

**Guidelines:**

- This Request Submission Form should be completed by the organisation requesting technical assistance from the Climate Technology Centre & Network (CTCN) in collaboration with the National Designated Entity (NDE) of the country in question
- The Form must be signed by the NDE. Please see updated contact list of NDEs here: <http://unfccc.int/tclear/support/national-designated-entity.html>
- The Form can be submitted as a Word file containing a digital signature or as a signed and scanned PDF file in combination with an un-signed Word file
- For requests submitted by multiple countries, all the NDEs of the respective countries shall sign identical Forms before official submission to the CTCN
- NDEs have the opportunity to submit CTCN requests in collaboration with National Designated Authorities (NDAs) for the Green Climate Fund (GCF) if targeting the GCF Readiness Programme.

<b>Requesting country or countries:</b>	Tanzania
<b>Request title:</b>	Feasibility Study of Optimal Design Conditions for Biogas Plant for the Improvement of CH <sub>4</sub> Capture Efficiency
<b>NDE</b>	Tanzania Commission for Science and Technology Name: Dr. Gerald Majella Kafuku Position: Director, Centre for Development and Transfer of Technology Email: <a href="mailto:kafukugm@gmail.com">kafukugm@gmail.com</a> , <a href="mailto:gerald.kafuku@costech.or.tz">gerald.kafuku@costech.or.tz</a> Address: P.O. Box 4302, Ali Hassan Mwinyi Road, Kijitonyama(Saynasi) COSTECH Building, Dar es Salaam, Tanzania
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**Climate objective:**

Adaptation to climate change

Mitigation of climate change

Combination of adaptation and mitigation of climate change

**Geographical scope:**

Community level

Sub-national

National

Multi-country

If the request is at a sub-national or multi-country level, please describe specific geographical areas (provinces, states, countries, regions, etc.).

**Problem statement related to climate change** (up to one page)

Tanzania uses fuels such as LPG, natural gas, and Biomass as its main energy sources. Biomass, which emits a lot of greenhouse gases, uses about 20% in cities and 92% in rural areas at home. Therefore, greenhouse gas emissions are greater in rural Tanzania than in cities.

According to Tanzania's national energy policy, it is proposing a policy aimed at 60% of renewable energy as a whole by 2026. Investments are being made to replace biomass with natural energy to cope with climate change. However, most of the investment facilities are concentrated in cities, and investment is still insufficient in rural areas where greenhouse gases are emitted a lot, so climate change response is weak. Therefore, because rural households use Biomass such as wood and coal for cooking, CO<sub>2</sub>, the main greenhouse gas of global warming, is released into the atmosphere in large quantities. Indoor air pollution caused by Biomass causes health and environmental problems at home. In Arusha Rural area, north of Tanzania, cooking fuel indoors shows that the level of smoke-exposure risk (SER) is 84.3%, higher than the urban area of 60.1%. Since the use of Biomass is high in rural households, personal hygiene problems such as respiratory diseases and eye diseases caused by fine particles are serious due to indoor air pollution caused by toxic gas. Rural families are also burdened by the cost of purchasing trees. Because it occurs about \$10/month on a family basis (4 people), the majority of residents use the surrounding trees at home by logging them without permission. Such logging promotes desertification due to deforestation and causes natural disasters such as landslides. This can act as a cause of further accelerating climate change on Earth. Tanzania has the second-largest livestock in Africa, according to the Ministry of Livestock and Fishery Development. In particular, because cattle are raised in rural areas, large amounts of feces and urine generated on farms are dumped outdoors without permission, which causes odor and soil pollution, and CH<sub>4</sub> and N<sub>2</sub>O, a large amount of greenhouse gases generated from livestock manure, have a greater impact on global warming than CO<sub>2</sub>, accelerating climate change.

Therefore, Arusha, Tanzania, the project target area, aims to reduce Biomass at home by collecting excrement discarded from livestock farms, collecting CH<sub>4</sub>, a renewable energy source, through the Biogas plant, and supplying it to households as an alternative energy source. In addition, the purpose is to reduce climate change by collecting manure generated from livestock farms and lowering greenhouse gases.

**Past and on-going efforts to address the problem** (up to half a page):

Arusha, a project target area, purchases and uses LPG from some households, but Biomass is also using it because the cost of purchasing fuel costs is burdensome. Arusha produces CH<sub>4</sub>, a fuel source that can replace Biomass, through the Biogas plant. It is under way to reduce residents' personal hygiene, health problems and the burden of domestic fuel costs. However, due to technical problems with the Biogas plant, CH<sub>4</sub> production efficiency is low, so residents still use Biomass such as Wood and Charcoal as their main fuel source. Biomass generates a lot of CO<sub>2</sub>, a major factor of greenhouse gases, so it is urgent for rural villagers to improve their awareness of the international environmental crisis caused by climate change and the need to build an improved Biogas plant. Therefore, a feasibility study is required to improve the efficiency of the currently used Biogas plant. In order to perform The Feasibility Study, it is first necessary to check the size of livestock farms operated in the region. The amount of livestock's feces and urine available should be determined to determine the capacity of the Biogas plant that can be operated in the surrounding households. This can confirm the amount of CH<sub>4</sub> collection according to the amount of livestock excrement. Currently, it is not clear whether the amount of CH<sub>4</sub> collected by livestock excrement injected from the Biogas plant is sufficient for household, so the existing environment needs to be investigated. Therefore, it is necessary to prevent natural disasters by improving the health environment problem at home and blocking forest damage by increasing the CH<sub>4</sub>

collection efficiency and reducing the use of Biomass by solving the structural problem of the currently introduced Biogas plant. By distributing the improved Biogas plant to the Arusha region of Tanzania, this project can reduce Biomass usage and CO<sub>2</sub> generation to achieve effective results by simultaneously pursuing the direction of Tanzania's energy policy and CTCN's climate change response strategy.

