Technical Assistance Closure Report Template

Objective of the technical assistance (TA) Closure Report:

- To communicate publicly in one document a summary of progress made and lessons learned during the TA towards the anticipated impact (sections 1-4).
- To document qualitative and quantitative data collected during TA, for use in donor and UN reporting (Annex 1).

Steps for completing the TA closure report:

1. The lead TA implementer submits the closure report at the end of the technical assistance as a final deliverable. The TA closure report will capture outputs, outcomes and impacts of all activities conducted under the TA. Please copy and summarise relevant material from previous TA outputs/deliverables and the Response Plan, as relevant.
2. A CTCN Manager will review and revise the closure report before final approval by the CTCN Deputy Director.

Important note on public and internal use of the closure report:
Once approved by the CTCN Deputy Director, the TA closure report will be a public document available on the CTCN website www.ctc-n.org. Selected content will be used for targeted communication activities. Annex 2 is for internal use only and will not be publicly available.

Closure Report for CTCN Technical Assistance

1. Basic information

Title of response plan	Technical Assistance to Identify the Most Suitable Direct Use Applications and Technologies in Low to Medium Temperature Geothermal Systems in Six African Countries
Technical assistance reference number	CTCN request ref: 2019000050
Country / countries	Djibouti, Ethiopia, Kenya, Rwanda, Tanzania and Uganda
NDE focal point	**Djibouti:** Mr. Idriss Ismael Nour, distri_play@yahoo.fr **Ethiopia:** Ms. Yamelakesira Tamene Bekele, yamelakesira516@gmail.com **Kenya:** Mr. Kelvin Khisa, kelvin.khisa@kirdi.go.ke **Rwanda:** Mr. Faustin Munyazikwiye, fmunyazikwiye@rema.gov.rw **Tanzania:** Dr. Gerald Majella Kafuku, kafukugm@gmail.com **Uganda:** Dr. Maxwell Otim Onapa, m.onapa@uncst.go.ug
Proponent focal point and organisation	**Djibouti:** Abdek Mahamoud Abdi, abdek.mahamoud@oddeg.dj Djibouti Geothermal Energy Development Authority (Office Djiboutien de Développement de l'Énergie Géothermique, ODDEG)

	Ethiopia: Hundie Melka, hundiemelkay@yahoo.com Geological Survey of Ethiopia (GSE) **Kenya:** Dr. Peketsa Mangi, pmangi@kengen.co.ke Kenya Electricity Generating Company PLC (KenGen), Geothermal Development Division (GDD) **Rwanda:** Gilbert Haganje, ghaganje@edcl.reg.rw Rwanda Energy Development Corporation Limited (EDCL) **Tanzania:** Kato Kabaka, tkkabaka@gmail.com Tanzania Geothermal Development Company Limited (TGDC) **Uganda:** Godfrey Bahati, gbahati@gmail.com Uganda Ministry of Energy and Mineral Development (MEMD)
Designer of the response plan	Climate Technology Centre and Network (CTCN)
Implementer(s) of technical assistance	GreenMax Capital Advisors
Beneficiaries	Project Proponents, industry stakeholders and local communities in Djibouti, Ethiopia, Kenya, Rwanda, Tanzania and Uganda
Sector(s) addressed	Renewable Energy, Agriculture and Forestry, Industry
Technologies supported	Renewable Energy (geothermal), Agriculture and Forestry (demand efficiency, crop drying, increasing crop resilience and productivity); Industry (conventional power plant efficiency)[1]
Implementation start date	November 15, 2019
Implementation end date	August 11, 2021
Total budget for implementation	$232,849
Description of delivered outputs and products as well as the activities undertaken to achieve them. In doing so, review the log frame of the original response plan and refer to it as appropriate	In each country, the CTCN technical assistance identified potential direct use geothermal applications as well as the corresponding sectors and technologies that are best suited to benefit from the utilization of direct use geothermal projects. This activity included identification and classification of geothermal sites followed by identification and engagement with communities located near the identified sites in each project country. The TA then established the economic and market viability of the identified direct use projects/technologies. The TA concluded with capacity building of Project Proponents on the identified direct use technologies, including both technical guidelines/a methodology for geothermal direct use project identification and categorization, as well as a comprehensive financial model and associated user guide to assess the feasibility of specific direct use technologies, including: (i) fruit/vegetable/grain drying (ii) fish drying (iii) greenhouse heating (iv) balneotherapy/geothermal spa (v) pyrethrum drying (vi) tobacco curing

