



Department
for Environment
Food & Rural Affairs

SUSTAINABLE COOLING AND COLD CHAIN SOLUTIONS

An Official Development Assistance Business Case
Department for Environment, Food and Rural Affairs

EXECUTIVE SUMMARY

Meeting the growing cooling demand sustainably

Cooling and cold chain demand is growing rapidly, especially in developing countries where most of the unmet air conditioning and refrigeration needs are and with a massive additional projected demand driven by climate change (the cooling paradox), rapid economic growth, and rising living standards. Projected refrigerator stock in use in developing and emerging economies is expected to double from approximately 1 billion today to nearly 2 billion by 2030 and by 2030, 80% of cooling equipment is projected to be in the new developing markets.

Most cooling is highly polluting due to the climate impact of the refrigerants (hydrofluorocarbons) and the indirect emissions from energy use to run the appliances, equipment and systems.

Hydrofluorocarbons (HFCs) from cooling and refrigeration are the fastest-growing source of greenhouse gas (GHG) emissions in the world, with existing cold chain technologies representing a third of HFC emissions and projected significant increases by 2050 without action. If current trends continue, cooling alone will make the Paris Agreement goals unattainable.

Intervention now is therefore vital to deliver clean efficient cooling and avoid lock-in through the installation of climate polluting, inefficient cooling technologies that then creates a servicing legacy for the next twenty to thirty years.

Cooling doesn't have an institution or fund dedicated to it and consequently, most cooling efficiency support has been provided in an ad hoc, uncoordinated manner, failing in particular to capitalise on the successes of the UN Montreal Protocol (MP).

In 2020 the Economist Intelligence Unit recognised the MP as the most successful climate policy to date and the critical importance of an effective MP for climate change is clear with the phaseout of ozone depleting substances already avoiding 1.1 degrees or warming over the Arctic by 2021. In 2016, Parties to the Protocol adopted the Kigali Amendment which introduces a global phase down of HFCs and includes actions to enhance the energy efficiency (EE) of cooling equipment alongside the phasedown.

Integrated activities addressing EE in parallel to the HFC phase down is a way to ensure sustainable development and cut GHGs. Whilst the global Covid-19 pandemic and economic slowdown reduced CO₂ emissions by 8% in 2020/21 compared with 2019 levels they have since rebounded. The MP could support a green economic recovery and the Defra ODA funded activities under the Sustainable Cooling and Cold Chains Portfolio directly support policies to drive towards more climate friendly, efficient cooling and faster actions to reduce the growth of HFCs.

Scaling cold chain (refrigeration) capacity to deliver resilient and sustainable food supply chain

To meet both agri-economic and nutritional goals, the urgent challenge for emerging economies is scaling cold chain capacity. While the average cold storage capacity in North America, Western Europe and Oceania is around 200 cubic metres per 1,000 inhabitants, in the least developed countries it is only around 20 cubic metres per 1,000 inhabitants on average, or even less (*IIR 2021*).

Cold chains are an integrated and resilient complex network of refrigerated and temperature-controlled buildings, cold storage, distribution hubs and vehicles used to maintain and trace the safety, quality and quantity of food produce (and vaccines, etc)¹. They are vital to the food system to deliver food that is affordable, nutritious and safe whilst providing optimal returns to farmers and others in the value chain and minimising environmental and climate impacts.

¹ Cold chain must also consider the packaging used and other environmental parameters that affect the usable or saleable life of produce and products under care.

Populations in most developing countries depend heavily on agriculture for their livelihoods, making cold chain development a powerful tool to boost incomes and foster economic growth.

In emerging economies, high proportions of the agricultural workforce are usually composed of small and marginal farmers.

Lack of effective refrigeration today directly results in losses of 475 million tonnes or 13% of total food production, which is enough to feed approximately 950 million people in a world, where 690 million people are hungry and 2 billion suffer from food insecurity.

In near-East and North Africa, 55% of fruits and vegetables, 22% of meats, 30% of seafood and 20% of dairy is lost mainly due to lack of cold-chain infrastructure, which leads to loss of income for small-scale farmers and higher prices for poor consumers. In Rwanda's case, food loss equates to 21% of its total land use, 16% of GHG emissions, and 12% loss to its annual Gross Domestic Product (GDP).

Most postharvest losses occur in the 'first mile' of the food supply chain where produce aggregation and processing hubs and integrated cold chains for perishable produce are predominantly absent. Lack of cooling is due to multiple challenges - affordability and appropriate financing and business models to support technology deployment and skills for after-sales services and knowledge/support in system design, as well as access for users to energy.

Covid-19 has also highlighted the need for robust cold-chains for vaccines and pharma. WHO estimates that pre-Covid, 25% of all vaccines were lost in developing markets primarily due to lack of cold-chains. The speed and volume of Covid-19 immunisation (as well as the sub-zero and even ultra-low temperatures required) has created the urgent need for new cold-chains - these need to operate off-grid, reach remote communities often in harsh locations, and be both efficient and environmentally sustainable.

Business as usual cold-chain systems typically use fossil-fuels and refrigerants with a high climate impact. Studies suggest that unless cold-chain cooling systems are designed for efficient operation and operated using low carbon fuel and climate friendly refrigerants they create undesirable pollution and compromise the socio-economic benefits.

We need to secure the transition in developing markets to EE, environmental, and sustainable refrigeration for the fast-growing food and vaccine supply chains.

Scaling up the existing F gas ODA programme

Many developing countries lack the technical capacity and insights on global best practice to rapidly decrease or avoid HFC use as they transition from ozone depleting substances in cooling and cold chains. Instead, they continue to deploy conventional HFC technologies, locking-in to obsolete climate polluting technologies despite increasingly available alternatives that enable leapfrogging to more sustainable cooling and cold-chain infrastructure.

Defra ODA programming has been providing valuable assistance to developing countries through additional international contributions to one of the four implementing agencies to the UN Montreal Protocol (UNEP), funding technical and practical support to deliver accelerated HFC reductions and energy efficient cooling solutions, directly supporting the work of the Montreal Protocol in a way that is aligned with the Paris Agreement and contributes to multiple Sustainable Development Goals.

Activities will apply and bring to market climate friendly, energy efficient cooling solutions, accelerating the transition in Africa and other developing markets to sustainable refrigeration reducing food loss and improving vaccine supply chains. They support the development of policies and tools and offer technical assistance through undertaking and sharing research, demonstrations and knowledge transfer to rural communities.

This funding will support four workstreams through further additional voluntary contributions to UNEP to build on the previous Defra ODA bilateral funded activities through a continuation of different but related workstreams that have been scaled up since 2019.

These workstreams include the development of modelling, policies and tools that implement global best practice and technical assistance through undertaking and sharing research, demonstrations and knowledge transfer to rural communities.

Collectively, these workstreams all support the overarching objective of delivering Sustainable Cooling and Cold Chain Solutions, accelerating the climate benefits of the Kigali Amendment and elevating the importance of access to sustainable cooling. In particular, the different activities promote opportunities for early integrated actions on HFCs and EE cooling, helping to contribute towards the overall potential to avoid up to one degree of warming globally by the end of the century. Earlier and faster actions to simultaneously reduce HFCs and enhance EE of cooling equipment could potentially halve cumulative emissions by 2050 compared to a just compliant scenario.

To date, these different workstreams have been detailed through individual concept notes and a business case for the largest of the workstreams. None of these have exceeded £10m and so have not needed clearance from the Investment Committee. They have been cleared through a combination of the ODA Board (for the smaller funds directed at three of the workstreams) and most recently by Lord Goldsmith for the reallocation of ODA funding within the existing budget lines to fund the largest flagship project (the Africa Centre of Excellence for Sustainable Cooling and Cold Chain (ACES)).

This business case now seeks to bring all four workstreams into one document and contains a summary of activities and spend to date across the different areas.

This further funding was secured following a successful SR21 ODA bid. The original bid was for £15m but was reduced to £12m during the bidding process with proposals and activities having to be adjusted accordingly to fit with available funding. The £12m was ringfenced by HMT to address F-gases and cooling in developing countries and was announced at COP26. Only one of the workstreams (ACES) will exceed the £10m threshold through the further investment as a result of the SR21 allocation so has proportionately addressed in the following sections of this document.

As a consolidated programme business case, this document has therefore been set out to capture the overarching purpose of the programme in the different sections. It also contains chapters that relate to each of the four workstreams, includes a summary of spend and activity to date in each of those areas and sets out the specific deliverables and activities to be supported through this further funding.

COUNTRY / REGION	Pan-Africa region, Rwanda, Kenya, India
PROGRAMME VALUE	Funding to Date (since 2019): £7,897,760 Funding from 2022: £12 million Total Programme: £19,897,760
START DATE	May 2019
END DATE	March 2025 (by which time many of the elements of the ACES headquarters would be self-sustaining) but with potential to extend the wider Pan-African reach if sufficient funds available
OVERALL RISK RATING	Overall risk of the programme is low. In Section 6.3, comprehensive risk analysis has been developed, including implementation risks, fiducy risk and reputational risks; prohibited practices, money laundering or terrorist financing, with clear policies in place linked to safeguarding and sensitivity related risk. It was identified that the probability of occurrence and the impact of those risks range from low to medium and specific mitigation actions have been provided. The project team will run a risk register and closely monitor the risk areas and take effective actions to reduce the probability of occurrence and minimise the negative impacts of those risks to the programme.

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GLOSSARY

ABM	Agent Based Modelling
ACES	Africa Centre of Excellence of Sustainable Cooling and Cold Chain
AI	Artificial intelligence
AU	African Union
ARLC	Academic Research and Learning Committee
AASR	Africa Agriculture Status Report
CCH	Community Cooling Hub
CoE	Centre of Excellence
CSC	Centre for Sustainable Cooling
CfSRF	Centre for Sustainable Road Freight
CPD	Continuing Professional Development
CU	Cranfield University
Defra	Department for Environment, Food & Rural Affairs
EAC	East African Community
EE	Energy Efficiency
FPOs	Farmer Producer Organisations
GDP	Gross domestic product
GoR	Governments of Rwanda
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GHG	Greenhouse gas
GT	gigatons
GWP	Global warming potential
HFCs	Hydrofluorocarbons
HWU	Heriot-Watt University
IATI	International Aid Transparency Initiative
LoI	Letter of interest
LIC	Low-income countries
LSBU	London South Bank University
M&E	Monitor and evaluation
MIC	Middle-income countries

MINAGRI	Ministry of Agriculture and Animal Resources
MNRE	Ministry of new & renewable energy
MLF	Multilateral Fund for the Implementation of the Montreal Protocol
MoH	Ministry of Health
MP	Montreal Protocol
NAEB	National Agricultural Export Development Board
NCS	National Cooling Strategy
NDC	National Determined Contributions
NTAC	National Technical Advisory Committee
ODA	Official Development Assistance
ODP	Ozone depletion potential
PCA	Project Cooperation Agreement
PHM	Post-harvest management
PSC	Programme Support Cost
PSTA4	Strategic Plan for Agriculture Transformation 2018 – 2024
RAB	Rwanda Agriculture Board
RACHP	Refrigeration, Air Conditioning and Heat Pumps
R-COOL	Rwanda Cooling Initiative
REMA	Rwanda Environment Management Authority
SDG	Sustainable Development Goals
SC	Steering Committee
SPOKE	Specialised Outreach and Knowledge Establishment
SPIU	Single Project Implementation Unit
TEAP	Technology and Economic Assessment Panel
ToR	Terms of reference
TRU	Transport refrigeration units
U4E	United for Efficiency
UK	United Kingdom
UN	United Nations
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UoB	University of Birmingham
UR	University of Rwanda
WHO	World Health Organization
WP	Working package

1. STRATEGIC CASE

1.1 GLOBAL CONTEXT

Sustainable cooling and cold chain is everything that keeps things cold in our warming world, including air conditioners and refrigeration. It is especially important in food and vaccine supply chains. For many crops up to 40% of the harvested produce is lost between the farm and the marketplace. As we strive to produce more food, if the logistics mechanisms are not available, or are unable to cope with the amount of farm produce, the production does not equal supply, and the losses that result will wipe out much of the hoped-for benefits. Given that most food loss and waste in developing countries occurs during production and after it is harvested, the greatest potential for reduction is investment in infrastructure related to storage, transport, cold-chains and distribution. The current missing components are effective and integrated physical post-harvest management and market connectivity (cold chain)

Lack of effective refrigeration today directly results in losses of 475 million tonnes or 13% of total food production, which is enough to feed approximately 950 million people in a world, where 690 million people are hungry and 2 billion suffer from food insecurity. Food saved is now recognised to be as important as food produced. Food availability must increase 70% by 2050 to feed the rapidly growing global population. Globally less than 50% of food that requires refrigeration is refrigerated worldwide. Currently 63% food losses from lack of refrigeration come from the developing countries. These countries could save approximately 144 million tons of food if they had the same level of refrigerated equipment as developed nations. The challenge is how to reduce food loss without commensurate increase in HFC emissions because the food cold chain alone is already responsible for one third of HFC emissions.

At the same time, Covid-19 has highlighted the need for robust cold-chains for vaccines and pharma. WHO estimates that pre-Covid, 25% of all vaccines were lost in developing markets primarily due to lack of cold chain. The speed and volume of Covid-19 immunisation (as well as the sub-zero and even ultra-low temperatures required) has created the urgent need for new cold chains - these need to operate off-grid, reach remote communities often in harsh locations, and be both efficient and environmentally sustainable.

Alongside meeting existing unserved needs, the demand for more extensive cooling and cold chain is going to increase due to increasing temperatures. Sustainable cold chains must address all the functional areas from the perspective of maximising the economic, social, and environmental benefits from the cold chain while minimising the potential large climatic impacts associated with refrigerants and energy consumption of the equipment.

1.1.1 KIGALI AMENDMENT TO THE MONTREAL PROTOCOL

Under the Kigali Amendment to the MP, countries will phase-down HFCs by more than 80% over the next 30 years. HFCs are highly polluting greenhouse gases commonly found in cooling equipment and the climate benefits are significantly enhanced by incorporating renewable energy strategies and improving energy efficiency (EE) of the equipment whilst phasing down HFCs. In the Scientific Assessment of Ozone Depletion, the World Meteorological Organization states that 'improvements in energy efficiency in refrigeration and air-conditioner equipment during the transition to low-GWP alternative refrigerants can potentially double the climate benefits of the HFC phasedown of the Kigali Amendment'.

1.1.2 CONTEXT IN AFRICA

In Africa, 80% of farms are smaller than two hectares; in combination they produce 70% of the continent's total food. In Near-East and North Africa, it is estimated that 55% of fruits and vegetables,

22% of meats, 30% of fish and seafood, and 20% of dairy is lost mainly due to lack of cold-chain infrastructure, causing loss of income for small-scale farmers and higher prices for poor consumers.

In Rwanda's case, food loss equates to 21% of its total land use, 16% of GHG emissions, and 12% loss to its annual GDP. Inadequate postharvest handling is responsible for 40% of this food loss because only 5% of firms in the food and agriculture sector have refrigerated trucks, and only 9% have a cold room to store fresh produce. In the case of small and marginal farmers, functional cold chains are almost completely absent (less than 1% of country's cold chain capacity).

In Africa, only ~1.3% of the population have so far been fully vaccinated against Covid-19, with 1.35 billion people still at risk of contracting the virus. WHO estimates suggest that African countries need to 'ramp up significantly three to five times their capacity to roll out the vaccine'. A recent WHO survey of 34 countries identified that 31% (11 countries) had over 50% of districts with gaps in cold chain capacity, let alone capacity for speed and volume.