**Specific technology<sup>1</sup> barriers** (up to one page):

Through structural improvement of the conventional Biogas plant operated by Arusha, technical support is required to effectively collect a large amount of CH<sub>4</sub> and operate it sustainably locally. The currently in operation Biogas plant has a lower CH<sub>4</sub> collection efficiency than the amount of livestock excrement injection. It can be seen that the efficiency of anaerobic digestion of sludge discharged to the outside is low.

When both feces and urine are injected, the amount of CH<sub>4</sub> generated varies depending on the temperature (20-40°C) inside the digestion and the residence time (30-40 days), but the locally operated Biogas plant has not been reviewed for temperature and time to collect CH<sub>4</sub>. And, the combination of livestock excrement and water (3:4) is important for increasing CH<sub>4</sub> efficiency, but these are not technically specified. Therefore, an engineering technical feasibility study is required to overcome these technical limitations. In addition, when supplying CH<sub>4</sub> to homes in the Biogas plant, no clear description of the injection distance is presented. It is difficult to apply the currently installed gas piping to various ground environments because it has been worked in consideration of the characteristics of low-density CH<sub>4</sub> without clear design drawings. Therefore, there is a need for design conditions that can be effectively operated when used at home depending on the material, diameter, and distance of the pipe. Pressure gauges and flow meters should be installed and operated when using CH<sub>4</sub> at home. The pressure gauge can indirectly check the amount of CH<sub>4</sub> and the amount of fluid emission produced by the Biogas plant. It can be seen that the currently built Biogas plant generates more sludge than CH<sub>4</sub> production by periodically injecting livestock feces and urine every day.

Therefore, it is an efficient operation method to inject livestock feces and urine while checking the sufficient capacity of CH<sub>4</sub> in the chamber through a pressure gauge after excrement injection. In addition, a flow meter capable of monitoring the usage of CH<sub>4</sub> at home can be installed to statistically calculate the usage of CH<sub>4</sub> and investigate the usage of livestock feces and urine relative to the dose of the Biogas plant. Livestock feces and urine injected into the Biogas plant undergoes anaerobic reaction in Chamber to produce CH<sub>4</sub>, and the waste sludge is discharged to the outside in a natural flow method. Therefore, it is necessary to promote feasibility studies to derive improved Biogas plant optimal design conditions with specialized engineering technologies and policy support from Tanzania government agencies through CTCN.

**Sectors:**

Please indicate the main sectors related to the request:

- |  |   |  |  |
|--|---|--|--|
| <input type="checkbox"/> Coastal zones | <input type="checkbox"/> Early Warning and Environmental Assessment | <input checked="" type="checkbox"/> Human Health | <input type="checkbox"/> Infrastructure and Urban planning |
| <input type="checkbox"/> Marine and    | <input type="checkbox"/> Water                                      | <input type="checkbox"/> Agriculture             | <input checked="" type="checkbox"/> Carbon fixation        |

<sup>1</sup> *"any equipment, techniques, practical knowledge and skills needed for reducing greenhouse gas emissions and adapting to climate change"* (Special Report on Technology Transfer, IPCC, 2000)

Fisheries

- Energy Efficiency   
  Forestry   
  Industry   
  Renewable energy  
 Transport   
  Waste management

Please add other relevant sectors:

**Cross-sectoral enablers and approaches:**

Please indicate the main cross-sectoral enablers and approaches

- Communication and awareness   
  Economics and financial decision-making   
  Governance and planning   
  Community based  
 Disaster risk reduction   
 Ecosystems and biodiversity   
 Gender

**Technical assistance requested** (up to one page):

Overall objective:

- A Technological Feasibility Study for Improving CH<sub>4</sub> Collection Efficiency and Responding to Climate Change through Structural Design Improvement of Biogas Plant. Anticipated groups of activities to be performed by the technical assistance:
- When operating a Biogas plant of less than 10 m<sup>3</sup>, sludge accumulates inside the chamber where CH<sub>4</sub> is collected, resulting in continuous odor generation and difficulty in lowering the CH<sub>4</sub> collection efficiency. The sludge generated from the Biogas plant is operated by discharging it to the outside through a natural flow method, but the efficiency of the Biogas plant is decreasing as some of the sludge continues to accumulate inside the chamber. Therefore, in order to find a technical alternative to discharge internal sludge, a technical assistance is required to improve the CH<sub>4</sub> efficiency by deriving a structural design improvement plan for the Biogas plant. Currently, a Biogas plant has been established and operated around the home, but the optimal distance and method for transporting low-density CH<sub>4</sub> through a gas pipe have not been suggested. Since alternatives to supply CH<sub>4</sub> differ depending on the ground environment of each region, technical measures are needed to derive optimal operating conditions according to the generous pressure standard. Rural Tanzania residents emit a large amount of CO<sub>2</sub>, a greenhouse gas that has a significant impact on climate change, because the main heat used at home is Biomass, such as Wood and Charcoal. If CH<sub>4</sub> can be replaced with a major firepower through the improved Biogas plant, greenhouse gases generated by Biomass can be reduced, which is expected to have a significant impact on climate change mitigation. However, since the currently operating Biogas plant is unsustainable due to low-efficiency CH<sub>4</sub> collection technology, it is necessary to create an environment so that residents can not use Biomass again through improved technical assistance for the Biogas plant.

