LEAP-RE

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Presentation of a more detailed Plan of Activities for the whole WP11

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Summary

The EU-funded (H2020) project 'Geothermal Village', within the LEAP-RE program, aims to introduce geothermal-based stand-alone electric and thermal energy systems to off-grid African communities. The Geothermal Village (GV) concept proposes a geothermal exploitation in a cascade mode, from electricity production from hot geothermal fluids to thermal energy direct use from lower temperature fluids for a large variety of applications, based on the local needs and income sources (e.g. agricultural drying process, manufactural uses, greenhouses heating, hot-springs-based tourism). Based on both geological and socio-economic analyses of selected sites, the project?s contributors will provide template case-studies on developing a suitable GV energy plan, adapted to the local community needs. Templates and guidebooks produced by this project for the implementation of the GV concept will seek to keep the energy plans to the technology level appropriate to the local operation and maintenance capacities. This effort will be made in order to optimize the large-scale replicability of the GV concept, as well as the local appropriation of the geothermal facilities. The use of satellite images and data, especially DEM, is fundamental for the geological investigations in order to characterize the structural and hydrogeological features of the prospect areas. The targeted areas of this project are located in Djibouti, Kenya, Ethiopia and Rwanda, all localized within the East African Rift System.

Approval

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LEAP-RE

Long-Term Joint EU-AU Research
and Innovation Partnership on Renewable Energy

Detailed Work Plan WP11
Geothermal Village

Deliverable D11.1

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Table of Content

Acronym

DoA	Description of Action
GA	Grant Agreement
MS	Milestone
M&E	Monitoring & Evaluation
O&F	Organisational & Funding
tbd	to be determined
WP	Work Package

1.1. Description of WP11– GEOTHERMAL VILLAGE

See Annex 1: WP11 GANTT Chart
Work Package Leader- co-Leader: Yves Geraud, Université de Lorraine (UL),

State of the Art

As background, Africa - in particular all along the East African Rift System (EARS), and the Cameroon line - has geothermal resources of high value (shallow volcano-tectonic related, Varet, 2018, Gardo & Varet, 2018). Kenya now relies on large-size geothermal plants (700 MWe!) to ensure the country's electric baseload. Nevertheless, the resource – even if exceptional with steam available at the surface - is essentially untapped, particularly in the remote regions of the countries where the societal needs are highest (Mariita et al, 2016). Thus, relatively inexpensive boreholes can tap quite hot fluids (150°C), sufficient for electricity and many domestic, agricultural and industrial processes. That this energy resource is not used is due largely to a lack of reference (demonstration) projects. The principal is understood, but R&D (know-how) is required to implement at the local organization level. It has to come from Africa: the nature of the geothermal resource and energy demand in Africa is significantly different from that in Europe (Varet et al, 2014; Onyango & Varet, 2018). This energy will alleviate reliance on oil and wood, provide stable local power for unreliable grid, reduce the demand for extension of the electric grid and eventually contribute to feed the grid. It is amenable to integration with all other REs.

This project consists of the two first steps along the path towards installing physical "Geothermal Village" energy demonstration systems. The first step is identifying sites, characterizing them, and arriving at a generic energy-system plan. All these have technical and social elements. The second step is site feasibility and design. The third step, not in this project, would be the construction of demonstrator systems.

Here we propose to determine four suitable "Geothermal Village" sites selected from the EARS in the volcanic areas of the 4 African participating countries. Thus, for Rwanda partnership is with EDCL; for Ethiopia it is with AAU and AGAP; for Kenya it is with SEPCO and local CBO), and for Djibouti it is with ODDEG. We aim to develop model plans for high-enthalpy sites in the Eastern Rift and Afar, and a medium-enthalpy site in the W Rifts (cf. Arnason et al 2016) and to represent the variation in societal context, where the requirements of pastoral indigenous, fishing or agricultural communities each imply a different use of the electricity and thermal water. (Onyango & Varet, 2014; 2018).

Objectives

Our main objective is to introduce geothermal-based stand-alone electric and thermal energy systems to off-grid African communities. Geothermal is a flexible, permanent energy source, hence a *second objective* of our African-European R&D group is to provide template case-studies on adapting the energy systems to community needs. We will demonstrate this by choosing sites with different thermal and socio-economic characteristics, developing for each a suitable energy plan. We aim to keep the technology level appropriate to local operation, maintenance and even replication, which furthers the long-term objective of capacity building, economic and social welfare, and encourage young educated people to stay on their homeland. Finally, these systems can supply fresh water and supplant oil and firewood which, in addition to environmental and health benefits, reduces the domestic expense and workload on women and girls allowing time for education and productivity.

