CTCN
CLIMATE TECHNOLOGY CENTRE & NETWORK

# Technical Assistance Response Plan – Terms of Reference

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| **Country** | **South Africa** |
| **Request ID#** | **2021000022** |
| **Title** | Develop Capacity for Determining and Unlocking Untapped Demand-Side Potential in South Africa |
| **NDE** | Department of Science and Innovation (DSI)<br>Dr Henry Roman<br>Director: Environmental Services and Technologies<br>Henry.roman@dst.co.za<br>627 Meiring Naude Rd<br>Brummeria<br>Pretoria<br>South Africa |
| **Proponent** | Council for Scientific and Industrial Research (CSIR)<br>Dr Peter Mukoma<br>Principal Researcher: Energy Efficiency and Demand Response<br>pmukoma@csir.co.za<br>627 Meiring Naude Rd<br>Brummeria<br>Pretoria<br>South Africa |

**Summary of the CTCN technical assistance**

South Africa is currently seeing electricity supply shortages that have resulted in large-scale blackouts for the country. In 2019, South Africa's Council for Scientific and Industrial Research (CSIR) reported 530 hours of blackouts and has continued to forecast widespread load shedding. ESKOM, South Africa's major public electricity utility, has already implemented significant capacity industrial demand-side management (DSM) programs that have helped provide peak load alleviation and flexible capacity. Beyond the current activities, DSM approaches have a high potential to provide flexibility to balance and reduce energy consumption.

The CTCN through its Consortium Partner, the U.S. National Renewable Energy Laboratory (NREL), plans to provide technical assistance to examine the potential benefits of demand-side management measures that could be provided by the commercial and residential load sectors. Demand-side management can be implemented through demand response (DR), energy efficiency or distributed generation. NREL will identify end-uses and associated DR that are best suited to provided flexibility, reducing energy consumption and quantify the potential capacity of these commercial and residential DR. NREL will also provide considerations for ESKOM and CSIR to implement a pilot project to demonstrate DR in the field. Training and capacity building at CSIR and ESKOM will be provided in this project.

**Agreement:**

*(If possible, please use electronic signatures in Microsoft Word file format)*

**National Designated Entity to the UNFCCC Technology Mechanism**
Name: *Dr Henry Roman*

Title: *Director: Environmental Services and Technologies, DSI*

Date: 08/03/22

Signature:
Signed by:Henry James Roman
Signed at:2022-03-08 13:11:25 +02:00
Reason:Witnessing Henry James Roman

**Proponent** (signature of the Proponent is optional)
Name: *Dr Peter Mukoma*

Title: *Principal Researcher: Energy Efficiency and Demand Response, CSIR*

Date: 08/03/2022

Signature:

**UNFCCC Climate Technology Centre and Network (CTCN)**

Name: Rose Mwebaza
Title: CTCN Director

Date: 7 March 2022

Signature:

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CLIMATE TECHNOLOGY CENTRE & NETWORK

**Technical Assistance Response Plan – Terms of Reference**

## 1. Background and context

Demand-side management (DSM) encompasses energy efficiency, demand response (DR) and can include distributed generation (DG) and storage, particularly if those resources are behind-the-meter. DSM programs can assist with reducing electricity consumption, reducing both peak-demand and required network and generation capacity, providing ancillary services such as reserve capacity, provide regulation services and can help integrate renewable generation by providing demand-side flexibility. The demand-side can be segmented into multiple subgroups, e.g. load classes (e.g. industrial, commercial, residential, agricultural, etc.), end-use (e.g. lighting, heating, cooling, cooking, water heating, etc.), load electrical characteristics (e.g. motor, resistive, inductive, capacitive, power electronic loads, etc.) and socioeconomic factors of consumers (e.g. occupancy, income, education, rural, urban, etc.).

DSM in South Africa could help alleviate electricity shortage supplies and rolling blackouts (in 2019 CSIR reported 530 hours of blackouts, with wide-scale load shedding forecast for at least the next five years), by providing targeted energy voluntary load shedding programs, energy efficiency and shifting and reducing peak demand from dispatchable and incentive-based DSM programs. The high economic cost impact of blackouts, which CSIR estimated for 2019 to be between R60 to R120 billion, shows that there is significant market potential for providing economic opportunities for DR. Energy efficiency, and deployment of local onsite DG (e.g. rooftop solar) could help reduce energy intensive end-uses and emissions to ensure sustainable load growth (particularly with 90% of current electricity generation coming from coal-fired power plants). Achieving large-scale renewable energy (RE) deployment (37% by 2030, with 19 GW of capacity) will require enhanced flexibility, which dispatchable DR could provide through behind-the-meter energy storage and demand-side units/aggregators in the wholesale market.

This technical assistance will examine forms of DSM from the commercial and residential sector that can help South Africa in providing enhanced reliability (through load reduction and shifting alleviating capacity constraints), energy efficiency and flexibility. This effort will identify end-uses that can be leveraged for energy reduction, deferral of use, emergency DR and load shifting, provide estimates of the potential available DR capacity and guidelines on implementing a pilot demonstration.

## 2. Problem statement

South Africa is onset with major challenges relating to capacity shortages, coal heavy generation mix and meeting ambitious renewable energy targets. Major capacity shortage challenges are resulting in blackouts, with the Electricity Supply Commission (ESKOM) needing to implement far reaching load shedding programs. 90% of electricity generation comes from coal-fired power plants that account of roughly 80% of the country's total emissions. The government has approved an Integrated Resource Plan (IRP) in 2019 that has targets for 37% of the power to be generated by renewable energy sources by 2030. The combinations of the challenges faced by the energy system require enhanced flexibility and new capacity, in the form of new plants and demand-side measures.

Demand Response can provide peak demand alleviation and flexibility for both situations of capacity shortages but also to help integrate RE generation. Current DR programs at Eskom have heavily leveraged the industrial load sector, but these have the potential to be expanded to residential and small to medium size commercial customers. This technical assistance will quantify and provide a path to implementing a pilot program demonstration project for residential and commercial DR in South Africa.