Anticipated products to be delivered by the technical assistance:

- CH<sub>4</sub> emission monitoring report in Biogas plant through technical support
- Estimation of Greenhouse Gas Reduction by Using Existing Biomass by Using CH<sub>4</sub>

- Proposal of Technical Support for the Efficient Operation of Gas Pipeline
- Structural Improvement Design Report of Biogas Plant for Sludge Removal
- Improved Biogas Plant Survey Results Report by Collecting Residents' Opinions

**Expected timeframe: 24 months**

24 months (2 year)

**Anticipated gender and other co-benefits from the technical assistance:**

There is an anticipated gender and other co-benefit through the technical assistant of the Biogas plant, and here are some of the compelling observations:

1. When cooking in the kitchen, women use Biomass such as Wood and Charcoal to generate toxic gases and fine particles. This is a major cause of respiratory disease. These diseases are also accompanied by economic problems because medical expenses are spent. Therefore, these problems can solve women's respiratory problems and help eco-friendly personal hygiene in the kitchen when cooking by building a Biogas plant at home.
2. Since the Biogas plant operated at home must periodically inject and operate livestock feces and urine, it can bring about the effect of creating jobs for human resources. The work of injecting livestock manure can be operated at low labor costs in the region. Therefore, the effect of creating employment manpower in the community can be expected
3. Wood purchased at home is the main firepower used when cooking. If CH<sub>4</sub> is used to reduce these purchase costs, economic life is possible. In addition, CH<sub>4</sub> has the advantage of being able to use it at night in areas without electricity because it can be used as a gas light.
4. Since Tanzania is an agricultural country, we can suggest to farmers in agriculture that the sludge generated from the Biogas plant can be used as compost. When using Sludge as compost, it can be harvested as high-quality crops, which can increase farm profits. Therefore, it can provide opportunities for rural residents to improve their quality of life.
5. Livestock farms can cause of groundwater and soil pollution by discharging feces and urine to the surrounding areas without permission, but operating the Biogas plant can be a way to reduce these environmental problems.

**Key stakeholders:**

Please list the stakeholders who will be involved in the implementation of the requested CTCN technical assistance and describe their role during the implementation (for example, government agencies and ministries, academic institutions and universities, private sector, community organizations, civil society, etc.).

Stakeholders	Role to support the implementation of the technical assistance
Tanzania Science and Technology Commission as National Designated Entity	The Tanzania Science and Technology Commission can provide government policy or administrative support. In addition, Public seminars can be held at the government level to publicize the commercialization of the Biogas plant and present the potential spread of the project continuously.
Nelson Mandela African Institution of Science and Technology	Nelson Mandela African Institution of Science and Technology can help the improved Biogas plant operate as a pilot project locally. And research can be supported to leap forward into more efficient technologies through R&D.

Gongali Model Co. Ltd	Since Gongali Model Co. Ltd has experience in building a biogas plant in Tanzania, it can carry out local production of the improved designed biogas plant.
Tanzania Human Development Foundation (TAHUDE Foundation)	The Tanzania Human Development Foundation (TAHUDE Foundation) is a local organization engaged in environmental NGO activities in Tanzania and plans to implement a role in improving awareness and promoting the residents of the Biogas plant. Also TAHUDE has got funds from the United States Africa Development Foundation (USADF) to build Biogas systems on flexible loans to the grassroots community. The NGO will support the improved Biogas
International Academic institutions (Dankook University, South Korea)	Participating as an international consulting institution, Dankook University conducts a role in reviewing the existing Biogas plant by professional engineers and deriving design conditions for the improved biogas plant.

**Alignment with national priorities** (up to 2000 characters including spaces):

**[Status of Tanzania Energy]** Tanzania has abundant energy potential, including natural gas, hydroelectric power, coal, uranium oxide, biomass, solar and geothermal power. Among them, natural gas has recently been steadily developed as a key energy industry of the government and has become a major energy source that generates 45% of the total electricity. Tanzania began developing natural gas in 1952, and in 1974, natural gas was first discovered in the Songo Songo area 194 km south of Dar es Salaam, and further natural gas was discovered near the Indian Ocean through continuous exploration, resulting in a total of 57.25 TCF (trillion cubic feet) reserves in Tanzania, 2018. The IMF said the reserves are sufficient to supply the UK's demand for 30 years and have the potential to generate \$6 billion in annual revenue. In particular, Tanzania is planning to produce about 20 BCM of natural gas in 2040. As such, I think natural gas will account for a significant part of Tanzania's energy policy in the future. Tanzania's urban areas use LNG or LPG, but in rural areas, only some residents use LPG for cooking at home. World Energy Market Insight reports that the proportion of raw materials such as biomass in cities is expected to decrease due to the introduction of alternative fuels such as LPG and kerosene, but it is difficult to have such an effect in rural areas (World Energy Insight No. 15-1, 2015). In Tanzania, a life culture that uses gas has been established. Therefore, it is believed that there will be no great rejection for residents to use the Biogas provided by the Biogas plant.