1.2 PROGRAMME THEORY OF CHANGE

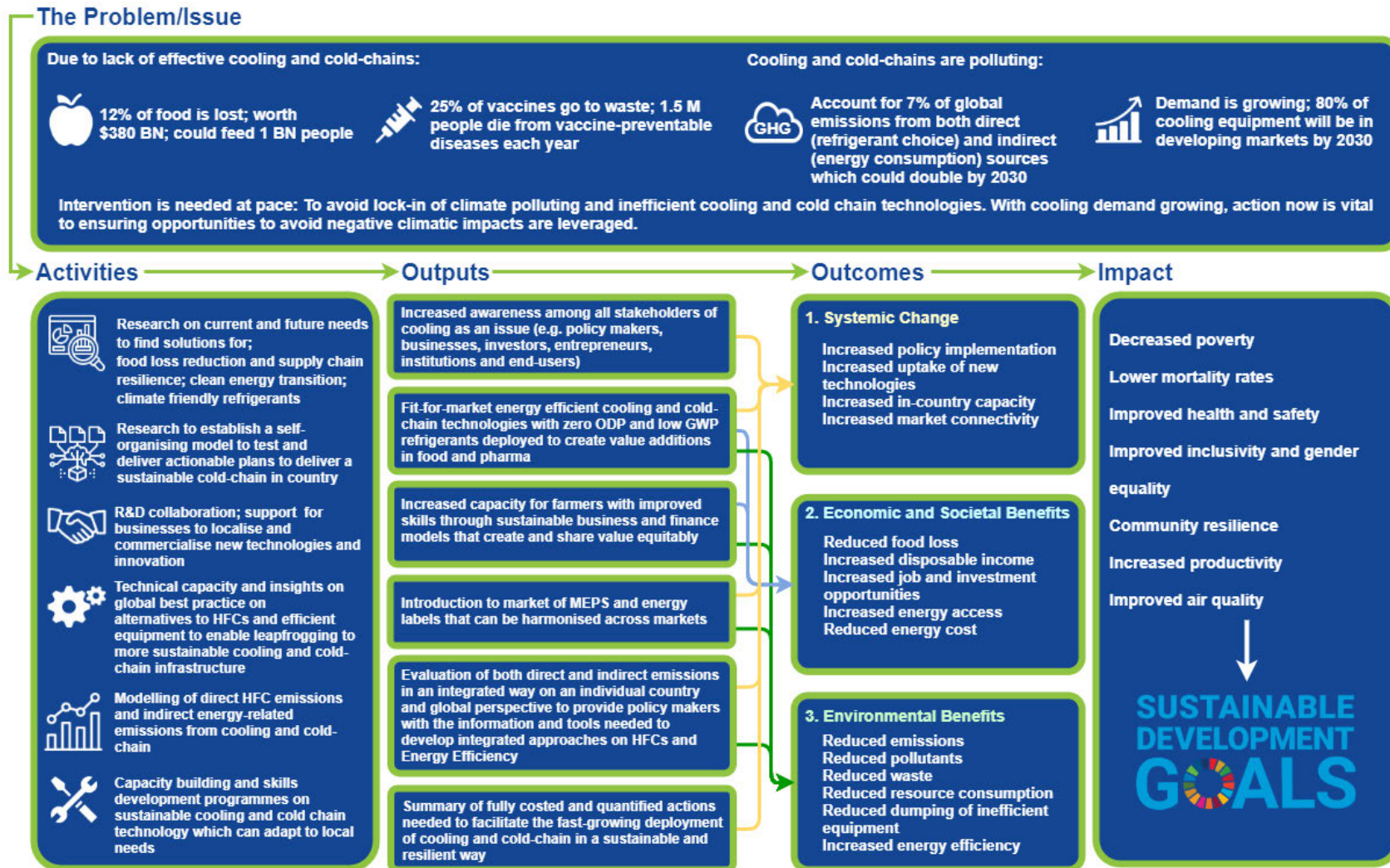


Figure 2. Sustainable Cooling and Cold Chain Solutions Programme Theory of Change

1.3 THEORY OF CHANGE NARRATIVE

1.3.1 PROBLEM/ISSUE

To meet agri-economic, nutrition and health goals, the urgent challenge for emerging economies is scaling 'Farm Gate to Fork' and 'Manufacturer to Arm' cold chain capacity and infrastructure and ensuring its seamless operation from source to destination. Cold chains are vital to help the food system deliver food that is affordable, nutritious and safe, whilst providing optimal returns to farmers and others in the value chain and minimising environmental and climate impacts.

A cold chain is however not a cold store. It is a complex system that requires accountability from multiple levels through the chain, varying by country and depending on local economic, environmental, social, cultural and political circumstances. For food, they typically involve primary processing (such as sorting and grading), precooling, cold storage, refrigerated transport as well as domestic storage to maintain the safety, quality and quantity of food produce. However, these processes are energy-intensive, often relying on diesel and fossil fuel-based power generation, whether on- or off-grid, and use refrigerants with a high climate impact. As the uptake in demand for cold chain technologies increases in developing countries, the dumping of inefficient technologies exists (new or second hand), locking countries into costly, high-carbon, energy-inefficient cooling pathways.

From a whole system perspective, it is also important to integrate elements of the wider food system, such as on-farm/close to farm food processing, which can unlock many value addition opportunities. Food processing can take many forms, including freezing, curing, drying, pasteurizing, fermenting, canning, aseptic packaging, etc. and can provide significant economic benefits by extending the usable life of food products or reducing need for cooling. Such an integrated system is also needed for the healthcare sector, to allow for the proper storage and deployment of vaccines.

The challenge of designing sustainable supply chains has been tackled to date in a disintegrated way, looking at energy and food separately. This programme of activities approaches this global issue from a synergistic perspective, having the nexus between food and energy at the core of its activities.

1.3.2 ACTIVITIES

This tranche of funding provides continued support for existing Official Development Assistance (ODA) funded activities aimed at optimised implementation of the Kigali Amendment and the development of sustainable cooling and cold chain solutions, supporting UK leadership for faster action on HFCs under the Montreal Protocol (MP) and parallel improvements to the energy efficiency of cooling equipment making a strong contribution to climate change objectives.

The programme is unique in that all the activities target the whole cold chain which has never been done before, with expert input at all stages from academics, industry and governments. We know that the presence of capital is not the barrier here due to studies from the World Bank clearly highlighting how the availability of cold stores, does not mean they are used as 96% of farmers living in the vicinity of the cold rooms don't currently use them. The findings from the surveys in the early needs assessment underscore the lack of comprehensive cold-chain. The common barriers are identified in finance, technical, social, policy and management areas. Furthermore, the assessment shows that training and capacity building on the benefits of cold chain is what is currently needed to enable uptake in cold chain technologies and is the gap this programme can support. Further detail of this assessment explained in Section 3.2. The activities outlined in the Programme Case for each workstream will create the behaviour change, from both those in the field and governments, that is required to tackle the issues of a lack of connectivity in Section 1.3.1.

In developing countries where populations depend heavily on agriculture for their livelihoods rural women and youth under age 18 are the most vulnerable groups in the context of this programme. There are inequalities regarding the distribution of this support which is an ongoing challenge. Women

lack access to agricultural land and finances, and relevant skills to successfully develop agri-businesses. Women also earn less than men and are more frequently engaged in unpaid and informal agricultural work. The programme will tackle this through providing both groups with the education and training to equip them to pursue higher value-added economic opportunities beyond the traditional subsistence farming pathway. Workstream One in particular will directly address these inequities, including through having a creche at the campus and ensuring inclusivity in both the training made available and the business model support. Further, women are disproportionately affected by energy access, the programme looks at how energy efficient cooling technologies can improve the lives of women and other underserved populations living in remote areas through saving both time and money. Access for these marginalised groups will run through all activities through ensuring female participation in training.

This will be done through the ongoing delivery of four workstreams receiving part of the £12 million and spend is intended to be profiled across the next three years (£4 million a year) to support stable and deliverable outcomes but there is flexibility to adjust how this is profiled across the three years subject to wider ODA funding profiling across the Defra ODA portfolio. Through workstream one, this programme will support the continued delivery of the first 'Africa Centre of Excellence for Sustainable Cooling and Cold Chain' (ACES) and related activities with this workstream receiving the largest amount of new funding (around 80%) and this will continue to be the largest contribution going forwards. The remaining £2.5 million of the programme will support the remaining three workstreams.

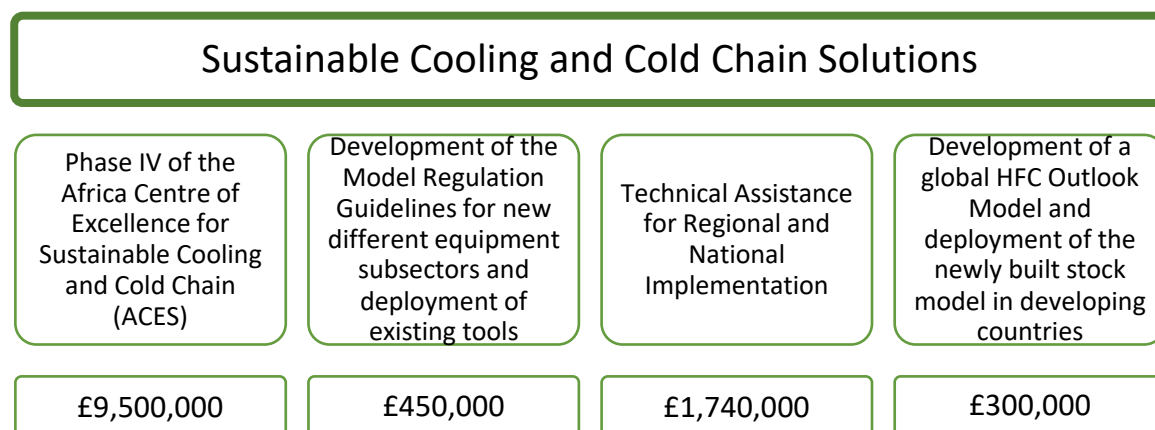


Figure 1: Overview of Sustainable Cooling and Cold Chain Solutions Workstreams

These funds will be paid up front in order to be able to deliver this project, which isn't uncommon with ODA projects due to the nature of the work and the delivery partners used. However, they will be profiled across the next three years (£4 million a year) to support stable and deliverable outcomes but there is flexibility to adjust how this is profiled across the three years subject to wider ODA funding profiling across the Defra ODA portfolio

UNEP will be primarily responsible for the implementation of the activities and for procurement and contractual services, as well as reporting on the progress of this implementation in close coordination and strategic guidance from Defra. Further information on the flows of money can be found in Section 4.2. The procurement actions and the operational services will be carried forward in accordance with UN policies and procurement guidelines. Which can be accessed [here](#). There are a number of scenarios that can lead to the potential suspension of funding, termination and returns to Defra if we feel benefits are not being met and this is detailed in Section 5.8.

1.3.3 OUTPUTS

Activities will accelerate and grow a network of resilient and climate friendly solutions across cold chain and refrigeration (food and vaccines) networks. This will lead to a range of outputs addressing all aspects of the cold chain.

- Improved understanding of the cold chain for key stakeholders including farmers and medical staff, as well as governments. Currently this is lacking and leading to present interventions from other donors to fail. The assessment of needs showed a social lack of awareness, especially in rural communities. Fresh products are preferred to refrigerated products, which discourages investment into cooling equipment. Fortunately, raising public awareness is easy in Rwanda through the monthly gatherings, where every person aged above 18 years of age is required by law to participate.
- Developed policy for governments through guidance and advise to policy makers on how to effectively implement climate friendly, energy efficient solutions across the cold chain, in line with government aims and visions to ensure uptake.
- Sustained engagement through exchange of lessons learnt through a hub and spoke model and instilling change within government processes to maintain progress.
- Climate benefits from improved energy efficiency and use of climate friendly equipment from the capacity building and training for refrigeration engineers and the improved guidance to governments. Training in maintenance and securing buy-in from stakeholders before undertaking the capacity building will ensure behaviour change is realised.
- Research outputs through on the information being collected and the use of models to fully understand the problems of the cold chain and take action from these outputs.

We know that this kind of intervention is what is needed to secure outcomes. Evidence from efforts in India (led primarily by DIT) to develop a cooling centre of excellence shows one off investment and individual uncoordinated projects don't provide scalable pathways. Furthermore, a Millennium Challenge Corporation study showed donors often continue to pour money and effort into the same flawed solutions. There has been proven success however in India where a pilot of creating a cold chain around Kinnow² (a seasonal, high-yield and low-cost mandarin-variety fruit produced in the western Punjab area), previously only sold locally due to the lack of suitable cold chain facilities in the region was able to see huge benefits when interventions to create a joined up cold chain were implemented. Food losses declined 76%, adding to higher returns for farmers (10x increase in profit), and system-wide greenhouse gas emissions fell by 16%. The interventions included training on benefits of cold chain and linking farmers and suppliers up effectively with cold chain solutions.

1.3.4 OUTCOMES AND IMPACT

There are three expected outcomes from the programme:

- a) **Transformational Systems Change:** Through an increase in policy and technical capacity within country on sustainable cooling and cold chain solutions to deliver a transformational systems change.
- b) **Economic and Societal Benefits:** Through an increase in skills and jobs for refrigeration engineers and technical capacity for farmers on sustainable cooling and cold chain solutions to deliver economic and societal benefits.
- c) **Environment and Climate Benefits:** Through reduced food loss due to improved availability of sustainable, climate friendly cooling and cold chain solutions to deliver environmental and climate benefits avoiding locking in to obsolete, polluting technologies, because food saved is as important as food produced.

² [Kinnow-PILOT-Report.pdf \(nccd.gov.in\)](https://nccd.gov.in/Kinnow-PILOT-Report.pdf)

These outcomes are all focused on key stakeholders (farmers and businesses) and creating systemic change within countries (policy level). Ensuring engagement and uptake of practices are addressed at every stage of the cold chain. This integrated approach to programming with multiple workstreams that are all connected through a mutual goal speaks directly to Ministerial steers that UK ODA should be strategically placed and coherent, and that activities should have multiple benefits.

For details on how we will monitor and evaluate these outcomes through three impact indicators (ICF KPIs 1, 6 and 15) and six outcome indicators (linked to Defra framework of KPIs), please see section 6.5 and the Log Frame for more details in Annex G. A benefits map for the programme can also be seen in Annex H.

1.3.5 DISBENEFITS AND ASSUMPTIONS

As we are still at an early stage in developing our Log Frame and KPIs, it is hard to assess and identify disbenefits at this stage of the programme. Disbenefits of the programme will be identified in further detail with a clear management plan set out as we develop the benefits realisation plan. This is considered further in Section 6.4. Potential disbenefits include:

- Increase in electricity demand as the availability and use of cold chain increases.
- Local pollution increased as people travel to Centre of Excellence and relevant SPOKES.
- If programme does not become self-sustaining, temporary jobs supported in programme would be lost resulting in lack of stability for those employed.

Assumptions associated with the programme have been detailed in Section 6.1.3.

1.4 STRATEGIC FIT

The UK Government recognises the tremendous opportunity for ambitious government, business and civil society action to deliver against the goals of the Kigali Amendment to the Montreal Protocol (MP), leveraging the success, experience and importance of what is seen as the most successful Multilateral Environmental Agreement to date and the UN Sustainable Development Goals to develop climate friendly, energy efficient cooling and cold chain solutions. As a champion member of the UN [Cool Coalition](#), and co-lead of Mission Innovation's 'Affordable heating and cooling of buildings' innovation challenge (IC7) with the European Commission and United Arab Emirates, the UK pledges to share knowledge, advocate and act on sustainable cooling and access to cooling for all.

As noted in the 25-year Environment Plan, the UK was at the forefront of international efforts that have phased out 98% of ozone depleting substances globally, under the MP. The UK played a leading role in securing a global deal to reduce the use of HFCs under the MP, helping to avoid 0.4°C of global warming by the end of this century.

The further work supports activities under the Montreal Protocol through funding early integrated action on HFCs and sustainable, efficient cooling in a number of Africa countries. Global action under the MP, could potentially avoiding up to 1°C of warming by the end of the century with earlier and faster actions to reduce HFCs and enhance energy efficiency of cooling equipment potentially halving cumulative emissions globally by 2050 compared to a just compliant scenario.

Combining the phase down of HFCs with energy efficiency measures, such as the mitigation/adaptation potential of action on environmental pollution contributes to UK's 'Net Zero' agenda, supporting the phase-down of strong GHGs and driving the development of energy efficient infrastructure links. The wider connections to the provision of sustainable, clean efficient cooling also links with work relating to nature-based solutions when designing ACES (e.g. approaches to passive cooling).

Defra is the Department responsible for the MP and the only Department with the expertise and HFC-related ODA spend that directly supports the objectives and discussions under the MP. These activities

will provide complementary overlaps with FCDO and BEIS related joint activities on sustainable cooling.

This Programme helps to contribute to the Defra International Strategy Departmental outcome 5 (DO5) on Strengthening the union and international by providing strong international leadership on climate as well as demonstrating our commitment to a Global Britain through engaging bilaterally with other countries with this funding and being a leading player in the climate change agenda.

Further, across government it links to the newly published [Strategy for International Development](#). This programme helps to meet the four priorities through taking forward UK leadership on climate change, science and technology as well as actively supporting women and girls and reducing poverty to prevent the worst forms of human suffering around the world.

2 PROGRAMME CASE

2.1 WORKSTREAM ONE – AFRICA CENTRE OF EXCELLENCE FOR SUSTAINABLE COOLING AND COLD CHAIN-FLAGSHIP PROJECT

This workstream is over 75% of overall programme spend and is thus captured in detail within this document. With Defra ODA funding and the support of the Rwanda Government, the Africa Centre of Excellence for Sustainable Cooling and Cold Chain (ACES) programme was launched in 2020. The focus is to work with governments, academia, industry, rural communities and wider stakeholders to develop 'Farm Gate to Fork' and 'Manufacturer to Arm' strategies for the global food and vaccine systems.

ACES serves as a hub and spoke model with the headquarters ('the hub') being located at the University of Rwanda in Kigali and up to five SPOKES (Specialised Outreach Knowledge Establishments) located across Africa to export knowledge from ACES and grow a network to implement solutions across cold chain and refrigeration.

