**Programme of Work implementation**
**Key concept notes for technical assistance for transformative areas as per CTCN PoW**

- Water-Food-Energy Nexus: Agrivoltaics
- National Systems of Innovation: Establishing a National Innovation System for Climate Action; Technology Need Assessment (TNAs)
- Energy Systems: Net Metering; Green Hydrogen; Decarbonization of Grids through phase-out of SF6
- Business and Industry: Cement
- Building and Resilient infrastructure: Hydroponics / Aquaponics.

# Water-Food-Energy Nexus

## Concept Note
## Pre-feasibility study for deploying Agrivoltaics technology.

Agrivoltaic (AV) systems present an opportunity for farmers to improve their crop production and develop higher value agricultural crops and commodities and powering post-harvest processing equipment. Despite the benefits of agrivoltaic systems being demonstrated by research in the Global North, there is yet very limited empirical evidence of the potential benefits of agrivoltaic systems in Africa, and awareness of such alternatives to conventional solar parks by development decision makers is lacking. Further, the absence of cross-sectoral policy support remains an uncertainty and a challenge for farmers and agribusinesses seeking electrification infrastructure that offers benefits beyond electricity provision.

Empirical research generating locally relevant evidence and demonstrating the benefits of such systems given the local environmental conditions and target crop varieties is required to gain political, business and community support for agrivoltaic systems in Africa.

**Overall objective**
This multi-country technical assistance aims to conduct a feasibility assessment for the deployment of Agri-Voltaic technology in **multiple countries**. This will help establish the technical, economic and market viability of the technology in the requesting countries.

**Activity 1: Feasibility assessment for implementing Agri-voltaic technology in the requesting countries.**

- Developing country profile for each requesting party to map the baselines for: The energy needs of the requesting countries and percentage of the population who have power access, the specific farming systems e.g., types of crops that could benefit from agrivoltaics, sustainability and feasibility of using agrivoltaic technologies by region, by crop, expected impact of the agrivoltaic technology on farmers and agricultural communities.
- Architectural requirements for each Agrivoltaic system

**Activity 2: Develop the roadmap for deploying agrivoltaic technology in the requesting countries,**

- Defining the technology baseline specifically for agrivoltaics in the requesting countries.
- Conduct a Technology forecast in country context for Agrivoltaics systems.
- Identify barriers to large scale deployment:
- Proposed Agrivoltaic Technology Roadmap (ATRM)

**Activity 3**: **Market and economic assessment on Commercial viability of implementing Agrivoltaic technology.**

- Estimating the expected costs of implementing agrivoltaic systems in the eligible countries/communes, conducting a cost comparison between agrivoltaic systems and conventional practices involving both solar implementation and farming on separate fields, comprehensive analysis of environment forces, market trends, entry barriers, competition, risks, opportunities (SWOT Analysis),
- Develop a business and financial model for an agrivoltaic technology project (a case example).

**Activity 4: Multi-country Validation workshop on the results of the technical assistance**

- 2-days workshops for presenting the ATRMs developed. In this workshop key stakeholders will be invited including, financial institutions such as local banks, NGOs, representatives from global funding agencies such as country NDAs of the GCF.DAs of the Adaptation fund etc.,

**Anticipated products to be delivered**

- Extensive review of the environmental conditions for all requesting countries
- Report on Architectural requirements for each Agrivoltaic system and Guidelines for Agrivoltaics architectural design requirements.
- Technology baseline of each requesting country and technology forecast report.
- Barriers to large scale deployment report
- Agrivoltaic Technology roadmap
- Market and economic assessment report with cost comparisons to conventional practices, comprehensive analysis of environment forces, market trends, entry barriers, competition, risks, opportunities (SWOT Analysis),
- Business and financial models for agrivoltaic technology project (a case example)

# National Systems of Innovation

## Concept Note (1)
## Establishing a National Innovation System for Climate Action

In the face of escalating climate change impacts and the imperative for sustainable development, developing countries find themselves at the forefront of global challenges. The pursuit of economic growth, poverty alleviation, and social progress must now navigate the intricate landscape of climate vulnerability and environmental degradation. Developing countries are not only grappling with the traditional obstacles of development but are also contending with the urgent need to address climate change and build resilience against its effects.

Sustainable development in developing countries is beset by a myriad of challenges. From inadequate infrastructure and limited access to basic services to disparities in wealth distribution and governance issues. Moreover, developing countries often face heightened climate vulnerability, exposure to extreme weather events, and dependence on climate-sensitive sectors like agriculture and fisheries.

In this context, the development of a robust national innovation system for climate action emerges as a strategic imperative. Such a system would serve as a catalyst for transformative change, facilitating the integration of climate considerations into development planning and fostering innovation-driven and endogenous solutions to address climate challenges. By harnessing the power of innovation, developing countries can unlock new pathways for sustainable development and economic competitiveness while simultaneously enhancing their resilience to climate impacts.