Table 1: Electricity production status in Tanzania

	Natural Gas	Hydraulic Energy	Liquid Natural Gas
Product (MW)	625.5	609	188.5
Supply (%)	45	42	13

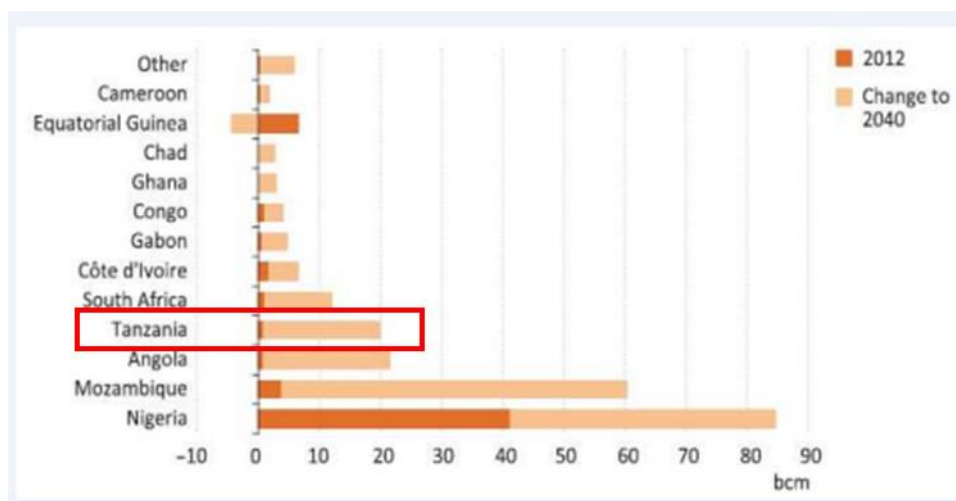


Figure 1: Current status and prospects of Gas production in Sub-Saharan Africa

Arusha, who conducts this project, uses LPG only in some households that can afford living conditions, and most households use it to cook using biomass such as mounting, coal, and brown coal. These solid biomass fuels are still used as energy sources that are highly dependent on local rural residents, and CO<sub>2</sub> generation is also increasing, which is a factor that negatively affects the environment. According to the International Energy Agency (IEA), biomass use accounts for about 70% of the final energy consumption in sub-Saharan Africa. Most biomass consists of firewood, charcoal, straw, and waste, and when used at home, it is not properly ventilated indoors, which is negatively affecting health and the environment by toxic gases (NO<sub>x</sub>, VOC, etc.). Therefore, there is an urgent need for measures to introduce new and renewable energy for residents in rural areas.



Figure 2: LPG Gas (left) and LPG Delivery (Right)

**[Tanzania Energy Policy Direction]** Tanzania established and operated Tanzania Development Vision 2025 (TDV 2025), a long-term development strategy in 2001. TDV 2025 aims to enter a middle-income country with per capita income of \$2,000 by 2025 by improving the quality of people's lives, establishing governance based on the rule of law, and strengthening economic competitiveness. In Tanzania, most of the energy fields were carried out in terms of energy supply and demand for large strategic supply. In the past, in the 400 KV national transmission network construction project, the transmission network construction project between Kenya, Tanzania, and Zambia was actively promoted. However, in rural

areas with poor power support, public electricity using power grids is not available, so it is used as living energy using wood and fossil fuels or LPG. Tanzania first enacted the National Energy Policy (NEP) in 1992 and revised it in 2003. The main focus has been to promote the development of alternative energy and natural resources and to link power systems to provincial areas, but most infrastructure tends to be invested in cities. According to the Tanzania government's power master plan, it plans to improve the power supply rate (%) from 18.4% to 37% in 2012 by 2020, and aims to reach 78% by 2035. Currently, Tanzania has established and operated an urban-centered power infrastructure project plan, but there is still no energy procurement strategy in rural areas, which are underdeveloped areas. Therefore, Korea intends to transfer Korea's accumulated technological know-how, such as the expansion of off-grid using renewable energy, etc. to energy-supported areas.

Table 2: Tanzania Development Vision 2025 and NSGRP Key Goals and Fields

Priority	Goals
1. Growth to reduce poverty	1. Pursuing macroeconomics 2. Reducing poverty through inclusive, sustainable, and job-linked development 3. Creating and maintaining productive and high-quality employment (especially focusing on women, young people, and the disabled) 4. Food security, nutrition improvement, and climate change response 5. Improving the leverage effect of natural resources
2. Quality of life improvement and welfare	6. Ensuring access to quality pre-admission and secondary education for all children 7. Expanding quality vocational education and higher education 8. Improving livelihood, health, nutrition, and welfare 9. Improves access to adequate drinking water and sanitation facilities 10. Development of Residential Environment 11. Providing social protection to vulnerable groups
3. Governance and Accountability	12. Establishing legal order, establishing democratic, effective, accountable, predictable, and transparent governance structures and systems 13. Expansion of service delivery 14. Protection and Promotion of Human Rights for the Poor 15. Preservation and establishment of moral values

**[Carbon Neutral Support by Reducing Carbon Generation]** The international community is trying to raise the temperature of the rapidly warming Earth by 1.5°C by 2050. Therefore, while developed countries offer various national policy directions for carbon neutrality, developing countries are facing difficulties due to clear policy directions and lack of budgets to reduce carbon dioxide, the main cause of the greenhouse effect. Most developed countries are promoting carbon-neutral projects through renewable energy projects such as solar, hydro, and wind power, which are sustainable energy sources in developing countries. Therefore, the project aims to provide residents in Arusha, Tanzania with a plan for carbon neutrality by providing Biogas instead of fossil fuels used at home. In addition, most residents living in the region are farming, so they intend to promote the project by providing natural fertilizers, not chemical fertilizers, to improve the quality of crops and increase farm profits. Therefore, the Biogas plant project provided in this project aims to promote the project in a direction for carbon neutrality by

reducing carbon generation at home, increasing farm profits, and reducing local environmental pollution.

