Preparation of the Abaya Project for Geothermal Sustainability Assessment Protocol (GSAP) in Ethiopia

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ABSTRACT

The primary aim of this study was to assess the Abaya Geothermal Development Project in Southern Ethiopia using the Draft Geothermal Sustainability Assessment Protocol (GSAP). The Abaya project is being developed by Reykjavik Geothermal and there are plans for the installation of a 300 MW geothermal power plant with prospects for future expansion. The GSAP, adapted from the Hydropower Sustainability Assessment Protocol, provides a comprehensive framework designed to evaluate geothermal projects across various environmental, social, and technical criteria.

This assessment, conducted collaboratively with Reykjavik Geothermal management, focused on evaluating the GSAP's suitability within the Ethiopian context, given the region's unique socio-economic and regulatory conditions. The project was evaluated on six crucial sustainability dimensions, achieving basic good practice (Level 3) on five topics, while one topic scored slightly lower (Level 2), highlighting specific improvement needs. The findings confirm that GSAP is highly applicable to the Ethiopian setting, demonstrating significant potential for guiding future geothermal projects towards international standards of sustainability. The protocol effectively facilitates stakeholder engagement, ensuring environmental and social considerations are adequately addressed, thereby enhancing community support and long-term project viability. The results underscore GSAP's importance as an essential tool for sustainable geothermal resource management and development in Ethiopia.

1. INTRODUCTION

Access to sustainable energy is central to achieving Ethiopia's Sustainable Development Goals (SDGs), particularly Goal 7, which targets affordable, reliable, sustainable, and modern energy supply for all. However, the country faces multiple energy challenges, including widespread energy poverty, heavy reliance on unsustainable biomass use, inefficient energy systems, limited institutional and technological capacity, low private sector engagement, and dependence on imported petroleum fuels (Ethiopia National Energy Policy, 2015).

With a growing population and expanding demands from the industrial, agricultural, and transport sectors, energy consumption in Ethiopia is projected to rise significantly. To meet this demand sustainably, the Ethiopian government emphasizes the use of renewable energy sources, supported by the national Energy Policy and the Climate Resilient Green Economy (CRGE) strategy (Ethiopia Energy Authority, 2017). Ongoing reforms, such as energy and environmental regulations and Public-Private Partnership (PPP) frameworks, aim to facilitate private investment, improve transparency, and promote long-term energy sustainability.

Geothermal energy, abundant in Ethiopia's segment of the East African Rift Valley, represents a key renewable resource. The government, through the Geological Survey of Ethiopia, has identified 22 geothermal prospects characterized by major fault systems (JICA, 2015). Despite this potential, geothermal development raises sustainability concerns that necessitate structured management tools.

One such tool is the Hydropower Sustainability Assessment Protocol (HSAP), a multi-stakeholder-developed framework launched in 2011 to assess hydropower project performance across 23 sustainability criteria. The HSAP's documented benefits include improved sustainability practices, enhanced financing opportunities, and greater public acceptance through stakeholder engagement (Hydropower Sustainability, 2019a).

Given the success of HSAP, stakeholders in Iceland adapted it for geothermal projects, resulting in the Geothermal Sustainability Assessment Protocol (GSAP). Tested in Icelandic projects, GSAP aims to offer a globally applicable tool for evaluating the environmental, social, technical, and financial dimensions of geothermal development.

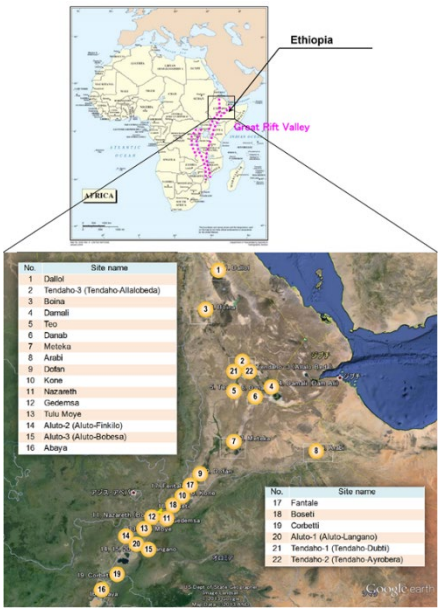

Figure 1: Map of the study area (16) and other potential geothermal development projects (JICA, 2015).

In response to the success of the Hydropower Sustainability Assessment Protocol (HSAP), Icelandic stakeholders adapted it for geothermal energy projects, creating the

Geothermal Sustainability Assessment Protocol (GSAP). Initial tests of GSAP were conducted on two Icelandic projects: the preparation stage of the Theistareykir 90 MWe geothermal plant in 2016, and the operation stage of the Hellisheidi 300 MWe/130 MWth geothermal plant in 2017.

