# What is Arica Centre of Excellence for Sustainable Cooling and Cold-Chains (ACES) and the integrated systems approach and how does it differ from other Centres of Excellence (CoE)?

## Traditional CoE approach

Normally Centres of Excellence are developed to reflect where an organisation has expertise in a specific element within a system. i.e. a sub-system and where they have clear boundaries and established to address a specific issue (e.g. developing and promoting best practices, innovation, and high performance in a specific area of expertise). However, they are not designed to address the wider system itself.

Please see Annex A below for a detailed explanation of the systems of systems approach.

## The ACES approach

The key point of ACES it that the model and approach brings experts together to deliver the comprehensive, collaborative and intertwined approach across the whole system – vertically and horizontally to make the system accessible, sustainable and robust.

In doing so, it addresses the questions and challenges as a system rather than within the boundaries of a specific area within that system, thus changing the why, how and what to meet the needs and properly define the question and issue to be addressed.

## How is ACES designed?

ACES has been designed and developed around nine pillars and three foundations:

**How is ACES implemented?**

Through the nine pillars, ACES deploys a coordinated suite of solutions - fit-for-purpose and market technologies, infrastructure, financing mechanisms, policies, and human capacity - to build robust, end-to-end cold-chain systems that are sustainable, inclusive, and resilient.

Delivery is through a hub and SPOKE model and a hybrid physical and online delivery approach which includes:

- ACES - The 1st physical specialised CoE - A 4-hectare multi-zone campus providing comprehensive, state-of-the-art facilities for applied research, technical assistance, learning and teaching, and knowledge transfer along the complete 'fork-to-farm-to-fork' continuum. It includes a Demo Hall, Community Cooling Hub, Test Bed facilities, Technical Training Centres and Labs (solar and refrigeration); Environmental Test Centre and variable temperature Rooms; 200-person conference facilities; and 200-hectare research park.
- SPOKEs - Complementing the CoE (hub), the Programme establishes regional "SPOKE" centres in strategic locations, with expertise tailored to specific areas (e.g. value chain opportunities suited to local communities) to demonstrate how solutions can be deployed practically across the continent. The first reference SPOKE is operational in Kenya, with two additional SPOKEs currently being developed.
- Clean Cooling Network, Training Academy and Online Knowledge Platform - The online platform (http://www.cleancooling.org) provides global accessibility, offering comprehensive training, resources, and community engagement
- Scale and Replicability. A "reference and replicate" approach, as designed by ACES allows for scale-up and roll-out into markets through a blueprint to support a Build-Own-Operate model.

# ANNEX A - DESIGNING SPECIALISED CENTRES OF EXCELLENCE FOR SUSTAINABLE COOLING AND COLD-CHAINS THROUGH AN INTEGRATED SYSTEMS APPROACH (DEMONSTRATED THROUGH ACES)

## 1. The programme

The specialised Centres of Excellence (CoE) activities are part of a UK-funded Programme addressing Sustainable Cooling and Cold-Chains. As the flagship activity, and with over $30m to date which has been 100% matched support from government, grants, and industry, the CoE work is a multi-year investment to:

(i) design and build the pillars for the necessary system transformation and the development of inclusive, equitable and future-proofed cooling and cold-chain solutions with minimum environmental impact;

(ii) provide the tools, knowledge, training and support and engage all members of the system to enable transformational change

(iii) transition through the testing and validation stages and proof of concept to the point of self-sustained "acceleration".

Realisation of these goals will have economic, social and environmental wins.

The UK-funded activities are using a **system of systems** approach to understand the seven elements — **use, make, store, move, manage, finance, and regulate** and employ a **"reduce, shift, improve, aggregate"** approach to minimise climate impact, aiming for immediate benefits and long-term reductions in GHG emissions.

This Interdisciplinary approach brings together more than 65 global sectoral experts and researchers in science, engineering/(transition engineering), governance, logistics, food safety and postharvest management, vaccines, food and health logistics, finance, business and community systems, pedagogy to develop the cooling and cold-chain systems that both meet the needs of today without compromising the environmental, societal and economics system on which future generations will depend to meet their own needs and build the capability for delivery.