### 3. Logical Framework for the CTCN Technical Assistance:

*(Guidance: Please note that multiple activities lead to one Output, and multiple Outputs lead to one Outcome. There can be several Outputs, but only one Outcome description capturing the CTCN technical assistance. Deliverables are the products or services to be delivered to the NDE/Proponent/CTCN based on the Activities and the Outputs.)*

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| ***Objective**: Please provide a one sentence description of the Objective of the technical assistance. The objective of the CTCN technical assistance reflects what the assistance aims to produce and impact.*<br>To support CSIR and ESKOM, NREL will analyze residential and commercial load end-uses to identify, quantify and recommend paths towards a pilot implementation for 1-2 DSM programs. The overall objective is to find DSM programs that will help alleviate capacity shortages in SA and provide necessary technical assistance to CSIR to help build the national capacity to examine and develop DSM programs. The DSM programs are anticipated to provide benefits of energy efficiency and potential load flexibility for integrating RE generation. | | | | | | | | | | | | |
| **Outcome:** *(Guidance: The Outcome articulates changes in the institutional and behavioural capacities for climate technology development or deployment. Activities and Outputs contribute to the Outcome but the Outcome is not within the direct control of the CTCN activities). (maximum 400 characters including spaces)*<br>Quantifying and establishing a path to unlocking untapped demand-side potential for the residential and commercial load sectors in South Africa to alleviate capacity shortages. | | | | | | | | | | | | |
| | **Month** | | | | | | | | | | | |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| **Output 1: Development of implementation planning and communication documents** | | | | | | | | | | | | |
| **Activity 1:** *All implementers must undertake the following activities at the beginning and at the end of the CTCN technical assistance.*<br>i) A detailed work plan of all activities, deliveries, outputs, deadlines and responsible persons/organisations and detailed budget to implement the Response Plan. The detailed work plan and budget must be based directly on this Response Plan;<br>ii) Based on the work plan, a monitoring and evaluation plan with specific, measurable, achievable, relevant, and time-bound indicators used to monitor and evaluate the timeliness and appropriateness of the implementation. The monitoring and evaluation plan should apply selected indicators from the Closure and Data Collection report template and enable the lead implementer to complete the CTCN Closure and Data collection report at the end of the assignment (please refer to item iv below and section 14 in the Response Plan);<br>iii) A two-page CTCN Impact Description formulated in the beginning of the technical assistance and update/revised once the technical assistance is fully delivered (a template will be provided);<br>iv) A Closure and Data Collection report completed at the end of the technical assistance (a template will be provided). | | | | | | | | | | | | |
| **Deliverable 1:**<br>i) Detailed work plan | X | | | | | | | | | | | |

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| ii) Monitoring and evaluation plan<br>iii) CTCN Impact Description<br>iv) Closure and Data Collection report | X | | | | | | | | | | | X<br><br>X |
| **Output 2:** ***Characterization of Load Sectors and End-Use in South Africa and Current DSM Programs*** – *This output will capture the load consumption and contribution to peak load of current load sectors in South Africa and will be dependent on data provided by Eskom and CSIR. The output will also capture DSM programs currently implemented by Eskom by load sector (e.g. industrial, commercial and residential), type of DSM program (e.g. energy efficiency, dispatchable DR) and associated capacity for each program. This output will help assess the current status of DSM and provide the baseline for output 3 which will identify gaps in DSM programs.* | | | | | | | | | | | | |
| **Activity 2.1: Identifying DSM Programs currently established in South Africa -** This task will work with ESKOM and municipalities in characterizing the types of demand response currently in use, categorizing DSM by; types of customers, available capacity, types of DSM (e.g. energy efficiency, dispatchable and non-dispatchable) and the percentage of load sector with DSM programs. This will involve training with CSIR and other stakeholders in bi-weekly meetings.<br>**Stakeholders:** ESKOM, CSIR and 1-2 municipalities participating in DSM<br>**Data:** ESKOM DSM programs and associated capacity, annual system load data, disaggregate load data (e.g. commercial, residential and industrial load data), consumer energy surveys (if available). | | | | | | | | | | | | |
| **Activity 2.2: Evaluation of the DSM Capacity required in South Africa -** This task will make a high-level preliminary exploration on the volume of demand response required in South Africa and what customers are currently untapped. This will involve training with CSIR and other stakeholders in bi-weekly meetings.<br>**Stakeholders:** ESKOM, CSIR and 1-2 municipalities participating in DSM<br>**Data:** ESKOM DSM programs and associated capacity, annual system load data, disaggregate load data (e.g. commercial, residential and industrial load data), consumer energy surveys (if available). | | | | | | | | | | | | |
| **Activity 2.3: Examining DSM Examples from around the World -** This task will detail the types of DSM programs in use around the world giving key examples that are unique from those in SA. This information will be used to guide later tasks in helping inform new DSM programs that could be implemented in SA. A special attention will be given to DSM examples with gender perspectives. This will involve training with CSIR and other stakeholders in bi-weekly meetings. | | | | | | | | | | | | |
| **Deliverable 2:**<br>*Report (5-10 pages) detailing the different DSM programs and available capacity. Identification of load sectors with low levels of DSM programs and load characteristics of these sectors. Present at a high-level the different types of DSM programs available using examples from around the world. Bi-weekly training reports.* | | | | | X | | | | | | | |
| **Output 3:** ***Identifying Untapped Potential and Applicable DSM Schemes for Under-Utilized Load Sectors –*** *From output 2, NREL will have identified the consumption patterns of different load sectors and existing Eskom* | | | | | | | | | | | | |