[1] https://www.ctc-n.org/resources/ctcn-taxonomy

	(vii) tea processing (viii) chicken hatchery (ix) milk pasteurization
Methodologies applied to produce outputs and products	Data collection (desk research, stakeholder consultations), technology cost comparison, sensitivity analysis, SWOT analysis
Reference to knowledge resources	Extensive reference documentation (obtained through desk research and/or provided by the Project Proponents) was analyzed to identify appropriate geothermal sites. A sample reference document from each country is included below: • **Djibouti** Moussa, O. and Souleiman, H., 2015. "Country Report, Geothermal Development in Djibouti Republic," Ministry of Energy and Natural Resources, (World Geothermal Congress, 2015): http://agid.theargeo.org/reports/Djibouti/Country%20Report-%20Geothermal%20Development%20in%20Djibouti.pdf • **Ethiopia** Kebede, S., 2016. "Country Update on Geothermal Exploration and Development in Ethiopia. Proceedings, 6th African Rift Geothermal Conference," Addis Ababa, Ethiopia, (2 – 4 November 2016). • **Kenya** Omenda, P. and Mangi, P., 2016. "Country update report for Kenya: 2016. Proceedings, 6th African Rift Geothermal Conference Addis Ababa, Ethiopia, (2nd – 4th November 2016): http://theargeo.org/fullpapers/COUNTRY%20UPDATE%20REPORT%20FOR%20KENYA%202016.pdf • **Rwanda** Rutagarama, U. 2018. "Geothermal Resource Exploration in Rwanda: A Country Update," Proceedings, 7th African Rift Geothermal Conference, Kigali, Rwanda, (31st October – 2nd November 2018): http://theargeo.org/fullpapers/C7/Geothermal%20Resource%20Exploration%20in%20Rwanda-converted.pdf • **Tanzania** Kajugus, S.I., Kabaka, K.T. and Mnjokava, T. 2018. Geothermal Development in Tanzania - a Country Update. Proceedings, 7th African Rift Geothermal Conference, Kigali, Rwanda, (31st October – 2nd November 2018): http://theargeo.org/fullpapers/C7/Geothermal%20Development%20in%20Tanzania%20-%20a%20Country%20Update-converted.pdf • **Uganda** Alexander, K., Cumming, W.B., and Marini, L., 2016. "Geothermal Resource Assessment Report, Kibiro geothermal prospect, Uganda," (2016).
Deviations	The assignment took nearly a full year longer than anticipated due to the COVID-19 pandemic, which resulted in three separate contract amendments to adjust the work plan to remove international travel. There was no international travel (as originally planned), and all stakeholder consultation activities took place remotely through online teleconference platforms.
Anticipated follow-up activities and next steps	• Follow-up on the TA led by the CTCN to conduct full feasibility studies on identified direct use technologies • Use of new expertise acquired during training led by CTCN

2. Lessons learned

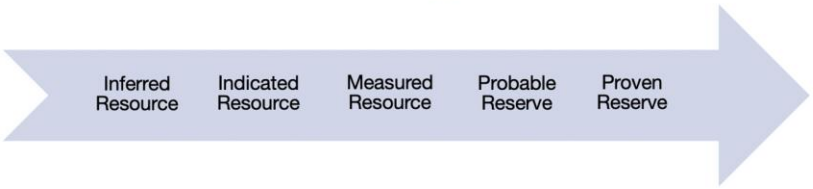
	Lessons learned	Recommendations
Lessons learned from the CTCN TA process	• There was an overall lack of understanding of the scope of work; for example, many of the Project Proponents envisioned a full feasibility study would be undertaken – whereas the scope of work was only a pre-feasibility study • The TA was negatively impacted by the COVID-19 pandemic, which restricted both international and domestic travel, did not allow for gatherings of stakeholders for meetings etc.	• Set clear expectations in relation to available funding for the TA and its associated outputs • CTCN was flexible and did an overall excellent job working with the consultant to adjust the TA according to dynamics on the ground in each project country / to allow for a remote work arrangement aligned with international and domestic protocols
Lessons learned related to climate technology transfer	• In addition to supporting rural livelihoods and economic development, the TA supported each country's efforts to develop indigenous geothermal resources and thus advance their climate commitments given the positive impact of geothermal development on energy sector decarbonization.	• Continue to build local capacity and provide funding to support full feasibility studies of direct use geothermal applications/technologies based on the outputs of this TA. The Project Proponents expressed a desire to build upon the outputs of this TA.

3. Illustration of the TA and photos

For communication purposes, please provide 2-4 Power Point slides, including illustrations or charts, describing barriers, opportunities, methodology, activities, outputs and achieved results. The illustrations must be copied into the TA Closure report but must also be delivered as power point files. Also, please provide at least five high-resolution pictures in jpg format, capturing technical assistance. The pictures should illustrate how the TA has impacted the lives of the beneficiaries in particular and the communities in general.

