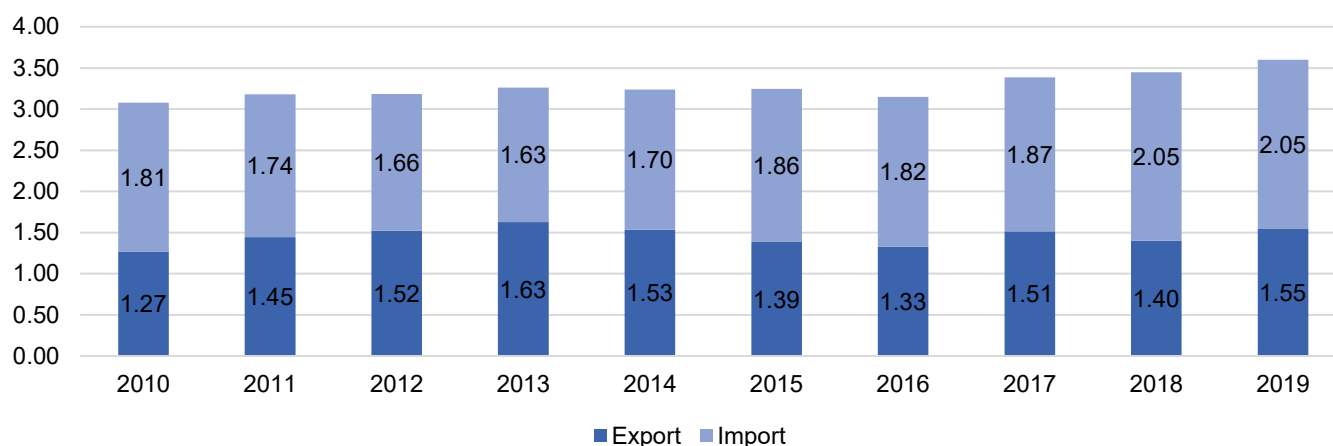
Malaysia is the UK's second-largest trading partner in ASEAN after Singapore.³⁸ The trade volume between Malaysia and the UK increased from £3.24 billion in 2014 to £3.60 billion in 2019. In 2019, the top three imported goods from Malaysia were machinery and transport equipment (48%), miscellaneous manufactures (26%), and material manufacture (10%). UK exports to Malaysia mainly comprise of machinery and transport equipment (49%), chemicals (17%) and miscellaneous manufactures (12%).³⁹ The top three imported goods from Malaysia have remained the same since 2014.

³⁷ National Bibliometric Study (2001-2017) Bibliometric Study 2015, Bibliometric Study 2012, Bibliometric Study 2008 and Bibliometric Study 2003.

³⁸ The Edge Markets (2020) More needs to be done to boost UK exports to Malaysia, says British envoy. Available at: <https://www.theedgemarkets.com/article/more-needs-be-done-boost-uk-exports-malaysia-says-british-envoy>

³⁹ Data extracted by Office for National Statistics UK.

Figure 5. Malaysia – UK trade in goods



Source: Office for National Statistics UK. Unit: billion £

The relationship between Malaysia and the UK is underpinned by centuries of direct contact and exchanges. It can be described as mature, with a clear willingness to deepen areas considered strategically important by both sides, such as science, trade, knowledge exchange, and innovation. To date, Malaysia has had the strongest student engagement with the UK among all Newton Fund countries. At End line, the UK was the most popular destination for international study for Malaysian students.⁴⁰

However, the strength of people-to-people relations and research networks between Malaysian and UK researchers predates the Newton Fund. Pre-existing research networks have been a major catalyst to a range of projects implemented under the NUOF, including those sampled as part of this case study. Numerous Malaysian graduates from UK universities returning to Malaysia have a strong interest in collaborating with UK and UK-affiliated institutions. This is partly due to their familiarity with the UK and its research practices and their perception of further career opportunities and professional development options that could arise through further collaborations with UK networks or UK-funded projects.

2.6 International collaborations in science & innovation (S&I)

Malaysia has long-standing cooperation agreements in the science and technology fields with both the UK and others, including the EU and other Asian countries like Japan.

Malaysia is on track to become an ‘Education Hub’ of the ASEAN region and ranks as the 11th largest exporter of education in the world.⁴¹ British products and services linked to education and training were worth over £280m in 2018.⁴² The UK and Malaysia have a high number of education ties: approximately 60 UK tertiary institutions have links or collaborative arrangements with Malaysian counterparts. Malaysia has the third largest Chevening

⁴⁰ Baseline Study Updates, p. 1; student engagement defined in line with methodology delineated by Universities UK International. 2019. International Facts and Figures 2019.

⁴¹ Cheng, & Mahmood, & Yeap, Guan-Yeow. (2013). Malaysia as a regional education hub: A demand-side analysis. Journal of Higher Education Policy and Management. 35. Available at:

https://www.researchgate.net/publication/263754573_Malaysia_as_a_regional_education_hub_A_demand-side_analysis

⁴² UK-ASEAN Business Council (2018). Introducing British Education and Training Providers to Malaysia and Indonesia. Available at: <https://www.ukabc.org.uk/event/introducing-british-education-training-providers-malaysia-indonesia/>

programme in the world.⁴³ As of 2020, there are ten international university campuses in Malaysia. From the UK, these include Heriot-Watt University, Newcastle University (for Medicine), the University of Nottingham, the University of Reading, and the University of Southampton (for Engineering).⁴⁴

Aside from the Newton Fund, the UK’s other main research and innovation initiative in Malaysia is the Global Challenges Research Fund (GCRF), also implemented by BEIS. The Prosperity Fund also operates in Malaysia and focuses on strengthening economic governance, anti-corruption, Islamic finance, education partnerships, healthcare, and enhancing low-carbon cities and green energy. Initiatives similar to the Newton Fund, from both the UK and others, are summarised in Table 4.

Table 4: Summary of major funding initiatives similar to the Newton Fund

Funding initiative	Description of activity
Global Challenges Research Fund	A £1.5 billion fund announced by the UK Government in late 2015 to support cutting-edge research that addresses challenges faced by emerging countries and implemented by BEIS.
ASEAN-EU Cooperation in Science, Technology and Innovation jointly tackling global challenges (SEA-EU-NET II)	An EU programme active between 2012 and 2016 to support research collaboration activities between EU member states and ASEAN countries, as part of ASEAN participation in the Horizon 2020 economic development programme. Activities involved 21 institutions and focused on three areas: health, food security and safety, and water management.
Horizon 2020	Horizon 2020 is an €80 billion EU funding programme for research and innovation which started in 2014. Its thematic pillars are: i) excellent science; ii) competitive industries; and iii) tackling global societal challenges. Funding is available for entities from across the world, ⁴⁵ and by 2020, 28 projects were carried out with the government of Malaysia.
Science and Technology Research Partnership for	A Japanese programme ⁴⁶ aimed at promoting international joint research. Between 2008 and 2019, there were 145

⁴³ GOV.UK (2013) UK university success in Malaysia, Available at: <https://www.gov.uk/government/news/uk-university-success-in-malaysia>

⁴⁴ Prospects (2019) Study in Malaysia. Available at: [https://www.prospects.ac.uk/postgraduate-study/study-abroad/study-in-malaysia#:~:text=There%20are%20also%20ten%20international,University%20of%20Southampton%20\(engineering\)](https://www.prospects.ac.uk/postgraduate-study/study-abroad/study-in-malaysia#:~:text=There%20are%20also%20ten%20international,University%20of%20Southampton%20(engineering)).

⁴⁵ List of countries eligible for the funding can be found at: Horizon 2020 Work Programme 2016 – 2017, available at: https://ec.europa.eu/research/participants/data/ref/h2020/other/wp/2016-2017/annexes/h2020-wp1617-annex-a-countries-rules_en.pdf

⁴⁶ The programme was developed by three organisations: Japan Science and Technology Agency, Japan Agency for Medical Research and Development and Japan International Cooperation Agency.

Sustainable Development Program (SATREPS)	projects in 51 countries. The project budget is approximately £740,000 per project per year. ⁴⁷
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The long-standing Malaysia-EU cooperation in science and technology has provided institutional linkages and funding support. The **SEA-EU-NET II** was the successor to SEA-EU-NET, which was initiated to “*expand scientific collaboration between Europe and Southeast Asia*”. The four-year programme, which ended in 2016, was coordinated by the German Aerospace Centre. It involved 22 institutions from 17 countries in the two regions, including the Standard and Industrial Research Institute of Malaysia. Its science and technology projects specifically focused on societal challenges of health, food security and safety, meteorology, and water management. Activities included workshops, knowledge exchange, fellowships, and a bi-regional funding scheme.

There are 19 ongoing projects and nine completed projects involving Malaysia under **Horizon 2020** as of July 2020.⁴⁸ In 2020, the Bio-TUNE project, coordinated by the Polytechnic University of Catalonia, was launched to support collaboration between five EU participants and four partner countries, including Malaysia. The four-year project has a budget of €814,200 and aims to develop innovative multifunctional materials to produce a new generation of medical implants with cell instructive and antibacterial potential.⁴⁹

Japan’s **Science and Technology Research Partnership for Sustainable Development Program (SATREPS)** was launched in 2008 to promote international joint research. The programme supports four research fields, including environment and energy, bioresources, disaster prevention and mitigation, and infectious disease control.⁵⁰ As of 2019, seven projects were carried out in Malaysia under SATREPS. There are four ongoing projects, two of which⁵¹ started during the evaluation period, focusing on the environment and energy fields.⁵²

According to many stakeholders consulted as part of this case study, the UK is the number one partner for Malaysia in science and research collaborations. However, China, Japan and South Korea are also quite active in financing research activities. Compared to the UK, China stands out as funnelling more funds into projects without requiring match funding in return. This might be preferred by some researchers and research institutes, although in general, the match funding model is especially appreciated by Malaysian government representatives, as further outlined below. South Korea, Japan and Germany are seen as having particular expertise in certain research areas, such as energy, bioresources, disaster prevention and mitigation, and infectious diseases. Projects funded by these donors are seen as stronger in some thematic

⁴⁷ SATREPS (n.d.) About. Available at: <https://www.jst.go.jp/global/english/about.html>

⁴⁸ European Commission (n.d.) CORDIS – EU Research Results. Available at: [https://cordis.europa.eu/search/en?q=contenttype%3D%27project%27%20AND%20\(programme%2Fcode%3D%27H2020%27\)%20AND%20relatedRegion%2Fregion%2FeuCode%3D%27MY%27&p=1&num=10&srt=%2Fproject%2FcontentUpdateDate:decreasing](https://cordis.europa.eu/search/en?q=contenttype%3D%27project%27%20AND%20(programme%2Fcode%3D%27H2020%27)%20AND%20relatedRegion%2Fregion%2FeuCode%3D%27MY%27&p=1&num=10&srt=%2Fproject%2FcontentUpdateDate:decreasing)

⁴⁹ European Commission (2021) CORDIS - Fine tune of cellular behavior: multifunctional materials for medical implants. Available at: <https://cordis.europa.eu/project/id/872869>

⁵⁰ SATREPS – Research fields and areas. Available at: https://www.jst.go.jp/global/english/area_of_research.html

⁵¹ ‘Development of Management Systems for Cultural Utilization of Biodiversity in the Tropical Rainforests at the National Parks in Sarawak’ and ‘Sustainable Replantation of Oil Palm by Adding Value to Oil Palm Trunk through Scientific and Technological Innovation’.