Several developing countries are leading the way in terms of effective national innovation systems, such as South Africa and India. Yet, many countries are facing significant challenges in developing a comprehensive national innovation system. Some of these challenges are:

- **Limited Financial Resources**: Constrained budgets and limited financial resources available for investing in innovation and research and development (R&D) activities related to climate action.
- **Lack of Technical Expertise**: Shortage of skilled professionals and technical expertise in areas relevant to climate action and innovation, such as renewable energy technologies, climate modeling, and adaptation strategies.
- **Weak Institutional Capacity**: limited coordination among government agencies, insufficient regulatory frameworks, and bureaucratic inefficiencies impeding the effective establishment and operation of a national innovation system for climate action.
- **Infrastructure and Technology Gaps**: Lack of adequate infrastructure (telecommunication, transportation, energy supply, etc.) and access to advanced technologies needed to support innovation for climate action.
- **Intellectual Property Rights Issues**: Unclear or inadequate IPR regimes may hinder technology transfer, collaboration, and the sharing of innovations essential for addressing climate challenges.
- **Limited Access to Information and Data**: Challenges in collecting, analyzing, and disseminating data and information on climate change impacts, vulnerabilities, and adaptation strategies due to limited resources, capacity constraints, and data gaps.
- **Socio-economic and Cultural Factors**: Socio-economic and cultural factors, such as gender disparities, social inequalities, and traditional practices, can influence the adoption and acceptance of innovative climate solutions.

The CTCN supports several countries with the strengthening of national innovation systems, such as Zambia. An exemplarity outline of objectives and activities can be found below. The scope of activities may vary depending on national circumstances and priorities.

**Overall objective:**
This technical assistance aims to introduce an effective National Innovation System that fosters low-carbon and climate resilient economic development through endogenous innovation

**Activity 1: Evaluation of the national innovation environment for climate action**

- Analysis of the national innovation environment for climate action
- Assessment of strengths, weaknesses, opportunities and barriers

**Activity 2: Development of a framework and roadmap for the establishment of a National Innovation System**

- Formulation of the NIS Working Group and inception workshop
- Quarterly NIS Working Group meetings
- Development of the NIS Policy Framework
- Development of the NIS Implementation Roadmap

**Activity 3: Introduction of institutional innovation support schemes**

- Concept development of an innovation support agency
- Identification of funding and cooperation opportunities

**Activity 4: Introduction of schemes to enhance innovation capacity**

- Development of an innovation communication and capacity building strategy and plan
- Development of a web-based platform on innovation

**Anticipated outputs to be delivered by the technical assistance.**

1. National Schemes developed

**Concept Note (2)**
**Technology Needs Assessment**

Technology is an important aspect to be taken into consideration in climate change both in strengthening mitigation and adaptation measures and in building resilience. The absence of a comprehensive Technological Needs Assessment (TNA) for a country increases the difficulties in determining the level and extent of support needed for implementation of the National Determined Contribution (NDCs) and other national development priorities, as well as the Sustainable Development Goals (SDGs). Improving and adopting technologies for climate change mitigation and adaptation is key for leveraging of inputs for the implementations of NDCs.

In order to transition to a climate-resilient and low-carbon development, developing countries need to structurally adopt environmentally and socially sound, cost-effective, and better-performing climate technologies on a large and widespread scale. Developing countries usually face a lack of specialized skills required in climate technologies, innovations and knowledge. Other barriers include inadequate infrastructure services to ease the acquisition of appropriate technologies, lack of market awareness, lack of research and development of green technologies, inadequate incentives and enabling environment for technology transfer. Generally, these barriers affect the development and transfer of climate technologies, including:

- **Technological barriers**: High costs associated with researching and developing climate solutions, and lack of scalability.
- **Financial barriers**: Upfront costs of implementing climate technologies and limited access to capital.
- **Institutional barriers**: Dated policy and regulatory frameworks, and lack of incentives for climate technologies.
- **Lack of awareness and capacity**: Lack of knowledge about the benefits and potential of climate solutions, and lack of technical capacity.

The results of the TNA are expected to provide strategies for long-term participatory transformational action in all identified and prioritized sectors of a specific country to drive climate-resilient and low-carbon growth. The CTCN implement this work within the broader context of the technology needs assessments undertaken by many countries and recognized by the COP as a key element in identifying and planning for technology to address the challenges of climate change.

Throughout the 10 years of CTCN several technical assistances on technology needs assessment have been delivered, namely in Equatorial Guinea, Botswana, Sierra Leone, Mauritius, Georgia, Chile, Paraguay, Uzbekistan, Kyrgyzstan, among many other countries.

An exemplarity outline of objectives and activities is detailed below. The scope of activities is tailored on national circumstances and priorities, and whether a prioritization of sectors has been done or it has to be included in the scope of activities.

