Technical Assistance Closure Report Template

Closure Report for CTCN Technical Assistance

1. Basic information

Title of response plan	Preparation of a national roadmap for the use of low-enthalpy geothermal energy for thermal conditioning in the residential, industrial, and commercial sectors
Technical assistance reference number	2018000018
Country / countries	Uruguay
NDE organisation	División de Cambio Climático (DCC) Ministerio de Ambiente
NDE focal point	Natalie Pareja Directora Nacional de Cambio Climático
NDE contact information	natalie.pareja@ambiente.gub.uy
Proponent focal point and organisation	Fitzgerald Cantero Piali Dirección Nacional de Energía, Ministerio de Industria, Energía y Minería (MIEM), director.dne@miem.gub.uy Wilson Sierra Área Energías Renovables, MIEM wilson.sierra@miem.gub.uy Carla Zilli División de Cambio Climático, Ministerio de Ambiente carla.zilli@ambiente.gub.uy
Designer of the response plan	Wilson Sierra Área Energías Renovables, MIEM wilson.sierra@miem.gub.uy Carla Zilli División de Cambio Climático, Ministerio de Ambiente carla.zilli@ambiente.gub.uy
Implementer(s) of technical assistance	Servicios de Ingeniería Deuman Limitada
Beneficiaries	Área Energías Renovables, MIEM División de Cambio Climático, Ministerio de Ambiente
Sector(s) addressed	Mitigation: Renewable energy, geothermal,
Technologies supported	Heat pumps
Implementation start date	*02/03/2020*
Implementation end date	*25/01/2022*
Total budget for implementation	105,139.00 USD Phase I Initial Contract (Product 1 to 4): Date: March 02, 2020 Amount: USD 58,144.75 Annex Phase II: Date: November 04, 2021 Amount: USD 46,994.26
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	Below is the summary of products 2 – 4, corresponding to the original response plan and products 5 – 7, still under development, according to the changes made by the country. While **Output 1** corresponds to the development of the work plan and communication documents. ***Output 2:*** *Diagnosis of the key actors for the use of low enthalpy geothermal energy in the country*

	Deliverable 2.1 The methodology for prioritizing key actors was developed according to the criteria of commitment, experience, power or influence, and capacity of the key actor represented by an institution, municipality, university, association or company, along with information collected through virtual interviews. As a result, the diagnosis of the key governmental and non-governmental actors reached 34 stakeholders interviewed (42 interviewees, where 24% were women): 15 from governmental institutions, 10 from the private sector, 7 from academia and 2 from associations. In these meetings, relevant information was collected, not only about the current situation or experience of each interviewee, but also about the perceived future opportunities and barriers that the implementation of the technology would face. As a result, 6 key actors were designated as primary; 6, secondary; 13, tertiary and 9, quaternary. ***Deliverable 2.2*** The first preliminary presentation was held on June 5, 2020 (virtually), where 37 key actors were brought together to present the results obtained throughout this second product and strengthen the relationships of low-cost geothermal energy enthalpy and Uruguay. ***Output 3:*** *Analysis of the current scenario of geothermal energy in the country* ***Deliverable 3.1*** According to the geology of Uruguay, one of the geothermal resources with temperatures greater than 25°C was identified as the North Basin formed by basalts that confine the sedimentary aquifers, one of them being the Guarani Aquifer System (SAG). On the ohter hand, with temperatures below 25°C (low enthalpy), there are the geothermal heat pumps (BHP), which allow the use of available energy in rocks, sediments, shallow aquifers, and surface water bodies, located in the first 100 m of depth. Lastly, the identified groundwater resources respond to sedimentary aquifers such as fissured (fractured rock). In relation to the economic evaluation, it was concluded that from 25 kW and 50% of usage factor, the BHP enter the field of competition with aerothermal pumps and biomass boilers, which can have applications both in the residential sector (condominiums, district heating), commercial, and industrial. That is, for individual heating solutions, there is an economic gap between geothermal heat pump and other technologies. Regarding the analysis of the regulatory framework, legal gaps were identified in relation to the use and quality of groundwater for this purpose, as well as in the reinjection, for this reason it is recommended to develop a law that regulates the use of low enthalpy geothermal energy, of both open systems and the technical specifications that installations and BHPs must meet in closed systems. The market analysis identified companies with experience in climate projects in the residential sector and thermal systems in production processes, such as ESCO companies, designers and project planners, installers, operators, and maintenance throughout the value chain, although maintenance is also considered by engineering companies, with a future perspective of expanding their lines of business. The Greenhouse Gas Mitigation Power Assessment identified that 25% of carbon dioxide emissions would be avoided by switching from aerothermal pumps to geothermal heat pumps. While the reduction would be 97.52% if the technology is replaced by supergas stoves. According to the gender analysis, it is important to identify the specific energy needs of women derived from their position in the unequal system of gender relations and associated with carrying out domestic and reproductive activities, the quality of housing and the use of urban space and access to services, as well as associative and productive activities in which they participate. At the same time, special attention must be given to