A whole system approach is essential as cold chains currently lack integration between sectors in both food and pharma. ACES will deliver economic, environmental, and social benefits to rural communities, and contribute towards achieving SDGs, the Paris Agreement, and the Kigali Amendment. It will support farmers by reducing post-harvest food loss and improve access to safe and nutritious food, whilst ensuring that communities have continuing access to life-saving vaccines/health services. This will be done through training and capacity building in communities. Change will be sustained through successfully addressing social perspectives and current low importance of cold chain. Building on data collected through the market needs assessment, ACES-led activities will ensure raised public awareness through the farming cooperative and monthly gatherings, where every person aged above 18 years of age is required by law to participate.

Furthermore, the SPOKES which will be located in rural communities in Rwanda and throughout Africa will help export knowledge from the Centre, playing a key role in scaling up market connectivity, business models, technology, and technical skills to bridge critical gaps, complementing foundational efforts already underway by the Government of Rwanda and others in the region and across Africa.

The long-term outcomes include improved incomes, livelihoods, reduced hunger, new jobs and investment opportunities with the availability of equitable, resilient, affordable, sustainable cold chains, and reduced GHG emissions from cold chain and food loss.

Summary of Defra funding and work tranches to date

Defra funding to date totals £6.2 million, made up of:

- 1 **Phase I (2020 – 21) / Funding: £200,000:** Supported a Cooling Needs Assessment in Rwanda that, along with other existing studies, provided the validation, foundational underpinning and design concept of the Centre.
- 2 **Phase II (2021-22 - on-going) / Funding: £2,500,000:** Full design of the Centre, technology and staffing definition, hiring of key staff, first technology procurement for the Centre and industry engagement.
- 3 **Phase III (2022-23 – on-going) / Funding: £3,000,000:** Supported the scale up and delivery of the first 'Centre of Excellence' in Rwanda through key staffing, new revenue streams and expanding into the first remote SPOKE in Kenya as well as technical assistance to replicate model in India. This phase also includes:
 - **Roadmap (2022 - contracting and implementation)/Funding £500,000:** The first phase of using ACES (with Rwanda and Kenya³ as pilot markets) to develop comprehensive, robust and self-learning model, using country data sets that will create a sequenced and costed roadmap. This roadmap will allow cooling and cold chain solutions to be tested prior to investment to identify and mitigate risks and barriers and understand best approaches. From this, we can develop robust, budgeted and evidence-driven roadmaps with quantified impacts for governments to meet their targets and to achieve access to cooling and cold chain for all sustainably for developing market. There will also be a full return-on-investment analysis taking into account multiple benefits across social, economic and environmental dimensions.

The ACES programme is structured into different components with corresponding work programmes (Annex A), these are set out across the previous business case documents and define the steps to expand and consolidate ACES.

Overview of new activities to be funded in Phase IV

With funding secured to design, equip and launch ACES, the objective for Phase IV is to give ACES the necessary financial support (£9.5 million to 2025) to be fully operational from 2023 with a portfolio of actively engaged industry partners leading to elements of the hub in Rwanda being self-sufficient by mid-2025 (Figure 1). This will be achieved through co-financing from industry partners (who have already committed to providing equipment for the Centre and developing the training programmes) and other donors, as well as utilising the revenue from the loan of equipment already at the centre to industry that do not have an African presence.

Phases II and III detailed procurement plans and laid the foundations for work so that operation can begin to house equipment and training in Phase IV. The overarching outcome is the development of a pan-Africa applied research and knowledge centre for sustainable cooling and cold chain/postharvest management sectors. This will be done through:

1. Network building

- Create and sustain a transdisciplinary community of innovators and investors/users in innovation to help stimulate and co-design, research around cold-chain at the local, regional and national scale and accelerate the deployment of needs-driven solutions.

2. Research and learning capacity enhancement

- Further recruit and train-up the ACES management, staffing and research capacity in-country, in particular **Early Career Researchers** across the interdisciplinary areas covered by ACES that will ensure representation from women.
- Recruit and train-up the in-country capability to (i) deliver and operate the first three SPOKES until self-funded and (ii) build a pipeline of SPOKES.

³ Kenya is planned to be the first market hosting a SPOKE (step 3), currently in development.

- Inform and equally engage women and men in languages, forms and ways that are culturally appropriate and easy to understand.
- 3. Deployment of innovative technology**
 - Validate technology and ensure it is fit for purpose and does what is claimed.
 - Work with industry and financiers to create and test new finance and business models aligned to best-in-class equipment and Community Cooling Hub (CCH) models.
 - Continue to broaden out and develop optimised, sustainable cold-chain design for food and vaccines, including cross border models.
 - Accelerate the design and uptake of market-relevant digital innovation.
 - 4. Design and roll-out of two further SPOKES (following-on from Kenya and Rwanda pilots)**
 - These SPOKES will leverage existing activities, to disseminate knowledge and technologies and provide mentoring and training across East and Southern Africa to accelerate sustainable and resilient solutions across cold-chain and refrigeration (food and vaccines)
 - Develop the marketing of ACES (pan-Africa and internationally) and secure third party use of the equipment and facilities (to include defining services and charging rates).
 - 5. Provision of government policy services**
 - Support policy makers to develop holistic market development and transformation strategy on agriculture and vaccine cold chain, informed by robust data and gap analysis.
 - Epidemiology data on vaccine-preventable disease and population data driven public health decision making to underpin more efficient cold-chain
 - 6. Dissemination (including international), inter alia,**
 - Knowledge Exchange with Internal members and External Networks/ Communities through reports, papers, ACES website, media and social media.
 - Community toolkit, learning materials.
 - Hosted events at Campus and attendance at relevant conferences.
 - 7. Self-sustaining business model in Rwanda Hub**
 - Create new, secondary funding sources for ACES and SPOKES (especially through industry and development agency collaborations).
 - Building on the existing structure, ensure that ACES has the transparent, ethical and accountable management and governance, risk management and audit process, including clearly defined research and innovation leads.
 - 8. Replication in different markets**
 - The second permanent hub is planned to be built in Telangana, India, for which a MoU was signed on March 2nd 2022.
 - Replication in other markets (subject to availability of further funding), including Small Island Development States (SIDS) that face unique challenges of transitioning to renewables (and removing fossil fuel dependence) through creating in-market collaborations among key stakeholders and providing technical assistance and knowledge transfer

The work packages and resources for the funding over the next three years are detailed in Annexes A-D. After Defra funding ends in 2025, delivery partners will remain engaged due to their presence in the region through UNEPs BAU work and funding from new co-financing. UNEP colleagues on the ground will still be present to ensure success and that the impact of the programme is realised.

If any additional funding becomes available within Defra before or after 2025, there is potential to do more. It will allow for the expansion into other markets including developing of more SPOKES, further work in India and exploring new areas of need including Small Island Development States (SIDS) that have unique cooling challenges, as noted in point 8 above. Figure 3 provides an overview of how the next phase of ACES will be delivered till 2025.

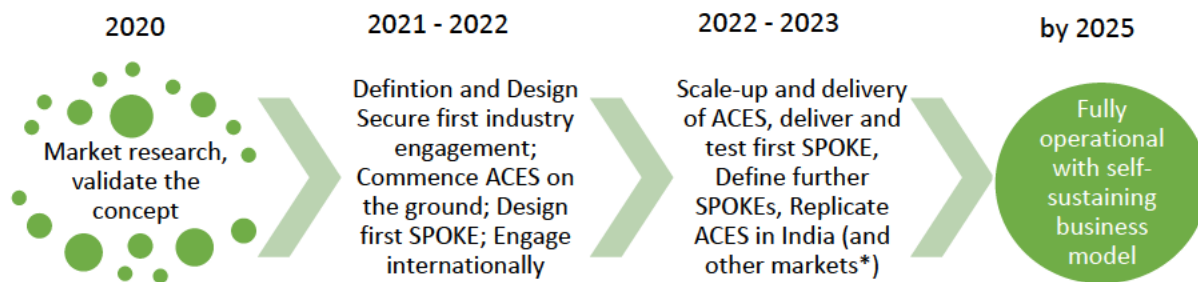


Figure 3. Development of Workstream One

*Subject to availability of further funding.

2.2 WORKSTREAM TWO – MODEL REGULATION GUIDELINES

Minimum Energy Performance Standards (MEPS) and energy labels are a great example of best practices and, if well-designed and implemented, are some of the fastest and most effective approaches to improve efficiency. Although dozens of countries have MEPS and energy labels, many are outdated or unenforced. Inadequate MEPS and labels leave countries vulnerable as dumping grounds for products that cannot be sold elsewhere. However, there are good examples to follow at a global level (e.g. in the EU, China and North American markets) which are driving the availability of far more energy-efficient and climate-friendly products.

Promoting modern energy efficient appliances can empower women. This can be done through saving time through modern technologies that tackles time poverty which is a key aspect of gender inequality and secondly, through income generation and improved livelihoods through saved money on using these newer more efficient technologies.

Summary of Defra funding and work tranches to date

Since 2019 Defra has been funding U4E to develop and deploy Model Regulation Guideline products on.

- [Domestic refrigerators](#) (September 2019)
- [Room Air Conditioners](#) (September 2019)
- [Commercial Refrigeration](#) (November 2021)
- Off-Grid (To be launched in late October/November 2022)

The contents address EE and refrigerant global warming potential simultaneously, enabling accelerated compliance with the Kigali Amendment and unlocking enormous energy, climate and economic co-benefits. Accompanying Supporting Information documents provide insights on global technology and policy trends for policymakers.

The guidelines also recognise that each country has unique characteristics. The general guidance is therefore intended as a starting point to inform regulatory considerations rather than a final template to adopt. Regulatory processes should be undertaken transparently and with sufficient time to address local circumstances (e.g. availability and prices of products, income levels, utility tariffs, etc.). It is typically led by an energy ministry with the support of a national standards body and conducted in consultation with many experts from the public and private sectors, and civil society.

Alongside this, U4E concluded a multi-year effort to update [Country Savings Assessments](#) (CSA) for 150 countries that illustrate the impacts of adopting the Model Regulations at the minimum energy efficiency grade, medium-efficiency grade, and high-efficiency grade.

Total funding to date is £350,000 and total planned over the next three years is £450,000.

Overview of new activities to be funded through the next tranche

Expansion of the portfolio of guidelines to address three product areas:

- Heat pumps (air to air)
- Water heaters (air to water)
- Commercial air conditioning

The contents for each product area will be pursued sequentially and each requires approximately one calendar year for development and initial promotional outreach. U4E will also expand its [Country Savings Assessments](#) methodology to address each of these product areas.

U4E and its collaborators (including LBNL with its renowned expertise in the standards and analysis arena and proven track record with U4E on model regulations development and deployment) will reference existing and forthcoming standards and related best practice interventions so that developing and emerging economies can benefit from adapting well-researched practices from elsewhere rather than attempting to pursue such content in an entirely bespoke fashion. The resulting Guidelines will be ideal for anchoring new MEPS and labels, informing public procurement schemes and other types of financial mechanisms (used in Workstream Three).

U4E will continue to use the proven approach that has enabled preparation and deployment of existing Model Regulation Guidelines through its own projects as well as by other collaborators, including UN agencies, CLASP, World Bank, IIEC, GiZ, and beyond.

The finished contents will be widely promoted through UNEP channels and its vast array of partners. Illustrative examples include high-profile side events led by U4E at Climate Conferences, Montreal Protocol meetings, and in national and regional market transformation projects that enable direct engagement with target audiences.

Summary of deliverables and costs in Annexes E and F.

2.3 WORKSTREAM THREE – TECHNICAL ASSISTANCE FOR REGIONAL AND NATIONAL IMPLEMENTATION

Guidelines provide an excellent starting point, but additional efforts are required to adapt these for use in a national or regional setting. Countries committed to pursuing mandatory MEPS and labels often do so with inadequate resources, insights on global best practices, and with an aim to yield a bespoke approach that suits their local demands but is not more widely applicable in other markets. Therefore, U4E have developed a suite of resources to facilitate this through technical assistance for national and regional implementation.

REGIONAL IMPLEMENTATION THROUGH POLICY HARMONISATION:

Aligning Energy Efficiency (EE) policies across countries facilitates trade and enables greater access to the latest technologies. In Africa, for example, the Common Market for Eastern and Southern Africa (COMESA) with over 20 participating countries provides a regional cooperation platform. This approach is resource and time intensive, but it has been successfully pursued in the European Union, and other regions such as Eastern and Southern Africa and Southeast Asia are keen to follow a similar path. It is critical to facilitate policy alignment opportunities by leveraging lessons learned and referencing data and analyses on global technology and policy trends.

Dumping grounds for inefficient products are less likely when countries decide to implement the same policies/MEPS and labels. A dumping ground often arises when one country has less stringent regulations than other countries in the region, because less efficient products that are forbidden for sale in other countries are still allowed to circulate in the market.

Therefore, within the roll out of Model Regulations Guidelines detailed above in Workstream Two, activities have been underway to support policy harmonisation in the 21 East African (EAC) and

Southern African Development Community (SADC) countries. This began in Q2-2020 and has the objective of developing MEPS and labels for room air conditioners and residential refrigerators.

Summary of Defra funding and work tranches to date

The workstream is being implemented in collaboration with the East African Centre of Excellence for Renewable Energy and Efficiency (EACREEE) as well as the SADC Centre for Renewable Energy and Energy Efficiency (SACREEE) and with support from Defra.

- Regional Market Assessments (completed in February 2021) of 21 countries to understand the current uptake and use of MEPS and Labels
- Technical Notes (completed in February 2021) that align with the Model Regulation Guidelines and recommend the establishment of a harmonized energy efficiency policy framework to ensure cost and energy savings while minimizing environmental impacts
- Regional Technical Committees (TC) (started in Q1-2021 – ongoing) to discuss the draft MEPS to be harmonised
- MEPS and labels (started since July 2021) based on the U4E Model Regulation Guidelines and adapted to fit the need of the regions. Currently the draft MEPS are being discussed at the national level and are to be finalized in early Q2-2022. The regional MEPS and labels will serve then as the reference for the implementation at the national level.

Overview of new activities to be funded through the next tranche

U4E support for the next tranche will be offered through the addition of two consultants that coordinated the development of the regional MEPS and labels.

U4E will support regional harmonization efforts in a region (e.g. approximately 5 or more countries in proximity) on a new EE, lower GWP cooling products which they currently do not cover at a level consistent with U4E Model Regulation Guidelines. This could be either on existing Model Regulations for Residential Refrigerators, Room Air Conditioners and Commercial Refrigeration or the forthcoming ones on Heat Pumps, Water Heaters and Commercial Air conditioners (outlined in Workstream Two).

The region to undergo policy harmonisation will be selected based on the matrix of key considerations, including likelihood (informed by past experience with their level of engagement and seriousness in terms of senior government-level buy-in) of the countries to move forward with implementation and the size of the greenhouse gas (direct and indirect) savings opportunity based on their anticipated level of ambition of the U4E Model Regulation Guidelines and the timing of when they anticipate implementation.

U4E will partner with the relevant regional centre(s) to ensure regional processes are followed. U4E will help convene and provide technical leadership in regional and national consultation meetings with the ministries of energy/environment, standards bodies, regional centres and relevant stakeholders (e.g. manufactures and NGOs). Summary of deliverables and costs in Annexes E and F.

NATIONAL IMPLEMENTATION THROUGH SUSTAINABLE PUBLIC PROCUREMENT:

Policy Harmonisation provides the regional framework for MEPS and labels for refrigerating and air conditioners appliances for all 21 countries. However, *national implementation* is also essential to ensure that savings are achieved.

A key financial mechanism and incentive to overcome many of the financial barriers to adoption of sustainable cooling solutions is Sustainable Public Procurement (SPP). SPP is the integration of SPP criteria and international regulatory, social and environmental best practices in the day-to-day purchasing activities of Government and public sector organisations.

There is a gap for SPP in ASEAN and much of Africa, where there is no emphasis on sustainable cooling products (often emphasis is on government procurement of food). Combined with the regional

harmonization efforts outlined above, SPP can provide an incentive for governments to move in a quicker manner and start priming the market with more EE and climate friendly products.

Summary of Defra funding and work tranches to date

- Sustainable Public Procurement toolkit: To provide a structured framework for implementing a SPP programme, with insights on regulatory, financial and technical considerations, to help tenderers to make more informed decisions when comparing different bids.
- Procurement Guidelines and specifications: To guide the procurement of energy efficient air conditioners and refrigerators in governments, using a step-by-step approach on how to apply the best international regulatory, social and environmental practices,.
- Technical assistance on SPP for Morocco: In January 2022, U4E and the Société d'Ingénierie Energétique (SIE), the Moroccan state-owned energy services company, announced their collaboration to promote SPP in Morocco using U4E's SPP Toolkit and Model Regulation Guidelines. Two more interventions are anticipated to allow for a variety of implementation examples (informed by U4E, conducted by SIE in due course) using the SPP format.
- Ecofridges project implemented in Ghana and Senegal: Financial mechanisms have been developed to promote efficient, climate-friendly refrigerators and air conditioners, with eligibility criteria adapted from U4E's Model Regulation Guidelines. Since August 2021, the [EcoFridges Green On-Wage \(GO\) online shop](#) has been available for consumers to finance EE and lower GWP refrigerators and air conditioners at 0% interest rate, for example.
- Rwanda Cooling Initiative's Green On-Wage (R-COOL GO) financing mechanism: Through which EE and lower GWP refrigerators and air conditioners are available at competitive interest rates, in Rwanda.