**[Tanzania's Energy Policy Direction for Climate Change Response]** Tanzania is preparing countermeasures against climate change by announcing the National Climate Change Response Strategy (NCCRS) 2021-2026 at the vice president's office in 2021. In particular, the 2015 National Energy Policy aims to respond to climate change through renewable energy as the main policy direction for sustainable operation of energy resources. In addition, the 2015 Tanzania Sustainable Energy for All (SE4All) Action Agenda presents policy directions to improve the efficiency of clean energy, and is used to relieve famine, provide safe drinking water, promote public health and education, strengthen women's social capabilities, and produce food. According to Tanzania Energy Policy 2015, biomass (85.7%) is used as a major energy source. More than 80 percent of biomass is highly dependent in rural areas. Therefore, it is observed as the main cause of destroying the forest. Since the progress of desertification using Biomass and environmental pollution caused by CO<sub>2</sub> generation affect climate change, it presents new and renewable energy policy directions to reduce Biomass in rural Tanzania. Therefore, 8.3 in the energy field of "Strategic Interventions and Action Plan" shown in the figure below suggests strategies for using low-carbon biomass and solar and LPG when using home cooking stoves. Therefore, it is necessary to propose a plan to increase energy efficiency by more than 60% in response to climate change for rural areas by 2026.

8. Energy							
To develop a less carbon-intensive and climate change-resilient energy infrastructures.	8.1 Increase the resilience of the energy system to climate change impact.	At least 60% Increased resilient energy system by 2026	<ul style="list-style-type: none"> <li>Percent increase of energy resilience system</li> <li>Number and gender-lens of energy end-users</li> </ul>	10	2021-2026	<ul style="list-style-type: none"> <li>New energy systems</li> <li>Reports</li> </ul>	Ministry responsible for Energy, Natural Resources, Environment, Local Government; TPDC, EWURA,
							TANESCO, TFS, TMA, Research and Academic Institutions; CSOs; and Private Sector
	8.2 Enhance integrated basin catchment and upstream land management for hydropower sources	At least 60% Improved integrated basin catchment management by 2026	<ul style="list-style-type: none"> <li>Percent of basins and land size managed</li> <li>Number of land use plan developed</li> </ul>	5	2021-2026	<ul style="list-style-type: none"> <li>Improved basin sites</li> <li>Reports</li> </ul>	Ministry responsible for Energy, Land, Water, Natural Resources, Agriculture, Environment, Local Government; Research and Academic Institutions; CSOs; and Private Sector
	8.3 Promote efficient firewood cooking stoves, solar and LPG uses	At least 60% increased use of energy efficient technologies by 2026	<ul style="list-style-type: none"> <li>Percent and types of energy efficient technologies adopted by end users</li> <li>Budget code targeting renewables and efficient technologies for poor households</li> </ul>	10	2021 - 2026	New energy systems Reports	Ministry responsible for Energy, Land, Water, Natural Resources, Finance and Planning, Local Government; Research and Academic Institutions; CSOs; and Private Sector

Figure 3: National Climate Change Response Strategy 2021-2026(Strategic Interventions and Action plan)

**[Biofuels for Greenhouse Gas Reduction]** Tanzania is promoting the use of low-carbon biofuels to reduce greenhouse gases to cope with climate change. Funded by the Global Environment Fund (GEF), UNIDO promoted a project to reduce carbon emissions by supplying bioethanol to 500,000 households living in Dares Salaam, the capital of Tanzania. It helps to raise health risks, especially in relation to indoor air pollution, which affects women and children a lot. Low-carbon biofuels are also in line with Tanzania's government's climate change policy to reduce greenhouse gas emissions and reduce deforestation and land degradation in Tanzania. One of the main goals of biofuels is to reduce

mathematical losses in agricultural products by producing bioethanol from agricultural waste such as sugar cane, molasses, and apples. So ultimately, natural fuel for cooking can be supplied to residents, but it can still be classified as marginalized energy because it consumes a lot of energy from factories to produce bioethanol and bioethanol is mostly supplied to urban residents. Ethanol, a biofuel, is future-oriented with eco-friendly energy, but it is still more expensive than electricity and LPG, which are mainly used by residents.

**[Importance of Biogas Plant Application]** Biogas methane collection technology using anaerobic digestion is a long-standing traditional technology used in many countries. Tanzania's local partners NM-AIST, Gongali Model Co. Ltd, and TAHUDE Foundation are using this technology to produce and distribute local Biogas plants to households so that they can use renewable energy instead of fossil fuels. The biogas methane gas collected using the Biogas plant can be used for cooking at home, reducing toxic gases and carbon dioxide generated from firewood and coal. However, there are many difficulties in the family situation of rural residents because it costs about \$2,000 to build one Biogas plant. Therefore, this project not only supplies new and renewable energy, Biogas, but also aims to use sludge, a by-product of the Biogas plant, as an eco-friendly natural fertilizer. This is the concept of an eco-friendly energy independent village to improve the quality of life of villagers. When promoting this project, a village joint organization is currently being discussed with local related agencies to establish and operate a business structure so that residents engaged in agriculture can receive eco-friendly natural fertilizers made in the Biogas plant. As shown in the figure below, if the existing Biogas plant was built at home and focused on supplying only Biogas, the project aims to build an eco-friendly energy self-supporting village where many farmers can benefit from farming by supplying biogas and using gas stoves and gas lamps.