	the transfer of specific technical knowledge and favour the participation of women in decision-making at different stages of project implementation (diagnosis, implementation, and evaluation). ***Deliverable 3.2*** A second event was held that brings together the key actors to publicize the progress of this technical assistance, on September 7, 2020 (virtually), reaching 25 attendees. ***Output 4:*** Identification of existing barriers to the use of low enthalpy geothermal energy in the country ***Deliverable 4.1*** Given the potential for the application of low enthalpy geothermal energy as an alternative and competitive technology even without promotion and development measures by the government; there are barriers that limit its development and condition it to limited growth. A situational analysis was developed where the weaknesses (gaps) of the microenvironment and the threats (barriers) of the macroenvironment were identified, using the PESTEL matrix, to evaluate the Political, Economic, Social, Technological, Ecological or environmental, and Legal fields. This matrix allows identifying the country's opportunities as measures to be developed. The barriers identified are: (P and L) lack of regulation of geothermal energy and groundwater reinjection, (E) competition from other technology costs in the industrial, residential and commercial sectors; (S) lack of scientific dissemination, ignorance of geothermal energy, its aspects and applications; and the use of firewood and its lack of knowledge of the impacts on health; (T) competition with infrastructure-independent technologies and low availability of BHPs; (E) Environmental ignorance and uncertainties due to environmental impact, drilling and groundwater quality in open systems. In the same way, natural barriers were determined for the same resource, these are due to geothermal conditions, and the site surface and previous works to be considered in the projects. Among the proposed measures are: • Create legislation that encompasses the technical, legal, and economic aspects of low enthalpy geothermal energy. • Disseminate and encourage the development of geothermal energy to generate confidence among consumers and developers. • Implement a register of facilities at the national level. • Promote the importance of the role of research and development that the academy can carry out together with private developers, will develop innovation and development projects. • Develop tools for a rapid assessment of both the available geothermal resource and the size of the underground infrastructure needed. • Giving visibility to equipment supplier and installation companies, for example, with the creation of catalogues that record relevant low enthalpy geothermal experiences, as well as installation companies. • Indicate the price ranges of the different equipment and facilities, to allow economic evaluation in the local market. • Build underground heat collection facilities in coordination with the rest of the infrastructure, which in turn must meet high energy efficiency standards (efficient mechanisms). ***Deliverable 4.2*** The third meeting of key actors was held on February 26, 2021 (virtually) and a meeting of 15 attendees was held to present the proposed measures that respond to the identified barriers. The attendees defined the level of priority and difficulty of the measures according to their experience in their sectors. As well as proposals for the

	dissemination of knowledge. In summary, most of the measures turned out to be all very high priority and very high to medium difficulty on average. ***Output 5:*** *Call for the selection of projects of interest to develop a low enthalpy geothermal pilot* The call was developed at the national level from October 18 to November 5, 2021, receiving 15 projects, 6 registered as expressions of interest and 9 registered as project ideas. From these projects, 5 applications were from the residential sector, another 5 within the commercial sector, 4 within the industrial sector and the last one was identified as an innovation and development project. These projects were prioritized for their relevance, replicability potential, environmental impact, project profitability and climate change mitigation; being these last two exclusive for project ideas. As result of the prioritization, three projects were pre-selected to know the status of each one and to evaluate the feasibility of carrying them out as a pilot demonstration project. Finally, the heating project at Rural School No. 76 in Colonia Wilson was selected having as an advantage the existence of an open system already installed by other research and with proven thermal potential. However, although its economic analysis was not feasible, since it is a social project, it is necessary to evaluate financing options for its development, adding the positive impact that it will generate in the community and the high potential for replicability in other types of similar spaces such as schools. ***Output 6:*** *Feasibility analysis for the development of a low enthalpy geothermal project* The feasibility analysis for the development of the project includes the sizing of the air conditioning system, the energy demand, the components of the climate system, the conditions of the land and civil works, the operating parameters and minimum characteristics of the equipment, the social impacts of the and environmental benefits, and the corresponding economic analysis. Part of the information was taken from the research of the Universidad de la República (UdelaR) "Project of seasonal accumulation of solar energy in aquifer for thermal conditioning". From the quantification of thermal loads, it was identified that there is an installed capacity of 21 kW that covers the air conditioning needs in the 3 classrooms of the rural school. This installed capacity is expected to be covered by a high-performance heat pump equivalent to a COP of 4.3, which is expected to reduce by 61% the current electricity consumption associated with the aerothermal air conditioning system. In addition, the study site has a predominance of coarse and very coarse-grained sandy sediments, with variations in the percentage of gravels and silty-clays, conditions that support the extraction and re-injection of groundwater. However, although the aquifer can be highly productive to supply the energy demands of small projects (<30tWt), it is necessary to consider the use of more than one well to afford the minimum required flow. Regarding the economic analysis, regarding the review of the CAPEX and demand for the project; although the CAPEX becomes 56% more expensive, the demand compensates by growing by 45%. When these elements are taken to a new economic assessment, the economic result improves with respect to the prefeasibility assessment, although the total result still shows an NPV of less than zero, which means that, under these conditions, the project does not generate economic value with respect to the base case (maintaining split systems). However, if there were a cost reduction of 26% with respect to the reviewed CAPEX, a break-even point is obtained, which means that for that CAPEX value (USD$34,775) and maintaining the demand, the NPV of the project is zero and then the difference with respect to the base case is reached. This cost reduction could be achieved if the equipment purchasing process allows for competitive bids from suppliers and other economic efficiency improvements. This cost reduction could also be achieved through financial support, where a grant or non-reimbursable fund of approximately US$ 12,500 would also make up the difference.