⁵² SATREPS – Projects. Available at: <https://www.jst.go.jp/global/english/kadai/index.html#>

areas, but the Newton Fund (and the broader UK suite of programmes) has more thematic diversity. Respondents did not frequently mention USAID and the French Development Agency.

3 Emerging results of the Newton-Ungku Omar Fund in Malaysia

This section sets out the emerging results of the Newton-Ungku Omar Fund. The findings are based on the three calls included as part of the case study as well as the broader consultations undertaken with the programme team (see Section 1.4 for details of the methodology).

3.1 Key findings

Overall, case study research shows that the NUOF can be considered a success story of UK-Malaysia collaboration. Consulted stakeholders reflected on its value in producing high-calibre research and raising the UK's profile as the research and innovation partner of choice for Malaysia. The support provided by the UK in the R&I sphere is seen as mature, responsive to Malaysian needs, and reflective of the strong relationship between the two countries.

The Newton Fund has been an important contributor to reinforcing strong, pre-existing links between the UK and Malaysia, but was not the only factor contributing to the projects' success and research relationships.

At the project level, the Fund's activities have helped increase the number and quality of research outputs, such as research papers, collaborations, commercial products, patents, and further follow-up research activities. If taken to scale, some of the projects have the potential to address not only specific socio-economic priorities for Malaysia, but also contribute to equitable growth and potentially to poverty alleviation in the long run.

As a reflection of the strength of the partnership with the UK, the Malaysian side has a strong interest in maintaining the ties with the UK and continuing to attract the current level of match funding from the UK side. The benefits accrued to Malaysia include access to cutting edge research methods and technology, in fields such as medical sciences and cancer research.

3.2 Factors supporting the NUOF's performance

The match funding delivery model is a key strength of the Newton Fund programme. Through this model, the NUOF has enhanced the UK's standing as the partner of choice for R&I collaborations. Match funding provides a sense of ownership among the Malaysian partners. The Malaysian government has suggested that this model be applied by other donors (although no evidence has been collected that this change has happened yet).

Match funding significantly increases buy-in and ownership among Malaysian researchers and institutions and is a preferred mode of collaboration to direct grants. Match funding also creates a sense of equal partnership. Researchers from both sides of the partnership collaborate on an equal footing and have an equal input to project design, rather than it being a donor-led process.

The Newton Fund In-Country Team (ICT) is recognised by stakeholders as playing an important role in ensuring the success of the programme. This includes the ICT's ability to advertise funding opportunities effectively, attract talented researchers and maintain communications with the Fund's stakeholders (Malaysian government ministries, UK DPs and

the Singapore-based NF team). Having an ICT to coordinate, facilitate and support relationships was a key strength of the programme.

The NUOF in Malaysia has a solid brand name, thanks to the success of flagship projects, such as the Green Data Centres. It serves as a model that the Malaysian government uses when initiating conversations with other donors about potential research collaborations.

While the NUOF is generally considered a very successful model of delivering research and innovation outputs, there are some remaining challenges and potential areas for improvement. From the Malaysian perspective, minor improvements to the project delivery modes could heighten its appeal to top researchers including:

- **Improve the flexibility of the Fund.** Once the funding for a project and the Delivery Partners are locked in place, there is reportedly little room to modify arrangements according to emerging research needs.
- **Project proposals could be more tailored to the Malaysian context.** Malaysian researchers and DPs are keen to make their research projects more cross-cutting and to introduce several themes of interest to respond to emerging needs and development priorities. UK DPs tend to be more focused on their research sector and in some cases, project proposals could be more tailored to the Malaysian context.
- **A better monitoring function** would allow researchers to track their progress in real-time and communicate success stories based on hard evidence. This is a Fund-level observation across the whole Newton Fund.
- **Provide more timely clarity on future funding phases.** There is an expectation that UK partners will continue funding projects through a second phase of the Newton Fund programme, which would further solidify the UK's status as the preferred partner of choice. A reduction in UK support could create a gap that, if not managed well, could be filled by other country partners.

4 Project: Next Generation Green Data Centres for Environmental and Business Sustainability

Summary

Project title	
Next Generation Green Data Centres for Environmental and Business Sustainability	
Call title	Research and Innovation Bridges
Short description	This project fits under the Research and Innovation Bridges programme call. It was an industry-academia collaboration between Green Data Centers LLP, Universiti Teknologi Malaysia, Dearman Engine Company and Heriot-Watt University. Green Data Centers LLP are the lead for this project.
Objective(s)	This project aimed to integrate existing technologies from the Green Data Center LLP and Dearman Engine to cool data centres, reduce the power outages in operating data centres, and take heat and energy released from data servers and convert them into electricity. The intended results were: reducing noise and atmospheric pollution from data servers and having energy security (without the need for a backup generator).
Pillar	Research
Acton value (total budget allocated in country, in GBP)	£628,520.00 (UK funding) MYR 9,158,899 (Malaysia funding)
Start/end date (Status: on-going or complete)	Start date: 14.11.2016 End date: 31.12.2019 Status: Completed
DP UK and overseas	Innovate UK (part of UKRI), MIGHT
Award holders/ grantees	Heriot-Watt University, University Teknologi Malaysia

Description of the project

The Next Generation Green Data Centres collaboration stemmed from the realisation that data centres (or huge servers that service the cloud computing needs, also referred to as ‘data farms’) have noticeable environmental impacts because of their high energy usage. The global data centre/storage industry generates a large share of greenhouse gas emissions: up to 2.5%-3% of global greenhouse emissions, which is almost on par with the aviation industry. This figure is expected to increase to 6% in the next ten years. If data centres were a country, it would rank fifth in the world in terms of CO² emissions.

While Malaysia itself is not a major player in the data centre industry (it has 32 data centres out of global 6205, representing 0.5% of the global market⁵³), it nevertheless hosted a sufficient number of data centres to present a CO² emissions reduction opportunity and, if successful, a business opportunity for the technology developer.

Main collaboration stakeholders

The project involved four stakeholders: two universities (UTM from Malaysia and Heriot-Watt from the UK) and two companies (Green Data Centres in Malaysia and Dearman Engine Company). Green Data Center LLP, the Malaysian counterpart for the project, is a family-owned company whose CEO invented the Submersify liquid cooling technology, which harnesses liquid air to deliver zero-emission power and cooling. In late 2019, Dearman Engine entered administration,⁵⁴ and was sold to Clean Cold Power.

Although this project was implemented under the Research Pillar, it fits well with the Theory of Change pathway for both Research and Translation pillars, as shown in Annex 4, Figure 6. The project applied existing technologies and industry experience, together with expertise from academia, to design and implement a product that uses minimal space and enables energy released from data servers to be re-used.

The project formed a link between industry and academia. For the companies involved, benefits were expected to include access to labs, equipment, and scientific expertise. It was hoped that it would lead to better understanding of the business world for the academics involved. The collaboration most strongly benefited the owner of the original intellectual property (IP) for the cooling solution, Green Data Centers LLP. The Malaysian commercial counterpart leveraged the collaboration and knowledge gained to create a new commercial solution for community data centres in the Malaysian market.

Pathway to impact

Figure 6 (in Annex 4) illustrates how collaborations under the Research and Innovation Bridges programme call relates to the theory of change for Newton Fund People and Translation Pillar activities. The partnership consists of the following:

Activities: The main **inputs** of this collaboration under the NUOF included:

- the Research and Innovation Bridges programme call – which required the collaboration to include parties from both academia and industry.

⁵³ Data collected from DATACENTE.RS WORLD MAP (n.d.). Available at: <https://www.datacente.rs/>

⁵⁴ Jones Day (2020). Dearman Engine Company enters administration. Available at:

<https://www.jonesday.com/en/practices/experience/2020/01/dearman-engine-company-enters-administration>

- focus on research and translation aligned with global challenges, targeting a reduction in greenhouse emissions.
- activities to strengthen and establish links and support an exchange of expertise (e.g. weekly conference meetings, strong communication links).
- activities to test the Submersify liquid cooling technology and the Dearmon Engine technology in outdoor, sheltered data centres to measure the system's energy gains and the viability of placing data centres outdoors.

Expected outputs: It was expected that the project would result in a marketable, sustainable computing model for Next Generation Green Data Centre Farms, replicable for use anywhere in the world, and academic research papers, publications, and presentations of emerging findings.

Expected outcomes: It was expected that the collaboration would involve a 50% reduction of energy consumption by data centres through a novel fluid submersion cooling process, the provision of zero-emissions backup power generators utilising innovative Dearman cryogenic engine technology, and fostering the creation of a green technology commercialisation hub in Malaysia.

Expected impact: The project sought to enable sustainable computing growth while simultaneously supporting manufacturing and enhanced job opportunities, improving energy security, and reducing CO² emissions. This would lead to improved urban air quality and enable sustainable connectivity and digital development.

4.1 Emerging project results

Relevance of Newton Fund activities

ODA relevance

The activities of the Green Data Centres project targeted economic development and socio-economic development in Malaysia. The thematic focus of this collaboration had a clear link to the NUOF's priorities for Malaysia. The project contributes to the NUOF's Priority 2 of improving environmental resilience and energy security in Malaysia.

The partnership could ultimately increase access to economic opportunities associated with increasing internet connectivity among low-income groups. Commercialisation of the spin-off product, the community data centres, if taken to scale, have the potential to generate employment and reduce costs of data transmission across neighbourhoods, including in low-income areas.

Relevance to Malaysia's socio-economic priorities

The project closely aligns with Malaysia's focus on energy and the environment and tackles global challenges related to global warming and excess greenhouse emissions. A collaboration linking the pre-existing technologies emerged from a matching workshop organised at the start of NUOF activities by the British High Commission in Kuala Lumpur.

The collaboration has created the opportunity to produce a technology which is deeply relevant to the fast-developing data storage and cloud computing industry. It has allowed the development of a nascent innovative idea through to commercialisation. The project has

allowed Malaysian academics to improve their technical understanding, improve their ability to disseminate research and work with industry.

Origins and quality of the collaboration

In Malaysia, the frequency of power outages caused by overheating poses a challenge for data centres. The technology initially developed by GDC aimed to reduce these outages. Liquid coolant technology could allow for substantial savings for traditional data centres, where servers are cooled by air conditioning. The project's idea originated in Malaysia, with the Dearmon Engine technology as an extension to this concept.

The project served as a testing ground for the combined technologies. Using standard shipping containers to host a large number of servers and the combined GDC and Dearman technologies and stacking them into a block formation, the integrated system became more resilient to extreme weather, power failure, and low-cost technologies.