A central element of the work is the build of a series of tools around robust needs assessments and a sophisticated, self-organising complex **virtual model** to enable Government and development agencies to understand and develop **optimised and future-proofed** cold-chain for food and health.

Delivery on the ground is underway through a **hybrid physical and online** delivery approach**:**

- **Specialised Centres of Excellence -** the Africa Centre of Excellence for Sustainable Cooling and Cold-chain (ACES), Kigali, Rwanda; 2nd CoE in Haryana, India;
- **SPOKEs** –reference SPOKE in Kenya, three further in development;
- **Clean Cooling Network and Online Knowledge Platform**

There are **six key pillars:**

- Training and capacity building;
- Finance and Business Models;
- Enabling Policies and thought leadership;
- Technologies (applied research, testing and demonstration);
- System Design and Modelling; Future-proofed sustainable vaccine cold-chain.

A reference and replicate approach allows quick scale-up and roll-out into markets through a Build Own Operate model for these CoE which are then country-owned an country driven.

## 2. The problem being addressed

Global demand for cooling is already putting energy systems and the environment under increasing pressure. It accounts for more than 10% of anthropogenic greenhouse gas emissions (GHG) while HFCs are in fact the fastest-growing source of GHG emissions in the world due to the increasing global demand for space cooling and refrigeration.

A key issue is that cooling and cold-chains are complex, multi-dimensional, temperature-controlled networks that include multiple stakeholders who are not always properly connected. The failure of previous projects in this space to date is that they have taken a siloed and not a systems approach and they have consequently struggled to achieve or sustain desired impacts, leading to inefficient allocation of resources and potentially higher financial and environmental costs in the long run. For example, The World Bank, has funded ten cold-storage rooms in Rwanda in the past few years, but estimated that at least 96% of the target farmer communities do not use them.

## 3. Designing Specialised CoE – a novel set of tools

The UK-funded CoE activities were conceived in 2019 using “a clean cooling” approach, as developed by the Centre for Sustainable Cooling, to “increase the adoption and uptake of resilient, efficient, inclusive and climate-friendly cooling and cold-chain with the objectives of reducing food and vaccine loss; improving equitable access; economically empowering subsistence and smallholder farmers and their communities, while mitigating the potential environmental impact of the cold-chain.”

***Cooling Needs Assessment Tool***

Governments must accurately assess how much cooling is actually required to meet societal, environmental, health, economic and adaptation goals in a warming world. If countries fail to properly answer this baseline question and **design for purpose** resilient systems, thermal planning will be inadequate, and they will risk contributing to a lack of ambition in policy, infrastructure, energy and technology development. This could have far-reaching social, economic and environmental consequences.

Developing an integrated systems approach to cooling and cold-chain provision therefore necessarily starts with a comprehensive understanding of the need. Based on detailed market studies and needs assessments across Africa and India and desk-based research, a framework was therefore designed using a National Landscape Cooling Needs Assessment tool[1] designed to gather insights into the current state of cooling and cold-chain availability and access at a

[1] This is underpinned by a secondary Community Cooling Needs Assessment tool for granular understanding and to drive robust Comunity Cooling design

national level - a necessary first step to designing a sustainable and resilient cold-chain system. This framework identifies key dimensions for understanding the sector, including:

- Current demand, need and supply capacity,
- Key drivers, opportunities, and barriers to meeting unmet need
- Economic opportunities, such as maintaining food quality and ensuring food safety, reducing loss, value-addition, and enabling access to distant markets.

***Optimising Cooling and Cold-Chains through systems modelling and Integration***

Alongside these needs assessments and market studies, there was a recognition that historically countries cold-chain facilities are rarely built within a planned, integrated system, even in the Global North. Therefore, no consideration is given to the total equipment, vehicles, infrastructure etc that may be needed and instead the result is a bottom-up chain that is planned in an ad-hoc way by individual actors for specific uses resulting in stranded or excess assets, no relationship between the system that is built and nationally-important objectives and expensive actions to reconfigure the network infrastructure to reflect a new realities.