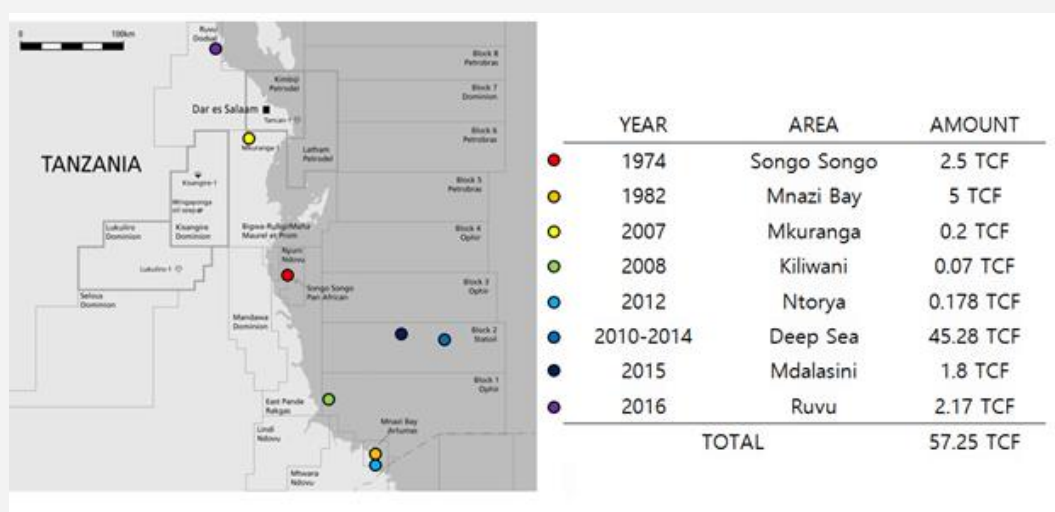
**[Essential project to achieve SDGs]** By 2030, the UN is making constant efforts to achieve 17 SDGs. In this project, the nine goals of SDGs can be classified as projects directly or indirectly, and have a project direction centered on rural areas rather than urban areas. Therefore, SDGs target 1 (reducing poverty and strengthening social safety), target 2 (strengthening food security and sustainable agriculture), goal 3 (ensuring healthy and happy life), goal 4 (quality education for all), goal 7 (greater energy production and economic growth), goal 9 (growth and innovation and infrastructure construction) and goal 15 (climate conservation). SDGs are still on the rise in achievement centered on densely populated cities, but in this project, we intend to cooperate in achieving SDGs goals by promoting projects for residents located in rural areas. The table below summarizes the SDGs goals and the contents of the goals that are consistent with this project.

<b>Reference document</b> (please include date of document)	IEA, 2014( <a href="https://www.iea.org/">https://www.iea.org/</a> ) National Climate Change Response Strategy (NCCRS) 2021-2026 Tanzania Development Vision (2025) Tanzania National Energy Policy Tanzania Domestic Biogas program Country partnership strategy, 2016, KOICA KOTRA, 2018 ( <a href="https://www.kotra.or.kr/index.do">https://www.kotra.or.kr/index.do</a> ) World Energy Market Insight (2015, 15)
Nationally Determined Contribution (NDC)	Direct alignment and contribution to NDC implementation is required for all CTCN technical assistances. Please include a direct reference to the INDC/NDC document (chapter, page number, etc.).
Technology Needs Assessment	Highly needed
National Adaptation Plans	Highly needed

Nationally Appropriate Mitigation Actions	Highly needed
Add others here as relevant	

**Development of the request** (up to 2000 characters including spaces):

**[Social status of Tanzania Energy]** Tanzania's electricity production consists of natural gas (625.5MW), hydroelectric (609MW), and liquefied fuel (188.5MW) as of 2017. Tanzania began developing natural gas in 1952, and in 1974, natural gas was first discovered in the Songo Songo area 194 km south of Dar es Salaam, and through continuous exploration, natural gas was discovered in the Ruvu area in 2016 and is currently producing 57.25 TCF. As such, it can be seen that Tanzania has a large proportion of natural gas use. Tanzania residents use LPG as their main power source in their homes, but they use it mostly in urban areas.



**Figure 4: Location and Status of Natural Gas Store Discovery in Tanzania**

**[Rural area of Tanzania using Biomass]** Tanzania produces natural gas, but most rural residents use Biomass, such as wood, as their main source of raw material. Rural residents are still unable to purchase LPG due to financial difficulties, so they use Biomass, such as the surrounding trees. As shown in the table below, Biomass is the largest energy source in rural areas at 92.4%. And the second most commonly used energy source is coal. Hygiene and health problems at home are caused by the use of Biogas and coal, but large amounts of greenhouse gas generation can lead to climate problems such as global warming.