Additionality

The Green Data Centres project would not have taken off without Newton Fund support. It was supported through the networking activities of Newton Fund and the High Commission staff in Malaysia. The partners had not previously worked together. The Newton Fund has facilitated contact with academic partners in Malaysia (UTM) and the UK (Heriot-Watt University) and helped to identify a commercial partner in the UK (Dearmon Engine Company, later sold to Clean Cold Energy).

The project benefitted from the Newton Fund model whereby academic and commercial partners with different expertise could collaborate and leverage each other's strengths, which would have otherwise not been available to the other parties in the partnership.

4.2 Effectiveness of Newton Fund activities

Translation of research into collaborative solutions to address development challenges

This was a successful collaboration between Malaysia and the UK, the benefits from which could translate into an innovative product that can help address development challenges. The combined technology, known as KoolKUBES, was found to have the potential to reduce energy consumption and generated interest in the Malaysian and international community. The technology was further developed by the Malaysian PI following the collaboration, leading to the Community Data Centres spin-off product. The outputs of the collaboration were:

- project-related workshops at Heriot-Watt University's Edinburgh and Dubai campuses.
- a paper accepted for publication in an electronic journal, Procedia Manufacturing.
- attendance at the 15th global conference on sustainable manufacturing (GCSM) organised by Technische Universität Berlin and Technion Haifa in Haifa, Israel in 2017.
- a paper published in the Journal of Renewable and Sustainable Energy Reviews, titled: 'Sustainable and Resilient Data Centres: A review of existing and emerging cooling technologies'.
- a Dearman Engine exhibit at Engine Expo in Germany (Stuttgart, 2019).

- recognition from MIGHT in the form of displaying the KoolKUBE cooler in its main foyer.
- securing a RM33.96 million (about £6,109,221) contract to build and deploy an ultra-green data centre facility in Shinsei Malaysia 1, south-east Asia's largest data centre.
- installation of an exhibit clean data centre at MIGHT premises.
- a commercial spin-off of the project's KoolKube technology. GDC is selling its data centres services to Malaysian Telcom tower operators.

The combination of complementary technologies resulted in an innovative product. For Malaysian partners, engagement in the Newton Fund helped establish new international links and partnerships. It resulted in tangible benefits in installing cooling data servers in the largest Malaysian 'data farm'. The opportunity to experiment with British technology helped enhance the operational efficiency of the system. The Green Data Centre's existing product has received high interest from other countries after exposure via the Newton Fund. For example, it was reported that an Australian company has contacted the Green Data Centre to use this technology in a solar panel farm.

The IP was split between the Green Data Centre and Dearman Engine allowing both the UK and the Malaysian PIs to continue if the other party discontinued their engagement in the project. UTM and Heriot-Watt's role was to provide additional research assistance and capability to the GDC and Dearman Engine companies and undertake research that both companies could not carry out in-house. In return, both universities had a chance to expose their researchers to the business world and apply research practices.

Capacity building of Malaysian researchers and institutions

The project outputs strengthened capacity among individual researchers, showcasing some results relevant to the People Pillar of the Newton Fund Theory of Change. While academics were able to learn more about the commercialisation of innovation and business processes, award-holders from industry also benefited from close collaboration with academics and research institutions. For Malaysian award-holders, the project was beneficial for students and researchers at UTM by enhancing their commercial knowledge.

UTM has developed a reputation for international collaboration. The researchers involved at UTM had already taken part in several NUOF programmes before, during, and after the funding was awarded for this collaboration. As a result of being involved in various Newton funded projects, UTM are being approached for guidance on NUOF applications and advice on how to engage with industry. Newton funding has also helped the University's overall ranking and increase its international collaboration.

Capacity-building of UK researchers and institutions

For UK partners, taking part in Newton Fund activities has heightened the potential to collaborate with international partners, including in Malaysia. Researchers at Heriot-Watt University were exposed to the novel technology developed in Malaysia and enhanced their expertise in the heat exchange transfer sector. Through the project, the Dearmon Engine company had the opportunity to test its technology jointly with the Submersify technology.

Challenges in the collaboration

There were some climate challenges in applying the technology in Malaysia. An adapted engine was tested in 2018 in Malaysia and initial teething problems were overcome, which led to the development of heat exchange transfer models and electricity conversion models suitable for a tropical climate.

There were some initial challenges in combining the working cultures of business and academia. One of the award-holders from industry was unsure why academic counterparts were not delivering outputs quickly and instead spent a large amount of their time going through detailed and lengthy analysis, design and methodology. After receiving the first output, he realised, however, that their company could not have produced this research, and that investing time at the outset would help avoid problems later down the line.

4.3 Emerging signs of impact

In the long run, the project is anticipated to help address broader socioeconomic challenges in Malaysia. The final products, the KoolKUBE and the Community Data Centres, if applied commercially at scale, have the potential to increase environmental resilience, reduce noise, atmospheric pollution and CO² emissions associated with cooling data centres using traditional technology.

Improving the speed of data transmission in Malaysia, if taken to scale, could generate jobs by making the country the manufacturing base of this technology. If the product were commercialised outside of Malaysia, this would further help reduce the carbon footprint, not only from data centres but also from other sectors.

Liquid cooling technology can be applied to other industries, such as vaccine production. These potential benefits could be realised even without the UK-based PI's inputs, the Clean Cold Power company, as the Malaysian PI retains the IP rights to the core Submersify technology and has enhanced the product further since project closure.

The NUOF is helping improve the relationship between the UK and Malaysia and saw it as very easy to work with UK counterparts because the countries share similar processes and systems. Perceptions of the UK in Malaysia have remained similar and positive.

The spin-off Community Data Centre can be placed underneath telecom towers resulting in more efficient running and faster data transmission. As a result of faster data transmission in the vicinity of the centre, the Green Data Centres company charges streaming services to provide a better service to end consumers of data and share the general data transmission revenues with the telecom tower owners.

Signs of sustainability

The Green Data Centres project evolved after the project was completed. The UK commercial partner (or its successor), the Clean Cold Energy company, has currently placed the project on hold, focusing on the UK domestic market. The contribution of the original UK PI to the technology created and explored throughout the project was smaller than the Malaysian counterpart, GDC. The original idea for cooling data centres came from the Malaysian PI himself, who aimed to experiment with making the system more efficient and enabling its

application outdoors. This has translated into greater sustainability of the research results for the Malaysian side of the collaboration.

Since the end of the initial project, GDC has tested their solution on an industrial scale. The actual solution that GDC commercialised (the Community Data Centre) is slightly different from the original idea set out in project design. However, it still emerged as a result of testing the technology in the outdoor setting together with Dearmon Engine, which is directly attributable to the Newton Fund.

Early separation of IP between the project collaborators supported sustainability by allowing either party to leave the collaboration. This was designed into the collaboration as a risk mitigation factor in case of failure of the joint technology to produce a sustainable or a marketable technological solution. The sale of Dearmon Energy and the resulting move away from the project on the UK side shows that this was a correct approach. Retaining their IP allowed GDC to continue developing outdoor installations of self-cooling data centres, creating a commercial spin-off of the initially tested KoolKUBE and transforming it into the Community Data Centre.

Complementarity and coordination

The project was not designed to affect policy change as it had a very practical, commercial application in mind, with a range of resulting environmental benefits. The purpose of most of the projects in this call has been to deliver practical and commercial outputs without ambition to influence policy, although stemming directly from priorities outlined in national and sectoral development plans. Malaysian award-holders received regular contact and effective operational support from MIGHT, for example, when components of the Dearmon engine were shipped to Malaysia.

4.4 Conclusions

- **The expected impacts of the project were to enable sustainable computing growth while simultaneously supporting manufacturing and enhanced job opportunities,** integrating novel Malaysian and UK green energy and cooling technologies to reduce energy consumption by 50%, improving energy security and reducing CO² emissions, improving urban air quality, enabling sustainable connectivity, supporting the sustainability of the data centre industry, and creating a green technology commercialisation hub in Malaysia.
- **The project combined the Malaysian GDC's Submersify liquid cooling technology and the UK Dearman engine's zero-emission cooling and power generation technology in an innovative way.** The project tested the Submersify liquid cooling technology and the Dearmon Engine technology in outdoor, sheltered data centres to measure the system's energy gains and the viability of placing data centres outdoors.
- **The partners had not collaborated before and were brought together by the Newton Fund networking efforts.** A collaboration linking the two pre-existing technologies through the Green Data Centres project would not have taken off without Newton Fund support, specifically without initial networking activities.
- **The project is a positive example of collaboration between Malaysia and the UK.** It has resulted in the experimentation and application of more efficient technologies, shown to have the potential to increase energy efficiency and sustainability, and reduce greenhouse

emissions. The research findings have resulted in the commercial application of the tested solution on the part of the Malaysian PI.

- **Results can be directly attributable to the Newton Fund.** Green Data Centres have tested their solution on an industrial scale. While the actual solution that the Green Data Centres eventually commercialised is slightly different to the original idea set out in the project design, it emerged as a result of testing the technology in the outdoor settings together with Dearmon Engine.

Lessons learned and points to consider going forward

- **The separation of IP rights for UK and partner country companies is good practice, especially if partners do not have a pre-existing history of working together.** If one party falters or leaves for whatever reason, the other is free to carry on the work from the project and develop further solutions. The research carried out in this project led to an exchange of ideas without compromising on IP rights, and enabled sustainability of research insights and findings on the part of the Malaysian PI.
- **Early networking events can be highly effective and crucial to project initiation.** A networking event organised by High Commission staff enabled the initial contact between GDC and Dearmon Engine.
- **The academic partnerships resulted in students experiencing the commercialisation process, making this one of the most successful NUOF projects.** The Green Data Centres project also shows that a successful project could be one where only one of the four main stakeholders continues the project's work and successfully commercialise it. GDC was able to take advantage of the opportunities enabled by the Newton Fund and develop them further.

5 Project: Micro bubble aeration system for nursery pond of shrimp aquaculture in Malaysia under energy, water quality and biofloc circulation constraints

Summary

Project title	Micro Bubble Aeration System For Nursery Pond Of Shrimp Aquaculture In Malaysia Under Energy, Water Quality And Biofloc Circulation Constraints
Call title	Joint call for small scale research and networking activities with South East Asia, including Malaysia
Short description	This project focuses on supporting microbubble aeration and increasing the oxygenation of water used in shrimp aquaculture farming to increase the yield of edible shrimp production.
Objective(s)	The main purpose is to increase food security in Malaysia via enhanced yield from shrimp aquaculture ponds. The project is divided into two parts. One is developing the method to create microbubbles (decreasing the dimension of bubbles in incumbent technology). The second is to test the feasibility of microbubbles in water to avoid the need to replace water needed in shrimp farming (reducing water pollution) and test the possibility of increasing yield.
Pillar	Research
Action value (total budget allocated in country, in GBP)	£91,848.33 (UK funding only)
Start/end date (Status: on-going or complete)	Start date: 15.05.2017 End date: 14.11.2019 Status: Completed

DP UK and overseas	Engineering and Physical Sciences Research Council (EPSRC) (part of UKRI), Ministry of Higher Education (MOHE)
Award holders/ grantees	Teesside University, University of Malaya

Description of the project

The ‘Micro Bubble Aeration System For Nursery Pond Of Shrimp Aquaculture In Malaysia Under Energy, Water Quality And Biofloc Circulation Constraints’ project is part of the UK – south-east Asia small scale research partnerships call rolled out between UK Research and Innovation (UKRI) (previously Research Councils UK, or RCUK) and multiple south-east Asian research organisations.