**Overall objective**
The objective of this technical assistance is to carry out and coordinate the assessment of technology needs within a specific country in order to advance the implementation of climate technologies in the area of adaptation and mitigation in selected country and to strengthen the fulfillment of the technology component of the country's NDC.

**Activity 1: Stakeholder analysis and establishment of a TNA Committee**

- Identification of key stakeholders to be directly involved in the National TNA Committee, and in the TNA and TAP process.

- Selection of the TNA committee members and constitution document where rules and procedures of the TNA process, and roles of the different members described. Capacity building training on the TNA processes.

**Activity 2: Prioritization of technologies and relevant action for increased access to finance**

- Obtain consensus about priority sectors (and subsectors) to shape the TNA and validate the challenges for each sector.
- Assess, validate, and prioritize key technologies with sectoral working groups.
- Develop a Technology Action Plan per sector and /or sub sector.
- Ensure national ownership and technology deployment through the engagement of the TNA Committee and key stakeholders, with the private sector as an important actor.

**Activity 3: Support for the implementation of the Technology Action Plan with communications, guidance and training**

- Roadmap development workshop with industry representatives, authorities and other stakeholders to define a set of objectives 2030 and 2050 for each identified decarbonization lever Development of training materials and dissemination strategy
- Delivery of TNA training workshops

**Activity 4: Enhance SME capacity and enable environment through innovative new business identification training programmes**

- Engaging with the private sector/ SMEs within the country and assisting in the identification of the country's' business needs and exploring new business opportunities in climate technology
- Provision of capacity building and training

**Activity 5: Develop concept notes for priority sectors for submission to the Financial Mechanism**

- Development of concept notes based on the Technology Action Plan on the sectoral technologies prioritized.

***Anticipated products to be delivered***

1. National Cement and Concrete Industry Analysis
2. Stakeholder analysis report
3. Official government circular establishing the national TNA committee
4. Methodology for sector the selection and prioritization of sectors
5. Analysis of sectoral priorities
6. Multi Criteria Analysis
7. Technology fact sheets
8. Technology Action Plans
9. Policy briefs and market-use cases for the selected technologies.
10. Training materials
11. Concept note for financing climate technology deployment

# Energy Systems

## Concept Note (1)
## Net Metering for Renewable Energy Grid Integration

As one of the largest contributors to global greenhouse gas emissions, particularly from fossil fuel combustion, the energy sector plays a pivotal role in shaping the trajectory of climate change. Rapid industrialization, urbanization, and population growth have intensified the demand for electricity, driving increased reliance on conventional energy sources and exacerbating the sector's climate footprint.

In response to these challenges, there is a pressing need for innovative policies and strategies that can promote the adoption of renewable energy sources, enhance energy efficiency, and ensure the equitable distribution of energy resources. Among these policies, net metering has emerged as a promising mechanism for empowering energy consumers, promoting renewable energy deployment, and fostering a more decentralized and resilient energy grid.

Net metering is a billing arrangement that allows energy consumers who generate their own electricity, typically through renewable energy sources like solar panels, to receive credit for the excess electricity they produce and feed back into the grid. This system enables consumers to offset their electricity bills by using the electricity they generate themselves, thus reducing their reliance on electricity from the grid.

Following the establishment of an enabling environment for net metering, several countries (i.e. India and USA) have witnessed an increase in renewable energy projects and electrification. Yet, many countries still face challenges in setting up such an enabling environment for net metering uptake, which includes:

- **Regulatory Framework**: Supportive regulatory framework defining the eligibility criteria, credit rates, billing arrangements, and other rules governing net metering participation.
- **Technology**: Net metering relies on bi-directional metering technology, which measures both the electricity consumed from the grid and the electricity fed back into the grid from the consumer's renewable energy system.
- **Metering and Billing Arrangements**: Net metering policies typically involve specific metering and billing arrangements to accurately measure and credit the electricity generated and fed back into the grid by net metering customers.
- **Utility Cooperation**: Successful implementation of net metering relies on cooperation and collaboration between net metering customers and utility companies.

The CTCN supports several countries with the development of net metering policies and energy grid integration, such as Comoros and Timor Leste. An exemplarity outline of objectives and activities can be found below. The scope of activities may vary depending on national circumstances and priorities.

**Overall objective:**
This technical assistance aims to support countries in developing net metering policies to promote the integration of renewable energy into the electricity grid.

**Activity 1: Assessment of the current infrastructure and regulatory environment**

- Geospatial analysis of the current electricity grid
- Analysis of current metering technologies and processes
- Mapping and analysis of regulations and policies for renewable energy, electricity metering and grid codes

**Activity 2: Assessment of the electricity grid integration potential**

- Assessment of electricity capacity of the national grid
- Estimation of renewable energy generation potential
- Consideration of population and economic growth
- Evaluation of the grid capacity to absorb renewable energy generation.