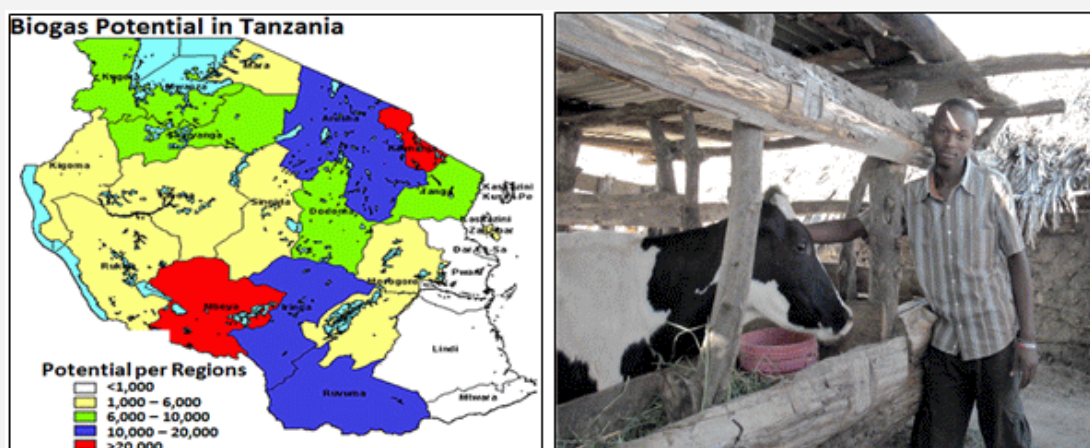
**Table 3: Energy consumption ratio in City and Rural area**

Energy Type	Urban	Rural
Electricity	3.8	0.2
LPG/Natural Gas/Biogas	0.9	0.0
Kerosene and Petroleum	9.4	0.4
Coal	62.2	6.3
Wood(biomass)	20.7	92.4
Etc.	3.1	0.6



**Figure 5: Rural house using Biomass for Cooking**

**[Strategy of Tanzania government to Reduce Biomass]** Tanzania's government is aware of personal hygiene and climate change problems caused by the use of Biomass by rural villagers. Therefore, as a solution to this problem, it is suggested that small feces are collected and Biogas ( $\text{CH}_4$ ) is produced through anaerobic digestion process and can be used as an energy source used at home. Tanzania has the second-largest number of cattle in Africa, and even in rural areas, cattle are raised at home, including livestock farms, so there is no big difficulty in collecting feces. However, producing and distributing Biogas as an appropriate technology suitable for the region requires policy and technical alternatives to be promoted into a small local infrastructure.

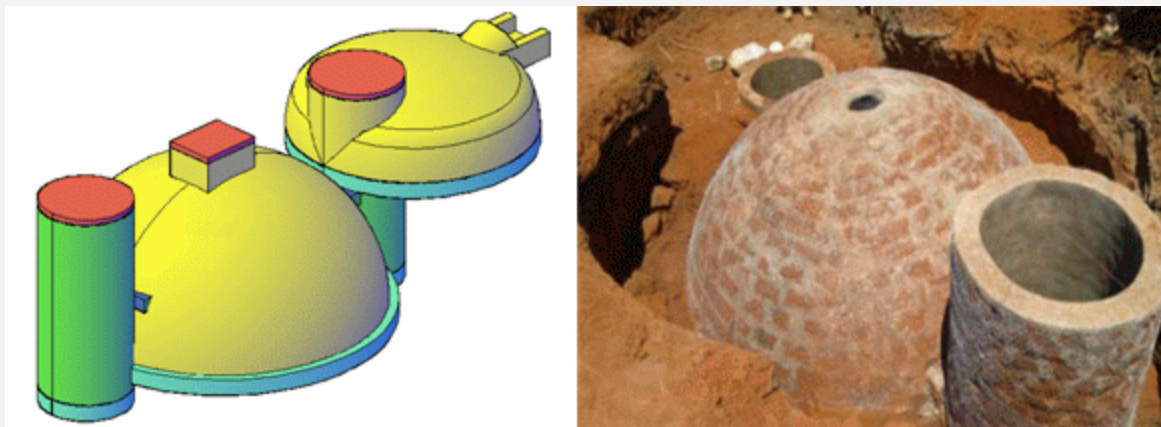


**Figure 6: Cattle areas (Left) and Cattle Farms (Right)**

**[Biogas Plant Suitable for Climate Change Response]** Recently, the Tanzanian government has supported the Biogas plant in rural areas to collect  $\text{CH}_4$  for household. Because the Biogas plant can be built at a low price (About \$2000), it can be supported by rural residents. If rural residents use  $\text{CH}_4$  instead of Biomass, which was used as an energy source at home, it is considered a suitable technology for responding to climate change because it can reduce the amount of  $\text{CO}_2$  generated by using Biomass. In addition, when excrement discharged from livestock farms is discarded, it is indiscriminately discarded to the outside, causing soil and water pollution. In order to purify this, power consumption is high because a purification device must be operated using electric power. Therefore, if feces generated from livestock farms are collected and consumed by the Biogas plant, carbon generation can be reduced while reducing the energy cost of the purification treatment device, and it can be collected up to  $\text{CH}_4$ , which is of great help to climate change.

**[Biogas plant for producing  $\text{CH}_4$ ]** A Professor at Nelson Mandela Africa Institution of Science and Technology (NM-AIST), located in Arusha, Tanzania, is working on a project to build a Biogas plant in

the Arusha area to supply CH<sub>4</sub> to residents. CH<sub>4</sub> produced by the Biogas plant is supplied to homes through gas pipes and used as a gas burner when cooking. However, in order to continuously collect CH<sub>4</sub> in the Biogas plant, a large amount of waste sludge is generated because small feces are injected with water every day. Although this waste sludge is designed to be carried out to the outside, CH<sub>4</sub> collection efficiency is reduced because some waste sludge exists in a state where they are sunk to the bottom of the digestive tank. Therefore, there is a need for a project to suggest a plan for rural residents to effectively embrace CH<sub>4</sub> by operating the Biogas plant.