This call provided flexible, short-term support for small-scale research to establish sustainable collaborations between UK and south-east Asian researchers in Indonesia, Malaysia, the Philippines and Thailand. UKRI (previously RCUK) led the call, in collaboration with seven research councils⁵⁵ and counterpart south-east Asian research organisations.⁵⁶ Partners in the project were the Malaysian Ministry of Higher Education and EPSRC.

The project tested the potential of adapting microbubble aeration technologies to shrimp aquaculture to benefit shrimp farmers in Malaysia. It sought to harness efficient new technologies and reduce the cost and environmental impact of shrimp farming to make the industry more sustainable from both an economic and environmental perspective.

Historically, shrimp aquaculture in Malaysia has been intensive but less productive than in neighbouring countries (such as Indonesia, Thailand and Vietnam). Recently Malaysia moved towards ‘super-intensive aquaculture’. To improve inefficient (and water-intensive) practices, the project created a controlled aquaculture environment to improve the productivity and yield of shrimp aquaculture ponds. Through microbubble aeration, it aimed to raise the saturation level of oxygen in the water to enhance any farmed organisms' growth.

Using marine prawns, the project team studied how biofloc (micro-organisms such as bacteria benign to shrimp, which naturally filter water) help maintain water quality and reduce the frequency of changing the water in aquaculture ponds. Instead, ammonia from the water would be converted by biofloc to clean organic matter.

The project tested the operational effects of a microbubble aeration system on biofloc, and the combined effect of microbubbles and biofloc in a shrimp pond. Previous studies investigated microbubble and nano-bubble technology principles and applications for water treatment and

⁵⁵ Engineering and Physical Sciences Research Council (EPSRC), Arts and Humanities Research Council (AHRC), Biotechnology and Biological Sciences Research Council (BBSRC), Economic and Social Research Council (ESRC), Natural Environment Research Council (NERC), Medical Research Council (MRC) and Science and Technology Facilities Council (STFC)

⁵⁶ The Malaysian Ministry of Higher Education Malaysia (MOHE), the Indonesia Science Fund (ISF), the Ministry of Research Technology and Higher Education Republic of Indonesia (Ristekdikti), the Department of Science and Technology Philippines (DOST), the Thailand Research Fund (TRF) and the National Astronomical Research Institute of Thailand (NARIT).

oxygen saturation in water and looked at novel designs of microbubble generators for bodies or tanks of water.

Separately, as a different research strain, shrimp and marine aquaculture methodologies were explored in a body of literature in Malaysia and globally. Only one research paper, *Fisheries experiments of cultivated shells using micro-bubbles technique*, published in Journal of the Heat Transfer Society of Japan in 2005, showcases some of the (limited) research carried out at the intersection of these disciplines.

Pathway to impact

Figure 7 (Annex 4) shows how the project fits with the Theory of Change for Newton Fund and with both the Research and Translation Pillars' activities and outputs.

Activities

- an off-field based study (in a controlled water tank environment) to test:
 - detailed characteristics of a microbubble aeration system in terms of its operational capabilities.
 - the suitable microbubble aeration system and configuration for a nursery pond of shrimp aquaculture.
 - the energy/power requirement of a microbubble aeration system.
 - the effect of a microbubble aeration system on biofloc and its circulation.
- a field test (in actual aquaculture ponds) assessing:
 - the effect of a microbubble aeration system on water quality and shrimp growth.
 - the effect of a microbubble aeration system on effluent water.
- the production of research papers.
- visits to shrimp farms.
- attendance at training courses on shrimp culture, water quality and biofloc.
- lab-scale experiments at the University of Malaya.

Expected outputs

- a research paper on developing and designing the microbubble generator, titled: *Effects of the geometrical configuration of air-water mixer on the size and distribution of micro-bubbles in aeration systems*. The paper was submitted for an Asian-Pacific chemical Engineering Journal and was under review at the time of this case study.
- a prototype of the microbubble generator; the experimental setup to record microbubbles in a finite volume of water, and an image-processing method to extract histograms of bubble diameter from a visualisation of a cloud of microbubbles.
- a calibrated model of the flow condition in tanks required to optimise aquaculture outputs.

- a conference paper published in April 2019 in Rome, Italy, at the 4th World Congress on Momentum, Heat and Mass Transfer, titled *Initial Results from the Experimental and Computational Study of Microbubble Generation*.
- two further research papers currently under preparation and peer review.
- a patent proposal submitted to Teesside University in December 2018 for an initial assessment to approve the funding for a patent application for the novel microbubble generator.
- two PhDs completed at the end of 2019 supervised by the UK PI.

Expected outcomes

- The project's main outcome was the model microbubble aeration system for use in aquaculture. Findings from the collaboration were disseminated to the Malaysian Ministry of Agriculture and the agriculture industry players in Malaysia via presentations and demonstrations. Researchers found a significant improvement in terms of water quality and shrimp size in the treatment sample. The actual technical solution was showcased to shrimp farmers in Malaysia more broadly to generate their interest in this system and potential application.
- Further testing on other species has been undertaken since completing the project, expanding to marine shrimp and even fish. Additionally, numerical models on shrimp farming productivity, energy and water use, and effluent reduction have been created. They could be applied to real-life settings or in bigger ponds to promote the potential of the project outcomes.

Expected impact

- Should learning from the project be taken to scale and tested in real-life, larger aquaculture ponds, a potential impact project will be to increase food security in Malaysia, a country where fish and seafood consumption is high, and the need to feed an increasing population is ever-present. There could also be a positive environmental impact from the reduced water usage in aquaculture, stemming from the decreased need to change the water during the shrimp growth process and the lower water pollution levels, as the biofloc would naturally remove the organic waste produced by shrimp.

5.1 Emerging project results

Relevance of Newton Fund activities

Activity targeting and ODA relevance

The projects' research contributes to SDG 2 (zero hunger and improved food security) and SDG 6 (clean water and sanitation, with a focus on avoiding wasting water). It has indirect relevance to ODA objectives of advancing the sustainable development goals, tackling the evolving global challenges to alleviate poverty and ensure prosperity. If taken to scale, the Shrimp Aquaculture project would have more direct potential to support poverty alleviation and lead to socio-economic benefits.

Targeting of Malaysian priorities

The project is relevant to both the Newton Fund and its Malaysian partners' food security and environmental sustainability priorities. The project has proposed a new direction for shrimp aquaculture in Malaysia to reduce the cost and environmental impact of shrimp farming and improve its sustainability. It has tackled the need to rapidly replace traditional aquaculture methods in Malaysia due to climate change and water pollution. Agri-technology is one of the specific priorities of the NUOF.

Additionality

Neither the Malaysian nor the UK PIs would have gone ahead without the Newton Fund, because the idea for it originated as a response to a Newton call for proposals. The project strengthened research networks between the UK PI and international players active in the aquaculture sector. Project outputs have generated interest among UK firms that carry out commercial aquaculture in the far north of Scotland and from individuals in sub-Saharan Africa (specifically Ghana). However, these are at very early stages, and potential collaborations are being discussed, with no project activities undertaken at this point.

5.2 Effectiveness of Newton Fund activities

Research collaborations on topics relevant to economic development and poverty reduction

The project has been prolific in terms of direct research outputs. Researchers from the UK and Malaysia have jointly published two papers in an academic journal and through a conference,⁵⁷ reporting their study findings. They have also submitted a patent application in the UK for the microbubble generator, or a nozzle that generates the reduced microbubbles. The Malaysian PI has also written two research papers, with the potential for further research papers to be produced, drawing on the research data.

The project has not been effective in influencing policy-level changes due to the small scale of activities. Nevertheless, researchers have reached out to farmers with their invention and invited aquaculture producers from around Malaysia to disseminate findings and raise awareness of their technology among potential users. Demonstrations have been successful and have generated interest. However, farmers require findings from studies of a much larger scale to fully take account of the complexity of variables present in live aquaculture ponds and the practical constraints to production.

Translating research findings into improved practices

Food security is an important priority for Malaysia, and the shrimp aquaculture research project holds substantial promise to increase the yield from aquaculture farming. This kind of research is seen as having high value with potential to lead to economic, nutritional, and environmental gains. Researchers have been working to realise this potential and following the project, the Malaysian PI carried out further research on his own.

⁵⁷ *Effects of the geometrical configuration of air-water mixer on the size and distribution of micro-bubbles in aeration systems*; Asia-Pacific Journal of Chemical Engineering, 2018; and *Initial Results from the Experimental and Computational Study of Microbubble Generation*; 4th World Congress on Momentum, Heat and Mass Transfer - Rome, Italy, 2019.

Capacity building of UK researchers and institutions

The project has been successful in terms of promoting capacity building and research excellence among UK participants. As a result of this project, other staff members from the UK PI's institute are applying for Newton Fund opportunities. One of the papers written as a result of this collaboration will be used to prepare a UK Research Excellence application through the Research Excellence Framework.⁵⁸

There were no notable challenges to the collaboration reported for this project. Both PIs knew each other prior to the project, and they have established effectiveness working procedures.

Additional benefits

The project's data is being integrated into the UK partner university's curriculum and some undergraduate and graduate research projects. Research in the same field is being undertaken by researchers from other universities and countries, who contacted the UK PI for guidance. For example, work is underway on a paper on microbubbles and their application in Sudan, led by a science student based in the country. Teesside University is also currently working on a proposal to use microbubbles to remove waste from water surfaces jointly with a PhD student from the Bandung Institute of Technology based in Indonesia.

Commercial research opportunities are being tested with a company based in Durham, and researchers are considering applying for follow-up funding (separate from the Newton Fund) to pursue this. The challenges brought about by the COVID-19 pandemic are delaying further research and translation activities.

5.3 Emerging signs of impact

Potential impact on poverty reduction and economic development

The project has achieved all its stated objectives and is likely to result in a patent application. The project has also led to the production of academic papers and the design of a microbubble generator and a significant amount of data being available at the disposal of researchers. The project's impact on aquaculture farming could be realised should further funding opportunities materialise to carry on the work. At the time of case study research, researchers were preparing applications for further funding opportunities.

The PIs from both the UK and Malaysian side of the collaboration have levered the project's impact by making additional changes to the technology to make it more energy efficient. Modifications to the system are taking place by the researchers who have been investing their private funds to continue their work. Two more aquaculture species, freshwater prawn and a species of fish have been tested in microbubble ponds. Modifications to the technology have already been made, and testing with fish is continuing, all of which is financed by the Malaysian PI.

There are clear signs of efforts aiming to change existing research practices. Towards the end of the Newton project, stakeholders from other Malaysian universities and research institutes were invited to scope out the testing facilities developed through the project and learn more about how the system works. In addition, PIs shared their project data and presented the findings in a Malaysian Technology Expo that publicised their activities.