	Finally, about the socioeconomic benefits associated with the implementation of the project, a reduction in greenhouse gas emissions of 0.009 tonCO_2 per year is projected, considering 2020 as the reference year; this reduction is associated with a decrease in energy consumption and is also linked to the mitigation of climate change in the area. In addition, the population that will mainly benefit the project, will be the students at the rural school, as the installation of the heat pump will ensure an improved performance of the air conditioning system regardless of the weather season, allowing children to have continuous and regular access to educational services. ***Output 7:*** *Financing Options Assessment Report and Training Report* The most appropriate financing instruments were identified for the projects registered in the call made in Output 5, considering their economic analysis. A review of the main financing offers available in the market was carried out, considering private and national banks, development and multilateral funds and the National Agency for Innovation and Research. Those funds with the greatest experience in financing green projects were selected, among other criteria. Additionally, financial incentives offered by the Uruguayan government to promote the development of energy efficiency projects were identified. In this review, no financial instruments with a specific focus on the development of low enthalpy geothermal projects were found available in the Uruguayan market, but it is possible to get access on lines of subsidies, loans, or general guarantees for any type of project, so that the efforts of the State to promote the development of low-enthalpy geothermal projects should be increased. Despite the abovementioned, the María Viñas Fund was identified as the most appropriate financing option for the previous selected pilot project, since the reimbursable funds allow the NPV of the project to take positive values and reduce the Payback to a period close to 2 years, allowing it to apply to an additional financial fund to cover the missing amount, as is the case of the loan offered by HSBC Bank. On the other hand, the other projects analysed were not found to be economically viable since the financing amounts are very high, so it is recommended to generate alliances with ESCO companies since they are companies with experience in the development of energy efficiency projects with financial institutions. Finally, in the last section is included the Training report of the workshops held from May 19 to June 2, where the topics developed in previous outputs were explained, such as basic concepts on geothermal energy, the current situation in Uruguay, geothermal heat pumps, project design and assessment, economic analysis, and financing options.
Methodologies applied to produce outputs and products	Specific methodologies were developed for the diagnosis of key actors in Output 2, through the development of a data base of actors, interviews, filling out information sheets, selection of prioritization criteria (commitment, experience, power or influence, and capacity) and categorization of actors. In Output 3, an economic evaluation was carried out, which consisted of a technological comparison on generic projects, to identify the scope of competition between the geothermal heat pump alternative and two of its direct competitors: electric heat pump and biomass boiler. Additionally, the Guidelines of the Intergovernmental Panel on Climate Change (IPCC) of the energy sector were used to calculate greenhouse gas emissions. As for Output 4, a methodology for identifying barriers was developed through a situational analysis and the PESTEL matrix; while the prioritization of measures to reduce barriers was carried out through surveys at the third stakeholder meeting. Additionally, surveys were carried out to call for pilot projects as part of the development of Output 5. In Output 5, the methodology was developed in 3 stages, the first one included the publication of the call on the communication pages of the Ministerio de Industria, Energía y Minas and the Ministerio de Ambiente. The second phase was the assessment of all projects submitted to the call under the following criteria: relevance, replicability potential, environmental impact, project profitability and climate change mitigation. From this evaluation, three projects were pre-selected. Finally, in the last phase, a pre-