Methodology

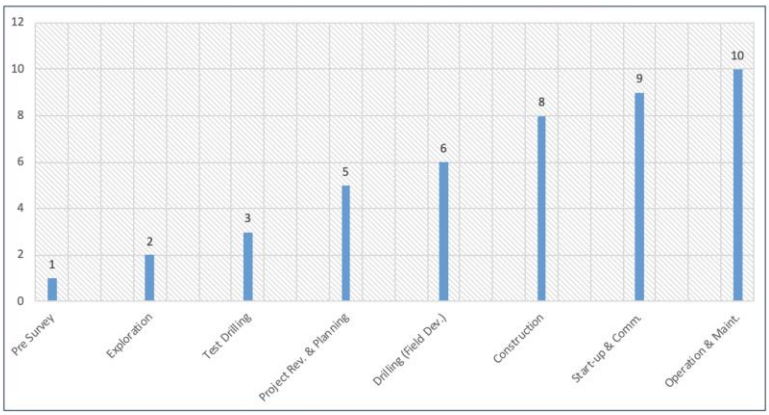
Resource Classification Degree of Confidence



- Inferred Resource - Low Confidence
- Indicated Resource - Moderate Confidence
- Measured Resource - High Confidence
- Probable Reserve
- Proven Reserve

Methodology

Geothermal Project Development Status and Associated Weighted Score



Source: World Bank ESMAP; GreenMax Capital Advisors analysis

Stages of Geothermal Project Development:

- Pre-survey
- Exploration
- Test Drilling
- Project Review and Planning
- Drilling (Field Development)
- Construction
- Start-up and Commissioning
- Operation and Maintenance

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CTCN-UNIDO EAST AFRICA GEOTHERMAL TECHNICAL ASSISTANCE

GEOTHERMAL RESOURCE ASSESSMENT SITE SELECTION GUIDELINES

1. Site Selection Approach and Methodology

The site selection methodology is presented in Figure 1.1. As an initial step, primary source documents (feasibility studies, technical reports etc.) should be obtained for the country/region/study area and where applicable, additional publicly available information should be gathered through supplemental research. The data generally includes reports and studies of geothermal resources at various stages of development – from pre-feasibility through more advanced stages (e.g., operation). In most cases, the data that has been generated comes from high enthalpy sites utilized for power generation, rather than for direct use applications. Therefore, gaps in the data should be identified for each site while taking into account the best practices that are applied in geothermal exploration. To account for these data gaps and utilize the existing data, a broader assessment should be undertaken, such as including cascading systems (in cascading systems, the effluent from a power plant can feed a direct use application before it is reinjected or disposed of). **Figure 1.1** shows the steps that can be followed in the data analysis and site selection, whereby a two-phased assessment is followed to identify a selected number of target resources (in this case, the top three resources were identified).

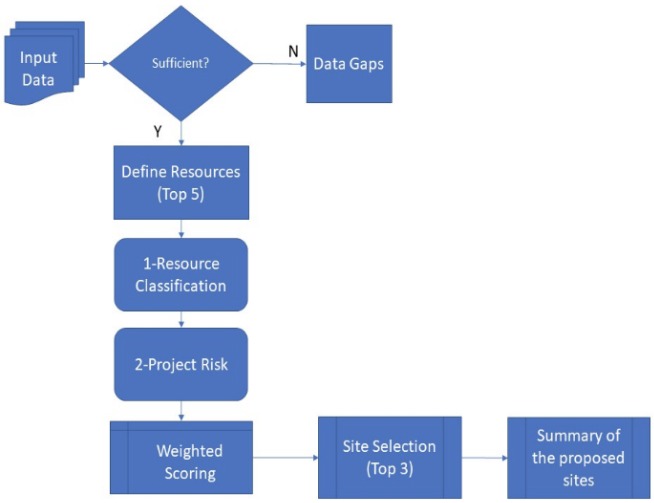

Figure 1.1: Site Selection Methodology

CTCN-UNIDO EAST AFRICA GEOTHERMAL TECHNICAL ASSISTANCE

GEOTHERMAL DIRECT USE FINANCIAL MODEL USER GUIDE

Introduction

The Geothermal Direct-Use financial model is an interactive MS Excel model designed to assist stakeholders in assessing the commercial viability of various geothermal direct use applications in six East African countries – Djibouti, Ethiopia, Kenya, Rwanda, Tanzania, and Uganda. The model aims to determine the ability of each project to adequately service debt while also providing attractive returns to equity investors.

This user guide is intended to provide an easy-to-follow road map to users who might not typically work with financial analysis, to ensure successful utilization of the model.