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| *DSM programs. NREL will use the data from output 2 to identify load sectors that have been underutilized for DSM, identifying seasonal consumption patterns and contribution towards peak demand. This output will provide identification of the level of capacity that has been untapped, identify end-uses within that load sector that could be utilized for demand response.* | | | | | | | | | | | | |
| **Activity 3.1: Identifying Underutilized Load Sectors –** The expectation is that large industrial customer demand response is already well explored and available capacity has already been identified and is in use in existing DSM programs. This task will firstly identify which load sectors are underutilized in existing DSM programs, examine in detail the load sector that is underutilized from output 2 and examine the end-uses of that load sector. This will involve training with CSIR and other stakeholders in bi-weekly project meetings.<br>**Potential data:** System demand and disaggregate (i.e. industrial, commercial, residential and end-use) consumption data. Load sector data (i.e. load classes, end-use, socioeconomic factors, etc.). Load monitoring data.<br>**Stakeholders:** ESKOM, CSIR and municipalities | | | | | | | | | | | | |
| **Activity 3.2: Identifying Underutilized Load Sector End-Use DR Potential -** This task will examine the end-uses of underutilized load sectors identified in 3.1. This will help identify potential end-uses and appliances that are suitable for DR. The end of this task will identify a particular sector; residential and/or commercial, and an end-use with a potential DR scheme to deliver grid value.<br>• Commercial and residential sectors are expected to be underutilized and this effort will explore:<br>o The end-uses that could be used for DR<br>o The type of DR programs that could be utilized<br>The evaluation will be made based on; load sectors not currently in use for DR, load sectors that have high coincidence with peak demand events, load sectors with end-uses that can provide flexibility and load reductions. The evaluation will be made taking into account considerations and inputs from CSIR and Eskom. This will involve training with CSIR and other stakeholders in bi- weekly project meetings.<br>**Potential data:** System demand and disaggregate (i.e. industrial, commercial, residential and end-use) consumption data. Load sector data (i.e. load classes, end-use, socioeconomic factors, etc.). Load monitoring data.<br>**Stakeholders:** ESKOM, CSIR and municipalities | | | | | | | | | | | | |
| **Deliverable 3:** *Report (5-10 pages) with identified load sector that has been underutilized for demand response and end-use identified that could provide DR flexibility. This will provide capacity (i.e. energy and demand reduction) values and characteristics of key end-uses that could be leveraged for flexibility, energy efficiency but also explore the potential for coupling behind-the-meter distributed generation to these load sectors (e.g. coincidence factors for solar production and load consumption). Bi-weekly training reports.* | | | | | | | X | | | | | |

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| **Output 4:** ***Modeling and Characterizing Specific Demand Response Schemes, Identifying the Potential Available Capacity and Response*** *– This output will identify 1-2 promising end-uses and DR programs and quantify the potential of these in terms of seasonality, time, and capacity available.* | | | | | | | | | | | | | |
| **Activity 4.1: Choosing 1-2 Maximum Benefit DR Opportunities -** From the end-use potential DR applications identified in activity 3.2, this effort will then choose 1-2 promising programs (i.e. based on demand reduction, duration of reduction, potential for peak demand reduction, gender aspects, etc.) for residential and/or commercial DR with consultation from Eskom and CSIR. This will involve training with CSIR and other stakeholders in bi-weekly project meetings.<br>**Stakeholders:** ESKOM, CSIR and municipalities | | | | | | | | | | | | | |
| **Activity 4.2: Detailed Quantification and Modeling of 1-2 Maximum Benefit DR Opportunities -** Examining the 1-2 promising programs for residential and/or commercial DR from 4.1 this activity will try to perform a more detailed quantification of the potential response in terms of seasonality, time and demand reduction available. It will include:<br>• Aggregate and disaggregate statistical load models and/or bottom-up load models will be used to perform the analysis and identify the load potential.<br>• The results of this task will identify the potential DR programs and their available capacity (i.e. energy and demand reduction achievable) and potential response from an untapped load sector and end-use (i.e. load sectors currently not used for DR programs in SA). This will involve training with CSIR and other stakeholders in bi-weekly project meetings.<br>**Stakeholders:** ESKOM, CSIR and municipalities | | | | | | | | | | | | | |
| **Deliverable 4:**<br>*5-10 page report quantifying the potential capacity and characteristics of identified DR program. This will outline the methodology used to quantify the DR program and any assumptions made in that estimation. Any code developed to identify and quantify the DR program will be shared as part of capacity building. Bi-weekly training reports.* | | | | | | | | | | X | | | |
| **Output 5:** ***Establish High-Level Steps Required to Implement and Pilot Identified DR Program*** **–** *This will outline high-level steps required to implement and pilot the identified DR program including; type of customers to target, time of year and duration of pilot, number of customers to try identify and any technical hurdles (e.g. communications, data monitoring) required for a successful pilot. It will also examine regulatory framework and policy barriers that may impede the program and present regulatory and policy considerations to implement the DR program. As part of deliverable 4 any code/material or methodologies developed will be shared and training sessions will be conducted to ensure these can be used by Eskom, CSIR and any participating municipalities.* | | | | | | | | | | | | | |
| **Activity 5.1: Examining High-Level Steps to Implement DR Pilot Program -** This task will identify the high-level steps required to implement and pilot the identified DR program identifying; types of customers, | | | | | | | | | | | | | |

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| technology required, potential aspects of trial design (e.g. seasonality, end-uses, communications required, monitoring and baselining). This will also include an examination of regulatory frameworks and policy barriers that may impede the program and present regulatory and policy considerations to implement the DR program. A special attention on gender aspects will be given when implementing the DR pilot program. This will involve training with CSIR and other stakeholders in bi-weekly project meetings. | | | | | | | | | | | | |
| **Activity 5.2: Capacity Building on DR Program**<br>Based on the code and methodology under deliverable 4, material will be shared and training sessions will be conducted to ensure these can be used by Eskom, CSIR and any participating municipalities. CSIR will outline how it will work with Eskom, regulators and municipalities to further develop DSM opportunities in South Africa and steps it will take to implement the pilot program. This will be included as part of the final deliverable.<br><br>The NREL project team will plan to travel to Pretoria to give in-person training to CSIR and ESKOM and other interested participants. Training participants will be expected to cover their own costs and CSIR is expected to host the training sessions at their campus in Pretoria, meals will be provided for training participants from the TA response plan budget. Travel will be for three NREL personnel and will include airfare, hotel and per diem. If travel cannot occur due to potential COVID-19 government or organization restrictions the training will be conducted virtually. | | | | | | | | | | | | |
| **Deliverable 5:**<br>*5-10 page report outlining high-level steps required to implement and pilot the identified DR program. Training material and report.* | | | | | | | | | | | | X |