Our ambition is to develop a few relevant demonstration systems of stand-alone systems discussed above (in *concepts* and *objectives*) adapted, ad hoc, to the specific socio-economic needs of the local community, at an appropriate technology level. This includes electricity production serving a local grid with an *en-cascade* of direct uses integrated with the local economy. First investigations (ref.3) show that hundreds of sites along the EARS have geothermal resources appropriate for such developments.

Each installation will allow modular expansion according to needs. The development of the *Geothermal Village* concept requires geoscientific and social sciences research, the development of appropriate technologies, engineering, and capacity building in both technologies and socio-economics (ref.4). In this project European and African entities will jointly research and develop the conceptual, engineering and physical tools to support community-based initiatives and develop local capabilities, working through schools, universities, public and private entities, cooperatives CBOs and NGOs. *Our ambition* is to create in Africa the capacities to master the whole chain of basic knowledge, technology management, social organizations and economic capabilities to ensure the maintenance, extension and replication of community-based geothermal projects.

Relation to the PRE-LEAP-RE Multi Annual Roadmaps: This project directly addresses the LEAP-RE multi-annual road maps N°4 (Smart grid for off grid application), N°3 (Smart stand-alone systems) and N°5 (Processes and appliances for productive uses). The project also addresses other roadmaps especially concerning climate resilience, developing capacities at the individual and institutional levels to engage modular developments and to adapt to further changes.

Overview

Two main steps are defined, subdivided in different tasks.

The first step towards a geothermal village is Geosciences, Social sciences and Engineering:

Task 1 Geosciences focuses on developing appropriate methods to efficiently identify and drill into the hot geothermal fluids at depths to 1000 m. integrating geology, geochemistry, and geophysics for high-resolution 3D models of the underground plumbing systems of the hydrothermally active, fractured areas (1 km^3 models).

Task 2 Social sciences aims to understand the traditional and prevailing social organization, gender dimension including societal roles (women and girls tasked with water and energy supply see ref.3&4), traditional economies and interest in geothermal technologies, and develop the knowledge, awareness and appropriation by local communities through anthropological and sociological approaches. Strategies and models for effective communities' engagement will be explored. Guidelines for potential business models will defined. Policy context (environmental, administrative and natural resources-based) governing geothermal development will be outlined.

Task 3 Engineering will identify, select and adapt ad-hoc African technologies and local engineering solutions to high temperature shallow drilling and production and handling the geothermal fluids (pipes, heat exchangers, and condensing systems) for the ORC and direct use cascade devices and further match these to the needs of pastoral, fishing and agricultural communities.

In the second step, *Task 4* analyses the feasibility of the specific sites with respect to the above results. The feasibility of community-based approaches will be assessed in terms of project design, stakeholders' and communities' engagement, and medium-long term sustainability of the project, in terms of potential business model for spreading the technical solution. *Task 6* implements the social and technical knowledge to prepare for the third step: the demonstrators, *GV Phase 2* and related capacity building.

Task 5 will be focussed on transfer knowledge & capacity building including training courses. This concerns the research partners associated in the project as well as the local communities where the project will be implemented.

Task 7 addresses project management.

Towards the third step, the implementation of demonstration projects, the consortium aims to obtain funding by year two, so that the demonstrator(s) can seamlessly follow this project.

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1.1.1. Task 11.1.: R&D Geosciences

Start date:M9; End date:M25
Task Leaders: Pascal Tarits, UBO & Balemwal Atnafu, AAU
Contributors: UL, UBO, NORCE, IEG, GéoD2, EDCL, AAU, ODDEG, SEPCO, IEG

Develop innovative integrated methodology for 3D mapping of underground plumbing systems of shallow hydrothermally active, fractured areas leading to quantitative 4D modeling of the geothermal system including hydrothermal fluid circulation distributions (target volume 1 cubic km). Focus on a maximum of 3 sites representative of the diversity of geological conditions (coordinated with WP 2). Geophysical imaging is central in the approach (EM, DC resistivity, seismic, magnetic, NMR) to elaborate 3D models. Drone surveys (e.g. IR, Mag LIDAR) will assist geological field mapping; geochemistry will constrain fluid-rock interaction processes and production parameters. The integration of all data will allow to build the conceptual model of the site. This model is used to determine the productive targets reachable by shallow drilling (100-800 m).
– Site selection: Narrow the project focus to 3 relevant sites in the 4 participating countries)
– Topography & Geology: Satellite imagery processing, drone surveys, structural geology, volcanology, hydrogeology
- Geochemistry: field sampling of rocks and fluids, analysis, study of fluid-rock interaction processes at different T-P conditions)
- Geophysics: field measurements, data processing, joint inversion, 3D modeling
- 3D-4D Modeling (including heat and water transfers) and conceptual modeling of the geothermal system:

Action 1: Site selection. Narrow the project focus to 3 relevant sites in the 4 participating countries, based on a strategy using bibliographic elements and synthesis of previous field data by different partners .