**Activity 3: Development of a net metering policy and grid codes**

- Evaluation of program design options (tariffs and financial mechanisms) for net energy metering
- Assessment of different renewable energy payback scenarios under different program design options
- Formulation of the net metering policy and grid codes
- Capacity building of policy makers and technicians

**Activity 4: Preparation of a pilot project**

- Geospatial analysis of rooftop solar potential in a selected city
- Pre-feasibility study for the installation of solar panels on selected buildings
- Development of a concept note for the pilot project.

**Anticipated outputs to be delivered by the technical assistance.**

1. Grid codes developed
2. Net metering policy developed

# Energy Systems

**Concept Note (2)**
**Green Hydrogen Uptake**

The energy sector is the biggest emitter of GHG emissions, with a record-high of 33.1 Gt in 2019. Urgent action is needed to replace fossil fuels, particularly in hard-to-electrify sectors like heavy industry, long-haul transportation, and manufacturing.

The IPCC AR6 identifies hydrogen as one of the alternative fuels to reduce fossil fuel use substantially and of all multiple energy supply options available to reduce emissions over the next decade, hydrogen produced from electrolysis ('Green') holds great potential to transform systems of heavy industry, residential and commercial buildings, and transport. However, the effectiveness of hydrogen will depend on how quickly and how far technology improves (p. 91).

Green hydrogen has several prominent use cases across various sectors. Green hydrogen can be used to store excess renewable energy generated during periods of low demand, which can then be converted back to electricity when demand is high. It can be used as a fuel for fuel cell vehicles, such as hydrogen-powered cars, buses, trucks, and trains. Green hydrogen can also be used as a feedstock in various industrial processes, including the production of ammonia for fertilizers, methanol for chemicals and fuels, and steel manufacturing. As such, hydrogen direct reduction for primary steelmaking is near-commercial in some regions.

Following the establishment of national economic and regulatory policy instruments for green hydrogen technology, developed countries (i.e. Australia, and Germany) have not only implemented first commercial scale examples but also multiple socio-behavioural change projects. Developing countries face several challenges in supporting the innovation and implementation of green hydrogen:

- **Policy and Regulatory environment**: Lack of clear policies, regulations, and incentives to support the development of green hydrogen projects. Policy uncertainty can deter investment and hinder the growth of the green hydrogen market.
- **Access to Technology and Expertise**: Limited access to the latest green hydrogen technologies and expertise needed to implement projects effectively. This can hinder the development of local capacity and slow down the adoption of green hydrogen.
- **Lack of Infrastructure**: Lack of necessary infrastructure for producing, storing, and distributing green hydrogen. Building this infrastructure requires coordinated efforts from governments and private sector stakeholders
- **High Initial Investment Costs**: Developing green hydrogen infrastructure requires significant upfront investment in renewable energy sources, electrolyzers, storage facilities, and distribution networks.
- **Market and Consumer Awareness**: Lack of awareness and understanding of the benefits of green hydrogen as a clean energy source. Building awareness among consumers, businesses, and policymakers is essential to drive adoption and consumption of green hydrogen.

To respond to the needs of developing countries, the CTCN has delivered a global series of capacity building workshops on green hydrogen. These workshops aimed to increase the knowledge of NDEs and representatives from energy regulators / Ministries of Energy on green hydrogen technology and the required enabling environment. As a follow-up several countries have expressed interest in green hydrogen production and usage.

An exemplarity outline of objectives and activities can be found below. The scope of activities may vary depending on national circumstances and priorities. Requests might focus on production for export or utilization in specific sectors only.

**Overall objective:**
This technical assistance aims to support countries in developing appropriate frameworks and conditions to promote a national green hydrogen economy.

**Activity 1: Conduct a national baseline study to assess green hydrogen production, use, transformation, transport and commercialization status quo and possibilities**

- Assessment of the current and perceived potential of hydrogen production, use, transformation, transport and commercialization
- Analysis of regulations, policies and standards relevant to hydrogen production and use
- Identification of relevant actors
- Mapping of opportunities and barriers

**Activity 2: Identification of most suitable business cases of green hydrogen production and usage**

- Assessment of the quantum of green hydrogen required for potential use in key sectors, such as:
    - Transport: personal vehicles, buses, heavy vehicles, industrial forklifts, etc.
    - Commerce: Off Grid power application for utility buildings like schools, health care centers, small communities, community heating and cooling, etc.
    - Industry: Ammonia production, steel smelting, reforming process in cement plants to produce natural gas, etc.
    - Agriculture: fertilizer production, etc.
- Multi criteria analysis to identify three most suitable application areas for use of green hydrogen and its climate benefits.
- Identification of the different technological options to produce hydrogen and develop their requirements in terms of resource requirement both qualitative and quantitative (water, electricity required, area of solar PV, storage requirements etc.)
    - Undertake SWOT analysis of the identified technologies.
    - Estimate the CAPEX and OPEX for three different size configurations including the local storage.
    - Identify most suitable geographical areas for location of manufacturing plants in countries.