Overview of new activities to be funded through the next tranche

U4E will also work with four key countries to ensure that the regional recommendations are implemented nationally. Support will include technical assistance for MEPS and labelling implementation and advising on the design of either SPP or consumer finance schemes that relate to the MEPS and labels. The product of focus will likely start with residential refrigerators and room air conditioners, but other products are also possible based on those produced in Workstream Two.

A Policy Working Group (PWG) will be created to work closely with the project team to help policy stakeholders understand how the regional MEPS and labels will impact their national market, which is why a cost-benefit analysis will be conducted. Next, a roadmap will be put together to map the policy implementation and a public consultation held to discuss the planned roadmap and MEPS/labels. Two final meetings will consider necessary amendments in the wording of the regional MEPS to adopt it to the local context and endorse them by the PWG.

U4E will also provide technical assistance in SPP to assure for a holistic market transformation to energy efficient cooling. U4E support will be offered through two consultants that coordinated the development of the regional MEPS and labels. On SPP, an additional expert will be involved who has developed the sustainable public procurement toolkit.

To incentivise the national stakeholder, activities on SPP or financial mechanism will be supported as well. For SPP, a second PWG will be created that involves procurement, energy and environment officials (and others as relevant for each country). A kick-off workshop with the members of the PWG ensures capacity building about SPP and provides awareness on the tools and resources that were developed by U4E. Thereafter, an analysis of the current public procurement processes in the country will be developed and integration of SPP toolkit components identified. Based on the individual needs of the country, an evaluation of the assistance will be conducted. In a final step, lessons learnt, and final recommendation to improve the analysed procurement processes will be put together and communicated during a final workshop with the PWG.

Gender equality at meetings will be vital because which appliances to buy are often gendered, with women having less influence than men about what is purchased, even for products that are typically used by women. Therefore, by having women present it will help policy makers create incentives and consumer financing schemes that improve affordability and avoid implicit gender bias

One of the countries that will be included in the technical assistance is South Africa. Many countries of the Southern African region import refrigerators that had been manufactured or imported into the country. South Africa has a noteworthy production of refrigerators⁴ and therefore, many countries follow the approach for policies that South Africa implements. The country is therefore a key player to have implementing the regional MEPS in a quick manner and technical assistance will assist in ensuring it is prioritized with the government and national stakeholders.

Most consultations will be conducted remotely, but at least two in-country mission is expected for each country. The timing is staggered to allow support for 2 countries starting in 2022 and 2 countries starting in 2023.

Summary of deliverables and costs in Annexes D and E.

2.4 WORKSTREAM FOUR - HFC OUTLOOK

The HFC Outlook model provides the capability to assess pathways to reduce GHG emissions from products and equipment that use HFCs. The model can be used to assess both the direct GHG emissions created by HFCs entering the atmosphere and the indirect GHG emissions created at power stations supplying the energy required to operate equipment that uses HFCs. Modelling analysis of future scenarios can support policy decisions related to both HFC phase-down and the energy efficiency of cooling and heat pump equipment. This analysis can help ensure that the most cost-effective pathway towards net zero GHG emissions can be established.

Summary of Defra funding and work tranches to date

From 2012-2018, the early development of HFC Outlook was funded by EPEE (a European RACHP trade association) and by UNEP Ozone Action (through funding from the MPs Multilateral Fund). The model created could only assess HFC phase-down issues. Defra recognised that the interactions between direct HFC emissions and indirect energy-related emissions is complex and that developing countries would benefit from modelling that evaluated both types of emission in an integrated way Defra ODA support therefore began in 2019 and has enabled the development and implementation of significant further modelling capabilities.

To date the model has been used at country level (for 10 developing countries). Current development work is aimed at creating a platform for building regional models covering all parts of the world and combining these in a global model of HFC use and GHG emissions. The development of this Global Model closely aligns with ongoing discussions under the MP. In particular, a Global Model will provide quantified data to show:

- The benefits of faster action to start HFC phase-down.
- The benefits of integrating HCFC phase-out and HFC phase-down activities.
- The relative contributions to GHG emission reduction from HFC phase-down and from improved energy efficiency.
- The benefits of linking energy efficiency improvements to the HFC phase-down process.

The development of regional HFC Outlook models relies on obtaining good data on the historic and current use of HFCs, particularly in the refrigeration, air-conditioning and heat pump (RACHP) markets. This is very challenging as there is limited data available for many geographic regions.

⁴ EACREEE, SACREEE and United for Efficiency, Overview of the Market on Refrigerating Appliances and Room Air Conditioners in East and Southern Africa, page 142. <https://united4efficiency.org/resources/regional-savings-assessment-southern-african-development-community/>

Funding to date has been £656,214 and work has been delivered in 2 phases as follows:

Phase 1-Energy modelling capability (2019 to 2021, work complete)

Key activities:

1. Energy modelling capability. This enables detailed analysis of energy used in each of the RACHP sectors being modelled, taking account of the climate conditions in the country being modelled. It also enables modelling of the energy-related CO₂ emissions, taking account of future electricity grid decarbonisation.
2. Testing of the energy modelling capability using the EU-28 model.
3. Delivery of the energy modelling to the 10 Article 5 countries with an HFC Outlook model.
4. Other improvements to the HFC Outlook model to make it easier and quicker to create new models for other developing countries.

Phase 2-Regional and global modelling capability (2021 to 2022, work on-going)

Key activities:

1. Software to combine regional models into a global model.
2. Algorithms to use macro-economic data to estimate RACHP stock levels in different geographic regions.
3. Data collection in key countries to confirm RACHP stock levels and types of refrigerant used.
4. Prototype Global Model of both HFC emissions and energy-related emissions. This is based on development of a number of regional sub-models (e.g. Northern Africa, Sub-Saharan Africa, South America, Latin America and Caribbean etc.)

Overview of new activities to be funded through the next tranche

In terms of software development, the HFC Outlook modelling platform has reached a good level of maturity. Via the Phase 1 and Phase 2 programmes funded by Defra ODA, the software provides most of the functionality that is required. The software is very sophisticated, so there is an on-going requirement for software maintenance that can be expected over the next few years.

The key requirements for on-going work falls into 4 distinct areas

1. Improving the data input assumptions for the Global Model. A significant amount of data has already been collected under the current work but there is considerable scope to collect better data that takes into account significant regional variations due to various factors including climate, wealth and “local practices”.
2. Using the Global Model to provide MP Parties with a better understanding of the importance of EE actions and of the potential to accelerate the HFC phase-down.
3. Providing more developing countries with a national model.
4. Software maintenance.

It is assumed that creating new national models will be funded via MP’s Multilateral Fund (MLF) which funds developing country compliance obligations under the MP, and that the focus of Defra ODA funding will be for items (1) and (2) above. The precise requirements for the next 3 years will evolve in response to the results of work carried out in the next year.

During FY 2022/23 it is also intended that the global model will be used to provide inputs into Defra negotiating priorities under the MP, to support the UK policy objectives advocating for faster action and an enhanced HFC phasedown combined with EE improvements.

For FYs 2023/24 and 2024/25 it is expected that there will be a continuing process of improving the data input assumptions and refining of the outputs and the strategic messaging that can be supported by the model. A key element of improving the input assumptions will be the availability of improved country level data from Kigali Implementation Plans and from new national level HFC Outlook models that are expected to be created with MLF funding over the next 2 years.

Summary of deliverables and costs in Annex E and F.

3. ECONOMIC CASE

3.1 INTRODUCTION

This section will set out the economic rationale behind the intervention, assess the relative costs and benefits and highlight the preferred option based on value for money. Due to the nature of the intervention, scope of this business case (programme-level) and the availability of data - we have not sought to undertake a full quantitative cost-benefit analysis. At this stage, the planned activities that will be undertaken through the four workstreams will have many intangible, qualitative benefits. Therefore, we have described the different options using a mixed quantitative and qualitative approach to assess the value for money (VfM) of the preferred option.

The purpose of the economic case is to establish an intervention option that not only tackles the identified challenges of cold chain from farm to fork and the climate impacts of cooling but can also expand the capacity of ACES across the cold chain and refrigeration, including vaccines and deliver scalability through replication of the ACES model in other fast-developing markets (India) and across Africa through SPOKE's, as well as expanding the knowledge and toolkits of ACES.

3.2 ECONOMIC RATIONALE

Populations in most developing countries depend heavily on agriculture for their livelihoods, making cold chain development a powerful tool to boost incomes and foster economic growth. According to the International Institute for Refrigeration, approximately 1/3rd of perishable products require refrigeration. Globally, approximately 400 million tonnes of food are preserved using refrigeration (in chilled and frozen state), but 2 billion tonnes require refrigerated processing. In Africa, less than 4% of the continent's fresh produce is transported under low-temperature conditions. By way of comparison, over 90% in the UK's fresh produce is transported under low-temperature conditions.

The Africa Agriculture Status Report (AASR) found that 80% of Africa's farms are smaller than two hectares. They produce 70% of the continent's total food requirements. As an example, 73% of the workforce in Rwanda are directly employed by agriculture and agriculture accounts for approximately 30% of national GDP. Food loss in Rwanda equates to 21% of its total land use, 16% of GHG emissions, and 12% loss to its annual Gross Domestic Product (GDP).

Ineffective delivery systems limit the producers' ability to extend sales beyond a restricted local area. Effective and efficient logistics, and in the case of perishable produce - temperature and climate managed environments through a cold chain, are essential to connect a farmer to new urban markets further afield for increased volume demand and higher price opportunities whilst avoiding any unintended consequences.

For vaccines, the Millennium Challenge Cooperation found that 25% of vaccines reach their destination with degraded efficacy mainly due to failures within the cold chains. Logistical issues alone are responsible for 30% of all scrapped pharmaceutical products, and 20% of temperature-sensitive products are damaged due to broken cold-chains.

A market needs assessment was conducted to inform the design of ACES with qualitative and quantitative data collected from five out of Rwanda's thirty Districts, including the capital Kigali, from a representative sample of farmers' cooperatives and organisations in the food and vaccine domains. Findings indicated major losses due to an almost total lack of cold chain for agriculture. Although better, vaccine cold chain was still lacking, particularly for the temperature range increasingly needed to address pandemics. The research concluded that there are opportunities across Rwanda to improve the cold chain, leveraging clean off-grid solutions and the rapidly increasing on-grid capacity that currently reach half of the country. The road network connects to every village, so some of the critical baseline infrastructure elements are in place.

Lack of knowledge, training, technical skills, business models and managerial knowledge were identified as key hindrances to cold chain development. ACES will play a key role in scaling up market connectivity, business models, technology, and technical skills to bridge critical gaps, complementing foundational efforts already underway by the Government of Rwanda and others in the region.

Key Conclusions indicated system-scale solutions in the technologies, skills, awareness raising, and business model arenas would help to improve post-harvest management, increase market connectivity and provide the benefits of cooling for agricultural products and maintaining food safety and quality of fresh produce. The full needs assessment report can be found [here](#).

Therefore, intervention now is vital to address these points. However, a Millennium Challenge Corporation study found that currently donors often focus on the same flawed investments such as:

- **MORE PRODUCTION** without addressing Post Harvest losses that floods local economies with cheap, low quality products and destroys crop value.
- **MORE COLD STORAGE** buildings which are relatively worthless without the other cold chain links (precooling, transportation, environmental controls), and therefore disengage farmers.
- **MORE DONOR-DRIVEN PROJECTS** that are not sustainable because they are not market-oriented and depend on grant funding to continue. Need to have a strong financial model to benefit constituents long-term
- **OLD TECHNOLOGY** that is not climate friendly or energy efficient and is expensive such as diesel-powered cold chains

Further to this, a recent assessment of the World Bank's ESMAP funding in Rwanda to deliver cold storage in agriculture, concluded that 96% of farmers living in the vicinity of the cold rooms didn't use them.

Therefore, ACES has a critical role as an enabler in pursuing sustainable cooling and cold chain solutions that tackle the current funding gap to address these in Africa and beyond. This enabling function creates an opportunity for other donors to collaborate and effectively work together. Currently other donors are funding the capital such as cold stores in rural areas, but ACES can produce the connectivity and training to make sure they produce their potential benefits by ensuring local technicians can maintain the equipment and that farmers know how to use them effectively. The collaborative nature of ACES can be demonstrated through ACES already having hosted successful summits with a range of NGOs and donor agencies to bring together cold chain experts and begin to work together to address the problem.

Whilst the big benefits will be linked with reduced food loss and waste, there are also carbon savings to be made through leapfrogging to efficient, climate friendly cooling solutions. The MP Technical Expert Body concluded that developing countries that continue to install a large base of inefficient equipment will be economically disadvantaged as valuable electricity capacity is lost from other uses and through the need to more generating capacity. This economic disadvantage could last for decades due to the long lifetime of the cooling equipment.

Rwanda is committed to using energy efficient and low GWP gases in its equipment as highlighted in its National Action Cooling Strategy which notes that refrigerators and cold rooms are among the top priorities, due to the growing amount of energy that they use and the essential services that they provide."⁵ Rwanda is committed to making these changes and in a recent speech President Kagame, noted that ACES is a concrete initiative providing a solution to the climate crisis, addressing sustainable cooling and cold chain and supporting efforts to achieve the goals of the Kigali Amendment to the Montreal Protocol. He also noted that, in doing so, ACES will help deliver financial security to farmers and address the need for sustainable vaccine cold chains.

3.3 APPRAISAL OF OPTIONS

⁵ National Cooling Strategy. Page 5.

All these options have been formulated based on what can tackle the issues/problem outlined in Section 1.3.1 based on the needs assessment of what is required to deliver change. A decision was made not to focus on delivering capital equipment because research showed that it was not the problem, but instead connectivity and regulations were. Therefore, the following options focus on these two interventions.

The assumptions that underpin the appraisal can be found in Section 3.5 under the Sensitivity Analysis and in 6.1.3 of the Management Case.

3.3.1 LONGLISTED OPTIONS

A longlist of options to meet our strategic objectives have been considered by policy teams and analysts and appraised against critical success factors (CSF). The detailed narrative around our assessment of these options is in Annex I along with the CSF used in Annex J. A summary of this assessment is below in Table 1. Under each option, ongoing delivery of existing activities being delivery through previous tranches of Defra funding is assumed.

Table 1. Summary of longlist option appraisal against each CSFs (Green = Meets CSF, Amber = Partially meets CSF so is less attractive, Red = Fails to meet CSF) and shortlisting decision.

CSF	MLF top up without conditions	MLF top up with conditions	Bilateral work w/different delivery body	Continue bilateral work through UNEP with £12 million	Continue bilateral work through UNEP with £5 million
1. Strategic fit	Low	Moderate	High	High	High
2. Value for money	Low	Low	Low	High	High
3. Fit with ODA policy	Low	Moderate	High	High	High
4. Speed/Deliverability	Low	Low	Low	High	High
Shortlisted				✓	✓

MLF TOP UP WITHOUT CONDITIONS

Under this option, we would commit no new funding to existing activities including ACES and funding would be channelled through the UN Montreal Protocol’s Multilateral Fund (MLF) as an additional contribution. This additional contribution would not have conditions and would be given to support existing work of the MLF⁶. However, projects must be in line with the procedures and conditions of the MLF to be eligible for funding. The UK tried this approach in 2019 to test this approach and failed as the ExCom has failed to reach consensus on whether additional funding could be accepted. This option is therefore **discounted** as it fails to meet CSF1, CS2, CS3 and CSF 4.

MLF TOP UP WITH CONDITIONS

Under this option, we would stop funding existing activities and channel available funding through the UN Montreal Protocol’s Multilateral Fund (MLF) as an additional contribution, however we would ringfence our contribution for specific actions. For the reason’s set out above, this is not a viable option. This option is **discounted** as it fails to meet CSF 2 and CSF 4.

BILATERAL WORK W/ DIFFERENT UN IMPLEMENTATION AGENCY

⁶ The MLF supports developing countries meet the compliance obligations of the Montreal Protocol and the UK is obligated to contribute annually to the fund (approx. £9 million). The Executive Committee is the decision making body of the MLF. Membership is made up of 7 developing countries and 7 developed countries. The UK shares a seat on the committee with France, Italy and Germany.