Action 2: Topography & Geology: Satellite imagery processing, drone surveys, structural geology, volcanology, hydrogeology

Action 3: Geochemistry: field sampling of rocks and fluids, analysis, study of fluid-rock interaction processes at different T-P conditions)

Action 4: Geophysics: field measurements, data processing, joint inversion, 3D modeling

Action 5: 3D-4D Modeling (including heat and water transfers) and conceptual modeling of the geothermal system.

Partner Contributions		
Partner	Activity	Actions
UL	Field measurements, geology, geophysics and geochemistry, contribution to geological model definition	1,2,3,4,5
UBO	Site selection, drone surveys, field measurement, data processing, 3D models (with contracting), data integration, conceptual model	1,2,4,5
NORCE	Field measurements, for geological model. Integration with geophysical model	1,2,5
Fh. IEG	Contribution to geochemical data interpretation	3
Géo2D	Selection of the most suitable sites, contribution to the best geoscience approach for each site, interpretation and conceptual models	1,2,3,4,5
EDCL	Site selection	1,5
AAU	Site selection, geology and geophysics of Ethiopian site, data integration	1,2,4,5
ODDEG	Site selection, geology and geophysics of Djibouti site, data integration	1,2,4,5
SEPCO	Site selection in Kenya; up-grading local facilities for shallow high-temperature drilling and production tests engineering.	1,2,4,5

Actions	Start Date	Due Date	Responsible
Action 1: Site selection	M9	M12	Géo2D- ODDEG
Action 2: Topography & Geology	M13	M25	UL-SEPCO
Action 3: Geochemistry	M13	M25	UL
Action 4: Geophysics	M13	M25	UBO-AAU
Action 5: 3D-4D modeling	M19	M25	UBO-AAU

1.1.2. Task 11.2.: R&D Social sciences

Start date: M9; End date:M32
Task Leaders: Eleonora Annunziata SSSA & Joseph Onjala UoN
Contributors: UNITO, SSSA, Géo2D, EDCL, UoN, ODDEG,

Determine the socio-economic needs of the communities living on each selected geothermal site, covering a population large enough to justify the geothermal production system. Understanding the living conditions, social organization, culture, values, gender dynamics such as gender relations and social division of roles. Provide the local communities' engagement strategies with anthropological and sociological approaches, analysis of best practices for developing renewables at local level and guidelines for developing potential business models to spread geothermal-based stand-alone electric and thermal energy systems to off-grid African communities Partner with local community-based organizations when existing and analyse their needs in order to better strengthen their capacity to further master the projects on sites.

Action 1: Context Analysis.
Identification and analysis of social & economic structural aspects of target countries (Rwanda, Ethiopia, Kenya and Djibouti) will be carried out by exploiting collected data from existing documents and databases.

Action 2: Social aspects and dynamics.
After a presentation of the project to establish trust with local entities and populations on the 4 selected sites, an analysis of anthropological dimension of selected local communities will be performed for identifying culture, beliefs, history, values, norms, social networks, socio-economic conditions, distribution of power, gender relations, life practices and behaviours related to energy, water and present use of geothermal indices. Based on data collected from the anthropological analysis, context-specific documents on possible direct use applications of geothermal energy for each of the 4 sites will be prepared and an identification of suitable potential local stakeholders will be done.

Action 3: Stakeholders analysis.
A stakeholder map will be defined to identify main actors concerned and those taking part in the development of local geothermal plants and support the development of engagement strategies. These results will be informative for the best cases analysis and the definition of potential guidelines for business models (Action 4 and 5).

Action 4: Best practices in renewable developments.
Best practices in the development of renewables at community level will be identified and analysed through the assessment of institutional and regulatory framework, socio-economic context and stakeholders' roles.

Action 5: Guidelines for Potential Business *Models.*
After the identification and analysis of components of business model archetypes to spread geothermal-based stand-alone electric and thermal energy systems to off-grid African communities, the definition of guidelines for selecting and developing business models for replicating Geothermal Village approach in other contexts will be carried out.

Action 6: Local organisations' capacity-building needs.
A capacity building needs assessment of AGAP and HHGCBO will be done in order to identify the existing gaps between current and the desired capacities for promoting community-based geothermal stand-alone electric and thermal energy systems to off-grid African communities.