**Activity 3: Develop national green hydrogen strategies/roadmaps in collaboration with the government, private sector entities, financing institutions, academia, and civil society organizations**

- Stakeholder workshops to present the baseline information and convey with public and private actors
- Development of the hydrogen economy strategy including i) short-, mid-and long-term strategic goals and recommendations, ii) linkages to the NDC and iii) an action plan and technology roadmap to implement the proposed strategy

**Activity 4: Operationalization of the green hydrogen strategy/roadmap and the identified business cases**

- Development of GCF concept notes for identified green hydrogen projects and business cases
- Organization of business matchmaking forums for private sector engagement
- Capacity Building of national policy makers to facilitate implementation of the action plan developed.

There is also a strong potential for regional coordination of green hydrogen activities in order to establish international value chains. Depending on the final set of countries, additional activities related to regional coordination in terms of roadmaps, project proposals and workshops may be added.

**Anticipated outputs to be delivered by the technical assistance.**

1. national green hydrogen strategies/roadmaps
2. Implementation action plan

## Energy Systems

### Concept Note (3)
### Decarbonization of Grids through Phase-out of SF6

Sulphur hexafluoride ($SF_6$) is mostly used as an insulating gas in electrical equipment (such as switchgears and circuit breakers) of electrical transmission and distribution lines. SF6 is a potent greenhouse gas with a Global Warming Potential (GWP) of 23,400. $SF_6$ emissions are increasing rapidly with grid expansion and modernization, as well as with the electrification of many industries. In a recently published report on "Electricity Grids and Secure Energy Transitions", the International Energy Agency (IEA) has stressed that $SF_6$-free equipment must be part of the solutions for decarbonizing the grid. Continuing to install equipment using $SF_6$ is not compatible with the targets of the Paris Agreement.

In response to the high GWP, switchgear manufacturers are building up a commercially viable portfolio of $SF_6$-free electrical equipment, by replacing the highly potent gas with clean air. In a move to phase out $SF_6$, the European Council and Parliament have reached an agreement in early October 2023 to fully ban medium voltage switchgears relying on F-gases, with a gradual phase-out by 2030, and high voltage switchgears by 2032. However, at the global stage, the level of awareness of $SF_6$ impacts and alternatives is very low. Countries are confronted with various challenges:

- **Decarbonization options**: Multiple SF6-free technology options are available for medium and high voltage applications, with some more mature and commercially viable than others which are still in the R&D stage. There is a lack of transparency on the technically and economically viable options considering the national context, grid expansion plans, and local availability of alternatives.
- **Standards and incentives**: Outdated or lack of standards, policies and incentives regarding SF6 usage, reporting and leakage, as well as procurement policies promoting SF6-free equipment led to continued SF6 emissions and lack of transparency.
- **Governance**: Absence of SF6 inventories, phase-out targets, actionable roadmaps, enabling policies, monitoring, verification, and enforcement mechanisms regarding SF6 usage and emissions data is impeding the transition away from SF6.
- **Financing**: The higher upfront costs of SF6-free equipment and related grid integration present an adoption constraint requiring innovative financing mechanisms and policy incentives.

The CTCN as delivered various capacity building and knowledge sharing sessions on SF6 in the past. An initial technical assistance on SF6 phase-out will be delivered to Kenya as a pilot country. The CTCN is currently preparing a Global SF6 Programme under which countries can access support on the gradual phase-out of SF6.

An overview of objectives and activities is as below.

**Overall objective**

The objective of this technical assistance is to support countries in eliminating SF6 from grid infrastructure through phase-out strategies, governance frameworks, capacity building and piloting SF6-free technologies.

**Anticipated activities to be performed by the technical assistance**

1. **Establishment of an SF6 inventory**
- Collect data on SF6 equipment and banks from utilities.
- Estimate SF6 quantities required for future grid expansions.
- Project SF6 emissions under business-as-usual scenario
- Awareness programmes with industry, installation partners, etc.

2. **Development of an SF6 monitoring, reporting and verification system**
- Develop an SF6 MV&E system for tracking SF6 installations, banks, emissions and reductions.
- Capacity building on inventory and MRV

3. **Evaluation of appropriate SF6-free equipment options**
- Identify viable technology alternatives for medium and high voltage segments
- Assess technical performance (technical feasibility), financial costs (financial feasibility) and local availability across options
- Prioritization of technology choices for pilot demonstrations

4. **Development of national SF6 phase-out roadmap and policy recommendations**
- Determine phase-out strategy with SF6 reduction targets
- Outline technology deployment plans and timelines
- Provide policy and regulatory recommendations based on international best practices
- Develop investment plans for enabling framework

5. **Capacity building on safe management of technologies using SF6**
- Develop a guideline on safe management practices for technologies using SF6
- Capacity building workshops with technicians

6. **Preparation of SF6-free technology pilots**
- Design pilot projects for prioritized technology options
- Update procurement guidelines for purchasing SF6-free equipment options
- Facilitate pilot financing and implementation

**Anticipated outputs to be delivered by the technical assistance.**

1. Accurate inventory of SF6 banks and future emission projections, as well as periodic reporting
2. Increased understanding of viable SF6-free technology options
3. Phase-out strategy with technology deployment plans and timelines
4. Policy recommendations and investment plans for enabling framework.
5. Pilot projects demonstrating SF6-free technologies, possibly for medium and high voltage
6. Local capacity built for safe management of existing technologies, as well as adoption and maintenance of new technologies.