Under this option we would commit no new funding to *UNEP* and *U4E* and would commit £12 million bilaterally to a different Montreal Protocol implementation agency (e.g. World Bank, UNIDO, UNDP). The other implementation agencies, such as the World Bank, have sustainable cooling related activities within the portfolio. However, *UNEP* are uniquely experienced both in terms of our priority locations and activities which are being addressed (as set out in Section 4.1). Consultations with the other implementing agencies would also be required to scope out how the funding could be effectively deployed to meet our strategic objectives and it would not be possible to utilise investments from previous tranches of funding under this approach. Defra has previously engaged with bilateral work through the World Bank where we experienced delays in deliverability and other challenges as a result of internal changes within the World Bank that meant Defra were less able to directly be involved with and contribute to the delivery of the work. **This option is therefore discounted as it fails to meet CSF2 and CSF4.**

CONTINUE BILATERAL WORK THROUGH UNEP WITH £12 MILLION

Under this option, the UK would spend £12 million on expanding existing activities under the Sustainable Cooling and Cold Chain programme – including ACES. *UNEP* would remain as delivery partner to the activities and existing donor agreements would be extended. This is a well-established programme, to which the UK has been involved and driven its strategic direction since its initiation. **This option meets the CSFs and is the preferred way forward. This option is carried forward to shortlist appraisal.**

CONTINUE BILATERAL WORK THROUGH UNEP WITH £4.2 MILLION

Under this option, the UK would spend £4.2 million on expanding existing activities under the Sustainable Cooling and Cold Chain programme – including ACES. This would be a reduction of £8 million from the committed spend. *UNEP* would remain as delivery partner to the activities and existing donor agreements would be extended. This is a well-established programme, to which the UK has been involved as a core delivery partner driving its strategic direction since its initiation. However, this option limits the ability to deliver towards our strategic objectives and effectively utilise previous UK investments into the programme. **This option meets CSFs and is carried forward to shortlist appraisal.**

3.3.2 SHORTLISTED OPTIONS

Due to previous experiences and difficulties associated with other long-listed options, it was agreed that these were not realistic approaches and that the only realistic option was to continue funding Sustainable Cooling Cold Chain Solutions in some capacity to ensure our strategic objectives are met and achieve VFM utilising the success of previous investments. Therefore, alongside the baselines: only two options are considered realistic when measured against our CSF.

- Option 1: *Minimum intervention*: Provide only a proportion of committed funding to all workstreams to allow for basic delivery.
- Option 2: *Full proposed*: Provide all committed funding to all workstreams as outlined in Section 2 (Programme Case).

DO NOTHING

Under this option, Defra no longer funds the Sustainable Cooling and Cold Chain Solutions Programme and the existing Donor Agreement with *UNEP* ends once activities related to existing funds have concluded. Essential activities will be finalised utilising existing funds and activities will be paused until further funding can be sourced. Full outline of activities which can be delivered under this scenario are outlined in Annex K and our summarised below for each of the workstreams.

Do Nothing

WS1	There will be no cascading knowledge elsewhere or new technologies deployed. No SPOKES can be implemented, early replication in India will be halted, those currently employed at Centre will be funded to end of 2023 and no equipment will be procured. Initial development will begin on creating a self-sustaining model on Cooling and Cold Chain needs in country with existing funding. All other current Defra funding will be redirected at running scaled back training sessions and paying the salaries of those in post whilst looking to provide funding from elsewhere to keep ACES going.
WS2	No other guidelines will be developed. No adaptation or dissemination of existing guidelines.
WS3	Scaled regional and national policy harmonisation and implementation of technical assistance not possible. SPP programmes will end.
WS4	No further work on Model can take place meaning model becomes unusable without required data to keep it fit for purpose.

Cost

No further cost to Defra beyond funds already released (£7,892,760). \$1 million from the Government of Rwanda for refurbishment of the demonstration hall, allocation of land for Smart Farm (200 hectares) and provision of the Rubirizi Campus for the Centre in Kigali. It is uncertain how much industry investment would be expected under this option as retracting previously announced funding would likely impact industry commitments.

As we would not be expanding these programmes further, it is less likely our strategic objectives of creating systemic and sustainable change in the cooling sector will be realised. For example, under WS1, although ACES has been built, the hub and spoke model has not been established and therefore a network of cold chain expertise and capacity would be absent. Furthermore, with no SPOKES, ACES cannot achieve its Pan-African reach. Similarly, without funding to maintain staff and facilities at ACES some of the disbenefits in 1.3.5 would be greater as jobs would be lost until another source of funding is secured.

For WS2, WS3 and WS4, without funding to adapt the activities to be specific in country – it is highly unlikely that that the funding delivered under BAU would deliver increased connectivity of the cold chain to reduce food loss. Without further funding for outreach it would not create sufficient incentives to support early adoption of climate friendly low-GWP and energy efficiency technologies in country due to lack of harmonisation of business models and best practices across regions.

There would be significant reputational damage under this option undermining UK’s climate leadership as the funding was announced and committed at COP26 and has since been reinforced and repeated at recent ACES Summits and related high-profile events.

Benefit

Existing funding into the Sustainable Cooling and Cold Chain Solutions Programme will secure the following quantifiable benefits:

- 200,000 tonnes of food saved till 2031 worth £217 million from ACES and at Kenya SPOKE following farmer cooperatives attending cold-chain training⁷ (see Annex L for details).
- 200 farmers saved 10% cost of farming inputs following capacity building on productivity

The above benefits assume that existing funding successfully delivers planned activities until 2023 and recognises the need to divert funding to essential activities and to leverage further funding. As many of the benefits are centred around capacity building and capability, the impacts of these benefits may not be realised until after programme completion and monetising these benefits is complex. Qualitative benefits include;

⁷ This assumes that 3 training session can be delivered in 2023, with an attendance of 30 farmers at ACES and SPOKES and that 50% of farmers implement cold-chain strategy as well as engage in support available at ACES. The assumptions and background data behind these figures is available in Annex L.

- **CO₂ and other highly polluting Greenhouse Gases avoided** from the installation of climate friendly and energy efficient equipment. This will be achieved through ACES providing tools and training in how to access the appropriate pieces of equipment in a way that is affordable and accessible to farmers and those across the supply chain. As ACES would only be funded to 2023 and the centre would not be pan-African – the scale of CO₂ avoided would be expected from a limited number of farmers at ACES who had the opportunity to attend the training till 2023.
- The launch of 4 model regulations at COP26 supporting support parallel integration of HFC phase-down and energy efficiency improvements
- **Increased industry engagement** in sustainable cooling and cold chain in Rwanda.
- **SPP criteria integrated into Morocco general tender docs** to encourage uptake of low GWP and high EE equipment

OPTION 1: MINIMUM INTERVENTION SCENARIO:

Under this option, Defra continues to fund the Sustainable Cooling and Cold Chain Solutions Programme as an established initiatives through existing Donor Agreement with UNEP. Funding is decreased from the committed funding of £12 million to £4.2 million to allow essential activities under the Programme to continue and protect existing investments. Full outline of activities which can be delivered under this scenario are outlined in Annex K and are summarised below for each of the workstreams:

Minimum Intervention	
WS1 £3.4 million	ACES Centre remains functional but only 1 SPOKE in Kenya can be implemented and early replication in India will be halted. Services offered including the innovation hub, research programmes and government policy services will all have to be stopped or scaled back. There is no funding for further equipment to support training in the centre. Additional funding will go towards maintenance of the Centre and facilitating the development of a self-sustaining model on Cooling and Cold Chain needs in country (first stage only).
WS2 £270,000	Three new guidelines will be developed (but not deployed in pilot countries), but no Country Savings Assessments, communications or translations will be able to take place.
WS3 £470,000	Only regional policy harmonisation and implementation of technical assistance is undertaken. No national implementation can take place.
WS4 £100,000	Global model not funded. Funding for maintenance of stock model only is continued. No further deployment of the model into developing countries.

Cost

£4,240,000 delivered through UNEP on the Sustainable Cooling and Cold Chain Solutions Programme over the next 3 years. Administration and evaluation costs would be approximately 14% (£593,600). Funding will be structured by:

- £3.4 million going to ACES (WS1)
- £270,000 going to Model Guidelines (WS2)
- £470,000 going to Technical support (WS3)
- £100,000 going to the HFC outlook model (WS4)

\$1 million from Government of Rwanda for refurbishment of the demonstration hall, allocation of land for Smart Farm (200 hectares) and provision of the Rubirizi Campus for the Centre in Kigali. It is uncertain how much industry investment would be expected under this option as retracting previously announced funding would likely impact industry commitments.

However, with less funding, there will be a reduced return on initial investment from phases I-V for ACES (WS1) which will mean **the full potential benefits cannot be realised**. Scaled back activity in Work Programme 1 – 15 of ACES means the infrastructure developed will not be effectively utilised to begin training and develop the mentoring and support services to facilitate implementation of these training practices (See Annex K for full outline of deliverables under Option 1). Furthermore, in relation to the Model Regulation Guidelines – without translation and national and regional policy

harmonisation of the guidelines, their uptake is likely to be significantly more limited as their replicability and usability will be significantly reduced. Similarly, the full benefits of the HFC outlook model would not be realised as funding to improve adapt the model in country is absent and without the Global model, reduced negotiation tools to encourage developing countries to address EE along with HFC phase-down. The lack of training and support services to implement the tools developed alongside the reduced facilities available (1 SPOKE and no Indian Centre) would reduce the benefit that this programme could have on community livelihoods and it would be less likely that transformational change in cold-chain and cooling would be delivered.

As in the *baseline*, this option will have **negative reputational impacts** and undermine our role as climate leaders post COP26 as funding committed at COP26 has been significantly reduced. Disbenefits should remain the similar to as expected in section 1.3.5 with some reductions in pollution as fewer farmers and technicians travel for training as there is only one SPOKE.

Benefit

This option meets our strategic objectives of increasing sustainable cold-chain availability and providing developing countries with effective tools and increased capacity more than *the baseline*. Activities under Option 1 will deliver the same benefits as under the Do-Nothing scenario, plus additional benefits due to more funding, including:

- 1.6 million tonnes of food **saved** worth £1.729 million from ACES and SPOKES following farmer cooperatives attending cold-chain training⁸⁹ (Full explanation of methodology is in Annex L).
- **10 countries** use HFC model to support development of EE and HFC-phase-down policy

As in the *Do-Nothing* baseline, there are likely *qualitative* benefits not being captured such as:

- **CO₂ and other highly polluting Greenhouse Gases avoided** through same mechanism as in the *do nothing*. However, CO₂ avoided will be greater as we will be able to deploy more SPOKES and hence more training courses and support for farmers to allow adoption of this equipment.
- **Increased availability in policy tools** with three new model regulation guidelines (Heat Pumps, Water Heaters, Commercial Air Conditioners) and MEPs and labelling recommendations produced for SADC and EAC regions.
- **Increased cold-chain connectivity** due to infrastructure and governance frameworks.
- **Improved livelihoods of farmers and local business community** with increased revenue and food availability due to cold-chain availability and tailored training.

Other non-quantifiable benefits delivered under *do nothing* will also be expected here but at a greater scale. For example, industry engagement would be expanded with more likelihood of securing collaboration and commitments from industry in ACES than what would be expected under a *do nothing* approach.

OPTION 2: FULL PROPOSED FUNDING OF ALL FOUR WORKSTREAMS

Under this option Defra continues to fund the Sustainable Cooling and Cold Chain Solutions Programme and expands the work of all four workstreams as detailed in Section 2 to enable systemic change in the cooling sector and secure significant environmental, economic and social benefits (as outlined in Annex H). UNEP would continue as the delivery partner and existing Donor Agreements would be extended.

⁸ The relatively large, and non-linear, increase in tonnes of food saved (and thus the economic benefit) under options 1 and 2 compared to the counterfactual option is explained by: (1) The hub and spoke model, by nature, has relatively high set-up & fixed costs (hub), with relatively low ongoing costs (for the spokes). Funds dispersed thus far have primarily gone to set up the ACES hub, with future funds (as per this BC) being spent on implementation. (2) We assume that up-take will increase as the program develops, leading to more co-op's implementation SC solutions. (3) The self-sustainable model post 2025 will mean little additional cost to Defra (but with continued additional benefits).

⁹ This assumes that 47 training session can be delivered to 2032 at ACES and SPOKES with an attendance of 30 at each session and an uptake rate of 60%. The assumptions and background data behind these figures is available in Annex L.

This project has progressed well over the last 3 years of funding, with little to no delays caused by the pandemic. The benefits attributed are based on previous success and the stability in the progression of the work through the delivery partners along with the ability of ACES to be an enabler of action and change. Under this level of funding we assume the following:

Full Proposed Funding	
WS1 £9.5 million	Allow scale up and delivery of ACES, delivery of further SPOKES across five African Countries after and begin early replication of the model in India. Funding available to support farmers trained to purchase sustainable cooling technologies.
WS2 £450,000	Development of three additional model regulations and associated country savings assessments and assuming uptake of these regulations.
WS3 £1,740,000	Facilitate regional and national harmonisation efforts consistent with the model regulation guidelines and support SPP in Morocco
WS4 £300,000	Build the Global HFC outlook model and continued maintenance and deployment of the country HFC model.

Under all options, we assume that the tools, training, and support provided under each of the workstreams will be an enabler for this systemic change in the cooling section and increased capacity to address cooling challenges. For detail on assumptions is in section 6.1.3.

Cost

The UK would spend an additional £12 million on Sustainable Cooling and Cold Chain Solutions Programme over the next 3 years with potential to invest further funding in the third year when the additional UK ODA funding of £1 billion is made available. Administration and evaluation costs would be approximately 14% (£1,680,000). Funding will be structured as set out in other parts of the business case, with:

- £9.5 million going to ACES (WS1)
- £450,000 going to Model Guidelines (WS2)
- £1,740,000 going to Technical support (WS3)
- £300,000 going to the HFC outlook model (WS4).

Other funding sources include:

- \$1 million for refurbishment of the demonstration hall, allocation of land for Smart Farm (200 hectares) and provision of Rubirizi Campus for the Centre in Kigali from Government of Rwanda.
- £300,000 from UK PACT in BEIS
- Industry funding includes donation of innovative technology and in-kind training resources¹⁰.
- £900,000 from Global Environment Facility (GEF) and Green Climate Fund (GCF) for workstream three. More detail in Annex F.
- £260,000 from Clean Cooling Collaborative for workstream two. More detail in Annex F.

Under this option further co-financing is expected and currently anticipated to come from the Millennium Challenge Corporation, World Food Programme and International Finance Corporation and other Governments have also expressed an interest in collaborating and co-financing elements of ACES. Disbenefits of loss of jobs will be reduced but there may be increase in local pollution as more farmers and technicians travel to access the increased amount of training on offer as discussed in section 1.3.5.

Benefit

Activities under this option will include all the benefits under Option 1, however due to the expanded scope and reach of the workstreams under this option – there are several additional benefits both qualitative and quantitative. These benefits can be expected to be delivered over a substantially

¹⁰ Carrier, Daikin, Danfoss as Founder Industrial Partners have a 3 year commitment and support is expected to equal £5 million by 2025.

longer time-period than under option 1. Full detail of the expected benefits of this option are detailed in the LogFrame in Annex G with a benefits map in Annex H). These include:

- **Revenue generation** from ACES planned from 11 different income streams estimated at £4,435,000 per year by 2025 (details on income streams detailed in Annex M) supporting the main elements of the centre becoming self-sustaining by 2025.
- 9.4 million tonnes of **food saved** to 2031 worth £10 billion from ACES and 4 SPOKES following farmer cooperatives attending cold-chain training (Full explanation of methodology is in Annex L)¹¹¹².
- **12 million tonnes of CO₂ equivalent savings by 2030** following regional policy harmonisation across 21 countries.

	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Total
Costs	£4m	£4m	£4m	Post-2025 we assume a self-sustaining model is in place and that the programme is running as effectively as we expect it to.							
Benefits (food loss only)¹³	N/A	N/A	£104m	£372m	£700m	£1bn	£1.4bn	£1.8bn	£2.1bn	£2.5bn	£10bn

As noted, due to the capacity building nature of these activities the outcomes are hard to monetise at this stage. *Qualitative* benefits are outlined in the benefits map in Annex H, but include:

- **CO₂ and other highly polluting Greenhouse Gases avoided** from the installation of climate-friendly and energy efficient equipment as outlined in the do nothing option. The impact will be significantly larger as reach of ACES through SPOKES, as well as establishment of funding in India is it will allow more farmers to be trained in and deploy climate friendly and energy efficient equipment.
- Increased ability to **address sustainable cooling challenges in country**,
- **Increased cold-chain connectivity** across and within regions,
- Increased collaboration and **sharing of best practices** on cold-chain challenges and solutions.
- **Stimulation of investment and innovation** in sustainable cooling technologies resulting in increased market availability and affordability of these technologies.
- **Improved livelihoods** through increased access to vaccines, food and disposable income.

Other non-quantifiable benefits delivered under *do nothing and option 1* will also be expected here but at a greater scale. For example, following Defra’s commitment of a further £12 million of funding towards these activities (including ACES) we have secured a three year commitment from industry worth approximately £5 million, including the donation of new and experimental equipment to ACES and they have increase activities in region with Danfoss (leading industry partner) opening a regional office in Kigali. This level of commitment from industry would only be possible following a significant funding commitment from Defra to provide ACES with secure foundations to which others will invest.