Model Architecture

The model consists of 7 sets of worksheets for each application:

(1) Summary: Shows the summary of results for each DU application;
(2) Input Sheets: The dashboard for most of the user-defined assumptions. The right side of the sheet also contains various data tables for sensitivity analysis;
(3) Cashflows: Computes the projects' cashflows on an annual basis;
(4) Debt Schedules: Computes the required annual debt service on the project debt;
(5) Depreciation Schedules: Computes the annual depreciation of the project assets;
(6) Currency: Allows users to input currency conversion/exchange rate assumptions and presents the average local lending rates;[1]
(7) Data Sources: Presents various data inputs obtained via the stakeholder surveys conducted and desk research. These data are linked to the input sheets and can be overwritten by the user on the relevant input sheet.

Entering Inputs

Blue Text	Blue text in grey cells denotes active user-defined inputs. The user is responsible for modifying these cells in line with the scenario being evaluated. These active inputs feed directly into the calculation sheets to determine the results.
Blue Text	Blue text in green cells denotes inactive user-defined inputs. The user is responsible for modifying these cells in line with the scenario being evaluated. However, these inactive inputs have no impact on the results.
Black Text	Black text in grey cells denotes inputs that cannot be varied by the user. These cells should not be modified.
Black Text	Black texts in white cells are either in-built or calculated automatically. These cells should not be modified.

[1] While all the calculations in the model are shown in USD for ease of comparison across the various countries, the model excludes foreign exchange fluctuation considerations as it is assumed that the projects will be financed in local currency and the project cashflows will all be in local currency.

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2. Summary of Results: Kenya

Geothermal Site	Categorized Direct Use Applications
KENYA	
Olkaria	1. Fish drying 2. Chicken hatchery
Eburru	1. Pyrethrum drying 2. Fruit drying
Menengai	1. Vegetable/grain drying 2. Greenhouse heating

Geothermal Site	Identified Community
Olkaria	Oloonongot, Kamere, Olomayiana Kubwa, Olomayiana Ndogo, Narasha, Rapland villages
Eburru	Eburru village / Gilgil town
Menengai	Olrongai village

GreenMax Senior Consultants, Lena Ngure and Barbara Kenya lead discussions in Naivasha (left) and Nakuru (right) with local community representatives from the three selected geothermal sites.

2. Summary of Results: Tanzania

Geothermal Site	Categorized Direct Use Applications
TANZANIA	
Kiejo-Mbaka	1. Vegetable/grain drying 2. Fish drying 3. Milk pasteurization 4. Balneotherapy 5. Tea processing 6. Greenhouse heating

Geothermal Site	Identified Community
Kiejo-Mbaka	Busekolo District Council, Ilamba Village

The GreenMax and TGDC teams meeting with the Busokelo District Council

4. Impact Statement

The information in the table below will be used to communicate results and anticipated impacts of this technical assistance publicly. Please copy information from impact statement developed in the M&E Plan and update as relevant.

Challenge	• The availability of geothermal energy resources in East Africa is promising for power generation and development of direct use projects. This region plans to utilize geothermal power to improve energy security, reduce dependence on imported fuels, and address the energy demand gap in order to increase electrification rates and support long-term economic development. • Geothermal energy also plays a significant role in helping countries advance their climate commitments given the impact of geothermal development on energy sector decarbonization. • There is significant untapped potential for direct use applications of geothermal energy in East Africa, particularly in the agricultural sector, which is a key driver of economic activity across the region. This is broadly attributed to limitations in access to finance as well as local capacity. It is therefore important to develop wider understanding regarding opportunities for direct use projects from technical, financial, market viability perspectives.
CTCN Assistance	• The objective of the TA was to conduct a review of low-to-medium temperature geothermal systems for direct use applications in six East African countries (Djibouti, Ethiopia, Kenya, Rwanda, Tanzania and Uganda) to promote sustainable development, particularly for rural beneficiary communities. • In each country, the TA identified potential direct use geothermal applications as well as the corresponding sectors and technologies that are best suited to benefit from direct use geothermal projects.
Anticipated impact	• In the short term, as the TA is expected to test the economic viability of direct use projects in specific sites within the region; availability of such information is expected to accelerate efforts to coordinate action that will spur investment to develop the geothermal potential of this region. • In concrete terms, implementing into practice the data, knowledge and skills acquired in the context of the TA provided should allow, in the long-term: - The implementation of geothermal energy direct use technologies appropriates to the identified sites in the six countries; - The continuous updating of the regional and national databases; - Strengthening the resilience capacity of people living in the project localities as a result of availability of energy