Partner Contributions		
Partner	Activity	actions
UNITO	Stakeholder analysis aimed at providing an exhaustive map of the main actors involved in the specific pilot sites. Development of communities' engagement strategies with specific attention payed to the gender issues. Surveys and in-depth interviews will be submitted to local stakeholders' to refine and support the implementation of engagement strategies and business models.	1,2,3,4,5,6
SSSA	Identification of best practices and case study through desktop research and/or interviews. Providing of guidelines for defining potential business models for the selected technical solution, and questionnaires and/or surveys to investigate specific stakeholder's role. Inputs to the provision of the stakeholder map and to the development of communities' engagement strategies. General supervision and leading of the task work and, if necessary, provision of inputs for the context analysis.	1,2,3,4,5,6
Géo2D	Anthropological research on sites in Kenya and Ethiopia; identification of needs of local CBOs. Contribution to socio-economic methodology all sites.	1,2,3,4,5,6
EDCL	Legal, administrative, economic and social frame in Rwanda.	1,2,3,4,5,6
UoN	Research on the policy context (environmental and natural-resources based) that governs geothermal development in Kenya and Ethiopia at the regional, national and/or local level Identification of capacity needs of CBOs in line with UoN's's specific role under task 2 Co-lead of the task	1,2,3,4,5,6
ODDEG	Legal, administrative, economic and social frame in Djibouti. Djibouti site ~~(~~studies~~)~~.	1,2,3,4,5,6

Actions	**Start Date**	**Due Date**	**Responsible**
Action 1: context analysis	M9	M19	UoN-ODDEG
Action 2: social aspect and dynamics	M14	M19	Geo2D-EDCL
Action 3: stakeholders' analysis	M17	M19	UNITO-UoN
Action 4: best practices	M13	M32	SSSA-UoN
Action 5: potential business	M13	M32	SSSA-UNITO
Action 6: local needs	M9	M32	Géo2D-SSSA

1.1.3. Task 11.3.: R&D engineering sciences

Start date:M21; End date:M39
Task Leaders: Walter H. Wheeler, NORCE & Peter Omenda, SEPCO
Contributors: UL, UBO, Fh. IEG, Géo2D, EDCL, AAU, UoN, ODDEG, SEPCO

This Task works to define the implementations of the geothermal plant, energy distribution and energy uses suited to the range of socio-economic and geological contexts representative of the selected sites and more generally encountered in the EARS region. The objective is to create general conceptual engineering models including the subsurface resources, drilling, fluid production devices (pumps, piping, heat exchangers), the ORC plant hot and cold sources, cascade use design, grid design (electricity, hot and cold water), interfaces with other RE, considerations of appropriate technology, and environment (links to 11.2):

Action 1: ORC-related conceptual designs.
Conceptual design models related to the production of thermal water and the ORC electrical plant in various hypotheses of the geothermal resource.

Action 2: Grid designs.
Grid designs (electricity, water): including storage in low-consumption hours and compatible RE**.**

Action 3: End-use of the energy.
Description of the potential industrial, cultural and economic applications of energies provided, such as manufacturing, food processing, agri- and aquaculture, bathing, cooking and eco-tourism.

Action 4: Environmental guidelines.

Partner Contributions		
Partner	Activity	actions
UL	Definition of the reservoir elements for the resource evaluation	1, 4
UBO	Definition of the reservoir elements for the resource evaluation	1, 4
NORCE	Advise on energy, drilling, combined electric and thermal grid, local engineering solutions, resource optimization.	1,2,3, 4
Fh. IEG	Conceptual definition of geothermal systems, heat driven processes (ORC, Sorption, Storage) and applications for the industry/commerce sector	1,3, 4
Géo2D	Conceptual design of cascade use of the geothermal resource answering the needs of the local communities (present and foreseen). Engineering follow-up	1, 3, 4
EDCL	Identification of end-use applications based on resource characteristics and engineering design of the direct use applications	1,2,3, 4
UoN	Socio-economic considerations for the designs and end uses	2,3, 4
AAU	Identification of end-use applications based on resource characteristics and engineering design of the direct use applications	1,2,3, 4
ODDEG	ODDEG will contribute, particularly for drilling engineering, and will in particular focus on the Djibouti site general engineering study.	1,2,3, 4
SEPCO	Identification of end-use applications based on resource characteristics and engineering design of the direct use applications	1,2,3, 4

Actions	**Start Date**	**Due Date**	**Responsible**
Action 1: ORC-related designs	M21	M39	NORCE-ODDEG
Action 2: Grid designs	M21	M39	NORCE-SEPCO
Action 3: End-use designs	M21	M39	SEPCO-Fh. IEG
Action 4: Environmental guidelines	M21	M39	NORCE-UoN

1.1.4. Task 11.4.: Feasibility studies on 3 relevant sites

Start date: M32; End date: M45
Task Leaders: Walter H. Wheeler, NORCE & Peter Omenda, SEPCO
Contributors: UL, UBO, UNITO, Fh. IEG, Géo2D, EDCL, AAU, SEPCO, UoN

A joint feasibility frame will be defined and will be applied to the three selected sites by the project. The country without a selected site is present in the project in order to develop its own site later.