A key strategic outcome for us is facilitating increased connectivity of the cold chain in developing countries and improving the technical expertise and capacity in addressing cooling challenges. This option will deliver these strategic outcomes and benefits as a key element of ACES is about cascading

¹¹ The relatively large, and non-linear, increase in tonnes of food saved (and thus the economic benefit) under options 1 and 2 compared to the counterfactual option is explained by:

(1) The hub and spoke model, by nature, has relatively high set-up & fixed costs (hub), with relatively low ongoing costs (for the spokes). Funds dispersed thus far have primarily gone to set up the ACES hub, with future funds (as per this BC) being spent on implementation.

(2) We assume that up-take will increase as the program develops, leading to more co-op’s implementation SC solutions.

(3) The self-sustainable model post 2025 will mean little additional cost to Defra (but with continued additional benefits). This assumes that 215 training session can be delivered to 2031, with an attendance of 30 co-ops at each training session and that 80% of co-ops implement cold-chain strategy as well as engage in support available at ACES and SPOKES. The assumptions and background data behind these figures is available in Annex L.

¹² This assumes that 215 training session can be delivered to 2031, with an attendance of 30 co-ops at each training session and that 80% of co-ops implement cold-chain strategy as well as engage in support available at ACES and SPOKES. The assumptions and background data behind these figures is available in Annex L.

¹³ Benefits increase annually as number of co-ops implementing cooling solutions accrues cumulatively.

knowledge from the centre into SPOKES across Africa and replicating this model in other continents. This option will provide the funding to effectively utilise investments from previous tranches of funding to scale-up capacity building activities in the centre and establish functioning and replicable hub and spoke model across Africa and build on this success by beginning activities in India – allowing us to have substantial and sustained impact on cold-chain connectivity globally. Similarly, harmonisation of *best-in practice* cooling sector guidelines (WS2, WS3) across regions encourages trade and allows access to latest, more EE and climate friendly technologies in developing regions – supporting their ability address cooling challenges. Finally, WS2, WS3, WS4 will all increase capacity of developing countries in developing sustainable cooling related policy and provide them with effective tools to decide on the role of HFC phase-down and EE improvements within these policies.

In addition to these benefits, there will also likely be intangible reputational and geopolitical benefits for the UK by continuing to fund these workstreams, an initiative with high UK visibility, demonstrated by a UK Ministerial visit to ACES during CHOGM 2022. HMG through continuing to fund these activities will also further demonstrate internationally its leadership and commitment to tackling climate change following commitments made at COP26, including a specific announcement for the £12 million to deliver sustainable cooling solutions. It also aligns with the UK international development strategy which commits increased support of bilateral activities.

3.4 JUSTIFICATION FOR PREFERRED OPTION

Option 2 is our preferred approach and allows us to release the full proposed funding for all four workstreams to expand the existing workstreams started in 2019 through additional international contributions and delivery through UNEP. This option continues to give Defra full control of the outcomes and enables Defra to build on the progress to date.

For Workstream One, it will be possible to continue to operationalise the ACES campus and begin the expansion into SPOKES. It will be possible to engage with industry and key international partners to develop collaborative partnerships and leverage additional funding and in-kind support. ACES will deliver significant economic, environmental and social benefits during the life of the programme from food loss reductions alone. Table 2 shows the potential economic impact of ACES across all three options with a focus on the impact of food saved and highlights the significant benefits that Option 2 can have in comparison to Do Nothing and Option 1 (See Annex L for further detail on these figures). By tripling our investment from Option 1 to Option 2, the quantifiable benefits more than triple providing sound rationale for assuming the multiplicative benefits which Option 2 can have on real world impact.

Table 2: Benefits of Workstream One in all options

Workstream One	Do Nothing	Option 1	Option 2
Total number of 8 week training sessions by 2031	3	47	215
Total number of farmer co-ops implementing cold chain solutions by 2031	35*	846*	4584**
Total food saved by 2031	151,000 tonnes	1.6 million tonnes	9.4 million tonnes
Value of food saved at centre by 2031	£0.161 billion	£1.73 billion	£10.04 billion

*Assuming 60% uptake of Sustainable Cooling practices from those trained.

**Assuming 80% uptake of Sustainable Cooling practices from those trained.

Option 2 is the only option that will be able to effectively facilitate the transformational change through funding to support integration and uptake of sustainable cooling practices across the cold chain to meet the desired outcomes in Section 1.3.4. This option allows for outreach and engagement to be completely Pan-African which brings with it the potential for greater learnings and impact which would not possible under other levels of funding.

The full potential benefits from the other three workstreams can only be realised through Option 2. Proper roll out of Model Regulations will ensure uptake can happen with translation and communications required, regional *and* national policy implementation will allow for greater success in policy harmonisation across Africa and the HFC Outlook Model can benefit more countries through the development of the Global Model.

Providing more funding now to make rapid progress on the reductions of harmful HFCs as the demand for cooling technology increases will avoid the installation of obsolete and polluting equipment, mitigating climate impacts and avoiding creating a servicing legacy for the next 20 years. Therefore, if more funding was available it would be able to make an even larger impact as diminishing returns is not an issue for this programme given the lack of action in this space, making all investment high in positive returns.

The portfolio of activities under Option 2 aligns well with commitments under three key international instruments, the Kigali Amendment to the Montreal Protocol, the Paris Agreement and the SDGs by promoting a global need to address sustainable cooling and cold chains in an integrated, whole systems way. This Programme all fits well with the portfolio of UK Policies including the 2022 Strategy for International Development and the UK’s ‘Net Zero’ agenda, supporting the phase-down of high global warming potential greenhouse gases and driving the development of energy efficient infrastructure links.

3.5 SENSITIVITY ANALYSIS

As noted, given the challenges in quantifying the cost-benefit analysis it is difficult to carry out a purely quantitative sensitivity analysis and test the robustness of recommendations to changes in assumptions. However, the economic impact of food loss avoided was assessed on each of the shortlisted options (see Annex L). The economic impact of food loss avoided does not capture the value of many of the qualitative benefits of the programme, such as CO₂ avoided and improved livelihoods and therefore it can be considered a conservative estimate of the benefits based on what can be quantified. We consider that the recommendation to proceed with Option 2 is robust to any likely variation in key assumptions.

Key Assumption to the Valuation	Basis for Assumption
30 farmers attend each cooperative training session at ACES and SPOKES.	This is 75% capacity for each training session based on size of the classrooms-there is high demand for this training based on outreach during field visits so assume they will be filled. A test-pilot is about to begin that will bring back farmers regularly to feedback on the training programmes.
80% of coops that implement cold-chain strategy	This is thanks to mentoring and support to minimise fall-out rate and 20% is reasonable to expect. Must sign up to 8 weeks training therefore, commitment has been made and trust will implement strategies.
90% of food loss is avoided by co-ops following training sessions	Based on the level of food loss in Rwanda due to lack of Post-Harvest Management practices and we assume this applies to a cooperative level.
100% of the food loss avoided is attributed to ACES and associated activities.	Even if other programmes are active in the area, they will be part of our collaboration and therefore gains can be attributed to ACES.
The same amount of training continues from 2025 – 2031.	Due to establishment of self-sustaining model which will provide funding to continue training and the basis of the training programmes to continue to roll out.

Farmers and those across the Cold Chain supply chain can access affordable climate friendly	Energy efficient and climate friendly equipment will be accessed from industry and NGO partners following training at ACES on how to access these and we already have partners involved.
Economic, social and environmental cost of food loss and waste in the developing world is half that of the developed world.	1.3 billion tonnes of food is lost and wasted globally each year. Roughly the same quantities of food are lost and wasted (in total) in developed and developing countries. Economic cost of food losses and waste amounts to roughly \$680 billion in developed countries and \$310 billion in developing countries. Reference here and here . As part of the programme we are developing a model to allow FCA of the impact of reducing food lost at a country-level, based on their metrics and government’s missions and development targets which will be able to better define this.

There is no strong basis for accounting for extreme variation in the performance (scale of benefits achieved) of the different activities. UNEP and U4E have an established a track record of delivering results under previous tranches of funding.

Attendance at training: Under option two, the first assumption is that 30 farmers attended each training session at ACES and 30 attend training sessions at the SPOKES. If expected attendance is 50% lower than anticipated this would reduce the expected benefits from the programme by 50% with the total value of food saved by 2031 is reduced to £5.021 billion. With reduced attendance at training, we would also expect this to result in less CO₂ avoided as less farmers would have the training and support to deploy climate friendly and energy efficient cooling equipment. There is no evidence to suggest that this reduction in attendance would be likely as engagement of co-ops and local businesses to date has been high.

Uptake rate of coops trained: Another assumption relates to the uptake rate of coops of the training and lessons learnt. Currently under option 2, we assume an 80% uptake of sustainable cooling practices following training and mentoring. If we assume a lower uptake at 60% of coops which attended training, this would reduce the value of our food saved by 25% by 2031, meaning £7.5 billion food will be saved through the programme. With a lower update rate of coops trained, we would anticipate lower CO₂ emissions avoided. However, 80% uptake is a realistic assumption given the level of mentoring and support which is available post training to facilitate co-op uptake of the PHM practices.

Percentage of food loss avoided: We assume that each coop eliminates the 90% of their food that would have been lost due to insufficient PHM practices (36% of total food produced). This is based on the level of food loss in Rwanda due to lack of PHM practices and we assume this applies to a cooperative level. This would have a subsequent impact on the CO₂ saved and livelihood benefits which would be expected from increased food availability. However, a high variation in this assumption is unlikely. The amount of food that would need to be saved to achieve this figure is low and completely achievable. T Furthermore, it’s unlikely that cooperatives would invest and attend 8 weeks of training at ACES and then not implement the technologies and solutions needed – however, if we assume that only 50% of the food lost is avoided following the training, return on investment is still high with £5.579 billion.

Attribution: One key assumption is how much of the food loss avoided can be attributed to this programme. As mentioned, ACES plays a key and unique enabling function in the market. Evidence has shown that existing efforts and money have been poured into the same flawed solutions that have approached the issue in a fragmented, rather than whole systems way (Millennium Challenge Corporation; World Bank) As a result, in the case of small and marginal farmers, functional cold chains are almost completely absent (less than 1% of country’s cold chain capacity). ACES will deliver the whole systems approach that is needed to address all the elements, including business models and

helping access to available funding and will act as a connector between farmers and solutions. In a space which is currently lacking any form of join-up, ACES can be credited for any changes seen.

If we consider the entire cost of ACES under option 2 (£15 million including already committed funds) and the realistic estimate of food loss avoided (£10.04 billion), attribution of the food loss avoided as a result of ACES would have **to be below 0.15%** for the costs to become greater than the benefits. This would be a very unrealistic scenario, unsupported by the evidence available to us.

Worst-case scenario

In a worst case scenario where:

- Only 3 SPOKEs become operational with 90% of the expected classes held.
- 66% attendance rate (20 per training) with only a 50% uptake of sustainable cooling practices following training.
- % of food loss avoided is 66% (rather than 90%) with the tonnes of food loss saved at 432 tonnes per co-op per year.

The economic return by 2031 is £2.51 billion. It is clear that even in a worst-case scenario with unlikely changes to key variables, there is still a significant economic return from Option 2 (preferred option).

Breakeven Analysis

ACES would only have to directly lead to 22,945 tonnes of food loss avoided by 2031 (assuming £1.56k/tonne) to breakeven on the £23 million investment to date, including the £9.5 million being proposed here. With this level of food loss avoided, we would anticipate a change in the qualitative benefits including the expected benefits for livelihoods through increase food and vaccine availability as well as a reduction in the amount of climate friendly cooling equipment which would be deployed. This return on investment is extremely likely as noted in the rationale given the success achieved to date and the community, industry and government engagement that has been effectively established in the programme. Details of the breakeven assessment are in Annex L under this scenario.

3.6 VALUE FOR MONEY ASSESSMENT OF THE PREFERRED OPTION

The Programme design will bring value through economic, social and environmental benefits, demonstrated in the Benefits Map in Annex G. This programme can make a substantial contribution to climate outcomes for the scale of funding involved. VfM for HMG in ICF mitigation programming is about investing in ways which are most likely to trigger catalytic change at the scale and scope required to mitigate the impacts of climate change. This programme aims to facilitate a systemic change in cold chain connectivity and support the transition towards climate friendly cooling technologies through both capacity building and market engagement, therefore transformational change is anticipated. We will continue to monitor VfM and spend against activity through our governance structures outlined in Section 6.2.

We expect to generate further co-funding from the private sector to secure match-funding and industry sustained commitments, delivering investment and allow core elements of the programme to be sustained after Defra funding ceases. For Workstream One, existing Defra ODA-funded activities have provided first mover status, acting as a catalyst and creating a scalable platform to achieve cost-leverage of approximately £6 million for the ACES work to date and £1.7 million for workstreams two, three and four. Details of cost-leverage for workstreams two and three can be found in Annex F.

4. COMMERCIAL CASE

4.1 ENSURING VALUE FOR MONEY THROUGH PROCUREMENT AND FINANCIAL MANAGEMENT AND ABILITY OF PARTNERS TO DELIVER

As set out in the options appraisals section above, funding will continue to be delivered through the approach outlined in preferred option two, i.e. working directly with delivery partners UNEP to support and expanding existing activities. In practice, this is disbursed as additional international contributions, as is the case for other international climate or forestry projects. Activities will continue to indirectly support the priorities and objectives of the Montreal Protocol supporting in particular integrated activities that address the HFC and energy efficiency related aspects of cooling equipment and which deliver on the Rome Declaration on the Contribution of the Montreal Protocol to Food Loss Reduction through Sustainable Cold Chain Development. This option gives us full control of the outcomes and has been successfully led out of the International F gas team since early 2019.

UNEP was selected as the preferred delivery partner, working through its United for Efficiency initiative (U4E) team for the reasons explained in the options appraisal section in Section 3.3 above.

U4E are uniquely positioned to deliver workstream one due to their long-standing relationship with the Government of Rwanda. This includes support for Rwanda's award-winning National Cooling Action Plan, the Rwanda Cooling Initiative (R-COOL)¹⁴. Implementation efforts are now underway and Defra ODA funded activities directly support key elements of this.

Detailed discussions with policy, finance and commercial colleagues in 2019 concluded that, as this was being classed as international contributions to one of the four implementing agencies to the Montreal Protocol to support optimised Kigali implementation and sustainable cooling and cold chain solutions, that there was no commercial route or support required. The work is managed through a donor agreement between UNEP and Defra, setting conditions for use and management of the funds and which includes an annex setting out regular reporting and progress updates as follows. Details of the reporting are within section 6.5.1.

As set out in Section 6.2, activities and delivery partnership relationships have been managed through the more formal quarterly meetings with more informal regular check-ins and meetings on a weekly basis to demonstrate the trusted and pragmatic relationship formed between Defra and delivery partners over the past three years of funding. For workstream one, alongside the formally established NTAC and SC there are also bi-weekly calls with the core ACES team to drive and monitor progress and carefully manage the activities, spend and outcomes.

As detailed in Section 6.3, there are no novel, contentious or high risks elements across any of the workstreams

4.2 PROCUREMENT OF ACTIVITIES AND SERVICES

As set out in Section 1.3, UNEP will be primarily responsible for the implementation of the activities and for procurement and contractual services, as well as reporting on the progress of this implementation in close coordination and strategic guidance from the donor (Defra). The procurement actions and the operational services will be carried forward in accordance with UN policies and procurement guidelines.

There are no novel, contentious or high risk elements related to this procurement.

For ACES, procurement of activities and requirements have been identified for Phase III with final equipment lists for the demonstration hall technologies being further refined and final procurement plans being revised. The procurement actions and the operational services will be carried forward in accordance with UN policies and procurement guidelines which has been linked in section 1.3. In addition, UNEP will amend the current Project Cooperation Agreement (PCA) with UR for procurement of equipment and hiring of staff at the Centre to allow for expedited contracting for additional activities. The PCA will establish clear roles and responsibilities for the execution of the above-

¹⁴ The Government of Rwanda and UNEP U4E launched R-COOL in 2018 to holistically transition the country toward more sustainable cooling solutions in buildings, industry, agriculture and medical sectors. In 2019, R-COOL finalised a comprehensive and award-winning National Cooling Strategy that was approved by the Cabinet.

mentioned project activities and to ensure that the activities are executed in line with Defra and UNEP rules, policies, and requirements (see Section 5.9 for more details). The overall financial management and procurement of goods and services under this proposal will be guided by UN regulations, rules, policies and procedures and follow the terms in the Donor Agreement between UNEP, UoB and Defra.

Elements of this work will be sub-contracted to the UoB as a core delivery partner within the ACES programme. UoB will demonstrate VFM through a competitive environment, in accordance with The Public Contracts Regulations 2006 and its own Procurement Strategy. The selection of procurement approach and the evaluation criteria will be set to reflect, the [University's Procurement Strategy](#).

All procurement undertaken by UoB and UK academic partners will be run in compliance with the University's Procurement and Purchasing Procedures (May 2018) and consistent with UNEP procurement requirements as referenced in the PCAs with the Parties. Where possible goods and services will be procured from Framework Agreements with "Approved Suppliers". Approved Suppliers are those suppliers that have Framework Agreements with the University – these Framework Agreements having been competitively tendered either by the University or by one of the University Purchasing Consortia. Where required, a mini-competition process will be undertaken with Approved Suppliers to ensure best value is achieved.