	that is instrumental in supporting and diversifying their livelihood. This can be envisioned in reduced loss of livelihood (e.g., through prevention of post-harvest losses that are mainly attributed to improper drying of agricultural produce) and/or through establishment of local industries such as agro-processing facilities that would result in production of agricultural value-added products, hence increased income and employment opportunities • Greenhouse gases abatement: geothermal technologies for power generation or direct use operate with little or no emissions. Geothermal energy development has thus great CO_2 emission reduction potential when substituting fossil sources of energy.
Gender aspects of the TA and co-benefits	• While the TA did not include a specific gender analysis component, in order to ensure that the outputs of the TA accounted for the priorities and perspectives of women, gender-disaggregated data was a focus of the data collection activities, including the surveys and focus group meetings administered in the identified communities • Gender considerations are critical to the overall TA given the clear linkages between energy and gender, namely different rates of access and use as well as the impacts of energy sources and appliances in the home, community and wider society
Anticipated contribution to NDC	Geothermal energy offers a clean, reliable and affordable source of power/heat that can support sustainable development as countries aim to reduce emissions to meet their National Determined Contributions (NDCs): • **Djibouti** has prioritized geothermal development in order to meet its 2015 NDC, which aims to reduce emissions by up to 60% compared to the business-as-usual (BAU) scenario by 2030. • **Ethiopia** plans to reduce emissions by 64% from the BAU scenario by 2030 through the development of renewable energy, including geothermal • **Kenya** seeks to abate its GHG emissions by 30% by 2030 relative to BAU. The country is the leader in the region in geothermal development. • **Rwanda** has prioritized low-carbon energy development with a vision to establish new grid connection from renewable energy. • **Tanzania** has made a commitment to reduce greenhouse gas emissions economy wide between 10-20% by 2030 and has made geothermal development a priority. • **Uganda** intends to increase the amount of renewable energy capacity by at least 1,100 MW compared to BAU by 2030, with priority technologies including hydro, solar, biomass and geothermal.

The narrative story	To date, the main focus of utilizing geothermal resources in East Africa has been for power generation, as the technology offers a clean source of baseload power that reduces emissions and improves energy security. However, there is also significant untapped potential for direct use applications of geothermal energy, particularly in the agricultural sector, which is a key driver of economic activity across the region. In this context, this assignment provided specialized TA in order to identify potential geothermal direct use applications in six East African countries – Djibouti, Ethiopia, Kenya, Rwanda, Tanzania and Uganda. The services included capacity building to inform policymakers in each country to improve their understanding of opportunities for direct use geothermal projects from technical, financial and market viability perspectives. In each country, the TA identified potential direct use geothermal applications as well as the corresponding sectors and technologies that may benefit from the utilization of direct use geothermal projects. The TA also established the economic and market viability of the identified direct use technologies and projects. In addition to supporting rural livelihoods and economic development, this project supported each country's efforts to advance their climate commitments given the impact of geothermal development on energy sector decarbonization.
Contribution to SDGs A complete list of SDGs and their targets is available here.	• **SDG-1** (End poverty): Among the envisioned long-term impact of the technical assistance is the enhanced community resilience and improved livelihood. • **SDG-2** (End hunger, achieve food security and improved nutrition and promote sustainable agriculture): Many of the identified geothermal direct use applications involved sustainable practices in the agricultural sector (e.g., geothermal drying and heating) • **SDG-7** (Ensure access to affordable, reliable, sustainable, and modern energy for all): geothermal energy is sustainable and is a key driver of low-carbon growth • **SDG-13** (Take urgent action to combat climate change and its impacts): The envisioned long-term impact of the TA is enhanced community resilience and improved livelihood. In addition, practical training for national and regional experts will strengthen their technical capacity in geothermal direct use technologies for their exploitation

Annex 1 Technical assistance data collection

Please add quantitative and qualitative values for the indicators selected in the M&E plan and monitored throughout the technical assistance in the tables below. Indicators which have been monitored in addition to the proposed indicators below may be added at the end of table A. Non-relevant indicators should be left blank.

A. Output and outcome indicators

Indicator Please note indicators below highlighted as **anticipated**	**Quantitative value** *Numerals only; disaggregates must sum to the total*	**Qualitative description** *List the various elements corresponding to the quantitative value as well as timelines and responsible institutions*
Total number of events organized by proponents and implementing partners	*13*	Two workshops held with each of the six countries (12 total): (1) July 2020 Industry Stakeholder Consultations x 6 (2) July 2021 Capacity Building Workshop x 6 (3) Final Validation Workshop
Number of participants in events organized by proponents and implementing partners	*82*	
a) Number of men	*74*	
b) Number of women	*8*	
Number of climate technology RD&D related events		
Number of participants in climate technology RD&D events	*List total number here*	
a) Number of men		
b) Number of women		
Number of training organized by proponents and implementing partners	6	Guidelines and tools for geothermal resource assessments for direct use applications
Number of participants in trainings organized by proponents and implementing partners	*34*	
a) Number of men	30	
b) Number of women	4	
Total number of institutions trained	*6*	
a) Governmental (national or subnational)	6	1. Djibouti Geothermal Energy Development Authority (Office Djiboutien de Développement