Thus, in Rwanda with EDCL, in Djibouti with ODDEG or Ethiopia with AGAP, and Kenya with the community organization HHCBO. Legal framework & financial arrangement for projects. implementation.

Action 1: *Rwanda - NORCE, EDCL*
Action 2: *Djibouti - NORCE, ODDEG*
Action 3: *Ethiopia - NORCE, AAU*
Action 4: *Kenya - NORCE, SEPCO*

Partner Contributions		
Partner	Activity	actions
UL	Definition of the geological models for each selected site	1,2,3,4
UBO	Definition of the geophysical models for each selected site	1,2,3,4
UNITO	Supporting the feasibility and site-design decisions with respect to the interests of and interaction with local stakeholders and the adaptation of the implementation strategies to the local social and regulatory context.	1,2,3,4
UoN	Supporting the feasibility and site-design decisions with respect to the interests of and interaction with local stakeholders and the adaptation of the implementation strategies to the local social and regulatory context.	1,2,3,4
NORCE	Advise on and contribute to the application of Task 3 studies to each site, leading to a drilling and resource plan as well as energy distribution and loads plans	1,2,3,4
Fh. IEG	Contribution to joint feasibility studies frames	1,2,3,4
Géo2D	Defining methodologies for feasibility studies, including sub-surface and surface, and supervision of their applications in the sites selected.	1,2,3,4
EDCL	Contribute to the feasibility study of geothermal site selected in Rwanda. Give input as needed for other sites.	1,2,3,4
AAU	Contribute to feasibility study of site selected in Ethiopia / Djibouti Republic. Give input as needed for other sites	1,2,3,4
ODDEG	Contribute to the feasibility study of geothermal site selected in Djibouti Republic or Ethiopia. Give input as needed for other sites.	1,2,3,4
SEPCO	Contribute to the feasibility studies for the direct use geothermal projects for each of the selected sites. Contribute to the definition of methodologies for DU feasibility study.	1,2,3,4

Actions	**Start Date**	**Due Date**	**Responsible**
Action 1: Rwanda	M32	M45	NORCE-EDCL
Action 2: Djibouti	M32	M45	NORCE-ODDEG
Action 3: Ethiopia	M32	M45	NORCE-AAU
Action 4: Kenya	M32	M45	NORCE-SEPCO

1.1.5. Task 11.5.: Transfer knowledge and capacity building

Start date: M9; End date: M45
Task Leaders: Isabella Nardini, Fh. IEG & Balemwal Atnafu, AAU
Contributors: UL, UBO, UNITO, NORCE, Géo2D, EDCL, SEPCO, ODDEG, SSSA, UoN

Direct interaction between researchers and students contributes greatly to the dissemination of knowledge and skills between EU and AU countries. This will be achieved through research mobility of students. Knowledge transfer helps to enhance the skills of partners. This will be attained through training courses, workshops and personal contacts between academia and other stakeholders - Links between researchers and institutions both inter- and intra-Africa and Europe will be further developed.

Capacity building actions for the two (2) local CBOs (HHGCBO and AGAP) is another project focus. Capacity gaps will have been assessed early within Task 2, followed by identification of capacity-building needs. These needs will then be planned for and developed here. Corresponding trainings will be conducted with prospects of pilot projects in the future in mind.

A peer-learning forum will be organised between the geothermal populations in this project. Capacity-building of EU by AU will be embedded in the project structure.

Action 1: Research mobility.
PhD and MSc. students of the African partners will be invited to participate in courses and training in European laboratories/infrastructures. PhD and MSc. students of the involved partners could follow field formations in collaboration with all the teams. Knowledge-transfer proposals for African-partners, researchers and student mobility will be defined together with the involved EU-AU partners.

Action 2: Capacity building.
Capacity building targets the 2 CBOs (HHGCBO and AGAP). Our approach will include development of courses to conduct trainings that equip the CBOs with skills and knowledge for managing a community-based geothermal project. An information and experience-sharing forum that brings together the geothermal populations in this project will be held. A similar forum will be organised for the 2 African geothermal entities (EDCL and ODDEG) in the project. Hence these capacity-building initiatives will involve both EU-AU and AU-AU efforts.
Capacity-building of EU by AU is embedded in the project structure. Specifically, this will be in the project's EU partners' increased understanding and knowledge of the traditional and present socio-economic aspects of the targeted geothermal populations (particularly from a geothermal perspective) that speak to the notion of sustainable societies and economies, more so in the context of climate change. -This will include how these populations interpret their world in relation to the geothermal resources on their land. The enhanced understanding and knowledge will be attained through the said EU partners' interaction with the project's African geothermal entities and local populations in the course of project implementation.