If there is no Approved Supplier available for the products or services the University's Procurement and Purchasing Procedures sets out the extent of competition that is required to provide evidence that best value is being secured and that compliance is being achieved with both the Public Contracts Regulations 2015, and the University's Financial Rules.

OVERSIGHT AND AUDIT

For workstream one The Academic Research and Learning Committee (ARLC) will support the Steering Committee (SC) in the delivery and auditing of innovation and impact as well as provide oversight of recruitment strategies and senior level recruitment of academics and executive team.

Commencing in June 2022, ARLC members will provide strategic guidance for the first two years (initial term of 'office' for members) in order to establish a strong foundation for ACES. Members will meet at least bi-monthly for first 12 months and then the frequency will be reviewed with the SC. Further information on the ARLC is in the Section 6.2 and in Annex N.

Within this, it will

- Provide strategic guidance to align ACES goals with those of UR such as enhancing quality and excellence in research and education and the vision of the country of creating a knowledge driven economy to enhance inclusive economic growth.
- Ensure that ACES remains aligned to global sustainability and net-zero emission goals (UN SDGs, Paris Climate Agreement and Kigali Amendment to the Montreal Protocol).
- Advise on curriculum development and delivery of accredited teaching and training programs.
- Advise on the scope, quality, limitations and appropriate uses of research carried out by ACES and project partners.
- Provide oversight of the learning programmes and modules, including inclusivity and assessment examination/accreditation.
- Support annual reviews and risk assessments of teaching and research performance.

4.3 SAFEGUARDING AND EQUALITY

4.3.1. SAFEGUARDING

Both UNEP and the UoB have clear policies in place linked to safeguarding. In the case of UNEP, the United Nations has a comprehensive approach to prevent sexual exploitation and abuse as well as sexual harassment, as outlined in bulletins issued by the Secretary General, Standards of Conducting, screening processes, protocols, legal frameworks and related policies.

As for the UoB, as a University, they are committed to ensuring a safe environment for all their staff, students, visitors and their wider community and engagement. They have in place the policies, process and training to protect against, among other things, sexual exploitation and abuse (SEA) and sexual harassment (SH), as well as support services and procedures to manage any complaints or concerns raised and provide support. All their research is also governed by clear ethics procedures which must be signed off as part of the approvals process before programme implementation. The policies apply to all areas where University activities are undertaken, including overseas delivery and research, in shared premises, and as part of all other partnership working arrangements.

They will continuously ensure that their partners in-country operate to their same standards. They shall specifically work with their partners to make sure that ACES' policies and procedures meet their ethics and standards and ensure that adherence to SEA and SH in particular is monitored and reported against as part of their quarterly programme review. This will necessarily include all outreach and in-field activities (as a requirement of our research ethics approvals). They shall ensure that SEA and SH is included in risk assessments and training is provided to partners/in-field operators where necessary.

4.3.2 EQUALITY

Approximately 1.1 billion people face cooling access risks, including an estimated 470 million people living in poor rural areas without access to electricity and cold chains for food and medicines. Research and anecdotal evidence have shown that women and youth are marginalized groups and that gender disparities still exist in the agricultural sector¹⁵.

Rural women and youth under age 18 are the most vulnerable groups in the context of this programme. Rural youth are disproportionately under-nourished and lack education and training to equip them to pursue higher value-added economic opportunities beyond the traditional subsistence farming pathway. Women lack access to agricultural land and finances and relevant skills to successfully develop agri-businesses. Data shows that in sub-Saharan African poverty and climate change effects are not gender neutral. Although their presence in this sector is substantial, women earn less than men and are more frequently engaged in unpaid and informal agricultural work. In addition, they are majorly engaging in subsistence farming and lack access to necessary inputs and services to enhance their productivity and market access including access to adequate post-harvest storage and clean cold-chain services that would enable them to sell their products further afield at a higher price. While there is a growing number of innovations deployed to reduce post-harvest across different agricultural value chains, barriers to accessing finance among women has further impacted their ability to afford these solutions.

There are clear gender differences relating to participation in clean energy technology and development and equitable energy services are linked to wellbeing of men and women. Energy poverty has distinct gender characteristics, disproportionately affecting women and girls. As such, supporting women to develop and manage greener technologies and renewable energy sources would enhance national mitigation strategies, employment opportunities, poverty reduction and women's economic empowerment. To address gender issues in the energy sector, the project will monitor non-discriminatory practices to energy access and green technologies, gender-inclusive, gender-balanced and directed towards addressing any identified inequalities. Aligned with [UNEP Gender Policy](#), the project will work with relevant stakeholders to encourage gender sensitivity.

Specifically, for workstream one, ACES itself will house a creche for women to use whilst they are attending the training and capacity building sessions, whilst the Community Cooling Hubs out in the rural communities will in its design look at domestic cooling lockers, including for breast milk to support women with young children to still be able to use the facilities and equipment. This is especially important in Rwanda where 82% of women are employed in agriculture, compared to 63% for males.

¹⁵ National Institute of Statistics Rwanda 2012; USAID 2019c

The urgent challenge for rural economies is to ensure that the social and economic benefits of efficient Post-harvest management, logistics and cold chain capacity are created quickly and affordably, while ensuring minimal pollution and adverse environmental effects. A key element of the Workstream One will develop interventions supporting small holder farmer empowerment, identifying barriers and constraints to accessing integrated cooling services.

Most notably for Workstream One, Rwanda's rural poor lack affordable and reliable access to the electricity grid and other infrastructure, financial and other services, and alternative employment opportunities relative to urban counterparts. Furthermore, over 90% of the poor in Rwanda live in rural areas, 70% of the labour force is in agriculture, yet the sector only receives 10% of total public investment. Wage-farm workers in rural areas are a fast-growing yet vulnerable occupational group with the highest poverty rate.

The design and implementation of the Workstream One is guided by a **gender and social inclusion (GESI) framework** that has will seek to ensure that the project outcomes and impacts increase equality among women and men and male and female youth. The framework will be developed in line with a GESI action plan. The results chain will be identifying the key performance indicators (KPIs) and develop tools to adequately capture data to be monitored as part of the impact assessment. These are all in compliance with gender sections of 2002 international development act

The programme will integrate key principles that ensure investments will ensure gender and social inclusion through:

1. Taking a GESI approach in the project that proactively address gender inequalities, including men's and women's differential access to assets, capacity building, finance, and other resources that the project will work on. Particularly attention will be paid to the most vulnerable groups;
2. Integration of GESI analyses and risk assessments into all project design and implementation that respond to distinct gender, care work, and other needs that can contribute to gender-responsive transformative and inclusive sustainable development goals;
3. Identifying and preventing potentially harmful impacts on women, men, girls and boys, including changes in livelihood, environmental degradation, and heightened violence directly or indirectly related to projects, programs or policies;
4. Accounting for specific needs of female-headed households, as well women and children within male-headed households; with a lens that understands vulnerability and marginalization within and between households,
5. Collecting sex-disaggregated data that pay attention to the heterogeneity of gender and social inclusion dimensions across project indicators to measure the investment's GESI impacts;
6. Particularly pay attention to protecting women's human rights and comply with international women's and human rights standards, treaties, and due diligence practices, and ensure unintended consequences that can reverse gains related to GESI are looked into.
7. Providing full and complete project, program and policy information to inform and equally engage women and men in languages, forms and ways that are culturally appropriate and easy to understand.

4.5 STATE AID

The project is funded by Defra. The funding will be directed at a range of activities to support the welfare of developing countries alongside mitigating global warming by delivering the aims of the MP (an OECD DAC Annex B ODA eligible organisation) in a way that is aligned with the Paris Agreement and SDGs.

4.6 COMMERCIAL RISKS

See Section 6.3.

5. FINANCIAL CASE

5.1 ACCOUNTING OFFICER TESTS

An Accounting Officer Test has been undertaken and is attached as Annex O to this business case. All tests are met, and the overall assessment is that these activities represent a good use of funding and will directly support objectives under the Montreal Protocol and an important policy for Defra.

5.2 NATURE AND VALUE OF THE EXPECTED COSTS

Outline of previous funding to the programme totalling £7,897,760 is outlined in table 3.

Table 3. Total Funding to Date of Programme

Workstream	Funding
One-ACES	£6,171,897
Two-Model Regulation Guidelines	£438,460
Three-Technical Assistance for Regional and National Implementation	£642,754
Four-HFC Outlook	£644,647

5.3 SCHEDULE OF FUNDING / COSTS (I.E. HIGH-LEVEL BUDGET)

The total budget for the new activities is £12 million with Third Party admin costs making up 14% of this.

Table 4. Total Funding of new tranche of Programme

Workstream	Funding
One-ACES	£9.5 million
Two-Model Regulation Guidelines	£450,000
Three-Technical Assistance for Regional and National Implementation	£1,750,000
Four-HFC Outlook	£300,000

The costs breakdown by activity for each of the workstreams are included in Annexes D and F.

Funding is profiled as £4 million annually over the three years. This is transferred to UNEP as a payment in advance then dispersed to the workstreams depending on needs.

Workstream one will receive funding initially for the continued development of the hub in Rwanda, then funding will be focused to activities to expand the SPOKES and thus will have steady funding through the whole period (Annex B). Workstream four by comparison will receive most of its funding in first 2 years due to activities being completed by December 2023 (Annex E), whilst Workstream two requires most funding in the final 2 years when the supporting documents are being developed (Annex D). Timing of activities being delivered is detailed in Annexes D and E which corresponds to the year in which funding will be distributed.

Profiling it across 4 years also allows for funding to be easily halted between annual payments if at any point Defra feels there has been a mismanagement of funds at any point through the fortnightly and ad-hoc check ins or the formal quarterly reports. More detail in Section 5.8 on withdrawing funds.

HMG FRONT-LINE DELIVERY COSTS

Within HM Government, managing the UK's contribution, as well as influencing and participating in key decisions, will require the below staff dedication (full time equivalent (FTE)) from Defra and the overseas network: (include expected FTE and FLD costs).

There is no recruitment plan required to support delivery method as all delivered through BAU. The F gas international team bid for a new SEO position in SR20 to support, inter alia, delivery of a further enhanced ODA portfolio. SEO recruited and in post by September 2021 and a core part of the delivery programme as outlined in Table 5. Ongoing support also required through a proportionate call on small central FLD pot of 5% across the Defra ODA portfolio. Although there will be an increase in

activities through the new tranche of funding, there will be no need for further recruitment and no future recruitment plans at this stage. Scaled up duties and responsibilities will be managed through asking delivery partners to take up activities where required and will be written into contracts through MOUs, donor agreements and working strategies to make it clear the difference in responsibilities.

Table 5. Defra Staff Costs for Programme

Grade	Annual Cost	Allocation	Cost
Grade 7	£53,935	0.6	£32,361
SEO	£38,751	0.6	£23,251
HEO	£32,679	0.2	£6,536
Total			£62,148

ADMINISTRATIVE COST

The administrative cost of the project includes 1% of UNEP levy and 13% PSC on the funding to be allocated to UNEP (See Section 5.3). In total, the administrative cost of the project is 14% of spend.

5.4 FINANCIAL ACCOUNTING CONSIDERATIONS FOR DEFRA

Programme resource is all RDEL and has been carefully costed to deliver the required activities.

5.5 MONITORING, REPORTING AND ACCOUNTING FOR EXPENDITURE

UNEP are responsible for realising the benefits of this programme and accurately reporting progress to Defra through the following mechanisms detailed in table 6.

Table 6. Summary of reporting from Delivery Partners

Document	Lead	Description	Form	Cycle	Deadline
Unaudited financial reports	UNEP	Reports on financial data	Microsoft Excel	Every quarter	15 days after each quarter
Substantive progress report	UNEP/ UoB	Report on activities and impact of activities.	Microsoft Word, Excel	Annual basis	15 days after each year
Final report	UNEP/ UoB	Final report on activities and impact of activities as well as financial data.	Microsoft Word, Excel	N/A	Within six months after the date of completion or termination of the Agreement

5.6 FINANCIAL MANAGEMENT

The Contribution shall be subject exclusively to the internal and external auditing procedures provided for in the financial regulations and rules. Should an Audit Report of the Board of Auditors of UNEP and UoB contain observations relevant to the contributions, such information shall be made available to the Donor. See Section 4.2 for more information.

5.7 FINANCIAL AND FRAUD RISK ASSESSMENT

See Section 6.3.

5.8 PROVISIONS FOR DEFRA TO WITHDRAW FUNDING

UNEP are responsible for realising the benefits of this programme. The following scenarios in table 7 can lead to the potential suspension of funding, termination and returns to Defra if we feel these benefits are not being met:

Table 7. Summary of scenarios for withdrawal of funding

Scenario	Timing and reporting trigger (if relevant)
Occurrence of any illegal or corrupt practice	30 days
'Extraordinary circumstances that seriously jeopardise the implementation, operation or purpose of the programme' This is primarily designed to cover instances of force majeure. We assess this may also provide some cover in extreme cases of under-delivery.	30 days
'If UNEP and UoB do not fulfil their commitments according to the cooperation contract'	45 days

5.9 POWERS FOR SPENDING

UNEP will be granted the power to use funding from Defra, including contracting and procurement, to ensure the smooth implementation of the project

As mentioned previously in Section 4.2, the PCA between UNEP and UR will be updated for procurement of equipment and hiring of staff at the Centre. UR's Single Project Implementation Unit (SPIU) is highly experienced with procurements for such Centres, leveraging funds from international donors for specialized equipment and materials.

6. MANAGEMENT CASE

6.1 MANAGEMENT FOR IMPLEMENTATION

6.1.1 ISSUES

The issues that the Programme will address and the reason for intervention can be found in the Theory of Change in Section 1.2. These highlight why funding is required. They will all be reported on through the KPIs outlined in Section 6.5.1 and robust governance arrangements outlined in Section 6.2. will ensure that the Programme is tackling these issues.

6.1.2 DEPENDENCIES

This programme has low dependencies on other projects, programmes and legislation within Defra however is dependent on government ODA and ICF frameworks. These dependencies on wider Defra work will be managed through attendance at ODA boards as required.

There are dependencies on delivery partners to ensure benefits are realised. These dependencies have been managed through putting in place relevant contracts, donor agreements and MoUs with partners to protect these dependencies. Regular relationship maintenance will be achieved as outlined in the governance arrangements in Section 6.2.

There are dependencies on national and local governments/co-operatives being supportive of the programme and engaged in its implementation. This dependency is managed through demonstrating the alignment of activities with national policy and regulations and regular engagement through the programme lifetime. Relevant ministries have confirmed their interest in and support for (including financially in some cases) the proposed readiness activities, this will allow the programme to continue after Defra funding ends. For example, the Rwandan government's committed to input \$1 million to support the development of ACES, as well as having allocated a whole campus for the ACES headquarters and land for a 200 hectare Smart Farm adjacent to the campus. Further, Sustainable Cooling is aligned with Rwanda, Kenya and India's national policies such as Rwanda's Vision 2050 and commitments under the Montreal Protocol and its associated Kigali Amendment. Also, relevant governments will be regularly involved in the coordination of the programme as outlined in the governance Section in 6.2, to ensure commitment in supporting its implementation, allowing the project team and delivery partners to effectively manage this dependency.

6.1.3 ASSUMPTIONS

The assumptions related to the programme being a success are outlined below:

1. Continued progress on the implementation of ACES Phase III activities by time of release of phase IV funding.
2. Appetite continues to exist to address cooling and cold chain issues and to adopt policy and best practices in the sector.
3. Delivery partners continue to deliver high quality outputs and provisions remain in place to protect changes in delivery.
4. Skilled consultants remain available to assist in the delivery of the programme.
5. Stakeholders, communities, enterprises, local and national government bodies, non-governmental organisations, and academics remain engaged early and appropriately.
6. Industry move to formal contracts
7. National economic situation in countries where programmes being implemented remain stable
8. Duplication of activities across other programmes is avoided.
9. Better data, information and training will help prevent creating a base of inefficient, polluting equipment through coordinated and complementary work to develop and apply a common set of rules and approaches.
10. Provision of tools, technical expertise and training will lead to increased capacity to address cooling challenges.
11. Overall impact will likely be expected after Defra support has ended because some of the activities are analytical and advisory in nature so assume finance will be available to ensure programme can be self-sustaining after Defra funding ends.

These assumptions will remain updated throughout the programme to check that they still hold and this will be reviewed through the regular governance arrangements outlined in 6.2. If any of the assumptions or dependencies change they will be escalated through to risk management and the relevant procedures in 6.3.2.

6.2 GOVERNANCE

Robust governance arrangements are in place to ensure the success of the programme through, monitoring the issues, dependencies and assumptions outlined in 6.1 and managing the potential risks outlined in 6.3. This will allow for benefits realisation to take place by looking at best practice and regularly reviewing lessons learnt at periodic points. The success of this will be assessed against the MEL outlined in 6.5.