		de l'Énergie Géothermique, ODDEG) 2. Geological Survey of Ethiopia (GSE) 3. Kenya Electricity Generating Company PLC (KenGen) 4. Rwanda Energy Development Corporation Limited (EDCL) 5. Tanzania Geothermal Development Company Limited (TGDC) 6. Uganda Ministry of Energy and Mineral Development (MEMD)
b) Private sector (bank, corporation, etc.)		*List the name of organisations trained here*
c) Nongovernmental (NGO, University, etc.)		*List the name of organisations trained here*
Percentage of participants reporting satisfaction with CTCN training (from CTCN training feedback form)		*Satisfied= 4+ on 5-pt scale*
Percentage of participants reporting increased knowledge, capacity and/or understanding as a result of CTCN training (from CTCN training feedback form)		*Increased knowledge, capacity and/or understanding= 4+ on 5-pt scale*
a) Percentage of men		
b) Percentage of women		
Total number of deliverables produced during the assistance (excluding mission, progress and internal reports)	*3*	1. First Progress Report (technical guidelines for site selection) 2. Second/Third Progress Report (commercial/economic analysis) 3. Fourth Progress Report (capacity building and training workshop summary)
a) Number of communication materials, including news releases, newsletters, articles, presentations, social media postings, etc.		Misc. outreach to dozens of industry and community stakeholders in all six countries
b) Number of tools and technical documents strengthened, revised or developed	2	1. First Progress Report (technical guidelines for site selection) 2. Second/Third Progress Report (commercial/economic analysis)
3. Number of other information materials strengthened, revised or created (For example training and workshop reports, Power Points, exercise docs etc.)		*List the name of the documents*
Total number of policies, strategies, plans, laws, agreements or regulations supported by the assistance	*List total number here*	
a) Adaptation related		*List the type and name of documents supported*

b) Mitigation related		*List the type and name of documents supported*
c) Both adaptation- and mitigation related		*List the type and name of documents supported*
Anticipated number of policies, strategies, plans, laws, agreements or regulations proposed, adopted or implemented as a result of the TA	*List total number here*	
a) Adaptation related		*List the type of documents anticipated to be proposed, adopted or implemented*
b) Mitigation related		*List the type of documents anticipated to be proposed, adopted or implemented*
c) Both adaptation- and mitigation related		*List the type of documents anticipated to be proposed, adopted or implemented*
Anticipated number of technologies transferred or deployed as a result of CTCN support	*5+*	Renewable Energy (geothermal), Agriculture and Forestry (demand efficiency, crop drying, increasing crop resilience and productivity); Industry (conventional power plant efficiency)[2]
Anticipated number of collaborations facilitated or enabled as a result of technical assistance	*List total number here*	
a) Number of South-South collaborations		*List the names of the organisations (excluding the CTCN or TA implementers)*
b) Number of RD&D collaborations		*List the names of the organisations (excluding the CTCN or TA implementers)*
c) Number of private sector collaborations		*List the names of the organisations (excluding the CTCN or TA implementers)*
Number of countries with strengthened National System of Innovation as a result of CTCN support		*List names of countries*
Insert any additional indicators here		

[2] https://www.ctc-n.org/resources/ctcn-taxonomy

B. Core impact indicators

Please fill in the tables for anticipated impacts of the CTCN assistance. Every technical assistance should contribute to at least one of the indicators below. For guidance on how to report on core indicators see the 'M&E Guidance Document for TA Implementers'.

Core indicator 1	Anticipated metric tons of CO_2 equivalent (CO_2e) emissions reduced or avoided as a result of CTCN TA	
	Anticipated metric tons of CO_2e reduced or avoided as a result of the TA **on annual basis**	10,604.7 tons of CO_2e per year

The estimated GHG emission reduction potential for each country is based on estimated emission reductions (tons of CO_2/year) associated with fuel switching to geothermal energy for each direct use project. The analysis is based on the fuel requirements stated in the comparative analysis of the Second/Third Progress Report.[3] The following list of projects were used for each country (see Second/Third Progress Report),[4] and it was assumed that one of each project will be developed (i.e., three in each country):[5]