Partner Contributions		
Partner	Activity	actions
UL	Training of the local partners, supervision of doctoral and master students	1,2
UBO	Training of the local partners, supervision of doctoral and master students	1,2
UNITO	On the basis of the analysis and results carried out in Task 2, support will be provided to develop effective capacity building processes. UNITO's Internationalization office will then be involved in sharing strategies, practices and opportunities to involve students and researchers in exchanges.	1,2
SSSA	Training of the local partners, supervision of doctoral and master students	1,2
NORCE	Supervision and training of local partners in short-term projects in reservoir studies, smart grids, energy analysis etc.	1,2
Fh. IEG	Manage the task as co-leader. Workshop and training for transfer knowledge and capacity building actions.	1,2
Géo2D	Identify the best N-S partnership answering the needs of each specific site selected. Oversee the implementation of Action 2 (Capacity-building) under this Task in close collaboration with the Task Leaders (IEG and AAU).	1,2
EDCL	Train its own staff and contribute to training of local partners on site in Rwanda	1,2
AAU	Manage the task as co-leader. Train its own staff and student and contribute to training of local partners in Ethiopia	1,2
ODDEG	Train its own staff and contribute to training of local partners on site in Djibouti	1,2
SEPCO	Train own staff on direct use technology and potential benefits of its utilization in African context.	1,2

Actions	**Start Date**	**Due Date**	**Responsible**
Action 1: Research mobility	M9	M45	UNiTO-AAU
Action 2: Capacity building	M9	M45	Géo2D-SEPCO

1.1.6. Task 11.6.: Preparation of the geothermal village demonstration projects and piloting

Start date:M29; End date:M45
Task Leaders: Jacques Varet, Géo2D & Kayad Moussa, ODDEG
Contributors: UL, UBO, NORCE, Fh. IEG, UNITO, Géo2D, EDCL, AAU, UoN, SEPCO, ODDEG

Task 6 is preparation for the installation of physical GV demonstrations at the three sites selected in Task 11.1, Action 1 (Milestone 11.3, Month 13).

In the early months of the Task, the focus will be long-range initiatives such as the search for funding opportunities for the construction of 3 demonstration systems and their monitoring (for a follow-up project "Geothermal Village Phase 2"). In later stages the focus will be applying the results from Tasks 1 to 4 to specific technical planning, budgets, and business plans to present to funding agencies.

For the three site-actions listed below, the exact co-leader depends on the site-selection process (M11.3). However, ODDEG would co-lead a Djibouti site; EDCL would co-lead a Rwanda site; HHCBO would co-lead a Kenya site; and AGAP would co-lead an Ethiopia Afar site.

Action 1: Planning for the implementation of a demonstrator at S*ite 1.* (Site to be determined by Month 13 (Milestone M11.3). Planning goals are based on the interests and acceptance of the Site 1 local community, and include financing, the regulatory framework, and implementing the results of Task 11.4.

Action 2: Planning for the implementation of a demonstrator at S*ite 2.* (Site to be determined by Month 13 (Milestone M11.3). Planning goals are based on the interests and acceptance of the Site-2 local community, and include financing, the regulatory framework, and implementing the results of Task 11.4.

Action 3: Planning for the implementation of a demonstrator at S*ite 3.* (Site to be determined by Month 13 (Milestone M11.3). Planning goals are based on the interests and acceptance of the Site-3 local community, and include financing, the regulatory framework, and implementing the results of Task 11.4.

Partner Contributions		
Partner	Activity	actions
UL	Geological, geophysical and geochemical follow-up	1,2,3
UBO	Definition of geoscience exploration workflow	1,2,3
NORCE	Definition of the well, ORC and industrial implementation plans	1,2,3
Fh. IEG	Contribution to the development plans	1,2,3
UNITO	Social acceptance	1,2,3
Géo2D	Preparation of Task. Primary contribution to planning of GV2 site construction	1,2,3
EDCL	Facilitation including - transportation of staff to the field	1,2,3
AAU	Contribution to the planning and implementation if GV-2.	1,2,3
UoN	Contribution to the planning and implementation if GV-2.	1,2,3
ODDEG	Contribution to the planning and implementation if GV-2.	1,2,3
SEPCO	Contribution to the planning and implementation if GV-2.	1,2,3

Actions	Start Date	Due Date	Responsible
Action 1: site 1	M29	M45	Géo2D - Site-1 Partner*
Action 2: site 2	M29	M45	Géo2D - Site-2 Partner*
Action 3: site 3	M29	M45	Géo2D - Site-3 Partner*

* Co-leaders to be designated in M11.3, Month M13.