**Figure 7: Biogas plant**

**[Local application cases of biogas plant]** Gongali Model Co. Ltd., located in Arusha, Tanzania, operates a biogas plant (6,9,12 tons) with the support of the Tanzania government, collecting CH<sub>4</sub> and using it at home. Because feces are injected with water every day, a lot of organic sludge is generated. Since such sludge can be used as compost in nearby farms, crop harvesting efficiency can be increased. Gongali Model Co. Ltd is carrying out the CH<sub>4</sub> gas project through the Biogas plant project with support from the Tanzanian government (Skills Development Fund (SDF) under Tanzania Education Authority (TEA). In particular, even urban residents who are more economically relaxed than rural areas cannot use Biomass, so LPG is purchased and used at home, but they still feel an economic burden. Therefore, to meet the needs of these residents, Gongali Model Co. Ltd is planning to sell CH<sub>4</sub> collected from the Biogas plant to residents at a lower price than LPG. However, since the operation efficiency of the Biogas plant is low, a large amount of CH<sub>4</sub> compared to the injection amount cannot be obtained. If research that can increase the operational efficiency of the Biogas plant is conducted to derive optimal design conditions that can be operated in developing countries and collect a lot of CH<sub>4</sub> through this, it is believed that residents in rural areas will be able to respond to climate change by reducing the amount of carbon generated. In addition, residents living in urban areas have a lower economic burden and can participate in direct or indirect response to climate change by using CH<sub>4</sub>, a renewable energy rather than other fuels. Lastly, since feces generated from cattle are a major cause of environmental pollution, this can be solved at low cost, and the amount of carbon generated can be reduced by reducing the use of external power.

**[Role of project proponents and stakeholders]** This project was prepared in consultation with the Nelson Mandela Africa Institution of Science and Technology (NM-AIST) in Arusha, Tanzania, and Dankook University in Korea. Gongali Model Co. Ltd., a local stakeholder, participates in the design and local production of the Biogas plant and intends to promote the project in cooperation with the Tanzania Human Development Foundation (TAHUDE Foundation) for changes in local residents' perceptions and campaign activities. Through this project consultation system, NM-AIST would like to ask Tanzania NDE of the Tanzania Science and Technology Commission to approve the project, and NDE needs to

understand the current status and limitations of biogas plants in Tanzania to cope with climate change and to plan the project through cooperation. To overcome this, we work with overseas researchers. NDE has a variety of international project experience, so it is expected to join the project as a big collaborator. Therefore, we would like to proceed with the project through continuous discussion and consultation with NDE to promote the project successfully.

**Background documents and other information relevant for the request:**

- Please list all relevant documents that will help the CTCN analyse the context of the request and national priorities. Please note that all documents listed/provided should be mentioned in this request in the relevant section(s), and that their linkages with the request should be clearly indicated. For each document, please provide web-links (if available) or attach to the submission form. Please add any other relevant information as required.
- Please indicate if this request has been developed with the support of the CTCN Request Incubator.

**OPTIONAL: Linkages to Green Climate Fund Readiness and Preparatory Support**

The CTCN is collaborating with the GCF in order to facilitate access to environmentally sound technologies that address climate change and its effects, including through the provision of readiness and preparatory support delivered directly to countries through their GCF NDA. These actions are in line with the guidance of the GCF Board (Decision B.14/02) and the UNFCCC, particularly paragraphs 4 and 7 of 14/CP.22 that addresses Linkages between the Technology and the Financial Mechanisms<sup>2</sup>.

The CTCN is therefore implementing some of its technical assistance using GCF readiness funds accessed via the country's NDA. Any application for GCF support, including the amount of support provided, is subject to the terms and conditions of the GCF and should be developed in conjunction with the NDA.

Please indicate whether this request has been identified as preliminarily eligible by the NDA to be considered for readiness support from the GCF.

**Initial engagement:** The GCF NDA of the requesting country has been engaged in the design of this request and the NDA will be involved in the further process leading to an official agreement for accessing GCF readiness support.

**Advanced engagement (preferred):** The GCF NDA of the requesting country has been directly involved in the design of this request and is a co-signer of this request, the signature indicating provisional agreement to use readiness national funds to support the implementation of the technical assistance.

NDA name:

Date:

Signature:

**Monitoring and impact of the assistance:**

<sup>2</sup> Please see:

[https://unfccc.int/files/meetings/marrakech\\_nov\\_2016/application/pdf/auv\\_cop22\\_i8b\\_tm\\_fm.pdf](https://unfccc.int/files/meetings/marrakech_nov_2016/application/pdf/auv_cop22_i8b_tm_fm.pdf)

By signing this request, I affirm that processes are in place in the country to monitor and evaluate the technical assistance provided by the CTCN. I understand that these processes will be explicitly identified in the CTCN Response Plan and that they will be used in the country to monitor the implementation of the technical assistance following standard CTCN procedures.

I understand that, after the completion of the requested assistance, I shall support CTCN efforts to measure the success and effects of the support provided, including its short, medium and long-term impacts in the country.

**Signature:**

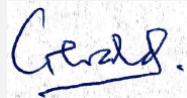
NDE name:

Dr. Gerald Majella Kafuku

Date:

18<sup>th</sup> April 2023

Signature:



**THE COMPLETED FORM SHALL BE SENT TO THE [CTCN@UNEP.ORG](mailto:CTCN@UNEP.ORG)**

The CTCN is available to answer all questions and provide guidance on the application process.