- **Djibouti:** (1) vegetable/grain drying; (2) fish drying; and (3) fruit drying
- **Ethiopia:** (1) fish drying; (2) greenhouse heating; and (3) tobacco curing
- **Kenya:** (1) chicken hatchery; (2) pyrethrum drying; and (3) greenhouse heating
- **Rwanda:** (1) fish drying; (2) vegetable/grain drying; and (3) milk pasteurization
- **Tanzania:** (1) vegetable/grain drying; (2) milk pasteurization; and (3) greenhouse heating
- **Uganda:** (1) vegetable/grain drying; (2) fish drying; and (3) tea processing

Djibouti

	Wood Fuel Requirement (kg/Yr.)	Estimated Annual GHG Reduction (tons of CO_2e/year)
Vegetable/grain drying	79,019.35	129.6
Fish drying	39,135.66	64.2
Fruit drying	35,063.25	57.5
Total		**251.3**

Ethiopia

	Fuel Requirement	Estimated Annual GHG Reduction (tons of CO_2e/year)
Fish drying	39,135.66 (Wood. Kg/Yr.)	64.2
Greenhouse heating	576,842.72 (Fuel Oil, Kg/Yr.), 517,040.45 (LPG, Kg/Yr.)	1966.2, 1536.9
Tobacco curing	378,452.38 (Diesel, liter/Yr.)	1015.5
Total		**2,616.6**

[3] See Chapter 2: Market and Economic Assessment of Commercial Viability of the Identified Direct Use Geothermal Technologies; and Annex 1: Methodology and Key Assumptions
[4] See Chapter 1: Categorization of Direct Use Geothermal Technologies at the Identified Sites
[5] NB: Balneotherapy (geothermal spas) were excluded from the GHG analysis (no fuel switching is involved).

KENYA

	Fuel Requirement	Estimated Annual GHG Reduction (tons of CO_2e/year)
Chicken hatchery	13,397.99 (Fuel Oil, Kg/Yr.), 12,355.92 (Gas, Kg/Yr.)	45.7 25.5
Pyrethrum drying	13,712.87 (Wood, Kg/Yr.)	22.5
Greenhouse heating	576,842.72 (Fuel Oil, Kg/Yr.), 517,040.45 (LPG, Kg/Yr.)	1966.2, 1536.9
Total		**1,630.6**

RWANDA

	Wood Fuel Requirement	Estimated Annual GHG Reduction (tons of CO_2e/year)
Fish drying	39,135.66 (Wood, kg/Yr.)	64.2
Vegetable/grain drying	79,019.35 (Wood, kg/Yr.)	129.6
Milk pasteurization	190,730.04 (Diesel, Liter/Yr.)	511.8
Total		**705.6**

TANZANIA

	Fuel Requirement	Estimated Annual GHG Reduction (tons of CO_2e/year)
Vegetable/grain drying	79,019.35 (Wood, kg/Yr.)	129.6
Milk pasteurization	190,730.04 (Diesel, Liter/Yr.)	511.8
Greenhouse heating	27,688.45 (Fuel Oil, kg/yr.), 24,817.94 (LPG, kg/Yr.)	94.4, 73.8
Total		**715.2**

UGANDA

	Fuel Requirement	Estimated Annual GHG Reduction (tons of CO_2e/year)
Vegetable/grain drying	79,019.35 (Wood, kg/Yr.)	129.6
Fish drying	39,135.66 (Wood, kg/Yr.)	64.2
Tea processing	11,371,126.53 (Diesel, kWh/Yr.) 11,371,126.53 (Wood, kWh/Yr.)	3051.1, 4491.6
Total		**4,685.4**

TOTAL (ALL SIX COUNTRIES)	**10,604.7 tons of CO_2e/year**

Core indicator 2	**Anticipated increased economic, health, well-being, infrastructure and built environment, and ecosystems resilience to climate change impacts as a result of technical assistance** *Please provide a **qualitative** description of the anticipated impacts on the categories below*
Infrastructure and built environment Anticipated increased infrastructure resilience (avoided/mitigated climate induced damages and strengthened physical assets)	
Ecosystems and biodiversity Anticipated increased ecosystem resilience (areas with increased resistance to climate-induced disturbances and with improved recovery rates)	*Direct utilization of geothermal resources reduces the reliance on biomass (wood fuels) for heating applications, which in turn reduces deforestation and improves ecosystem resilience.*
Economic Anticipated increased economic resilience (e.g., less reliance on vulnerable economic sectors or diversification of livelihood)	*There is significant untapped potential for direct use applications of geothermal energy in East Africa, particularly in the agricultural sector, which is a key driver of economic activity across the region. This technical assistance helped to identify possible direct use geothermal opportunities in each country from technical, financial and market viability perspectives. Understanding of these opportunities will lead to informed decisions regarding which direct use opportunities to develop and utilize. The implementation of direct use projects supports the diversification of livelihood, income generation and job creation (e.g., direct use geothermal projects can support the establishment of local industries such as agro-processing facilities that would result in production of agricultural value-added products).*
Health and wellbeing Anticipated increased health and wellbeing of target group (e.g., improved basic health, water and food security)	*Direct utilization of geothermal resources reduces emissions and improves indoor air quality by reducing the reliance on biomass (wood fuels) and other fossil fuels for heating applications; Direct use geothermal technologies also supports agricultural drying, which improves post-harvest preservation and improves food security.*