This is changing now in the Global North, especially for the transition to electrification and future-proofing, with the use of complex models. Another central part of the CoE work has therefore been to work with the same modelling teams to develop a complex virtual model to design country or State- level bespoke optimised cold-chains for food and health which can, inter alia:

- model the equipment (built environment and transport) that are required
- develop cost models for infrastructure and resourcing
- produce a family of different optimised solutions, changing the parameters or objectives to show countries and investors how this affects the optimal strategy
- test multiple solutions virtually including how to build resilience against future shocks and disturbances.

With the model, it is possible to:

- prioritise facilities (e.g. if funding is only available for x% of capacity where is best place to start);
- test the impact of policies or other external decisions (new export points) on the supply chain - do they create overcapacity in one part of the chain but have a dampening effect on a different region;
- consider how to transition to renewables and non-diesel transport;
- consider modal or infrastructure shifts;
- consider how to build resilience against future shocks and disturbances
- understand the optimum mix of assets and the capital investment requirements as well as human resource and skill requirements including number of trained engineers, etc- and indeed where to locate training hubs.

⇨ **help governments- and development agencies - develop holistic, robust and resilient, sequenced and budgeted evidence driven cold-chain delivery roadmaps and continuously test strategies or external impact (positive or negative).**

## 4. ACES – Findings / lessons learned through early activities and programme development

For ACES, the comprehensive cooling needs assessment and research focussed on different end-users, components and actors in the cold-chain for agriculture, livestock, fisheries, and vaccines in Rwanda and showed inadequate product preservation and transport systems and a lack of comprehensive cold-chain solutions in the technologies, skills and business model arenas.

Research also showed existing interventions target stand-alone equipment deployment focussing on cold-storage not cold-chain. Furthermore, 96% of farmers living in the vicinity of the cold rooms don't use them including 10 solar powered cold storage facilities built across SAIP[2] sites.

As activities have developed to deliver ACES, it has been shown that there is further work to be done in building standards in-country using the model developed through ACES and this has proved to be a slower process than first anticipated based on the third party reviews of work already in train. Issues encountered include:

- Some SME equipment companies do not have robust SOPs, commissioning plans or testing.
- There is no rigorous design of systems, rather arbitrary deployment of assets based on ease to engage or siloed private sector commercial objectives.
- Outside of South Africa, there are no testing facilities capable of handling commercial scale cooling equipment in Africa.
- Existing in-country refrigeration training does not meet international standards. Wider training is siloed.
- Previous needs assessments are surface level and lack the granularity needed; resilience planning non-existent.
- Radical intervention on business models to ensure inclusivity and support resilient cold-chains are limited.
- There is limited robust impact measurement rather than simply pathways.
- Outside of the ACES work, no other programme is looking consistently and coherently at addressing cold-chain interventions through a GESI lens.

Practical evidence of the points above in this period has been evident through early stage activities at the ACES "hub" in Kigali which has experienced challenges related to:

- **Novel equipment procurement –** specialised cold chain equipment is not available in-country so local technical expertise in terms of ability to specify technical requirements and conduct procurements is lacking. Different approaches have had to be developed to cater for the situation, with significant technical support and supplemental expertise from the international project team and bespoke procurement processes within UNEP, and expansion of outreach on tenders after local partners failed to secure satisfactory bids and execute awards in a timely fashion. NB - These experiences have since been used to develop the process for building capacity in-market for future procurement.
- **Long lead times (globally) and availability of alternative technologies in developing country markets –** these are a major challenge, exacerbated by high demand for cooling equipment globally, shipping delays amidst geopolitical strife in usual sea lanes (as nearly

[2] Sustainable Agricultural Intensification and Food security Project (SAIP) is the Global Agriculture and Food Security Program (GAFSP) funded project through the World Bank Group.

all equipment is imported) as well as high inflation and parts shortages (i.e. key components such as a compressor cause entire training rig to be delayed).

- **Skills –** historic training in-market is often informal and, where conducted to date, even by international agencies, is to a basic standard. Consequently, there has been a need to invest – and continue to invest - more time in building capacity in-country to meet international standards for system design, equipment installation, testing and maintenance. Following investment and targeted activities and support, ACES will have highly competent teams and operating procedures to train the trainers in other markets.