## Business and Industry

**Concept Note**
**Decarbonization of Cement and Concrete Sector**

Cement is the most widely consumed building product in the world. Due to the huge volume produced, cement production is responsible for around 5 - 8% of man-made CO2 emissions. In 2020, the level of cement consumption worldwide reached 4.2 billion tons with a constant growth trajectory for the next decades due to rapid urbanization and population increase.

Several international cement and concrete producers have adopted ambitious decarbonization targets. However, on the path to decarbonizing cement and concrete at a national level, countries are confronted with several challenges:

- **Decarbonization options:** Multiple decarbonization options are available with some being technically mature and others still in an R&D phase, and with a higher and lower CO2 reduction potential. Countries require transparency on viable options for the national context as the choice strongly depends on production volumes, technology setup and raw material.
- **Standards and incentives:** Outdated or a lack of standards and policies for cement and concrete products, but also for energy performance of buildings lead to excess material usage, energy inefficiency and a lack of transparency.
- **Governance**: A clear and actionable decarbonization roadmap, as well as monitoring, verification, and enforcement (MV&E) with regards to transparency on CO2 emissions and reduction targets is fundamental for the path to decarbonize cement and concrete.
- **Private sector engagement**: Coordination with businesses and industry players is critical for a successful development and enforcement of standards and regulations

The CTCN has delivered multiple technical assistances on cement and concrete decarbonization in the past, including in South Africa, Mozambique and Republic of Congo. In collaboration with the Global Cement and Concrete Association (GCCA) which represents 80% of the world cement capacity outside China, multiple knowledge sharing events were delivered on the topic of cement decarbonization.

An exemplarity outline of objectives and activities can be found below. The scope of activities may vary depending on national circumstances and priorities.

**Overall objective**
The objective of this technical assistance is to develop a national deep decarbonization roadmap for the cement sector which includes assessing evaluating viable technology options and scenarios, and identifying requirements for technology adoption, including standards and policy interventions, MV&E and private sector engagement. The expected outcomes of this technical assistance are on a short- and medium-term to establish the market requirements and incentives for low-carbon cement and concrete technology, and on a long-term to significantly reduce CO2 emissions in this sector.

**Activity 1: Analysis of the current (2023) national cement and concrete industry**
- Determination of current CO2 emissions from the cement industry through the main KPI like SPEC, STEC as well as all others KPI's needed.
- Analysis of cement market environment (stakeholders, regulations, laws, standards in place, future demand, etc.), including gender analysis

**Activity 2: Evaluation of appropriate low-carbon cement technology options and decarbonization levers**
- Identification of appropriate technology options and decarbonization levers along the value chain (based on GCCA low-carbon cement technology options and pathways): Energy Efficiency, Waste Heat recovery (clinker cooler) boiler, fuel substitution etc.
- Workshop series with industry representatives, authorities and other stakeholders to prioritize technology options and decarbonization levers.
- Evaluation of technology and economics viability of prioritized technology options in the national context, including potential co-benefits for gender and youth

**Activity 3: Development of a national deep decarbonization cement and concrete roadmap 2030 and 2050**
- Roadmap development workshop with industry representatives, authorities and other stakeholders to define a set of objectives 2030 and 2050 for each identified decarbonization lever
- Policy workshop to discuss policy asks with authorities to find common ground and understanding to enable the industry to reach targets
- Development of a national deep decarbonization cement and concrete roadmap 2030 and 2050, including CO2 reduction targets, activities (technologies, policy asks, etc.), co-benefits (gender and youth), timelines, and budget

**Activity 4: Operationalization of roadmap**
- Development of a MV&E framework
- Development of bankable proposals for the assessment and implementation of specific technologies of the roadmap.
- Provision of capacity building and training

**Activity 5: Introduction or updating of cement standards**
- Preparation of the draft standard to align to norm EN-197-5
- Public consultation process and workshop to endorse draft standard
- Preparation of standard adoption process

***Anticipated products to be delivered***
1. National Cement and Concrete Industry Analysis
2. Report on technology options and decarbonization levers
3. National deep decarbonization cement and concrete roadmap
4. MV&E Framework
5. Bankable proposals
6. Capacity building report and material
7. Draft cement standard

8. Public consultation report and workshop materials

# National Systems of Innovation

**Concept Note**
**Technology Needs Assessment**

Technology is an important aspect to be taken into consideration in climate change both in strengthening mitigation and adaptation measures and in building resilience. The absence of a comprehensive Technological Needs Assessment (TNA) for a country increases the difficulties in determining the level and extent of support needed for implementation of the National Determined Contribution (NDCs) and other national development priorities, as well as the Sustainable Development Goals (SDGs). Improving and adopting technologies for climate change mitigation and adaptation is key for leveraging of inputs for the implementations of NDCs.