**4. Resources required and itemized budget:**

*Please provide an indicative overview of the resources required and itemized budget required to implement the CTCN technical assistance, including for M&E-related activities, using the table below. Important to note that minimum 1% of the budget should explicitly target gender specific activities related to the technical assistance (please see section 10 for further information on gender). Once the Response Plan is completed, a Response Implementation partner(s) will be selected by the Climate Technology Centre (CTC). A detailed activity-based budget for the CTCN assistance will be finalized by the CTCN and selected Implementer.*

| **Activities and Outputs** | **Input: Human Resources** *(Title, role, estimated number of days)* | **Input: Travel** *(Purpose, national vs. international, number of days)* | **Inputs: Meetings/events** *(Meeting title, number of participants, number of days)* | **Input: Equipment/Material** *(Item, purpose, buy/rent, quantity)* | **Estimated cost** *Please accumulate the costing at Activity and Output level and provide an estimated costing range for each activity and the total Response Plan* | |
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| | | | | | **Minimum** | **Maximum** |
| **Output 1**: Development of implementation planning and communication documents | Senior engineer 1-2 days, Project manager 1-2 days | | | | | **USD 5,833.33** |
| Activity 1.1: Formulation of i) Detailed work plan, ii) Monitoring and evaluation plan, iii) CTCN Impact Description, iv) Closure and Data Collection report. | | | | | | *USD 5,833.33* |
| **Output 2: Characterization of Load Sectors and** | Senior engineer 6-7 days, | | *Phone call or virtual meeting with NDE,* | | | **USD 41.666,67** |

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| **End-Use in South Africa and Current DSM Programs** | Research engineer, 18-20 days<br>Project Manager, 1-2 days | | *Project proponent, and CTCN*<br>Senior Engineer 1-2 days,<br>Research Engineer 1-2 days | | | |
| Activity 2.1: Identifying DSM Programs currently established in South Africa | | | | | | *USD 15,625* |
| Activity 2.2: Evaluation of the DSM Capacity required in South Africa | | | | | | *USD 15,625* |
| Activity 2.3: Examining DSM Examples from around the World | | | | | | *USD 10,416.67* |
| **Output 3: Identifying Untapped Potential and Applicable DSM Schemes for Under-Utilized Load Sectors** | Senior engineer 6-7 days,<br>Research engineer, 18-20 days<br>Project Manager, 1-2 days | - | *Phone call or virtual meeting with NDE, Project proponent, and CTCN*<br>Senior Engineer 1-2 days,<br>Research Engineer 1-2 days | | | **USD 62,000** |

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| Activity 3.1: Identifying Underutilized Load Sectors | | | | | | *USD 26,250* |
| Activity 3.2: Identifying Underutilized Load Sector End-Use DR Potential | | | | | | *USD 36,250* |
| **Output 4: Modeling and Characterizing Specific Demand Response Schemes, Identifying the Potential Available Capacity and Response** | Senior engineer 12-13 days, Research Engineer 30-32 days Project Manager 1-2 days | | *Phone call or virtual meeting with NDE, Project proponent, and CTCN* Senior Engineer 2-3 days, Research Engineer 2-3 days | | | **USD 72,500** |
| Activity 4.1: Choosing 1-2 Maximum Benefit DR Opportunities | | | | | | *USD 36,250* |
| Activity 4.2: Detailed Quantification and Modeling of 1-2 Maximum Benefit DR Opportunities | | | | | | *USD 36,250* |
| **Output 5: Establish High-Level Steps Required to Implement and Pilot** | Senior engineer 5-6 days, Research Engineer 14-15 days Project Manager 1 days | | *Phone call or virtual meeting with NDE, Project proponent, and CTCN* Senior engineer 1 day, | | | **USD 67,500.01** |

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| **Identified DR Program** | | | Research Engineer 1-2 days | | | |
| Activity 5.1: Examining High-Level Steps to Implement DR Pilot Program | | | | | | *USD 15,624.91* |
| Activity 5.2: Capacity Building on DR Program | | | | | | *USD 51,875.10* |
| **Estimated range of costing for the entire Response Plan** | | | | | | **USD 250,000** |

## 5. Profile and experience of experts

*Based on the required Human Resources identified in section 4 (Resources required and itemized budget) please provide a description of the required profile of all involved experts for the implementation of the CTCN Response Plan.*

| Experts required | Brief description of required profile |
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| *Please use the same titles for all experts as applied in section 4.* | *Please provide a short description of expertise and experience needed (education, sectors of expertise, years of experience, country experience, language requirements, etc.).* |
| Senior Electrical Engineer (Killian McKenna) | Dr. McKenna is senior electrical engineer in the Grid Planning and Analysis Center at NREL. Dr McKenna an expert in DER modelling, storage and grid integration with a PhD and Bachelor degree in electrical engineering from University College Dublin, Ireland. He leads NREL research into distributed energy resource integration to distribution networks, demand-side management modelling and evaluation and characterization of energy storage. He is an R&D100 award winning researcher and has worked extensively with distribution utilities in the U.S. (SMUD, HECO, NG, SRP) and India (TANGEDCO, BRPL). |
| Research Engineer (Michael Blonsky) | Mr. Blonsky (NREL) is a research engineer in the Grid Planning and Analysis Center at NREL. He received his B.S. in Materials Science and Engineering from Cornell University and his M.S. in Electrical Engineering from the Colorado School of Mines. His primary research areas include modelling and stochastic control of residential buildings and behind-the-meter DERs. He works on a variety of co-simulation projects that integrate buildings, distribution systems, home energy management systems, transactive markets, and distribution-scale aggregators and controllers. He is the lead developer for OCHRE, a residential energy model for building-to-grid integration studies. |