⁵⁸ Research Excellence Framework (n.d.). Available at: <https://www.ref.ac.uk/>

Some small-scale aquaculture industry businesses in Malaysia were reportedly interested in various system components developed through the project. The Malaysian side of the collaboration is currently in discussions about the next steps in this collaboration.

Some stakeholders felt that if food security considerations were given more attention in the UK, there might be a greater number of follow-up funding opportunities. Agri-technology is stated as the fourth priority of the NUOF and tackling climate change and ensuring sustainable urbanisation are overarching NUOF themes. Arguably, the system devised by this project links at least indirectly to both these themes.

Change in perceptions of the UK

This relatively small project has not resulted in a change in perception of the UK as a partner of choice for research and science collaborations for two reasons: i) the collaboration between researchers and institutions predated the NUOF and were already considered of excellent quality, and ii) the research partnership was of small scale – essentially in the form of a collaboration lead by PIs who knew each other from their PhD studies in the UK – and did not involve other stakeholders whose perceptions could have been affected.

Signs of sustainability

The project has already shown signs of sustainability beyond its funding scope and horizon. Researchers tried to continue their collaboration by applying to the Newton Fund Impact scheme but were not successful. There was no official or written feedback as to why the follow-up funding was not provided. Still, from interviews with other stakeholders of the Fund, it is clear that the quality of applications for the scheme was high in the given year and the panel chose to focus on other projects.

Ongoing research has progressed informally and is being currently self-financed by the PIs. The Malaysian PI is now in possession of a large tank and has brought in a number of researchers from outside of his university and farmers to provide training on the application of the system. Any commercial/at-scale application of the system and resultant changes in aquaculture practices would be dependent on further testing of the system, which should be in live aquaculture ponds and not in tanks. For this purpose, additional funding is required, as aquaculture farmers have not shown an interest or availability to offer their ponds as testing facilities.

Pre-conditions for sustainability

The two PIs are continuing to apply for follow-up funding opportunities, one of which is through the Seafood Innovation Fund through the UK Government.⁵⁹ The UK PI has initiated talks with a company based in Scotland working in the shrimp farming industry, who could not employ microbubbles successfully on their own. Early talks on engagement have been held, but any concrete collaboration has been slow due to the lockdowns related to the COVID-19 pandemic.

Both PIs are working on the initial stage of a micro-aeration project with new stakeholders in Ghana. It is a promising collaboration opportunity because shrimp farming methods across sub-Saharan Africa are less modern than those used in Malaysia, and gains

⁵⁹ UK Seafood Innovation Fund, About. Available at: <https://www.seafoodinnovation.fund/>

could be realised quickly. If this project and application for funding through GCRF are successful, it will open up new opportunities to test live aquaculture ponds in other contexts.

It is likely that, for the continuation and future application of this project, additional funding would be needed for projects focusing on the food security sector.

Complementarity and coordination

The innovations created throughout this project could be taken up commercially either in the UK or Malaysia. Interest was shown by both a firm in Scotland and during demonstrations to farmers in Malaysia. However, as food security is not seen as a very high priority in the UK, this limits the possibility of affecting change in research practice in the UK. To date, there has been limited tangible evidence of commercial uptake of this system, though this has been delayed and negatively affected by the COVID-19 and could be taken up further in the future.

This project has built on a pre-existing relationship between a PhD candidate and a supervisor. Both PIs already had pre-established systems of work based on using their complementary strengths. PIs also reportedly had a workflow in place that enabled them to carry out research and testing in two time zones remotely and without major challenges. **They are continuing to apply for all potential new opportunities jointly.**

It is too early to discuss issues of mainstreaming or uptake of best practice from the collaboration. The small scale of the project and the relatively small body of evidence it has generated still need to be expanded upon through additional research to generate more interest. Partners have undertaken some behavioural change and awareness-raising activities among stakeholders through training on the novel methodology and sharing of project-level data. **Uptake of this technology is contingent upon testing it in live aquaculture ponds and on further funding.**

5.4 Conclusions

- **This project aimed to test the potential of applying microbubble aeration technologies to shrimp aquaculture to benefit shrimp farmers and shrimp production in Malaysia.** The specific technical concept being tested in this collaboration was the use of a nozzle that diminishes the size of the bubbles and increases their velocity and pressure as they enter the water. Increasing the oxygen level aids the growth of shrimp and cleanses the water, a process further enhanced by the presence of biofloc, which provide a natural filtration system.
- **The project fits well with the objectives of NUOF in Malaysia and the aims of this specific call, which focuses on the nexus between water, energy, pollution and food.** More specifically, the collaboration aimed to pilot a methodology which could reduce water use and generate more food utilising less energy and producing less pollution. It was relevant both to Malaysian priorities and NUOF objectives. Given the importance of aquaculture in the Malaysian economy, the project has paved the way to test new, more efficient and environmentally friendly food production methods.
- **The microbubble aeration in shrimp aquaculture farming project was successful, particularly given its small size and its initial ambition to combine two research strands that had not been jointly explored at length previously.** The results and the possibilities for further research exceeded both PIs' initial expectations, who saw significant

results in just two years: through experimental research, publishing research papers and producing a patent application.

- **Should the project's outputs be taken to scale and tested in real-life, bigger size aquaculture ponds, the expected impacts of the project could include increased food security in Malaysia and beyond.** There could also be a positive environmental impact due to the reduced use of water in aquaculture. In fact, the new technology sees a reduced need to change the water during the shrimp growth process and a lower level of water pollution, as biofloc was found to degrade the organic waste produced by shrimp naturally.

Lessons learned and points to consider going forward

- **Further research is being undertaken in this area, although on an informal and self-financed basis.** The researchers are unclear why the project did not receive the Newton Fund Impact Scheme follow up funding. It would be helpful for the selection panel to provide more feedback to unsuccessful teams to help them improve their applications for other funding opportunities.
- **Research findings from this collaboration have the potential to be applied to other countries with small-scale aquaculture production.** There is interest in the project data set from Malaysian aquaculture producers arising from demonstrations, and a Scottish company is interested in its commercial application in the UK.
- **Even though research findings, evidence, and data show significant potential, there are barriers to uptake.** For the system to be tested in live aquaculture ponds, further funding is required to fully explore the application at scale and its potential for commercialisation.

6 Project: The Identification Of Genetic Vulnerabilities In Head And Neck Cancers For The Development Of Novel Therapies

Summary

Project title	The Identification Of Genetic Vulnerabilities In Head And Neck Cancers For The Development Of Novel Therapies
Call title	UK-Malaysia Joint Health Research Call in Non-Communicable Diseases
Short description	New therapeutic targets for oral cancer (type squamous cell carcinoma, or OSCC) are urgently needed. The project conducted work on editing genes from 21 cell lines, primarily derived from Asians, to identify genetic vulnerabilities or specific cells vulnerable to cancers, that can be explored as targets for medical treatment.
Objective(s)	The project objectives are critical to deriving new targeted therapies for neck and head cancer, especially for oral cancer. Cancers of this type do not have very clear genes compared to others, which means that there is no clear sign that genes can be targeted for this kind of cancer. For this purpose, gene editing technology is used to identify relevant genes.
Pillar	Research
Acton value (total budget allocated in country, in GBP)	MRC funding: £208,804.42 ASM funding: £191,226.52 Total amount: £400,030.94
Start/end date (Status: on-going or complete)	Start date: 01.01.2017 End date: 31.12.2019 Project status: Completed

DP UK and overseas	MRC (part of UKRI), Academy of Sciences Malaysia (ASM)
Award holders/ grantees	Wellcome Trust Genome Campus, Cancer Research Malaysia

Description of the project

The Identification Of Genetic Vulnerabilities In Head And Neck Cancers For The Development Of Novel Therapies project was implemented under the Malaysia Joint Health Research Call in Non-Communicable Diseases (NCDs). The call was designed to finance collaborative research projects focused on addressing non-communicable diseases prevalent in Malaysia, particularly those impacting society's most vulnerable. The Funders for this call are the UK Medical Research Council and the Academy of Sciences Malaysia.

More specifically, the call intended to finance projects which fall within the spectrum of:

- obesity-related research.
- cardiovascular disease, especially young myocardial infarctions.
- Diabetes.
- Cancer.
- comorbidity of NCDs with infectious diseases.

The specific project on 'The Identification Of Genetic Vulnerabilities In Head And Neck Cancers For The Development Of Novel Therapies' fits under the fourth priority of this call. It was designed to tackle oral cavity cancer, one of several head and neck cancer types. This cancer (OSCC type) is seen as one of the biggest public health issues in Malaysia and across Asia and has an increasing incidence in the UK. It is expensive and difficult to treat, which leads to significant morbidity with survival rates that have not improved for several decades.

The project team, made up of molecular and cell biologists, had been studying neck cancer for 15 years prior to the project. Through collaboration with the Wellcome Sanger Institute, it sought to identify specific genes susceptible to cancer gene editing technology, to isolate and edit them out from gene lines.

Pathway to impact

Figure 8 (Annex 4), shows how the research collaboration aligns with the theory of change for Newton Fund, and how its activities and expected outputs and outcomes cover all Newton Fund Pillars.

Activities: the activities undertaken as part of the project involved laboratory experiments using a gene editing technology called CRISPR/ Cas9 to identify specific genes susceptible to cancer. Work was undertaken on cell lines from head and neck (most typically oral) cancer patients. The scientists have conducted testing of 21 gene lines, primarily derived from Asians, to identify genetic vulnerabilities that can be explored as targets for a potential vaccine.

Expected outputs

- identification of known and new genes that are either susceptible or not susceptible to cancer, demonstrating scientifically that many previously identified cancerous genes were limiting therapeutic value.
- identification of genes that warrant further investigation for their potential as therapeutic targets for a future vaccine.
- identification of biomarkers in gene lines which can have a favourable response towards immunotherapy and should be researched further.
- generation of substantial data on the core fitness genes and selective fitness genes for oral cancer that can be used as a resource to study oral cancer.

Expected outcomes

The collaboration has resulted in several research outcomes, including:

- identification of new drug targets for head and neck cancers, particularly the very prevalent oral cancer type OSCC.
- generation of a new highly annotated collection of cell models from Asian patients for the study of head and neck cancer at a time when most data sets on this type of cancer came from non-Asian populations.
- new insights into the characteristics of the gene lines and specific genes, and, as a result, information on therapeutic approaches to treating these genes and gene lines medically.
- identification of a subset of head and neck cancers that might be responsive to immunotherapy agents, and therefore, narrow down the scope of research for potential treatment and vaccine.

Expected impact

This project's expected long-term impact is the generation of information that would allow for the production of treatment options or a vaccine tackling oral cancer of the OSCC type and potentially other head and neck cancers. The project resulted in a CRUK-funded clinical trial (2019) to identify an oral cancer research vaccine. DNA vaccines are cost-effective to produce, stable, and well-tolerated by patients. If successful, the vaccines would help transform head and neck cancer treatment and would also benefit cancer therapy more broadly. Potential impact from a vaccine could reduce costs and difficulty of treatment of the OSCC type cancer, ultimately leading to fewer deaths and improved quality of life among cancer patients.