1.1.7. Task 11.7 : Project management

Start date: M9; End date:M45
Task Leaders: Yves Géraud, UL & Peter Omenda, SEPCO
Contributors: UL, UBO, UNITO, NORCE, Fh. IEG, Géo2D, EEDCL, AAU, SEPCO

The objective of this task is to ensure the coordination between the different WP teams, to ensure the communication with the other WP of the programme and in particular with the coordination WP3. The third action of this task is to prepare the guide of good practice for prospecting and preparing geothermal exploitation sites.

Action 1: Project Management
The management activity is developed in accordance and coordination with the WP3 Leaders (Pillar 2 coordinators) and in synergy with other WPs constituting the Pillar 2. Besides project management, this task includes: Quality assurance, respect of milestones. A specific team on the Teams platform is created.

Action 2: Dissemination
Organization of partners' conferences at least once a year on specific topics linked to the project advancement. The conferences will be accessible to all LEAP-RE partners, as well as to researchers of the scientific community. The publication of scientific articles is also one of the team's objectives.

Action 3: Guide book
Reporting, edition and diffusion of a guidebook. Website creation and maintenance, patents filing, press & media actions, videos, etc.

Partner Contributions		
Partner	Activity	actions
UL	Project management, Contribution to the reporting, edition and diffusion of a guidebook	1, 2, 3
UBO	Contribution to the reporting, edition and diffusion of a guidebook, conferences	2, 3
UNITO	Contribution to the reporting, edition and diffusion of a guidebook conferences	2, 3
NORCE	Contribution to the reporting, edition and diffusion of a guidebook, conferences	2, 3
Fh. IEG	Contribution to the reporting, edition and diffusion of a guidebook, conferences	2, 3
Géo2D	Contribution to the reporting, edition and diffusion of a guidebook, conferences	1, 2, 3
EDCL	Information (data, analysis, interpretation, reports), conferences	2, 3
AAU	Contribution to the reporting, edition and diffusion of a guidebook	2, 3
SEPCO	Governance, Contribution to the reporting, edition and diffusion of a guidebook	1, 2, 3

Actions	**Start Date**	**Due Date**	**Responsible**
Action 1: project management	M9	M45	UL-SEPCO
Action 2: conferences	M9	M45	Fh. IEG- UoN
Action 3: guide book	M32	M45	Géo2D-SEPCO

1.2. Deliverables

Number	Title	Due Date	Responsible
D11.1	Presentation of a more detailed Plan of Activities for the whole WP	M9	UL-SEPCO
D11.2	Surface geoscientific geothermal conceptual model	M25	UBO-AAU
D11.3	Socio-anthropological studies for community's appropriation guidebook	M32	SSA-UNO
D11.4	Technology and engineering guidebook for local geothermal fluids production systems. Feasibility study methodology and application on 3 sites, selection of one demonstration site	M45	NORCE-Géo2D
D11.5	Report on research mobility and capacity building actions. Creation and diffusion of guidebooks, schedules of the conferences and meetings	M45	Fh. IEG- EDCL
D11.6	Geothermal village project phase 2: planning of demonstrator report	M45	Géo2D-SEPCO

1.3. Milestones

Number	**Title**	**Verification mean**	**Due Date**	**Responsible**
M11.1	Sites selections	Minutes of the meeting	M13	Géo2D-SEPCO
M11.1.2	G3 elements for 3D modelling	Minutes of the meeting	M19	UBO-AAU
M11.2	Social input	Minutes of the meeting	M21	UoN-SSA
M11.3	transfer of generic engineering designs to Task 11.4	Minutes of the meeting	M37	NORCE-SEPCO
M11.5	Research mobility and capacity building actions performed	Trainings/workshops	M45	Fh. IEG-AAU
M11.7.1	Project governance	Minutes of the meeting	M20	UL-SEPCO
M11.7.2	Project governance	Minutes of the meeting	M32	UL-SEPCO