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| Research Engineer (Jal Desai) | Jal Desai is a researcher at the National Renewable Energy Laboratory (NREL). He provides technical assistance to local communities and federal clients through renewable energy feasibility studies. He has been at NREL for over four years now. Jal Desai holds MS in Energy Science Technology and Policy from Carnegie Mellon University and a BS in Electrical Engineering from the Nirma University of Technology in 2015. He along with Andy Walker lead photovoltaics training in Tanzania under Climate Technology Centre & Network (CTCN). He is also involved in building energy modelling, energy policy, grid optimization, and tecno-economic analysis studies. |
| Gender Expert (Sadie Cox) | Sadie Cox is a Senior Analyst in the Markets & Policy Group of the Strategic Energy Analysis Center. Sadie's areas of expertise include renewable energy policy and strategy design and good practices, advancing technical solutions for resilient power systems, and assessing development impacts of clean energy and climate actions. |

## 6. Intended contribution to impact over time

**Short-term**

NREL will evaluate potential untapped DR capacity and solutions for the commercial and residential sector and characterize the value of 1-2 DSM programs for those sectors. This will help CSIR and Eskom in identifying demand-side value that can be used to help with capacity shortages, achieve energy efficiency and aid with RE integration.

**Mid-term**

As part of NREL's evaluation, high-level steps will be documented for Eskom and CSIR to achieve a pilot demonstration of the DSM programs. Field demonstrations will provide important real-life proof of concept data and capture roll-out challenges. These should demonstrate energy savings and emissions reductions that can be achieved from the DSM program.

**Long-term**

South Africa is in the midst of capacity shortages and RE integration challenges. At current there is little use of residential and commercial DR programs, both of which can provide huge value in tackling the country's energy challenges. This project will help realize the value of residential and commercial DSM to achieve energy savings and emissions reduction in addition to help provide alleviation to capacity shortages from demand-side flexibility.. If this project can help Eskom and CSIR show the value of residential and commercial DR they can then engage with the Department of Mineral Resources and Energy (DMRE) and National Energy Regulator (NERSA) to advocate for a broader DR program.

## 7. Relevance to NDCs and other national priorities

This effort will help South Africa achieve energy efficiency and flexibility with can help reduce emissions and integrate renewable generation, advancing SA's National Determined Contributions (NDC). Approximately 90% of South Africa's electricity generation comes from coal-fired power plants that account of roughly 80% of the country's total emissions. Demand-side management that achieves energy efficiency will reduce emissions from this highly carbon intensive electricity generation mix. Using DSM to flatten the load profile should also enable inefficient peaking generation to reduce which should also aid in reducing emissions helping achieve the goals in the National Development Plan to achieve a low carbon economy.

For renewable generation, South Africa's Integrated Resource Plan (IRP) 2019 targets 37% of power to be generated by renewable energy sources by 2030 which will require enhanced flexibility for integration. Demand response can provide flexibility, shifting load consumption to match periods of RE generation, enabling integration of variable renewable generation sources (e.g. wind and solar) which will help reduce emissions.

Lastly, NREL plans to also investigate the potential of behind-the-meter distribution generation and storage (e.g. solar photovoltaic and battery resources) which could both further reduce reliance on fossil-fired generation. Examining coincidence factors for RE generation and residential and commercial demand will help answer whether behind-the-meter RE can both reduce the risk of capacity shortages, reduce the need to fossil-fired generation and reduce greenhouse gas emissions. Energy storage could also provide a form of energy shifting and arbitrage, consuming power during inexpensive and more efficient periods during the night and using the stored energy to displace expensive inefficient peaking generation during the day.

2016. "South Africa's Nationally Determined Contribution (NDC). 1 November." Tshwane. https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/South%20Africa%20First/South%20Africa.pdf

4. 2019. National Climate Change Adaptation Strategy https://www.environment.gov.za/sites/default/files/docs/nationalclimatechange_adaptationstrategy_ue10november2019.pdf

**8. Linkages to relevant parallel on-going activities:**

*Please identify relevant previous and ongoing public and private sector initiatives, projects or programmes that the CTCN assistance will specifically build on and contribute to. To the extent possible, please add practical and operational details on the linkages between existing activities and the CTCN assistance. (maximum 2500 characters including spaces)*

Despite numerous efforts by the Department of Mineral Resources and Energy (DMRE) in implementing and providing incentives for energy efficiency implementation in programs such as the 12L Energy Efficiency tax incentive, the development of the National Energy Efficiency Strategy (NEES) and other regulations, CSIR has stated that energy efficiency has not produced the desired results. Eskom has used DR to manage peak demand and participation has been focused industrial and commercial large energy consumers with significant loads. Eskom has characterized the consumption of the top 500 customers and the majority of the top 150 customers have some form of DSM flexibility. Aluminum smelters provide Eskom with approximately 2,000 MW of capacity and interruptible load supply agreements have been implemented that can be used on request. Eskom has also engaged the general public with television announcements requesting for reduced energy consumption during high-risk outage periods.

Despite Eskom DR programs, there is a lack of commercial and residential DSM programs an DR response has not enjoyed the same level of attention and support from the DMRE. There is significant potential in load reduction or shifting to provide stability to the grid and this potential need to be realized. Recognizing that no single energy source or demand side management program can meet South Africa's growing energy needs, energy efficiency and demand response technologies can give the nation time to rebuild and modernize the power system infrastructure.

**9. Anticipated follow up activities after this technical assistance is completed:**

This effort will involve capacity building and training for DSM evaluation, modelling and simulation techniques that will be disseminated to CSIR and Eskom. As part of NREL's evaluation, high-level steps will be documented that are needed to achieve a pilot demonstration of the DSM programs. This will help Eskom and CSIR in working towards a field demonstration and deployment of the DSM program. Field demonstrations will provide important real-life proof of concept and challenges that could not be capture through analysis and simulation. The field demonstration will provide Eskom and CSIR real-life data that can be used to evaluate whether to recommend fully rolling our the DR program.

Eskom and CSIR can take the following next steps after completion of this TA:

- Use the reports and analysis techniques to perform further investigation of DSM in SA for untapped load sectors.
- Use the identified DR program and recommended steps for a pilot program to work with multiple agencies to implement a pilot program including:

- Municipalities: Work with SA municipalities in developing out a pilot program including finding suitable customers, duration of pilot, technical implementation etc.
- National Energy Regulator of South Africa (NERSA): Work with NERSA to examine regulatory hurdles and policy recommendations to support DR in SA.