	feasibility re-evaluation was carried out, resulting in the final selection of a single project. For Output 6, the thermal loads of the rural school and the geothermal air conditioning system were quantified. To size the system equipment, the energy consumption was determined as well as the heating/cooling power to cover the energy demand of the school to be air-conditioned, this was based on the information of materials and meteorological characteristics of the area. From the calculated energy load, it was possible to calculate the necessary performance of the heat pump to be installed as well as the configuration of the air conditioning system. Finally, a detailed valuation of the different cost items associated with the project was carried out to establish the CAPEX value at the basic engineering level, corrected with respect to the preliminary evaluation previously carried out in the consultancy (prefeasibility). Finally, for Output 7, the economic analyses of the projects registered in the call were taken up again and, through a web-based review of available information, the different financing instruments available in the Uruguayan market for the development of energy efficiency projects were compiled, mainly considering those instruments offered by national banks and development funds.
Reference to knowledge resources	Does not apply.
Deviations	Although the results of products 2 – 4 confirmed the viability of the use of low enthalpy geothermal energy for thermal conditioning in the country, there are still significant barriers to starting a market in a significant period. Therefore, the decision is made to consider: • Output 5: Call for the selection of projects of interest to develop a low enthalpy geothermal pilot. • Output 6: Feasibility analysis for the development of a low enthalpy geothermal project. • Output 7: Assessment of Funding Options Report, and Training Report. In replacement of Output 5 “Development of the draft roadmap” and Output 6 “Development of a concept note for international climate finance”, described in the Response Plan.
Anticipated follow-up activities and next steps	Approval of the financing to be granted by the Ministry of Environment of Uruguay for the development/construction of the geothermal project in the rural school of Colonia Wilson.

2. Lessons learned

	Lessons learned	**Recommendations**
Lessons learned from the CTCN TA process	The support and participation of the person in charge of the CTCN was important for the monitoring and continuation of the TA. Participation of the focal points was essential in the call for projects, achieving a greater scope of responses.	The call of the interested parties must be made in conjunction with the focal points, which would guarantee a greater participation of these in the workshops held. Consider regulating the use of low enthalpy geothermal energy, especially the use of open systems, fundamental for a greater reach and understanding of the interested parties, as well as the participation of DINAGUA, through the focal points.
Lessons learned related to climate technology transfer	The development of workshops for meetings of interested parties to describe low enthalpy geothermal energy, helped to provide greater knowledge and reduce uncertainties in economic issues, environmental impact, and technology installation.	It is recommended in the long term to be able to generate the roadmap for the development of low enthalpy geothermal energy, which has great potential, especially in new installations, avoiding cost reduction.

		There are financing opportunities that currently exist for energy efficiency projects, which should be more visible to the population. Communication to the population about this little-known technology in the country.

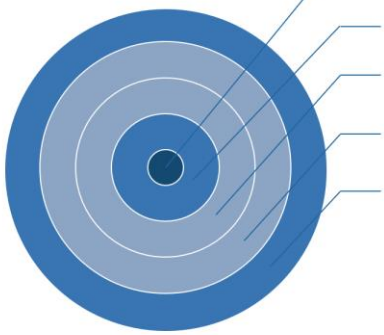
3. Illustration of the TA and photos

- **Second working table:** meeting with the Ministerio de Ambiente and the Ministerio de industria, energía y minería (MIEM) to present the stakeholder evaluation methodology.

- **First meeting with stakeholders** (preliminary presentation of Output 2)

Identificación de actores

5 ítems que reúnen las principales necesidades detectadas a través de las entrevistas realizadas, así como sus principales actores que responden a estas



LEY - REGULACIÓN
- MIEM (DNE), MVOTMA (DICACL, DINAMA, DINAGUA), CeReGAS (*asesoramiento técnico*)

SUBSIDIOS
- UTE, DNE, ANII, ANDE

POTENCIAL GEOTÉRMICO
- ACADEMIA, PRIVADOS

PROYECTOS
- INTENDENCIAS, CTA, CIU

VENTA DE TECNOLOGÍA - INSTALACIONES
- PRIVADOS: ESCOs

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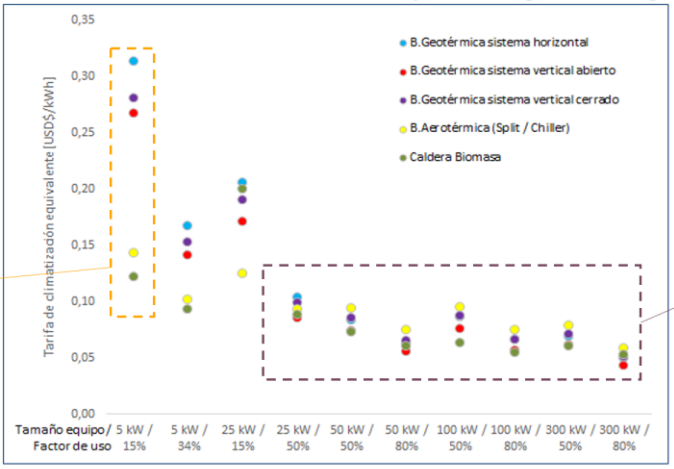
➢ **Second meeting with stakeholders** (preliminary presentation of Output 3)