These inter-related challenges have required adapted approaches to mitigate and manage the risks but have also provided valuable insights and evolution of the approach and support being provided. For example, as an intermediate step, activities for ACES are being undertaken utilising a “Build, Transfer, Own” approach to develop in-country self-sufficiency and competence in Africa rather than requiring local partners to develop certain aspects in-house. However, as part of expanded activities through the delivery of the reference and replicate approach, the model which will be implemented is a “Build Own Operate” one which is the optimum approach to support deployment and action at scale through a country-led approach with technical support as appropriate. The capacity and tools to underpin this approach is being developed through the work.

## 5. What is an integrated systems of systems approach for community cooling?

An integrated systems-of-systems approach for community cooling is a comprehensive framework that addresses cooling needs holistically by considering interconnections between social, economic, technological, and environmental factors. It ensures cooling solutions are fit-for-need, inclusive, efficient, and sustainable while fostering resilience to future challenges. Key elements include:

- **Alignment with social and development goals:** Ensures cooling solutions contribute to broader objectives such as health, economic development, education, and quality of life.
- **Comprehensive environmental focus:** Focuses on energy, refrigerants and emissions but also understands wider environmental and ecological implications of cooling/lack of cooling.
- **Integration across sectors:** Combines built environment, data services and transport (including logistics) into a single system to optimise resource use and functionality.
- **Resilience-building:** Considers how to build resilience against future shocks and disturbances
- **Needs-based approach:** Does not pre-suppose particular technology solutions, instead understands the portfolio of needs and matches them to passive, active, and hybrid solutions.
- **Demand and supply aggregation:** Aggregates demand and supply across the whole system to optimise energy and resource management.
- **Demand mitigation:** Reduces the need for mechanical cooling through passive cooling, service aggregation and behaviour change.
- **Innovative business models:** Stacks (bundles) revenues from diverse services in novels business models to maximise economic opportunity.
- **Localised and circular approaches:** Considers local manufacture and assembly and circular economy principles.
- **Human resource and skills development:** Identifies the human resource and skill requirements, along with strategic locations for establishing training hubs to build local capacity.
- **Regulatory alignment:** Considers the regulatory environment to ensure compliance.

- **Consumer engagement:** Actively engages the customer / consumer to effect behavioural change.

## 6. Considering MLF opportunities for specialised CoE for technical and policy assistance to phase down HFCs whilst also implementing energy efficiency activities

Through the MLF, CoE can play a bigger role in the transition to climate friendly, efficient cooling through:

- Support of a holistic (systems) approach to meet the cooling service needs and ensure individual cooling and cold-chain technologies are supported by the broader systems landscape in which they are embedded.
- Upgrading training content and infrastructure and capacity building to include energy efficiency (including a cross-sharing network of physical centres and SPOKES).
- Driving technology change - in-market technology testing and demonstration through the hub and SPOKES
- Technical consultancy for SMEs for adopting energy efficient technologies including elements relating to product design, manufacturing and assembly, related training support and after sales.
- Developing the local skills and training to provide and develop equipment that is specifically designed for the local markets and can be operated and maintained by local people to a high standard.
- Designs that are complex in their integration but will be able to be simply manufactured locally and which will flexibly fit the needs of local communities.
- Strategically located facilities - e.g. for ACES, “tested in Africa for Africa”.
- Support of non-investment activities in small local assembly and manufacturing activities to support in-Country expertise and access and availability to alternative technologies.
- National system design tools, modelling and data approaches.
- Development of finance and business models.

## 7. Measuring Impacts

It is important to consider the time taken between the different steps in the design and delivery which in turn will affect things like the systematic impact emissions reductions and how these are reflected across the activities, outputs, outcomes and impact. It is first necessary to develop the comprehensive needs assessment, detailed training materials and knowledge base and tailored equipment specifications to meet country needs. Time will then be needed for delivery of the training for example and whilst numbers can be carefully recorded and reported to demonstrate the uptake of the training, the actual impacts in terms of sustainable cold-chain uptake will inevitably have a lag phase and interval between training delivery and purchase impact and consumer practices.

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