- Using the pilot program CSIR and Eskom can show the value (i.e. energy savings, emissions reduction and capacity alleviation) of residential and commercial DR they can then engage with the Department of Mineral Resources and Energy (DMRE) and National Energy Regulator (NERSA) to advocate for a broader DR program.

**10. Gender and co-benefits:**

| | |
|---|---|
| Imbedded in design of the activities: | As part of this effort a gender expert will be assigned to carry out an assessment and evaluation regarding gender mainstreaming during the implementation of this technical assistance. It will be requested of the stakeholders that a fair gender balance will be guaranteed in presentations and training activities carried out during the implementation of this response plan if it is applicable with the required expertise.<br><br>This effort will pursue gender balance and ensure that female expertise, where available through the country's stakeholders, are involved at all levels.<br><br>For designing the DR program, it will be ensured that women are included its development and that women's interests are considered throughout. The current impacts of South Africa capacity shortages and outages may be disproportionately impacting women, and the designed DR program should take this into account. |
| Gender and co-benefits intended as result of the activities: | The deployment of DR has the opportunity to reduce the number of outages and load shedding events. Outages and load shedding have a greater impact on smaller businesses that cannot afford backup onsite generation or battery energy storage. This may have a disproportionate impact on women who run a greater share of smaller businesses than men.<br><br>A successful DR program with wide adoption and implementation can have a positive impact on everyone, reducing energy costs and decreasing the instances of unintentional load shedding. The design of the DR program will consider the impact on women and ensure that women's interests are considered throughout. |

**11. Main in-country stakeholders in implementation of the technical assistance activities:**

*Using the table below, please list and describe the role of in-country stakeholders, participants and beneficiaries who will be involved in or directly consulted during implementation of the assistance.*

| In country stakeholder | Role in implementation of the technical assistance |
|---|---|
| National Designated Entity - Department of Science and Innovation (DSI) | Support the request and monitor its implementation; Request Applicant |

| | |
|---|---|
| Council for Scientific and Industrial Research (CSIR) | Energy Centre of the CSIR is focused on energy research and will be working with the technical expert to build the capacity of the CSIR research team to spearhead further development of the DR market in South Africa. CSIR will receive and review deliverables and be the recipient of code and capacity building/training. |
| Eskom | Power utility who will benefit from power system balancing. In addition to CSIR, Eskom will receive and review deliverables and be the recipient of code and capacity building/training. |
| South African Local Government Association (SALGA) representing municipalities | Responsible for electricity distribution and potential implementors of DR to manage the stability of their distribution networks. Municipalities will be contacted, through Eskom and CSIR, for engagement and input on the design of DR programs. Municipalities may, through engagement with Eskom and CSIR, work on implementing future DR pilot projects. |
| NERSA | National Energy Regulator of South Africa – will have the responsibilities of improving the DR regulatory framework and create the necessary market conditions. NERSA may have to work with CSIR and Eskom to provide the regulatory frameworks to enable recommended DR programs. |
| SANEDI | Government agency responsible for research in the energy sector. |
| Department of Mineral Resources and Energy (DMRE) | Government department responsible for energy policy setting and implementation. |

## 12. SDG Contributions:

*Instructions: Please complete the grey section below for **a maximum of three SDGs** that will be advanced through this TA. A complete list of SDGs and their targets is available here: [https://sustainabledevelopment.un.org/partnership/register/](https://sustainabledevelopment.un.org/partnership/register/).*

| Goal | Sustainable Development Goal | Direct contribution from CTCN TA (1 sentence for top 1-3 SDGs) |
|---|---|---|
| 1 | End poverty in all its forms everywhere | |
| 2 | End hunger, achieve food security and improved nutrition, and promote sustainable agriculture | |
| 3 | Ensure healthy lives and promote well-being for all at all ages | |
| 4 | Ensure inclusive and equitable quality education and promote life-long learning opportunities for all | |
| 5 | Achieve gender equality and empower all women and girls | |
| 6 | Ensure availability and sustainable management of water and sanitation for all | |
| 7 | Ensure access to affordable, reliable, sustainable, and modern energy for all (consider adding targets for 7) | This technical assistance will help South Africa in providing demand-side capacity that can be leveraged in reducing blackouts caused by capacity shortages. The technical assistance examining demand response will help South Africa achieve greater energy efficiency (reducing fossil-fuel intensive electricity production) and integrating renewable generation by providing demand-side flexibility. |
| | 7.1 - By 2030, ensure universal access to affordable, reliable and modern energy services | |
| | 7.2 - By 2030, increase substantially the share of renewable energy in the global energy mix | |

| | | |
|---|---|---|
| | 7.3 - By 2030, double the global rate of improvement in energy efficiency | |
| | 7.a - By 2030, enhance international cooperation to facilitate access to clean energy research and technology, including renewable energy, energy efficiency and advanced and cleaner fossil-fuel technology, and promote investment in energy infrastructure and clean energy technology | |
| | 7.b - By 2030, expand infrastructure and upgrade technology for supplying modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States, and land-locked developing countries, in accordance with their respective programmes of support | |
| 8 | Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all | |
| 9 | Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation | The demand response programs identified in this work will help provide resiliency in the face of capacity shortages, but also for other events where the grid is capacity constrained due to extreme weather events that can impact generation portfolios. Energy efficiency reductions will help reduce emissions and demand-side flexibility will help integrated renewable energy generation. |
| 10 | Reduce inequality within and among countries | |
| 11 | Make cities and human settlements inclusive, safe, resilient and sustainable | |
| 12 | Ensure sustainable consumption and production patterns | |
| 13 | Take urgent action to combat climate change and its impacts | Flexible demand response will aid in the integration of RE generation helping reduce the impacts of climate change. |
| | 13.1 - Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries | |
| | 13.2 - Integrate climate change measures into national policies, strategies and planning | |
| | 13.3 - Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning | |
| | 13.a - Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible | |
| | 13.b - Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities | |
| 14 | Conserve and sustainably use the oceans, seas and marine resources for sustainable development | |
| 15 | Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss | |
| 16 | Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels | |
| 17 | Strengthen the means of implementation and revitalize the global partnership for sustainable development | |