For WS1, standard governance arrangement involve:

- Regular working-level bi-weekly meetings between the core delivery partner leads (UNEP, UoB, UoR, UK academics and UK and Rwandan Government officials) to check on progress and maintain working level relationships.
- Formal quarterly progress meetings with the delivery partners. The timeline of these are detailed within the Management delivery plan in Annex P.
- Informal regular check-ins and meetings on a weekly basis to demonstrate the trusted and pragmatic relationship formed between Defra and delivery partners over the past three years of funding.
- Due to the size of the programme, there are additional governance arrangements. These are summarised below but can be found in detail in Annex Q.
 - **Director** managing the day-to day management of the Centre, reporting to the University VC and in turn the Cabinet (once ACES becomes an Institute within the University).
 - **The ACES Steering Committee (SC)** which governs ACES against it's strategic priorities and provides overarching guidance.
 - **National Technical Advisory Committee (NTAC)** which provides sectoral expertise

- **Academic Research and Learning Committee (ARLC)** which provides academic expertise, financial and governance oversight and will guide the research and training agenda of the centre and annual review.
- **Single Project Implementation Unit (SPIU)** assist in daily operations of the centre, until ACES becomes an institute.

All areas of work will be done in consultation with ARLC and ultimately, the SC providing oversight as the guiding authority. The Centre will develop protocols informed by best practices of existing UR and international Centres of Excellence, and it will be financially audited according to standard audit procedures at UR. Where GoR funding is sought, planned activities and budget decisions will be reviewed and recommended for final authorization by the SC. ACES will be committed to equality, diversity and inclusivity. The current governance structure and the interaction of these bodies is outlined in Figure 4 below.

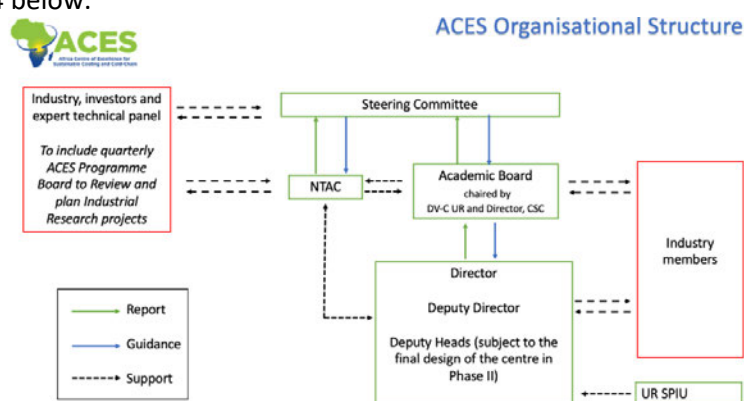


Figure 4. Current overview of Governance structure for Workstream One

For WS2, WS3, WS4, standard governance arrangement involve:

- Formal quarterly progress meetings with the delivery partners. The timeline of these are detailed within the Management Delivery Plan in Annex P.
- Informal regular check-ins and meetings on a weekly basis to demonstrate the trusted and pragmatic relationship formed between Defra and delivery partners over the past three years of funding.

Information on reporting for all workstreams can be found in 6.5.1.

6.2.1 ROLES, RESPONSIBILITIES AND ACCOUNTABILITIES

Defra – programme SRO –

Defra, as part of SC for Workstream One, will participate in SC meetings and provide high-level oversight of the project activities, review progress report and financial report.

Delivery partner

UNEP are the delivery partner with the programme being co-implemented by UNEP U4E, UoB, along with a range of academic institutions and relevant experts in UK (LSBU, HWU, CU), Rwanda, Kenya, and India.

UNEP will continue to oversee the programme and will manage the funds for the activities as per UN regulations, rules, and procedures. Elements of this work will be sub-contracted to the UoB and UR as core delivery partners within the ACES programme. Both UNEP and UoB will carry out fiduciary and safeguards oversight. UoB and other academic partners will provide the necessary scientific expertise and technical support to the project formulation, start up, implementation, evaluation and closure. UNEP will also ensure that the activities are executed in line with Defra and UNEP rules, policies, and requirements.

A UNEP Programme Management Officer will be responsible for programme supervision to ensure consistency with Defra and UNEP policies and procedures. The functions of the programme manager and that of the UoB Professor also involved in the implementation of the activities will include but will not be limited to the following: a) participating in the semi-annual SC, NTAC meetings for Workstream One; b) the clearance of periodic Progress Reports and Project Implementation Reviews; and c) the review of programme deliverables, d) providing input to periodic portfolio reporting to Defra; and e) preparing requests for disbursements.

Supporting expert consultants will be hired and will report to UNEP as per their contractual arrangements and in line with UN rules and regulations. They will produce regular progress and financial reports per the schedules in their Terms of Reference (ToRs) but no fewer than quarterly, and UNEP and UoB will review their deliverables. Consultant payments will be released if and when deliverables are satisfactory and cleared by UNEP.

Other stakeholders

The project team have conducted a detailed stakeholder engagement map to plan for our engagement with the key stakeholders and the frequency of this engagement. It can be found at this [link](#). The stakeholder map can be found in Annex R and a detailed profile of key stakeholders in Annex S.

6.2.2 ODA BOARD

The role of an ODA board is to provide accountability and assurance for Defra's ODA budget and to provide strategic direction for Defra's ODA spend. The ODA board meets quarterly and consists of Senior Civil servants from FCDO and Defra. Within Defra the ODA Board has a remit to:

- Monitor the strategic direction for ODA spend in Defra
- Monitor the implementation of Defra's ODA strategy and policy priorities
- Clear Business Cases for ODA spend above GBP 5 million
- Monitor progress against the results set out in business case
- Monitor and advising on significant risks to implementation
- Recommend remedial actions to the SRO if operational or financial performance is off track
- Ensure ODA rules are met
- Ensure consistency with cross-government ODA rules.

6.2.3 RESOURCING

As noted in Section 5.3 – no recruitment plan is required to support delivery method as all delivered through BAU a– existing Grade 7, SEO and HEO are all in post. The F gas international team bid for a new SEO position in SR20 to support, inter alia, delivery of a further enhanced ODA portfolio. SEO was recruited and in post by September 2021 and a core part of the delivery programme.

6.1.6 DELIVERY PLAN 2022/23

A delivery plan covering governance and management milestones for this year is in Annex P. A full high-level delivery plan for workstreams is outlined in Annex B and E. A detailed workplan will be developed to ensure proper management of these milestones and the workplan will be reviewed and updated through the bi-weekly (ACES) and quarterly progress meetings.

6.3 RISK MANAGEMENT

The overall risk of the programme is assessed as **Low/Medium**, and within our risk appetite.

6.3.1 PROGRAMME RISKS

Although issues, dependencies and assumptions have been analysed to ensure success. There remain some risks associated to the programme. These have been distilled into this high level summary in Table 8 below.

Table 8. Summary of High-Level Risks for Programme

Risk Type	Indicative High-Level Risks	Mitigation	Risk Level
Contextual	Risk of operating in politically volatile and economically unstable contexts or experiencing unexpected or unforeseen events.	Security assessments conducted to inform decisions and project risk frameworks. Ongoing engagement and analysis to monitor risk of working in each country and maintain close relationships with those in working at post and in country. Governments will be involved in the coordination of the programme to ensure commitment in supporting the implementation.	Medium
Delivery	Risk of challenging environments, implementing a programme of often novel activities across new countries. Risk of Covid-19 impacting forecasting/ future activities or the capacity to maintain plans.	Programme will be assessed on financial risks, forecasting, and demonstrate experience of successfully working in such environments.	Medium
Safeguarding	Risk of programme or partner staff doing harm or not reporting incidences of sexual exploitation, abuse, harassment or bullying.	Maintain close oversight and due diligence of activities across programme, providing training and advice to delivery partners, requiring a robust safeguarding policy in place including systems to enable reporting and support whistle-blowers. Both UNEP and UoB have a comprehensive approach to prevent sexual exploitation and abuse as well as sexual harassment. These are detailed further in the safeguarding section of this business case.	Low
Operational	Risk of lack of engagement with stakeholders Risk of Covid-19 impacting HMG's capacity Risk of delays	Strong governance through the Steering Committee with clear ToRs, comprehensive documentation of processes with members of all stakeholder groups ensures engagement. Closely monitor quarterly reports to inform whether to stop programme. A detailed work-plan will be developed. The programme personnel will ensure that the Steering Committee and the key stakeholders assemble regularly and provide effective input through a variety of channels to monitor delays	Low
Fiduciary	Risk of a project's funds being misappropriated for non-programme usage. Risk of poor financial management	Regular meetings and reporting will mitigate risk associated with the delivery partners, through enhanced due diligence, reporting frameworks and checks conducted prior to grant instalments being transferred. Disbursement practices enable close monitoring and the ability to halt expenditure, reducing the potential for misuse of funds.	Low
Reputational	HMG invests in poor quality projects/implementers Risk of interventions going wrong/ causing harm, or delivery partners acting in a way that causes reputational harm to HMG	Delivery Partners selected against rigorous technical and financial criteria to ensure programme meets delivery, quality and strategic objectives. Reporting frameworks regularly assessed through governance arrangements.	Low

6.3.2. RISK ASSESSMENT AND MANAGEMENT PROCESS

The programme level risk framework, to be reviewed every three months at quarterly progress meetings, assigning risks, developing mitigating actions and agreeing escalation processes as outlined in the governance Section 6.2.

Building on lessons learnt since its establishment, in addition to FCDO best practices, the programme has tried and tested approaches to managing risk with in-built processes to further refine the approach to risk.

6.4 BENEFITS REALISATION

6.4.1 BENEFITS REALISATION STRATEGY AND FRAMEWORK

The benefits realisation plan will be further iterated following development of project KPIs and will formally set out arrangements for the identification of potential benefits, their planning, modelling and tracking. As the programme progresses the benefits plan will also include lessons learnt from previous rounds, to ensure experience is considered and duplication avoided. The provisional responsibility for the management of these framework arrangements and the accountability for benefits being realised are attributed to each programme partners in the Benefit Realisation Strategy in Annex T.

The three main expected outcomes of the programme are outlined in Section 2.5, however, as noted, it is not possible to quantify all the benefits at this stage. Previous phases of funding have set up the programme for impact and key outputs from previous funding are detailed in the Programme Case. However, the full benefits can only be realised once this new funding has been mobilised and the programme begins to be fully implemented. These benefits will be identified further through our benefits realisation plan and as the MEL framework is finalised.

In absence of a complete benefits realisation plan, we have developed a benefits map in Annex H which identifies the economic, environmental and societal benefits which are expected from the programme and in the second diagram highlights expected benefits within Rwanda specifically by showing the direct benefits that can be realised in the Rwanda Vision 2050 objectives. This demonstrates the wide range of benefits the programme can have, making it critical across a range of sectors.

6.4.2 DISBENEFITS

Along with the development of the benefits realisation plan, disbenefits will be considered, identified and managed along with the benefits. Prior to this process, provisional disbenefits have been identified in Section 1.3.5.

6.5 MONITORING, EVALUATION AND LEARNING

Monitoring, evaluating and learning (MEL) is critical to good project management, assessing performance, demonstrating value for money, supporting transparency, and identifying evidence to correct or confirm the approach.

6.5.1 KEY PERFORMANCE INDICATORS AND OTHER INDICATORS

A suite of Key Performance Indicators (KPIs) and other indicators have been selected as metrics to assess impact and programme performance in order to evidence the success in achieving the outcomes and outputs developed from the Theory of Change (ToC) detailed in Section 1.2. A fully worked up first draft framework of the impact and outcomes KPIs is presented in the LogFrame in Annex G.

The three impact indicators are all ICF KPIs (1, 6 and 15) and the six outcome indicators are linked to the Defra framework of KPIs. These indicators are all focused on measuring the impacts on key stakeholders (farmers and businesses) and creating systemic change within countries (policy level). Ensuring engagement and uptake of practices are addressed at every stage of the cold chain.

All metrics outlined are SMART, however further work is being undertaken to establish quantitative social, economic and environmental baselines with which to measure targets against. This will be done with delivery partners through establishing BAU models without intervention against which impact will be measured. Further work is required to build these BAU models and complete the LogFrame, but we expect this to be complete by the end of 2022 so that the first output report can happen at the end of 2023. We are also working with the strategy and evidence team in the ODA hub to work up a viable method to assess transformational change. Transformation change requires methods to be developed at a department and possibility programme level, which has yet to be undertaken, thus, complete details are not able to be included at this stage, but we will work with the ODA hub to progress this over 2022. Further details of evaluation can be found in 6.5.2.

UNEP, as the Delivery Partner will agree on a plan with Defra to monitor the implementation of the activities using the grant proceeds. During 2022 work will be on-going with partners to design baselines assessments in order to understand progress on these indicators where needed. As required within ODA programming, annual reviews will be used to document progress against the programmes aims and objectives and to report on the KPIs. These annual reviews will be undertaken with support from the strategy and evidence team in the ODA Hub given their expert knowledge, to ensure solid programmes delivery, reporting and value for money.

The Steering Committee, with support from ARLC and NTAC will play a key role in the monitoring of progress of Workstream One providing programme oversight and advisory support, including a) overseeing implementation, and b) reviewing the annual budget and work plan. The SC will meet every six months with ad hoc meetings held as and when necessary to deal with emerging issues – to discuss the main performance indicators and provide strategic guidance. The ACES Director, supported by the programme managers from UNEP and UoB shall facilitate the meetings of SC and will be responsible for the meeting reports.

An overview of the implementation and execution roles and responsibilities can be found in Section 6.2 to show how the monitoring will be carried out.

We will be measuring and tracking all the indicators laid out in Annex G through rigorous MEL procedures. The activities included in the programme pay significant attention to MEL and there is the expectation that 5% of total budget will be spent on MEL through the programme duration. The programme will build capacity to conduct MEL activities and establish mechanisms to learn from the process of preparing, developing and implementing the workstreams in different countries.

6.5.2 EVALUATIONS

The programme delivery team and in-country partners consist of an impressive group of academics and researchers from a range of universities who run large multi-national, -partner and -million pound, multi-million £ programme and can ensure programme evaluations are as strong as possible with rigorous scientific data collection.

Initial plans for an interim and end of programme evaluations have been put in place. A mid programme evaluation focused on outputs will take place in 2023, followed by an impact evaluation in 2025. The first Annual Reviews will update on process and evaluation planning in July 2023 (assuming funding is released in summer 2022).

Both evaluations will set out to assess how effectively the programme is meeting its aims and objectives to provide impact and identify what further research can be targeted at the relevant areas to understand gaps in progress if required. The evaluations will also consider lessons learnt to ensure that future spend is used effectively and they will consider value for money and overall impact made. The budget for the evaluation has set aside in the programme plan. Advice will be taken from the MEL team within the Defra ODA hub on how best to structure and deliver on these evaluations in due course.

6.5.1 REPORTING

Reporting requirements of each of the workstreams is done quarterly. This is done through a written progress reports from UNEP covering activity highlights, milestones and achievements, costs, and lessons learned during implementation. Supplementary face-to-face meeting or teleconferences will be conducted as deemed necessary by Defra to discuss questions or ideas regarding this work.

Workstream One has the additional level of reporting to the Steering Committee on a quarterly basis to ensure progress continues to be made.

Annual reviews will be submitted and assessed as part of Defra's ODA programming requirements from 2023. A final report for all workstreams at the end of funding cycle will be submitted electronically containing a summary analysis on the accomplishments, challenges, and possible future opportunities, with attachments of all final deliverables.

The programme has already undergone day one readiness as the programme and its workstreams have been ongoing since 2019. They went through the relevant approval process and clearances as outlined in the IAAP attached. The critical path for day one readiness for approval and deployment of new funding, as outlined in this business case, is in Annex P. The delivery and reporting structures are established and fit for purpose there will be no changes to the delivery structure.

6.6 AVOIDING FRAUD AND CORRUPTION

Consistent with numerous United Nations Security Council resolutions, including S/RES/1269 (1999/S/RES/1368 (2001), and S/RES/1373 (2001), UNEP is firmly committed to the international fight against terrorism, and in particular, against the financing of terrorism. In accordance with UN Regulations, Rules and Policies, UNEP undertakes to use reasonable efforts to ensure that none of the Defra funds provided under the award are used to provide support to individuals or entities associated with terrorism.

The UoB is committed to the highest standards of ethical conduct in all their activities and has a zero-tolerance attitude to fraud. It has an Anti-fraud policy, a Code of Ethics, Anti-Bribery policy, Gifts and Hospitality policy, Anti-Money laundering policy that is applicable to all staff and the University's activities.

6.7 TRANSPARENCY

The project will meet the International Aid Transparency Initiative (IATI) standard that aims to ensure that organisations publish information to 'improve the coordination, accountability and effectiveness to maximise their impact on the world's poorest and most vulnerable people'. This includes information on the organisation, funds, and planned activities. This intervention will generate significant outputs including log frames, annual reviews, programme/project proposals and technical reports which will be of interest to other countries and stakeholders. All outputs should be published on IATI, free to users whenever possible. Most agencies are now following this standard.

Defra also uploads relevant programme outputs to the UK Development Tracker.