6.1 Emerging project results

Relevance of Newton Fund activities

Activity targeting and ODA relevance

The stated objectives of ODA are strengthening resilience and response to crisis and helping the world's most vulnerable, in addition to contributing towards the SDGs. In this sense, the project's research can provide some input into tackling public health crises and helping

vulnerable populations in Malaysia reach more effective and affordable treatments methods for OSCC type cancer.

It contributes to the achievement of SDG 3, namely good health and well-being, underpinned by development of vaccines and novel therapies. It aligns with the priorities of the NUOF, for which the first area is health and life sciences. Head and neck cancer, and specifically cancer of the nasal cavity, is the second most prevalent cancer type in Malaysia, and a significant public health issue in the country.

Targeting of Malaysian priorities

Research undertaken in this project feeds directly into Malaysian socio-economic development priorities. The 11th Malaysia Development Plan states that Malaysian economic growth should be accompanied by, among other services, better quality healthcare. Neck and head cancer is one of the most prevalent forms of cancer in Malaysia, especially oral cancer. Therefore, this research fits into addressing a specific public health issue in Malaysia and ties it to Ministry of Health sectoral activities.

Origins and quality of the collaboration

The project was initiated by the Malaysian PI and the original UK PI (who left the Wellcome Sanger Institute two years into the project's implementation). A unique characteristic of the research partners in this collaboration was that they were all highly skilled, high-end medical researchers specialised in deriving cancer models. Researchers received cancer patients' permission to sample their genes and recreate their gene lines in a laboratory setting. The Malaysian PI held possibly the largest number of Asian cancer cell lines in the world and shared these resources with other researchers globally. Funding from the Newton Fund further enhanced Cancer Research Malaysia's existing efforts, thereby contributing directly towards tackling a prevalent public health issue.

Currently, there are no clear gene targets on which to make drugs. Therefore, researchers engaged in the project used the gene editing technology – which deletes certain genes and causes cancer cells to die. As a result of the partnership between Cancer Research Malaysia and the Wellcome Sanger Institute, the top-end researchers collaborated and shared knowledge and datasets, thus pushing this research further.

Project outputs exhibit complementarity with the global research agenda on neck and oral cancer and enable the strengthening of this research base among the UK and Malaysia and the broader pool of countries with a high level of technical expertise. Cooperation and coordination from all the parties were seen as exemplary. The initial PI chose to remain on the project and attend most of the meetings, despite moving on officially from their post. The skill sets of both the Malaysian and UK PIs were complementary, and the research outputs produced as being highly integrated. For example, the gene lines investigated in the project are now contributing to the global neck and oral cancer research therapies databases, with Cancer Research Malaysia providing a third of the sample to this database (and the only Asian populations gene lines in this sample).

Additionality

There is clear additionality of the Newton Fund to the success of this collaboration. The scope of this research and the quality of the partners attracted to take part in the gene editing and building of global databases, would not have been possible without the model of the

Newton Fund, which brings together academics and private research partners from both the UK and Malaysia. The size of financing provided through the Fund is also noted as an enabling factor – experiments of the kind undertaken in this project are too expensive for non-governmental actors to fund.

The project has also strengthened the perception of the UK as a champion in gene editing technology and research and solidified the people-to-people networks in this research domain, ultimately allowing for a seamless integration of UK-schooled Malaysian talent into research institutes in Malaysia. The project's success has also heightened the interest of current Malaysian students finishing their education in the UK to return and contribute their newly acquired knowledge into ongoing neck and cancer research done in Malaysia. This is especially attractive to them as they are aware that Malaysian research institutes have strong links with the UK, and they perceive that they will be able to continue working with British expertise.

6.2 Effectiveness of Newton Fund activities

Research collaborations on topics relevant to economic development and poverty reduction

The research undertaken as part of this project was effective. The team progressed with all the outputs they set out to achieve and exceeded some milestones. Through the collaboration with the head of the genomics of drug sensitivity in cancer at the Wellcome Sanger Institute, the Cancer Research Malaysia team could access a significant amount of drug data for oral cancer treatment that was not available to them beforehand. This expanded their research base and allowed them to devise a new approach to experimentation with data editing techniques.

The project teams demonstrated flexibility by expanding the project scope. The plan to experiment with six cells was expanded after inputs from UK partners, who were able to re-design and rethink some of the experiments. Eventually, the joint team increased the number of gene editing lines from six to 21, and they were able to secure a no-cost extension to the project to complete this expanded scope of work.

Additional or unexpected benefits

A transfer of knowledge and working practices took place in both directions. Through the project, researchers who had just completed their doctoral courses were given the opportunity to collaborate with experienced researchers. The project provided an opportunity to integrate returning Malaysian students into Malaysia's cancer research community and immediately integrate them into high visibility and high impact projects. From Malaysia to the UK, this was through additional data to the global databases on cancerous genes. From the UK to Malaysia, this was through the provision of well-trained research staff who could contribute to ongoing projects effectively and seamlessly.

Other benefits of the collaboration included a range of engagements with professional practitioners, industry, business, policymakers and students. In 2017, the UK PI team were invited to a radio show in Malaysia (Business FM) to explain the CRISPR/Cas9 gene editing technology and how it added to the understanding of neck cancer and genetic vulnerabilities. There were another four international talks or presentations throughout the project's lifetime at various universities and professional associations.

Capacity-building of UK researchers and institutions

Further opportunities for capacity building arose in a number of settings. In 2018, the UK PI gave a talk at Royal Society's London premises entitled 'The CRISP Revolution: Changing Life'. The presentation targeted scientists and policymakers, sensitising them to issues specific to gene editing technology. Another talk was given during the Milner Therapeutics Symposium in Cambridge in 2018, and another delivered at the Wellcome Sanger Genome Campus, to discuss the application of this novel therapy. Separately, the UK PI was awarded the UK National Cancer Research Institute Innovation Award in 2019 for innovation in the cancer models' use and development.

Challenges in the collaboration

Some resource allocation restrictions caused the institute to juggle competing priorities from the UK PI perspective. There were two PIs from the UK during the project, with the initial award holder stepping down to take up a different medical research position in the private sector. The change in PI did not affect the collaboration's effectiveness, and the new PI was able to lead the research from the UK side seamlessly and with positive results.

6.3 Emerging signs of impact

There is an indirect link between project outputs and poverty reduction. Tangible results in the neck and head cancer research discipline have provided credibility and momentum to continue with additional funding and partnerships. The research has raised the profile of neck and oral cavity cancer research.

There are signs of practice and attitudinal changes, especially among the Malaysian project stakeholders. Some stakeholders have observed a shift in how medical research is approached. Through exposure to new ideas and techniques, Malaysia is now more inclined towards higher value-added research in technology and digital health, and towards the inclusion of artificial intelligence and 5G concepts into further pushing medical research. For example, the Cancer Research Malaysia team, due to exposure to the Newton Fund networks, is currently successfully experimenting with new ideas on the provision of telemedicine through a UKRI-funded project. This is especially relevant given the COVID-19 response as well as other potential future pandemic threats. It closely aligns with the national priorities related to public health, as the Ministry of Health has put telemedicine as a priority for oral cancer treatment and research.

Signs of sustainability

The neck and head cancer research project is showing clear signs of sustainability. The joint research teams successfully secured the Newton Fund Impact Scheme extension to build on their successful work on 21 gene lines. The extension design envisions the involvement of a pharmaceutical giant (company name not disclosed) from Malaysia commencing research on a potential vaccine targeting genes identified by the research teams, and even taking the vaccine to medical trials. This work has been delayed due to the COVID-19 pandemic. Separately, the Cancer Research Malaysia team has also secured some funding from UKRI, building on their expertise in generating successful proposals gained through the NUOF experience.

Further additional funding, albeit at a smaller scale, was awarded to the Malaysian side's project collaborators. The Women Graduates Association provided a research grant to carry

out the activities using the project's gene editing technology⁶⁰, in the amount of £46,653 (MYR 260,000). This grant is running between 2019 and 2021. Additionally, the Ong Hin Tiang and Ong Sek Pek Foundation provided a follow-up research grant to this project, entitled *Determining the genetic vulnerabilities of head and neck cancer for therapeutic purposes*, in the amount of £44,861 (MYR 250,000) and running from 2018 until 2021.

Further signs of sustainability include funding to both the UK and Malaysian PIs for a follow-up project financed under the Newton Fund Impact Scheme.

Professional development gained through the project is likely to benefit the neck and head cancer research disciplines years to come. The Malaysian PI's top two researchers have received four awards, three in Malaysia and one in Hong Kong, for outstanding presentation at post-doctoral conferences in the field of cancer and as recognition of research done in this space.

Complementarity and coordination

Evidence of complementarity and coordination of this project relates to the *leadership effect*. One of the lead researchers on the project from the Malaysian side returned to Malaysia from her latest post in Hong Kong to participate in the project. She was attracted to working with UK networks in her home country and valued the opportunity to undertake the specific line of research of this project. In this sense, the project has raised Malaysia's profile as a place where quality research in medical sciences is being conducted, networked with research excellence in the UK.

It is still too early to observe any *catalytic effects*, as follow-up research on finding oral cancer medication is continuing. Changes in attitudes or behaviours could only be expected if follow-up research proves to be successful.

6.4 Conclusions

- **This project was designed to tackle cancer of the oral cavity, which is one of several types of head and neck cancer.** It has aimed to identify specific genes susceptible to cancer and use a gene editing technology called CRISP/Cas9 to isolate and edit them out from gene lines. It had the added objective of identifying target genes for medical treatment and supporting the work being carried out to create a vaccine for this type of cancer.
- **The research team identified new drug targets for head and neck cancers, particularly the very prevalent oral cancer type OSCC and a subset of head and neck cancers that might respond to immunotherapy agents.** It has narrowed down the scope of research for potential treatment or vaccine and has also resulted in a CRUK-funded clinical trial (2019), scheduled to begin in 2021.
- **The project is an example of a highly successful Newton Fund initiative that has delivered tangible research outcomes, shows clear signs of sustainability, and contributes to finding novel therapies to tackle a pressing public health problem.** It has also built up the capacity of research in a field where expertise can take years or decades to materialise.

⁶⁰ CRISP/Cas9 Gene Editing Technology.

- **There is clear additionality of the Newton Fund to the success of this collaboration.** The scope of this research and the quality of the partners attracted to take part in the gene editing, and building of global databases would not have been possible without the Newton Fund, which brought together academics and private research partners from both the UK and Malaysia.
- **The project has strengthened the perception of the UK as a champion in gene editing technology** and research and solidified the people-to-people networks in this research domain, thus allowing for a seamless integration of UK-educated Malaysian talent into research institutes in Malaysia.
- **Other benefits of the collaboration include a range of engagements with professional practitioners, industry, business, policymakers, and students**, which increased the research's visibility, the particular research topic, and UK efforts and expertise in this area.