Resultados del ejercicio

Tarifa de acondicionamiento térmico equivalente [UYU$/kWh]



Para soluciones individuales de calefacción, existe una brecha entre bomba de calor geotérmica y otras tecnologías

A partir de 25 kW y 50% de factor de uso, bomba de calor geotérmica entra en ámbito de competencia con aerotermia y caldera a biomasa

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➢ **Third meeting with stakeholders** (preliminary presentation of Output 4)

2. Legal y política

BARRERA	Medidas a desarrollar
Falta de regulación	✓ Crear una legislación que abarque los aspectos técnicos, legales y económicos de la geotermia de baja entalpía. ✓ Divulgar e incentivar el desarrollo de la geotermia con el fin de generar confianza entre los consumidores y desarrolladores.
Regulación de sistemas abiertos	✓ Adoptar y modificar experiencias exitosas de países con tradición en la gestión de aguas subterráneas. ✓ Fomentar la importancia de los contextos hidrogeológicos de Uruguay para la reinyección de agua subterráneas ✓ Fomentar la importancia del rol de la investigación desde la academia en conjunto a privados, generando proyectos de innovación y desarrollo. ✓ Impulsar la participación de ANCAP y DINAMIGE, por su conocimiento e información disponible del subsuelo

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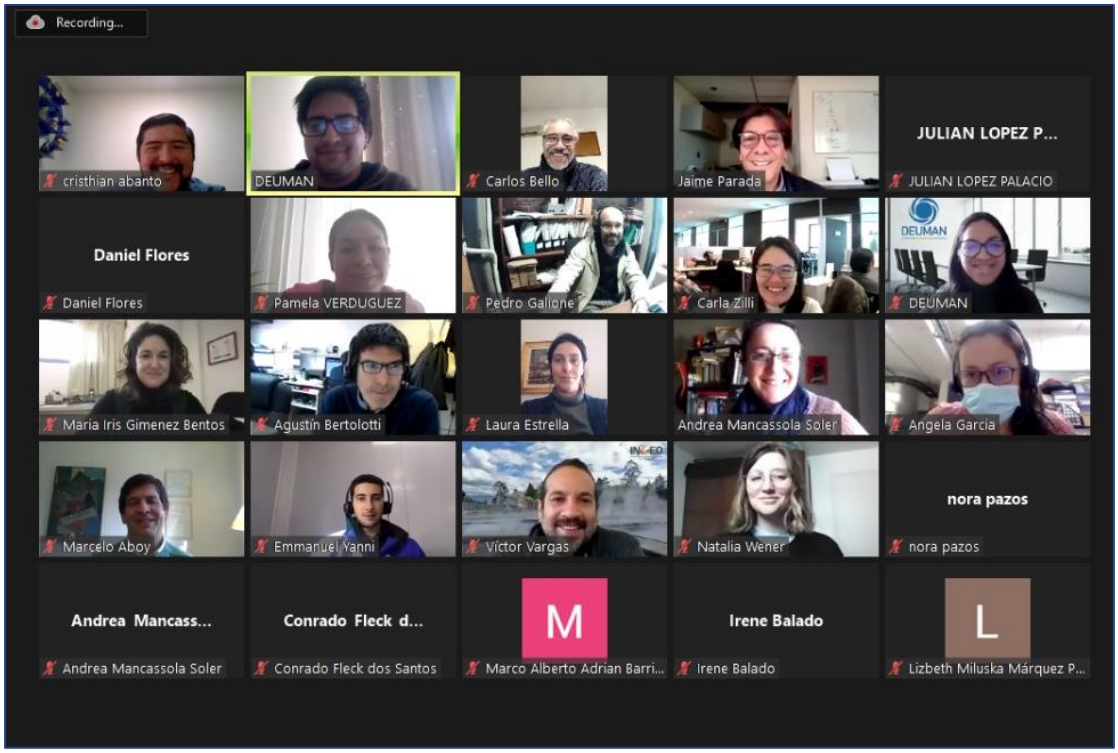
- **Photographs of attendance at the First Meeting** (June 5, 2020)

- **Cover page of the slides shown at the workshops**

- **Photographs of attendance at the last Workshop** (June 2, 2022)