## 13. Classification of technical assistance:

*Please indicate primary type of technical assistance. Optional: If desired, indicate secondary type of technical assistance.*

| *Please tick off the relevant boxes below* | *Primary* | *Secondary* |
|---|---|---|
| ☐ 1. Decision-making tools and/or information provision | ☐ | ☑ |
| ☐ 2. Sectoral roadmaps and strategies | ☐ | ☑ |
| ☐ 3. Recommendations for law, policy and regulations | ☐ | ☐ |

| | | |
|---|---|---|
| ☐ 4. Financing facilitation | ☐ | ☐ |
| ☐ 5. Private sector engagement and market creation | ☐ | ☐ |
| ☐ 6. Research and development of technologies | ☐ | ☐ |
| ☐ 7. Feasibility of technology options | ☐ | ☐ |
| ☐ 8. Piloting and deployment of technologies in local conditions | ☐ | ☑ |
| ☐ 9. Technology identification and prioritisation | ☑ | ☐ |

*Please note that all CTCN technical assistance contributes to strengthening the capacity of in country actors.*

## 14. Monitoring and Evaluation process

*Upon contracting of the implementing partners to implement this Response Plan, the lead implementer will produce a monitoring and evaluation plan for the technical assistance. The monitoring and evaluation plan must include specific, measurable, achievable, relevant, and time-bound indicators that will be used to monitor and evaluate the timeliness and appropriateness of the implementation. The CTCN Technology Manager responsible for the technical assistance will monitor the timeliness and appropriateness of the Response Plan implementation. Upon completion of all activities and outputs, evaluation forms will be completed by the (i) NDE about overall satisfaction level with the technical assistance service provided; (ii) the Lead Implementer about the knowledge and learning gained through delivery of technical assistance; and (iii) the CTCN Director about timeliness and appropriateness of the delivery of the activities and outputs.*

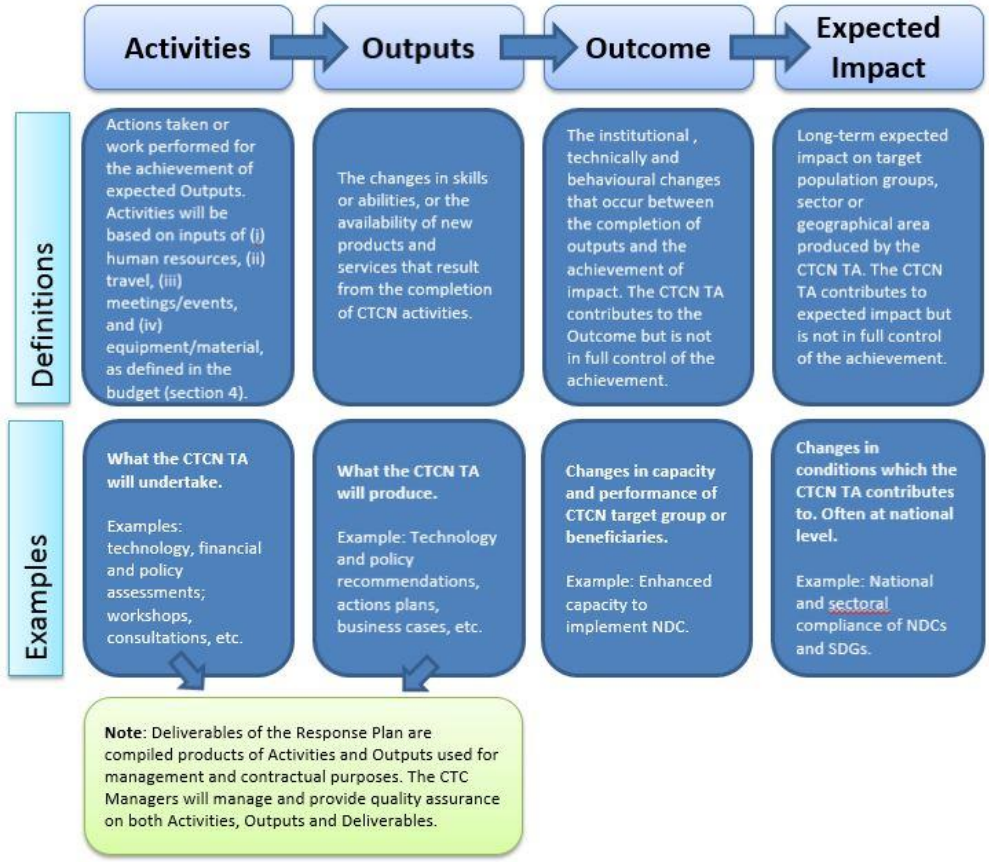
## Annex 1: Guidance note for designing a Response Plan (to be deleted when submitting the Response Plan)

### 1. Objective of the Response Plan

The Response Plan is developed by CTCN specialists in response to a country request for technical assistance. It constitutes the Terms of Reference of the CTCN technical assistance that will be provided to the country and it provides the formulation of and subsequent basis for the monitoring and evaluation of the Response Plan implementation, as well as its expected outcomes and anticipated impacts.

### 2. Results chain and Logical Framework Approach to be defined in the CTCN Response Plan

The result chain is the causal sequence that stipulates the necessary flow of actions and processes to achieve desired objectives and results – beginning with inputs, moving through activities and outputs, and culminating in individual outcomes. The outcome will contribute to the desired impact in the society. The Logical Framework Approach is an analytical process used to support objectives-oriented project planning and management. It provides a set of pre-defined concepts which are used as part of an iterative process to aid structured and systematic analysis and management of the CTCN technical assistance.



## 3. Role of the Response Planning Design Team

The Response Planning Design Team is selected by the Climate Technology Centre (CTC). The composition of the team depends on each particular request but may include the National Designated Entity (NDE), the request Proponent, Climate Technology Manager of the CTCN, experts from the CTCN Consortium, UNIDO and UNEP experts from regional offices and other experts as needed.