1.4. Interaction/synergies with other WPs

Number	Interaction description	Responsible
1	Project Management (Task 11.7) will be carried out in synergy with WP3 and the Pillar 2 Board Governance indications	UL, Fh. IEG
2	Information on the current capacity building /training activities within each WP9-WP16 will be valorized to increase the "impact" of each capacity building activity back to WP9-WP16. More capacity building actions can be organized in synergy with other WPs within the framework of the f Pillar 2.	Fh. IEG, UL
3	Based on the sharing during the first months of LEAP-RE, a constant link on cross-cutting interests relative to Technological development, methodological approach, modeling tools and other R&I related topics that will take place into WP9, WP10, WP11, WP12, WP13, WP14, WP15, WP16 is promoted in Task 3.1	Fh. IEG, UL
4	Scientific Dissemination will be carried out in agreement with the Scientific Dissemination Strategy defined in WP3	UL, Fh. IEG
5	Other dissemination activities will follow the guidelines provided by WP4 in the LEAP-RE Communication and Awareness Raising strategy	UL, Fh. IEG
6	Monitoring and Evaluation will be carried out receiving input from the M&E plan for Pillar 2 developed in WP3 and coordinated by WP5	UL
7	Financial Reporting (Task 11.7) will be managed in coordination with WP1 and supported by WP3	UL

1.5. Risks

Contractual risks (number, description, risk-mitigation), probability (1=low; 5=high) that the risk occurs and impact (1=low; 5=high) if the risk occurs. Other risks (not in GA) can be added so they can be followed during the project. Risk mitigation: P=preventive actions / C=contingency actions.

Number	Risk description	Risk mitigation	Proba	Impact
11.1	Covid-19	Vaccination and sanitary quarantine	3	3
11.2	Field accesses: political instability	information from partners and several sites considered	2	2
11.3	Local acceptance for field work	prior information by the social and local teams	2	2
11.4	Administrative risk concerning imports of materials and their export, which also concerns samples.	solid preparation between EU and local partners	3	3
11.5	Local acceptance of the resources development	information by the social and local teams	3	3
11.6	Coordination of the numerous teams over great distances	regular meetings and a person specially recruited for the coordination	2	2
11.7	Local health risks (malaria, dengue, sunstroke...)	easily contained by prevention and protection measures	2	2
11.8	Impact on the mode, distribution and effectiveness of research mobility and capacity building actions due to COVID pandemic.	Virtual workshops and training. Appropriate planning of the actions enforced by the co-leading of EU- AU partners	5	3

Annex 1: WP11 GANTT Chart

	WP11: Pillar 2 Coordination	Lead	2020			2021												2022													2023												2024											
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51
	Task 11.1 :	UBO-AAU																																																			
11.1	**R&D Geosciences**																																																				
	Site selection	Géo2D-ODDEG													M11.1																																						
	Topology & Geology	UL-SEPCO																			M11.1.2																																
	Geochemistry	UL																			M11.1.2																																
	Geophysics	UBO-AAU																			M11.1.2																																
	3D-4D modeling	UBO-AAU																									D11.2																										
	Task 11.2 :	SSSA-UoN																																																		
11.2	***R&D Social sciences***																																																			
	Context analysis	UoN-ODDEG																																																		
	Social aspects and dynalmics	Géo2D-EDCL																																																	
	Stakeholders' analysis	UNITO-UoN																																																	
	Best practices	SSSA-UoN																					M11.2											D11.3																			
	Potential business	SSSA-UNITO																					M11.2											D11.3																			
	Local needs	Géo2D-SSSA																					M11.2											D11.3																			
	Task 11.3 :	NORCE-SEPCO																																																	
11.3	**R&D Engineering sciences**																																																			
	ORC-related designs	NORCE-ODDEG																																				M11.3																
	Grid designs	NORCE-SEPCO																																				M11.3																
	End-use designs	SEPCO-Fh. IEG																																				M11.3																
	Environmental guidelines	NORCE-UoN																																																		
	Task 11.4 :	NORCE-SEPCO																																															D11.4				
11.4	**Feasibility studies on 3 relevant sites**																																																			
	Rwanda	NORCE-EDCL																																																		
	Djibouti	NORCE-ODDEG																																																		
	Ethiopia	NORCE-AAU																																																		
	Kenya	NORCE-UoN																																																		
	Task 11.5 :	Fh. IEG-AAU																																															D11.5				
11.5	**Transfer knowledge & capacity building**																																																			
	Research mobility	UNITO-AAU																																																	M11.5				
	Capacity building	Géo2D-SEPCO																																																M11.5				
	Task 11.6 :	Géo2D-ODDEG																																															D11.6				
11.6	**Preparation of the GV demonstration**																																																			
	Site 1	Géo2D-*																																																			
	Site 2	Géo2D-*																																																			
	Site 3	Géo2D-*																																																			
	Task 11.7 :	UL-SEPCO																																																			
11.7	**Project management**																																																			
	Project management	UL-SEPCO									D11.1											M11.7.1											M11.7.2																				
	Conferences	Fh. IEG-UoN																																																		
	Guide book	Géo2D-SEPCO																																																		

** Co-leaders to be designated in M11.1, Month M13.*

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