4. Impact Statement

Challenge	Uruguay has not focused until now on the development of projects or programmes in the public and/or private sector in relation to geothermal energy. This is because there are no real and/or conclusive assessments of geothermal potential in Uruguay. The limited knowledge and diffusion of technology, its applications and benefits, make it difficult to develop a regulatory framework to promote this type of energy, as prioritized in the report on the assessment of technological needs in the energy sector for climate change mitigation in Uruguay.
CTCN Assistance	• Diagnosis of key actors for the development of low enthalpy geothermal energy • Analysis of the low enthalpy geothermal potential and its technical-economic viability for thermal conditioning (heat/cold). • Identification of barriers and measures to reduce them for the use of this technology. • Identify potential projects for the residential, industrial, and commercial sector.
Anticipated impact	• *Reduction of the consumption of the electrical network, due to the lower electrical demand necessary with the use of geothermal heat pumps.* • Reduction of 0.09 tCO2e as a post TA result of developing the project "Geothermal air conditioning in a school in the Raigón aquifer" and the reduction of electricity demand of 3 195 kWh. • Closing of knowledge gaps about the technology and increased interest in the mapped actors.
Co-benefits: Achieved or anticipated co-benefits from the TA	• Contribution to energy sovereignty by reducing dependence on oil. • Lower costs in a scenario of rising prices of fossil fuels. • Compensation for fluctuations in electricity generation in complementarity with other renewable energies. • Reduction of pollutant emissions associated with combustion in thermal power plants. • Potential generation of skilled jobs in one of the country's most socio-economically depressed areas (North-West) • Settlement of the rural population and increased demand for services around the creation of a new energy industry • Synergies with other economic activities since in certain technologies the residual geothermal potential can be used for the tourism industry (hot springs) or other (heating of horticultural greenhouses, heating of stables for keeping confined animals, etc.) • Contribution to generating in the population a culture of sustainable development.
Gender aspects of the TA	The **gender balance** was developed in Output 3.1, this describes the situation of women in Uruguay in different relevant areas and the resources available to the country to guarantee gender inclusion in the project. This input on the current situation of women in the country served as a tool for the development of the **Gender Action Plan**, presented together with Output 4. For the development of these inputs, interviews were carried out with those in charge of the issue both in the Climate Change Directorate of the Ministry of Environment, Social Development and Gender Unit Coordinator of the National Directorate of Energy, National Women's Institute (INMujeres) and the Interinstitutional Table of Women in Science, Innovation and Technology (MIMCIT). The Gender Action Plan had gender guidelines for the preparation of a roadmap and guidelines to align future projects that will use low enthalpy geothermal energy with equality, gender equity and women's autonomy. Each of these guidelines with measurable indicators for monitoring and compliance.
Anticipated contribution to NDC	This TA will contribute to Uruguay's Nationally Determined Contribution in the following goals: • Develop with the lowest possible intensity of GHG emissions, decarbonizing its economy over time.

	• Reduce the intensity of CO_2 emissions per unit of GDP by 24% (unconditionally) in 2025 in relation to 1990 values. • Reduce 29% of conditional intensity to specific additional means of implementation.
The narrative story	In Uruguay, increased energy demand encouraged the country to work in a diversified energy matrix with a high component in autochthonous renewable energy. As a result, in 2018 62% of primary energy came from renewable sources, which in turn accounted for 97% of the national electricity generation. With the aim of contributing to a more robust and decarbonized energy system, Uruguay is willing to increase the percentage of Non-Conventional Renewable Energy (NCRE). Therefore, the country requested a technical assistance on the feasibility of geothermal energy for thermal conditioning to the CTCN. Among the barriers identified for its use, the lack of a regulatory framework and the lack of knowledge about the technology, its applications and benefits prevent the use of this technology in the energy sector for climate change mitigation. Thus, this technical assistance will carry out a general analysis of the potential of geothermal energy for thermal use in the country and to evaluate the technical and economic feasibility of the development of low-enthalpy geothermal energy (open and closed system) for the purpose of thermal conditioning (heat/cold).
Contribution to SDGs	• ***SDG 7.2:*** The technical assistance will contribute to the increase of geothermal energy in the primary supply matrix. • ***SDG 8:*** The project is expected to open opportunities for technology-related enterprise development and new jobs • ***SDG 13.2:*** It is expected that the use of low enthalpy geothermal energy will be regulated and the technology will be included in decarbonization strategies.