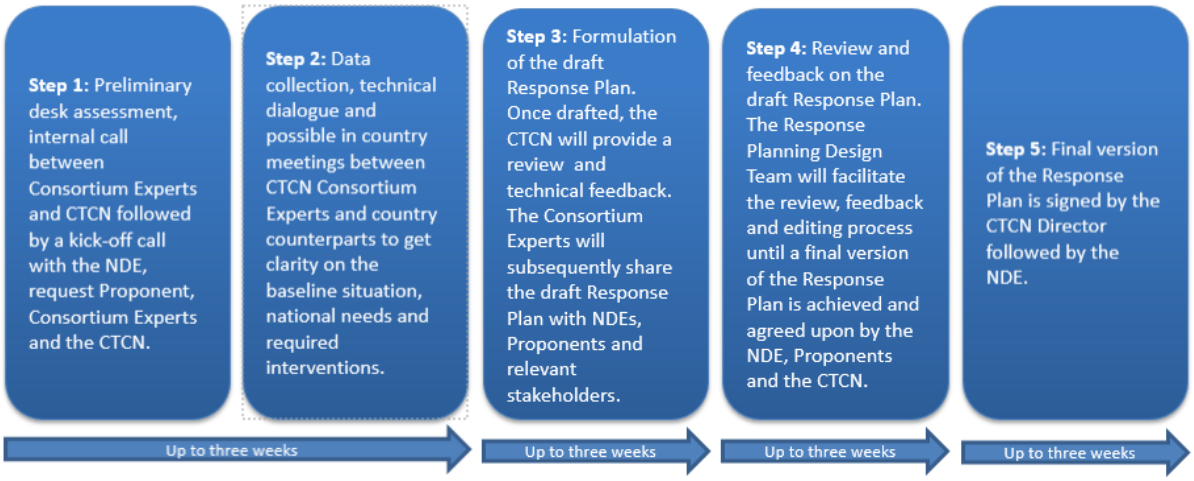
The role of CTCN Consortium experts is to lead the design of the Response Plan. The NDE will provide overall guidance on national context and priorities whereas the request Proponent will provide more detailed information on the sector, barriers and requested assistance. The Climate Technology Manager of the CTCN will provide quality assurance of timeliness and appropriateness of the Response Plan.

The Response Planning Design Team will draft all sections of the Response Plan template building on the information contained in the CTCN Request, based on expertise on the given topic and potentially further data collection, as required. This will be done by the CTCN Consortium Experts in consultation with the NDE, request Proponent and relevant stakeholders. The Response Plan has to be agreed to and approved by the NDE and the CTCN Director. This Response Plan will serve as the basis to identify, select and engage an expert institution from the Climate Technology Network or Consortium to lead the implementation of the CTCN Response Plan in the requesting country.

To the extent possible, staff from UNEP and UNIDO Regional, Sub-Regional and/or National Offices should be involve in all stages of formulation of the Response Plan to maximize synergies and avoid overlap with ongoing initiatives, as well as ensure relevance to regional and national context.

## 4. Process for designing the Response Plan

The Response Planning process should be completed over a period of up to 60 working days (12 weeks). Indicative steps and related timelines are laid out below:




## 5. Design Considerations

# Annex 1. Guidance Note for the Response Plan template

In order to maximize the impact of the technical assistance provided by the CTCN and provide an effective M&E process, the Response Plan should integrate as much as possible the considerations below:

Climate Technology focus: The Response Plan should have a clear focus on climate technologies, and identify activities that enable the identification, development, deployment or diffusion of one or several specific technologies (including equipment, techniques, knowledge and skills).

Barrier removal / Problem solving: The activities should contribute to address the specific problem statement identified in the Request. The barriers identified should be those hampering the identification, development, deployment or diffusion of one or several climate technologies or climate actions. Therefore, it may be necessary to limit the CTCN Response Plan to a set of activities for technical assistance commonly agreed with the NDE (and Proponent when needed) compared to the original request submitted. The CTCN will liaise with NDEs and Proponent in case the scope of the technical assistance deviates from the original request.

Use of the CTCN assistance by stakeholders: The Response Plan should identify clearly how the products of the CTCN assistance will be used in the short term once support is delivered, by who and when, to ensure it will lead to specific impacts in the country. The activities should engage the stakeholders that will use the concrete results of the assistance to deploy the technologies, including from the private sector, the public sector, research institutions, etc.

Within the scope of CTCN resources: The cost of the technical assistance provided by the CTCN cannot exceed USD 250,000 per Response Plan. Therefore, it may be necessary to prioritize activities and limit the CTCN Response Plan to a set of priority activities commonly agreed with the Proponent and the NDE to remain under this value. Under section 4 of the Response Plan template, an indicative activity based budget should be presented. The proposed budget is indicative and should present an estimated costing range per activity, output as well as a total costing range for the delivery of the Response Plan. Once the Response Plan is finalised and published for tendering, interested parties will provide competitive offer against the indicative budget.

CTCN activities and outputs should be linkable to monitoring and evaluation indicators: All proposed activities and outputs must be linkable to monitoring and evaluation indicators that are specific, measurable, achievable, relevant, and time-bound. The monitoring and evaluation process and corresponding indicators will be developed by the Lead Implementer as part of the work plan and will allow the CTCN technology Manager to monitor the timeliness and appropriateness of the implementation.

Synergies with existing efforts: The Response Plan should focus on activities that are not already being fully supported or that are in the process of being fully supported by another national, regional or international organization. Synergies and complementarity also require that the CTCN assistance is not duplicating past activities. It is possible in the Response Plan to indicate co-financing from the government, the Proponent or another stakeholder, that will maximize the effectiveness of the CTCN assistance.

Gender mainstreaming: The CTCN mission is to build or strengthen developing countries' capacities to identify technology needs, to facilitate the preparation and implementation of technology projects and strategies taking into account gender considerations. The Response Plan must therefore describe how gender considerations will be included and monitored within the proposed activities, and any gender co-benefits that will be gained as a result of implementing the CTCN technical assistance.