In order to transition to a climate-resilient and low-carbon development, developing countries need to structurally adopt environmentally and socially sound, cost-effective, and better-performing climate technologies on a large and widespread scale. Developing countries usually face a lack of specialized skills required in climate technologies, innovations and knowledge. Other barriers include inadequate infrastructure services to ease the acquisition of appropriate technologies, lack of market awareness, lack of research and development of green technologies, inadequate incentives and enabling environment for technology transfer. Generally, these barriers affect the development and transfer of climate technologies, including:

- **Technological barriers**: High costs associated with researching and developing climate solutions, and lack of scalability.
- **Financial barriers**: Upfront costs of implementing climate technologies and limited access to capital.
- **Institutional barriers**: Dated policy and regulatory frameworks, and lack of incentives for climate technologies.
- **Lack of awareness and capacity**: Lack of knowledge about the benefits and potential of climate solutions, and lack of technical capacity.

The results of the TNA are expected to provide strategies for long-term participatory transformational action in all identified and prioritized sectors of a specific country to drive climate-resilient and low-carbon growth. The CTCN implement this work within the broader context of the technology needs assessments undertaken by many countries and recognized by the COP as a key element in identifying and planning for technology to address the challenges of climate change.

Throughout the 10 years of CTCN several technical assistances on technology needs assessment have been delivered, namely in Equatorial Guinea, Botswana, Sierra Leone, Mauritius, Georgia, Chile, Paraguay, Uzbekistan, Kyrgyzstan, among many other countries.

An exemplarity outline of objectives and activities is detailed below. The scope of activities is tailored on national circumstances and priorities, and whether a prioritization of sectors has been done or it has to be included in the scope of activities.

**Overall objective**
The objective of this technical assistance is to carry out and coordinate the assessment of technology needs within a specific country in order to advance the implementation of climate technologies in the area of adaptation and mitigation in selected country and to strengthen the fulfillment of the technology component of the country's NDC.

**Activity 1: Stakeholder analysis and establishment of a TNA Committee**

- Identification of key stakeholders to be directly involved in the National TNA Committee, and in the TNA and TAP process.
- Selection of the TNA committee members and constitution document where rules and procedures of the TNA process, and roles of the different members described. Capacity building training on the TNA processes.

**Activity 2: Prioritization of technologies and relevant action for increased access to finance**

- Obtain consensus about priority sectors (and subsectors) to shape the TNA and validate the challenges for each sector.
- Assess, validate, and prioritize key technologies with sectoral working groups.
- Develop a Technology Action Plan per sector and /or sub sector.
- Ensure national ownership and technology deployment through the engagement of the TNA Committee and key stakeholders, with the private sector as an important actor.

**Activity 3: Support for the implementation of the Technology Action Plan with communications, guidance and training**

- Roadmap development workshop with industry representatives, authorities and other stakeholders to define a set of objectives 2030 and 2050 for each identified decarbonization lever Development of training materials and dissemination strategy
- Delivery of TNA training workshops

**Activity 4: Enhance SME capacity and enable environment through innovative new business identification training programmes**

- Engaging with the private sector/ SMEs within the country and assisting in the identification of the country's' business needs and exploring new business opportunities in climate technology
- Provision of capacity building and training

**Activity 5: Develop concept notes for priority sectors for submission to the Financial Mechanism**

- Development of concept notes based on the Technology Action Plan on the sectoral technologies prioritized.

***Anticipated products to be delivered***

1. National Cement and Concrete Industry Analysis
2. Stakeholder analysis report
3. Official government circular establishing the national TNA committee
4. Methodology for sector the selection and prioritization of sectors
5. Analysis of sectoral priorities
6. Multi Criteria Analysis
7. Technology fact sheets
8. Technology Action Plans
9. Policy briefs and market-use cases for the selected technologies.
10. Training materials
11. Concept note for financing climate technology deployment

## Building and Resilient Infrastructure

**Concept Note**
**Resilient Food supply through adopting Aquaponics**

Aquaponics is a sustainable system important in the context of climate change, because it addresses several challenges by promoting water conservation, reducing environmental impact, enabling year-round production, supporting localized food systems, enhancing resilience to extreme weather events, contributing to carbon sequestration, reducing land footprint and serving as an educational resource for sustainable farming practices.
The basic definition of aquaponics is the combination of aquaculture, raising freshwater fish in a controlled environment, and hydroponics, which is growing plants in a soil-less environment. To utilize both ecosystems working together to simultaneously create the nutrients and ultimately remove the nutrients in the form of up taking and growing products e.g., lettuce and other green leaves.
Aquaponics is highly water-efficient compared to traditional soil-based agriculture. The system recirculates water between the fish tanks and the plants, using only a fraction of the water that would be needed in conventional farming. This is especially crucial in regions facing water shortages due to changing climate conditions and changes in rainfall patterns. Aquaponics systems usually utilize fewer external inputs such as pesticides and synthetic fertilizers compared to traditional farming.