Lessons learned and points to consider going forward

- **Stakeholders reported that the UK is particularly effective at designing grants that enable bilateral research** requiring the collaboration of highly skilled researchers and a large financial investment. The research structure enabled by the Newton Fund was viewed as specifically helping promote global science and the advancement of science for diseases that have not received sufficient attention compared to others in recent years.
- **In Malaysia, the design of the Fund and this specific project have been hugely appreciated.** Malaysia is keen to attract further investment in state-of-the-art research facilities, expanding its data sets, and accessing expertise in specialised techniques to become a health research leader. This project has helped provide some of this expertise and required investment and could potentially help put Malaysia at the forefront of neck and oral cancer research.
- **Malaysian stakeholders note that lack of access to the Newton Fund or other UK funding schemes would set them back and delay the efforts to reach high-income country status.** The Newton Fund partnership model in Malaysia has compelled the national government to invest in this specific research to ensure that Malaysia does not remain behind global innovations and trends. This is an unexpected benefit of the Fund to its partner countries' socio-economic development more broadly.

Annex 1 – Methodology

Research methods and data collection approach

The thematic impact studies are central to our Final Evaluation approach and involved an intensive period of remote research by the evaluation team members.

Preparation for the research included a document review of country-specific documents on Malaysia's research and development context. These include the evaluation Malaysia Baseline and Endline Reports, Mid-Term Thematic Impact Report, and the updated Country Situation Note. We also conducted a literature review of additional documentation on Malaysia's research and innovation landscape and existing UK-Malaysia collaboration activities. Project-specific documentation, such as application forms and progress and final reports, were reviewed for each action included in the study, where provided by the Delivery Partner, local partners or researchers.

The document review was accompanied by **remote research with respondents in Malaysia and the UK** in July and August 2020. Three main categories of stakeholders were interviewed: i) in-country UK representatives and Newton Fund in-country team; ii) UK and local funders; and iii) participating researchers. In some cases, additional University staff, such as University leadership or other research teams, were also interviewed.

Our data collection was complemented with an analysis of the pathway to impact for each action, which can be found in Annex 4. Here, we analysed each project's trajectory to impact by placing it within the Newton Fund Theory of Change. This allowed us to visually represent the pathway to outputs, outcomes, and impact of each activity, and highlight its (potential) contribution to broader Newton Fund goals.

Limitations of the research approach

The short timeframe for country case study research meant that we could only include **three projects within our case study**. These are not representative of all Newton Fund activities as a whole. The short timeframe also limited the number of stakeholders we were able to interview in Malaysia. The volume of documentation provided varied by project, thus limiting the possibility of triangulating findings. The case study findings reflect the data provided by each project and what is available online.

Research findings have been triangulated across different stakeholder groups and various sources of documentation (project documents and online resources such as the RCUK Gateway to Research portal). However, the research team could not independently verify statements by all the different contributing stakeholders or verify what was reported in the documentation.

Additionally, the COVID-19 pandemic has resulted in the need to revisit our data collection approach, particularly in terms of our 11 country case studies. The case study research was originally scheduled to take place in three waves of partner country visits between March and August 2020. The inability to travel internationally and the closure of offices, embassies, universities and research centres required switching to a **remote-based approach**, as agreed with BEIS in March 2020.

In revising our case study approach, we recognised that switching to a remote-based approach would have likely implications on the quality of data collected, as outlined in our April 2020 Concept Note. The quality of interviews could have been affected for several reasons, including:

- problems with connectivity, technical issues and limited telephone or internet coverage, which posed the risk of lowering the quality of calls and cause loss of rapport, creating abrupt feelings in interviews and affecting the depth and quality of our findings.
- the absence of visual or nonverbal cues, inability to observe behaviour and body language, with the risk of telephone interviews becoming mechanical and cold.
- having little opportunity to establish rapport with respondents and having potentially shorter times for interviews as respondents may more easily become fatigued by telephone compared to face-to-face interaction.
- limited engagement, low response rates and little interest in participating in our research, which might limit the breadth and depth of our findings.
- the inability to visit laboratories or facilities, and limited scope for unplanned interviews with additional staff members, researchers, or others in the same institution.
- fewer opportunities for check-ins and informal conversations with in-country teams (ICTs), who are a rich source of data.

We mitigated these issues in several ways, where:

- we included additional time for document review prior to interviews so that conversations moved on to speaking about results, emerging impact, and challenges (to take into account for shorter interview times and potentially lower quality interviews). However, it is important to consider that availability and quality of project data and information varied considerably across sampled interventions.
- we favoured video interviews wherever possible to limit the lack of nonverbal cues and to help establish rapport with respondents.
- we had several email exchanges prior to interviews to create an initial connection and rapport with participants, and to set out the objectives and areas covered in the interviews by sharing topic guides prior to our calls.
- we organised follow-up interviews wherever possible to fill any remaining information gaps brought about by having shorter interview times. We also gathered interviewee insights on additional respondents and carried out additional interviews which emerged from email exchanges and interviews.
- we organised regular check-ins with ICTs via email or telephone and delivered online presentations and validation sessions with each ICT to share emerging findings after having carried out all interviews. This allowed us to ensure we had accurately reflected the Newton Fund's experience in each country.

Annex 2 – Case Studies Sampling Overview

This Annex summarises the sampling approach used for the country case studies which inform the Final Evaluation of the Newton Fund. Detail on the approach and criteria used to develop the sample for the case studies is annexed to Tetra Tech’s Newton Fund Final Evaluation Report.

Final evaluation country sample

A total sample of 11 countries with three calls per country (totalling 33 calls) was agreed with the Department of Business, Energy, Innovation and Science (BEIS).

The countries selected for the country sample were; China, Malaysia, Chile, Turkey, South Africa, Brazil, India, Philippines, Jordan, Peru and Kenya. The sample includes three additional countries (Jordan, Kenya and Peru)⁶¹ due to the Newton Fund’s expanded scope. Six of these countries were included in the Mid-Term Evaluation (MTE)⁶² of the Newton Fund case study research.⁶³

The criteria used for the country selection were:

- coverage of all regions covered by the Newton Fund.
- coverage of different levels of existing innovation and capacity of partner countries (as defined by the 2015 Global Innovation Index rankings and BEIS’ initial assessment of capacity).
- learning opportunities from new ways of working regionally in countries that either graduated from the DAC list or have ODA sensitivities; or operating in/ recovering from crises.
- the inclusion of Peru, Jordan, Kenya (countries that have not been explicitly included in the evaluation scope until now).

Non-selection of countries (or calls) does not reflect significance, quality or importance.

Proposed sample of calls and projects

Data from BEIS’ Newton Fund Activity Tracker (January 2020)⁶⁴ enabled the evaluation to determine ‘call’ activity and identify three ‘calls’ per country, giving a total of 33 calls in the sample. The following criteria were used to develop the call sample:

- ensuring coverage of all DPs.
- ensuring coverage of the three pillars.

⁶¹Jordan, Kenya and Peru were not included in the MTE data collection, as they had just joined the Newton Fund. BEIS agreed to carry out in-depth case studies in the three new countries to ensure coverage of activities there.

⁶² Mid-Term Evaluation of Newton Fund (December 2018). Accessible at: [Resources | Newton Fund and GCRF \(newton-gcrf.org\)](#)

⁶³ These were: China, Malaysia, South Africa, Brazil, India and the Philippines. Mexico and Egypt, which were part of our MTE sample, have been replaced with Turkey and Chile respectively to increase opportunity for learning.

⁶⁴ The BEIS ‘Activity Tracker’ is an Excel-based internal monitoring tool by BEIS and updated quarterly by the UK Delivery Partners.

- reflecting emphasis on spending/thematic priorities in each country.
- allowing for longitudinal analysis by including six projects analysed as part of the MTE.

The outcome of the call sampling approach allowed for the identification of specific projects under each selected call. This was achieved in consultation with DPs, BEIS ODA Research and Innovation and ICTs.

The project sample allows for coverage of all DPs and pillars within the Newton Fund portfolio. Six projects were analysed as part of the MTE and again at Final Evaluation to allow for longitudinal analysis. The sample list of 33 calls and projects is annexed to Tetra Tech's Newton Fund Final Evaluation Report.

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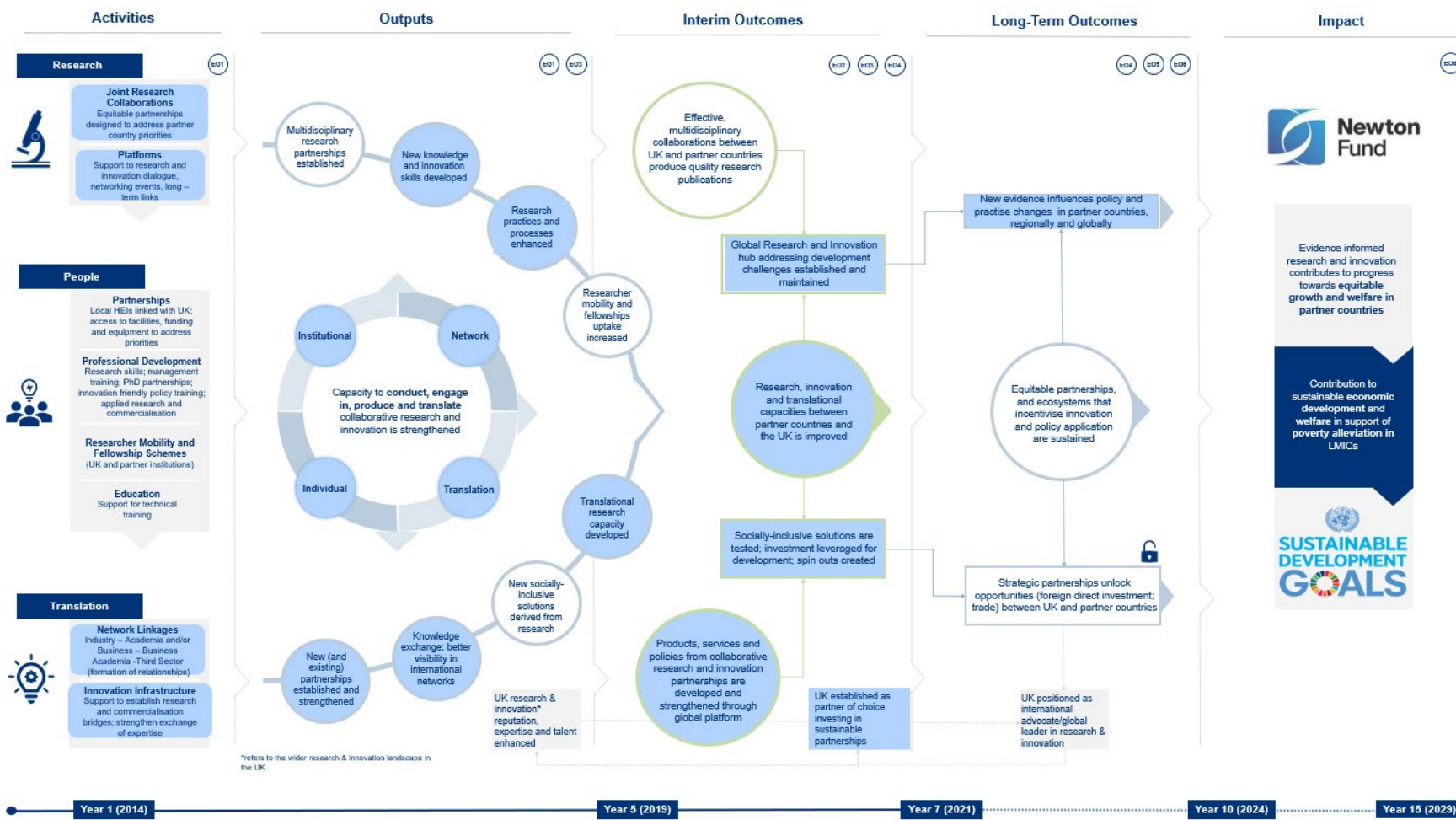
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Research Participants