Annex 1 Technical assistance data collection

A. Output and outcome indicators

Indicator	Quantitative value	Qualitative description
1. Events (other than trainings) held as part of the assistance		
Total number of events organized by proponents and implementing partners	*3*	Preliminary Presentations of results to stakeholders (Output 2, output 3 and output 4)
Number of participants in events organized by proponents and implementing partners	*78*	*37 participants in 1° Preliminary Presentations* *25 participants in 2° Preliminary Presentations* *16 participants in 3° Preliminary Presentations*
a) Number of men	*53*	*28 men participants in 1° Preliminary Presentations* *17 men participants in 2° Preliminary Presentations* *8 men participants in 3° Preliminary Presentations*
b) Number of women	*25*	*9 women participants in 1° Preliminary Presentations* *8 women participants in 2° Preliminary Presentations* *8 women participants in 3° Preliminary Presentations*
Number of climate technology RD&D related events	*Does not apply*	
Number of participants in climate technology RD&D events	*Does not apply*	
a) Number of men	*Does not apply*	
b) Number of women	*Does not apply*	
2. Training and capacity building activities conducted during the assistance		
Number of trainings organized by proponents and implementing partners	*1*	*Training Report of Output 7*
Number of participants in trainings organized by proponents and implementing partners	*75*	*46 participants in 1° workshop* *42 participants in 2° workshop* *51 participants in 3° workshop* *39 participants in 4° workshop* *32 participants in 5° workshop* *40 participants in 6° workshop*
a) Number of men	*49*	*31 men participants in 1° workshop* *28 men participants in 2° workshop* *34 men participants in 3° workshop* *25 men participants in 4° workshop* *24 men participants in 5° workshop* *25 men participants in 6° workshop*
b) Number of women	*26*	*15 women participants in 1° workshop* *14 women participants in 2° workshop* *17 women participants in 3° workshop* *14 women participants in 4° workshop* *8 women participants in 5° workshop* *15 women participants in 6° workshop*
Total number of institutions trained	*31*	*4 governmental organizations participants* *18 private corporations participants* *7 universities participants*
a) Governmental (national or subnational)	*4*	*2 national governmental organizations* *2 subnational governmental organizations*

Indicator	Quantitative value	Qualitative description
b) Private sector (bank, corporation, etc.)	*18*	*18 private corporation participants*
c) Nongovernmental (NGO, University, etc.)	*7*	*7 universities participants* *10 independent participants*
Percentage of participants reporting satisfaction with CTCN training (from CTCN training feedback form)	*30,7%*	*23 of the 75 attendees filled out the satisfaction survey (30.7%):* *Satisfaction with the topics covered* *-Excellent: 65%* *- Good: 35%* *- Regular: 0%* *-Bad: 0%* *Depth of topics covered* *-Excellent: 35%* *- Good: 61%* *- Regular: 4%* *-Bad: 0%* *Applicability to your professional area* *- A lot: 78%* *- Little: 22%* *- Nothing: 0%*
Percentage of participants reporting increased knowledge, capacity and/or understanding as a result of CTCN training (from CTCN training feedback form)	*30,7%*	*23 of the 75 attendees filled out the satisfaction survey (30.7%):* *Usefulness of the workshops for your knowledge* *- A lot: 96%* *- Little: 4%* *- Nothing: 0%*
Participants who received a certificate of participation for attending the workshops.	*39*	*Awarded to 52% of the participants for attending a minimum of 4 trainings out of the 6 total.*
a) Percentage of men	*66.7%*	*26 men received certificate of attendance*
b) Percentage of women	*33.3%*	*13 women received certificate of attendance*
3. Tools, technical reports and information material supported by the assistance		
Total number of deliverables produced during the assistance (excluding mission, progress, and internal reports)	*12*	*Output 1, 2 (2.1 and 2.2), 3 (3.1 and 3.2), 4 (4.1 and 4.2), 5, 6, 7, closure report and gender action plan*
Number of communication materials, including news releases, newsletters, articles, presentations, social media postings, etc.	*5*	*1 flyer calling for projects for the use of low enthalpy geothermal energy (Output 5)* *3 invitations to preliminary presentations to stakeholders (Output 2, 3 and 4)* *2 publications of the call on the official pages of the Ministerio de Ambiente and MIEM (Output 5)*
Number of tools and technical documents strengthened, revised or developed	*12*	*Output 1 (work plan, monitoring and evaluation plan, Impact description)* *Activity 1.4 Closure report* *Activity 2.1: Diagnosis of key actors* *Activity 2.2: Kick-off meeting to present the technical assistance to the key stakeholders* *Activity 3.1: Analysis of the current scenario of low enthalpy geothermal energy in the country*

Indicator	Quantitative value	Qualitative description
		Activity 3.2: Meeting for the presentation of the results to key stakeholders *Activity 4.1: Identify the barriers to the use of low enthalpy geothermal energy in the country and propose measures/recommendations to reduce them.* *Activity 4.2: Meeting for the presentation of the results to key stakeholders* *Gender action plan* *Output 5: Call for the selection of projects of interest to develop a low enthalpy geothermal pilot* *Output 6: Feasibility analysis for the development of a low enthalpy geothermal project* *Output 7: Assessment of Funding Options Report, and Training Report.*
Number of other information materials strengthened, revised or created (For example training and workshop reports, Power Points, exercise docs etc.)	*24*	*9 Power Points* for presentations to Local Authorities (working tables) *3 Power Points for* Preliminary Presentations of results to stakeholders (Output 2, output 3 and output 4) 9 minutes of the meeting of working tables 3 minutes of the meeting, including the participant list (preliminary presentation to stakeholders)
Number of working tables executed with Authorities of the ministry of environment and energy	*7*	*7 working tables executed*
4. Diagnosis of key actors		
Total, number of meetings with stakeholders	*34*	*15 public sector institutions* *10 private sector companies* *7 academy entities* *2 associations*
Number of participants in interviews	*58*	
a) Number of men	*40*	
b) Number of women	*18*	
Total, number of minutes of the meetings of the interview	*34*	*1 meeting minute for each interview*
5. Policies, laws and regulations supported by the assistance		
Total number of policies, strategies, plans, laws, agreements or regulations supported by the assistance	*Does not apply*	-
a) Adaptation related	*Does not apply*	-
b) Mitigation related	*Does not apply*	-
c) Both adaptation- and mitigation related	*Does not apply*	-
Anticipated number of policies, strategies, plans, laws, agreements or regulations proposed, adopted or implemented as a result of the TA	*Does not apply*	-
a) Adaptation related	*Does not apply*	-
b) Mitigation related	*Does not apply*	-