The accumulation of carbon dioxide and other greenhouse gases (GHG) in the atmosphere is modifying various characteristics of the climate, oceans, coastline and freshwater ecosystems that affect the sustainability of fisheries and aquaculture. Although the impact of climate change on aquatic ecosystems, fisheries and aquaculture is not yet known, changes are already being observed in the distribution and reproductivity of marine and freshwater species and their effects on biological processes and food chains. The implications of climate change for food security and livelihoods in small island states and many developing countries are profound, as fisheries and aquaculture are important contributors to both local and global food supplies.

Generally, the barriers that can hinder the widespread deployment of aquaponics are:

- **Financial barriers**: High initial investment costs (upfront costs/capex) for infrastructure, equipment, and components of the system.
- **Technical barriers**: High level of technical knowledge and expertise.
- **Regulatory barriers**: Regulatory barriers related to water use, or lack of clear guidelines for aquaponics operations.
- **Scale of production**: Aquaponics systems are usually linked to small-scale production. Maintenance, logistics for meeting a larger demand may face challenges.

The results of a technical assistance on aquaponics will be the application of good fishing practices, including aquaculture production of herbivorous species, as well as fuel reduction and the application of energy efficiency schemes to reduce energy and fuel consumption in equipment and vehicles. The system can provide nutritious food with a low carbon footprint.

The CTCN has received the request from countries, such as Perú, Nicaragua, Chad and Grenada to conduct a feasibility study of a semi closed/protected environment-based aquaponic facility. An exemplarity outline of objectives and activities is detailed below. The scope of activities is tailored on national circumstances and priorities, geographical location, availability of natural resources, scale of operation, and local regulations (e.g. Grenada focusing only on Hydroponics).

**Overall objective**
The objective of this technical assistance is to conduct a feasibility study of a semi closed/protected environment-based aquaponic facility for participating countries.

**Activity 1: Analysis of aquaponics configurations, stakeholder mapping, and information gathering.**

- Identification of various configurations for aquaponic facilities, designs and layouts, specific considerations associated with each configuration.
- Interviews with national stakeholders and experts in the field of aquaponics in each country.
- Suggestion of the most suitable aquaponic configuration for the specific needs, resources, and objectives of each country, taking into consideration factors such as scalability, space requirements, cost-effectiveness, efficiency, and adaptability to different climates.
- Gender analysis and recommendation for the potential increased participation of women

**Activity 2: Development of a detailed construction configuration based on 0.5-acre, 1-acre, and 2-acre land**

- A detailed explanation of the construction and sizing considerations for each component in an aquaponics system, including fish tanks, filtration systems, growing beds, water pumps, aeration systems, heating and cooling components.
- Identification of commonly used materials for floating media, piping, and other components of the aquaponic system.
- Detailed description of all types of equipment, including water pumps, air pumps and blowers, fans, heating and coolong systems, monitoring equipment.

**Activity 3: Development of an integrated hydraulic profile of the systems and blueprint of the three layouts**

- Development of an integrated hydraulic profile of the systems, considering the flow of water through the various components with an explanation of how the system is interconnected for each of the 3 configurations.
- Visual contents and drawings for all three configurations, including a description of the layout and components of each aquaponic system

**Activity 4: Capital expenditures CAPEX and Operational expenditures OPEX estimation costs**

- Estimation analysis of the cost economics of an aquaponics system, which involves considering both the capital expenditures (CAPEX) and the operational expenditures (OPEX) associated with setting up and running the system
- Detailed cost analysis specific to the three-aquaponics system designs and description of local conditions and local suppliers from each participating country

**Activity 5: Develop concept notes for priority sectors for submission to the Financial Mechanism**

- Development of concept notes based on the Technology Action Plan on the sectoral technologies prioritized.

***Anticipated products to be delivered***

1. Stakeholder mapping report.
2. Report on different configurations for aquaponic facilities for each country.
3. Report of the construction of each component and sizing for three different configurations based on 0.5-acre, 1-acre, and 2-acre land, floating media, and all types of equipment.
4. Detailed report of the integrated hydraulic profile of the three systems.
5. Blueprint of all the layouts for all three configurations.
6. Detailed report identifying the crops and the fish variety to be grown and the tentative market potential.
7. Detailed report with the cost estimation (CAPEX and OPEX) for the three aquaponic systems.
8. Workshops reports and training materials.