Core indicator 3	Anticipated number of direct and indirect beneficiaries as a result of the TA	
	Quantitative value	**Means of verification**
Total beneficiaries	*Total number:* • ***82 direct individual beneficiaries*** *participated in a total of* ***13*** *events* • ***16 beneficiary communities*** *across* ***six (6)*** *countries*	***Direct beneficiaries:*** *Two (2) workshops held with each of the six countries (12 workshops in total):* *(1) July 2020 Industry Stakeholder Consultations x 6* *(2) July 2021 Capacity Building Workshop x 6* *Plus one (1) Final Validation Workshop with all six countries together* ***Indirect beneficiaries:*** ***16 beneficiary communities*** *located near the identified sites in each project country were engaged with to assess the viability of each direct use geothermal technology*
Number of direct adaptation and mitigation beneficiaries	*The number of people who participated in the capacity building/training under the assignment was* ***82 people*** *across the* ***six (6)*** *project countries. Of this total, there were 34 people who participated in the final training activities under Output 5.*	*Direct beneficiaries under this TA can be defined as the estimated number of people who received training on the applications of direct-use geothermal technologies (held remotely through an online teleconference)*
Number of indirect adaptation and mitigation beneficiaries	*A total of* ***16 geothermal sites*** *were analyzed across the* ***six project countries****: three (3) sites were selected in five of the countries (Djibouti, Ethiopia, Kenya, Rwanda and Uganda), while Tanzania GDC opted only to have one site analyzed (Kiejo-Mbaka). The specific number of people that will benefit from geothermal direct use technology solutions (both adaptation and mitigation) is difficult to quantify, as the precise number of projects that would be developed in the identified localities will not be known until the full feasibility stage. However, each geothermal site had at least one beneficiary community, so it can be estimated that at least* ***16 localities across the six countries*** *have the potential to benefit from direct use projects/opportunities.*	*Indirect beneficiaries under this TA can be defined as the estimated number of people who will benefit from the "technology transfer" i.e., who will gain access to clean energy solutions and reduce their usage of (and mitigate the negative impacts of) polluting technologies (e.g., diesel generators) from switching to direct-use geothermal technology solutions (e.g., for heating, or agricultural processing activities etc.)*

Core indicator 4*	**Anticipated amount of funding/investment leveraged (USD) as a result of TA (disaggregated by public, private, national, and international sources, as well as between anticipated/confirmed funding)**			
	Quantitative value confirmed *in USD*	**Quantitative value anticipated** *in USD*	**Qualitative description** *List the institutions, timelines, and description or title of the investment*	**Methods** *Describe methods used for quantification of funds leveraged*
Total funding	*Total number in USD (numerals only, no rounding or abbreviations)*	*Total number in USD (numerals only, no rounding or abbreviations)*		
Anticipated amount of public funding mobilised from national/domestic sources	*N/A**	*N/A**	*N/A**	*N/A**
Anticipated amount of public funding mobilised from international/ regional sources	*N/A**	*N/A**	*N/A**	*N/A**
Anticipated amount of private funding mobilised from national/domestic sources	*N/A**	*N/A**	*N/A**	*N/A**
Anticipated amount of private funds mobilised from international/regional sources	*N/A**	*N/A**	*N/A**	*N/A**

** Core indicator 4 (funding/investment leveraged/mobilized) is not applicable to this Response Plan/technical assistance. This assignment involved only a pre-feasibility study and associated capacity building activities; specific funding requirements (and associated estimates around the amount of public and private funding sources necessary) will only be available once a full feasibility study is completed / specific projects are selected for development in each country.*

Annex 2 (for internal use – to be filled in by the CTCN)

CTCN evaluation

This section will be completed by the relevant CTCN Technology Manager.

- Evaluation of the timeliness of the TA implementation as measured against the timeline included in the response plan;
- Evaluation of TA quality as defined in the response plan;
- Overall performance of the Implementers;
- Overall engagement of the NDE and Proponent;
- Lessons learned on the CTCN process and steps taken by the CTCN to improve.