Indicator	Quantitative value	Qualitative description
c) Both adaptation- and mitigation related	*Does not apply*	-
Anticipated number of technologies transferred or deployed as a result of CTCN support	*1*	*Heat pumps*
6. Partnerships and cooperation		
Anticipated number of collaborations facilitated or enabled as a result of technical assistance	*0*	
a) Number of South-South collaborations	**0**	
b) Number of RD&D collaborations	**0**	
c) Number of private sector collaborations	**0**	
Number of countries with strengthened National System of Innovation as a result of CTCN support	**0**	

B. Core impact indicators

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**	Anticipated metric tons of CO_2e reduced or avoided as a result of the TA **in total**
Quantitative value *(emissions reductions)*	*0.09*	-
Unit	tCO_2e	tCO_2e
GHG assessment boundary (project emissions) Identify expected post-TA activities, associated effects and assess boundary for quantification of GHG emission reductions	*It is expected that the development of the project "Geothermal air conditioning in a school in the Raigón aquifer", a pilot project prioritized in Output 5 and evaluated in Output 6; installed optimally, resulting in an approximate reduction of 0.09 tCO2e.*	-
Baseline emissions Describe baseline scenario, baseline candidates, emission factors and emissions calculated	*The current demand of the Project (without geothermal energy) is 3.195 kWh, which would generate 0.14 tCO2e in one year, considering an emission factor for electricity transmission of 45tCO2/GWh for the year 2020 according to the Uruguayan National Energy Balance (MIEM, 2020).*	-
Methodology	*The data of the current demand of the project and the evaluation of the future demand in an open system are calculated in Output 5 (Project*	-

Explain the method or process of verifying the indicator and how data was gathered	*N°5), the first one was collected from the questionnaire for the call for projects.* *While, for the calculation of emissions, the following formula is considered:* *Emissions tCO2 = Emission factor [tCO2/GWh] x Electric demand [GWh]*	
Assumptions Describe assumptions made during calculation and quantification of GHG reductions	*Considering that the installation of a geothermal heat pump with a COP of 4.3 with an open vertical geothermal collector with a well that requires a necessary flow between 1.2 - 2.1 L/s; the electrical requirement would decrease to 1,248 kWh, which would generate 0.06 tCO2e (considering the same emission factor for electrical transmission as in 2020 for Uruguay)*	-

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**
Infrastructure and built environment	-
Ecosystems and biodiversity Anticipated increased ecosystem resilience (areas with increased resistance to climate-induced disturbances and with improved recovery rates)	-
Economic Anticipated increased economic resilience (e.g. less reliance on vulnerable economic sectors or diversification of livelihood)	Low enthalpy geothermal energy for heating and conditioning of large areas, presents economically profitable projects where energy savings allow low payback. This will increase the resilient economy of the urban and rural areas of Uruguay affected in the future by the increase in average temperatures and the presence of heat waves. The NDEs are expected to follow up on the results of the TA for the development of viable and profitable pilots.
Health and wellbeing Anticipated increased health and wellbeing of target group (e.g. improved basic health, water and 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	*60*	
Number of adaptation beneficiaries	-	-
Number of mitigation beneficiaries	-	-
Number of adaptation-and mitigation beneficiaries	60	*The Pilot Project to be developed in Rural School No. 76 in Colonia Wilson has 60 beneficiary students. In relation to adaptation to climate change, it ensures thermal comfort for students. On the other hand, the project would help reduce 61% of greenhouse gas emissions.*

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	-	-	-	-
Anticipated amount of public funding mobilised from national/domestic sources	-	-	-	-
Anticipated amount of public funding mobilised from international/ regional sources	-	-	-	-
Anticipated amount of private funding mobilised from national/domestic sources	-	-	-	-
Anticipated amount of private funds mobilised from international/regional sources	-	-	-	-

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.

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.