- His Excellency Charles Hay MVO, British High Commissioner to Malaysia.
- Nicola Willey, Southeast Asia Regional Director for Science & Innovation, British High Commission Singapore.
- Andrew Bowes, Counsellor, Political (External), British High Commission Kuala Lumpur.
- Murugadas Loganathan, Energy and Climate Change Advisor, British High Commission Kuala Lumpur.
- Maithili Vasudevan, Strategic Manager, Newton-Ungku Omar Fund.
- Poorani Krishnan, Science & Innovation Network (SIN) Officer, British High Commission, Kuala Lumpur.
- Ute Lynch, International Science and Innovation Policy Officer, Department for Business, Energy and Industrial Strategy, UK.
- Izza Ismail, Deputy Head, Prosperity Fund, British High Commission Kuala Lumpur.
- Ida Semurni Abdullah, Vice-President and Head of Newton-Ungku Omar Fund, Malaysian Industry-Government Group for High Technology, Malaysia.
- Dato' Dr Muhammad Fauzi Mohd Zain, Director, Higher Education Institutions (HEI) Excellence Planning Division, Ministry of Higher Education, Malaysia.
- Bibi Zarina Che Omar, Director, Water Resources & Hydrology Division, Department of Irrigation & Drainage, Ministry of Environment & Water, Malaysia.
- Vanessa O'Sullivan, International Panel Manager, UKRI Medical Research Council, UK.
- Melissa Lennartz-Walker, Newton Fund Project Manager, UKRI Medical Research Council, UK.
- Dr Annie Wai Yeeng Chain, Postdoctoral Scientist, Head and Neck Cancer Research Programme, Cancer Research Malaysia.
- Dr Sok Ching Cheong, PhD, Senior Group Leader, Head and Neck Cancer Research Group, Cancer Research Malaysia.
- Mathew Garnet, Group Leader, Wellcome Sanger Institute, UK.
- Poobalan Ganeshan, Associate Professor, Department of Mechanical Engineering, Faculty of Engineering, University Malaya, Malaysia.
- Dr Hamad Faik, Senior Lecturer, School of Science, Engineering and Design, Teesside University, UK.
- Matther Rajendra, CEO, Green Data Centres LLP, Malaysia.
- Dr John Andresen, Director, Smart Polymers Ltd, Herriot-Watt University, UK.
- Florian Wagner, Clean Cold Power Co. Ltd., UK.

Annex 4 – Theories of Change per Action⁶⁵

Figure 6: Research and Innovation Bridges



⁶⁵ The figures present the pathways to impact for the three projects reviewed in this case study, set within the overall Newton Fund theory of change. Specific pathways to impact for each project are indicated by the blue shaded shapes in each figure.

Figure 7: Joint call for small-scale research and network activities with south-east Asia

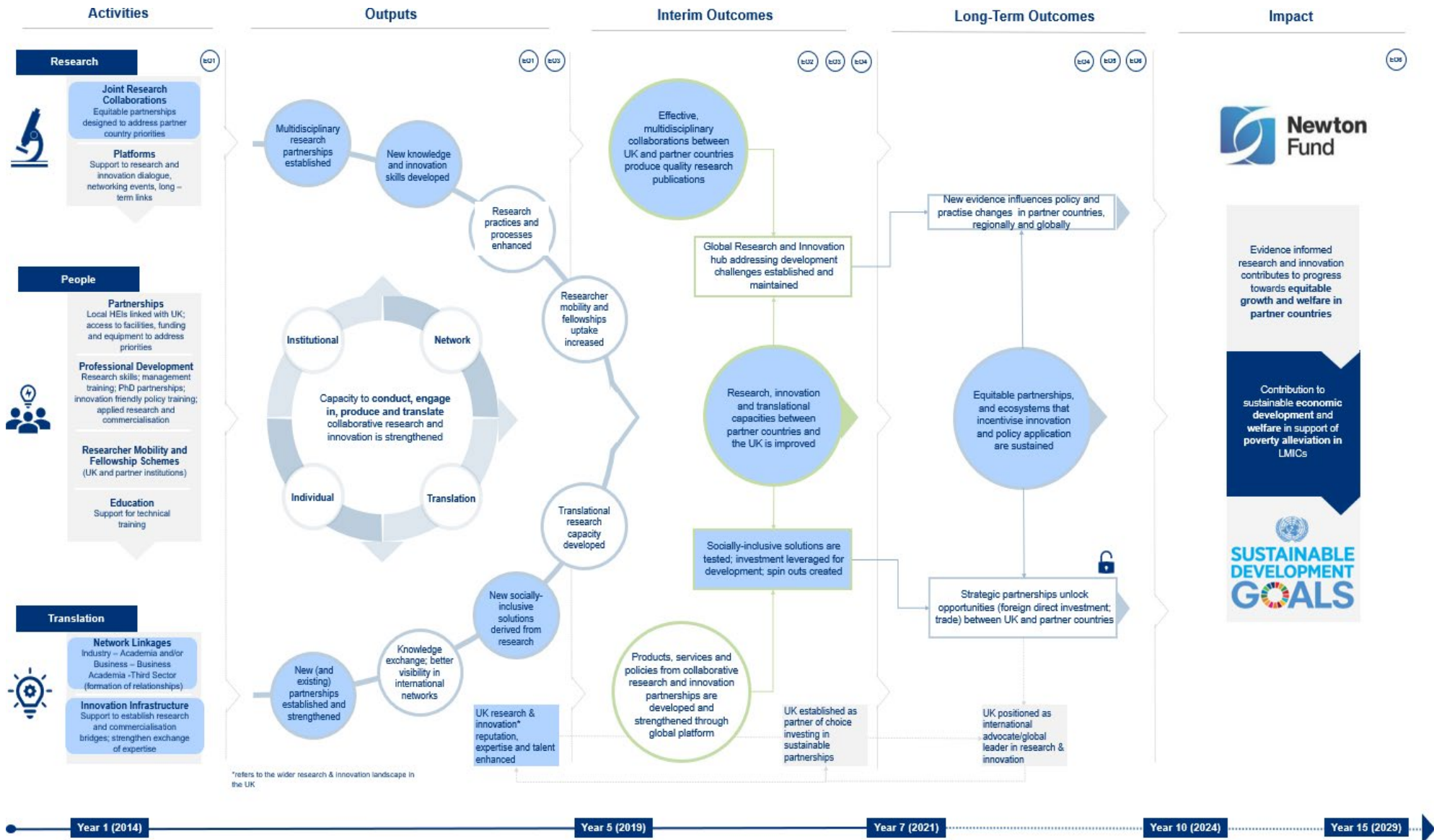
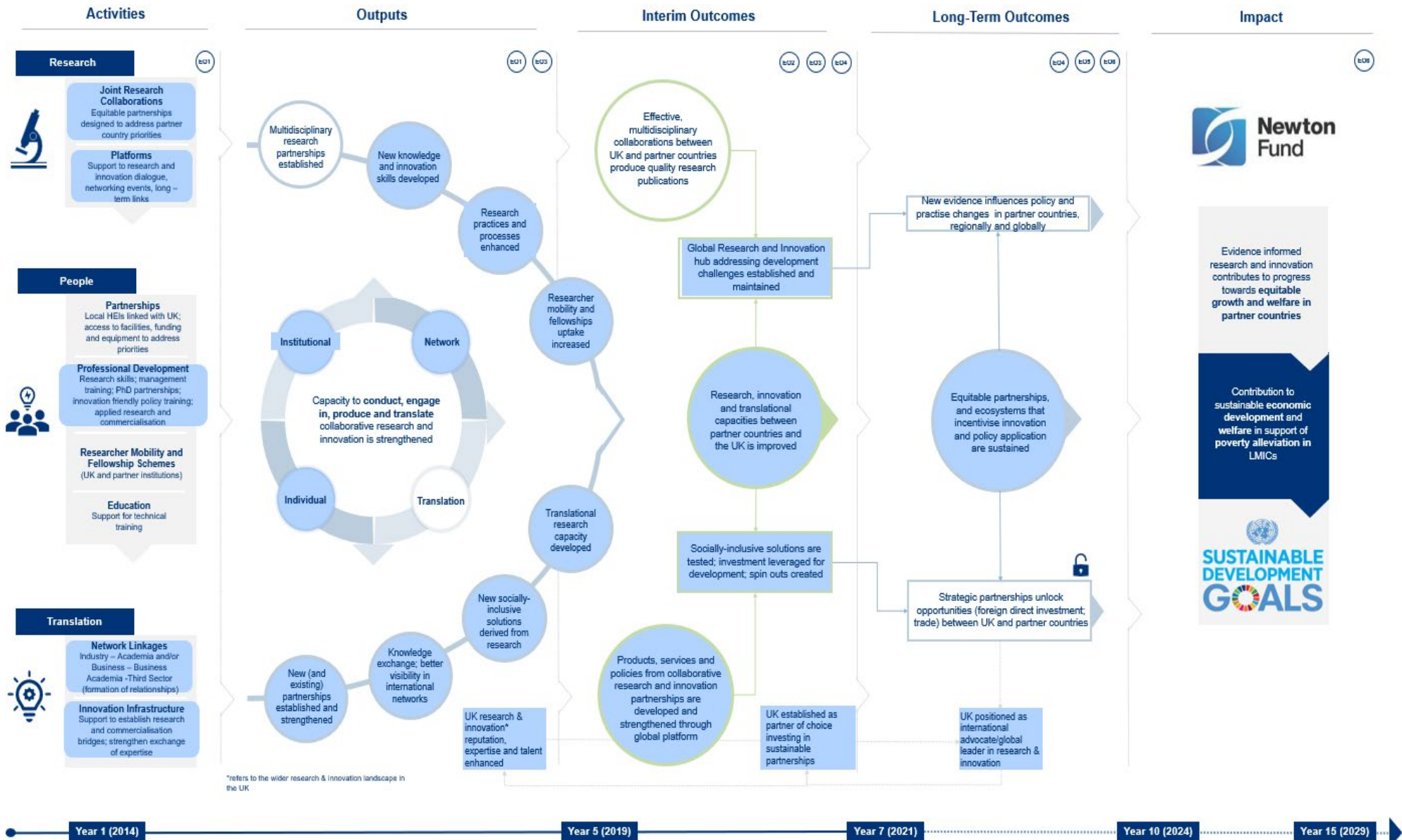


Figure 8: UK-Malaysia Joint Health Research Call in Non-Communicable Diseases



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