Building on these Icelandic experiences, this GRÓ-GTP project study evaluates the suitability of GSAP for geothermal projects in Ethiopia, using the Abaya Geothermal Development Project as a case study. Specifically, the study aims to:

- Assess GSAP's relevance to Ethiopian developers and governmental bodies within local legal frameworks;
- Identify areas for improvement in project preparation;
- Highlight critical data required for effective sustainability management;
- Showcase good and best practices applicable to current and future geothermal projects in Ethiopia; and

2. HYDROPOWER SUSTAINABILITY ASSESSMENT PROTOCOL AND GEOTHERMAL SUSTAINABILITY ASSESSMENT PROTOCOL

2.1 Hydropower Sustainability Assessment Protocol

The Hydropower Sustainability Assessment Protocol (HSAP) emerged from extensive discussions initiated by the International Hydropower Association (IHA), following recommendations from the World Commission on Dams' 2000 report. Recognizing the necessity for a practical sustainability assessment tool, IHA developed initial guidelines in 2004, culminating in the first version of the HSAP in 2006.

Subsequently, WWF and The Nature Conservancy suggested further refinement, leading to the creation of the Hydropower Sustainability Assessment Forum. This forum comprised representatives from environmental and social NGOs, government agencies of both developing and developed countries, financial institutions, development banks, and the hydropower industry. Each forum member engaged with a wider reference group, ensuring comprehensive stakeholder perspectives.

The current HSAP, finalized through rigorous negotiations and stakeholder consensus from 2008 to 2010, integrates best practices and standards from the World Bank safeguard policies, IFC performance standards, and guidelines of the World Commission on Dams. Its primary function is to consistently assess and guide the sustainable development and operation of hydropower projects globally.

2.2 Geothermal Sustainability Assessment Protocol

The Geothermal Sustainability Assessment Protocol (GSAP) is an adaptation of the Hydropower Sustainability Assessment Protocol (HSAP), designed to systematically assess geothermal projects across environmental, social, technical, and financial sustainability dimensions (GSAP, 2018). Developed by a working group of Icelandic power companies and government agencies, GSAP was purposefully aligned closely with HSAP to preserve its international recognition and multi-stakeholder consensus.

Initial evaluations of GSAP were successfully conducted at two Icelandic geothermal projects: the preparation stage at the Theistareykir 90 MWe power plant in late 2016, and the operational stage at the Hellisheidi 330 MWe/130 MWth geothermal facility in late 2017. Both assessments confirmed GSAP's suitability for geothermal energy projects, identifying no significant issues arising from its adaptation. While these tests validated GSAP's effectiveness in Iceland, further assessments in other countries are required to refine and streamline the protocol for broader international application.

2.3 Structure of the geothermal sustainability assessment protocol (draft GSAP preparation stage, April 2018)

The GSAP should be globally applicable and used on all types and sizes of geothermal projects, anywhere in the world, and be quality-controlled to ensure the reliability of the assessment findings. The protocol includes 20 topics (P-1 to P-20) as presented below. A new topic P-21, Climate Change Mitigation and Resilience, is in progress in 2019 (Sigurdur St Arnalds, pers. comm., Sept. 2019).

- P-1 Communications and Consultation: Effective stakeholder identification and engagement.
- P-2 Governance: Sound corporate policies, accountability, and external governance management.
- P-3 Demonstrated Need and Strategic Fit: Alignment with regional and national development goals.
- P-4 Siting and Design: Optimal project location and infrastructure planning.
- P-5 Environmental and Social Impact Assessment and Management: Impact evaluation and mitigation strategies.
- P-6 Integrated Project Management: Coordination of project construction and operational phases.
- P-7 Geothermal Resource: Resource capacity assessment, reliability, and efficiency planning.
- P-8 Public Health and Safety: Safeguarding health during drilling and operational activities.
- P-9 Financial Viability: Securing necessary project funding and financial sustainability.
- P-10 Project Benefits: Community benefits beyond immediate compensation.
- P-11 Economic Viability: Overall net economic benefit assessment.
- P-12 Procurement: Transparent, equitable project-related procurement processes.

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- P-13 Project Affected Communities and Livelihoods: Socio-economic impacts and opportunities.
- P-14 Resettlement: Ethical management of physical displacement.
- P-15 Indigenous Peoples: Protection and engagement of marginalized groups.
- P-16 Labour and Working Conditions: Ensuring fair and safe labor practices.
- P-17 Cultural Heritage: Preservation of physical cultural resources.
- P-18 Biodiversity and Invasive Species: Protecting local ecosystems and species.
- P-19 Induced Seismicity and Subsidence: Management of seismic risks and ground subsidence.
- P-20 Air and Water Quality: Protection of local air and water quality from project impacts.

Each topic is scored based on the following six criteria: assessment, management, stakeholder engagement, stakeholder support, conformation/compliance, and outcomes (Figure 2). However, all elements of the criteria may or may not be necessarily fulfilled for each of the topics. Figure 2 illustrates the protocol´s gradational approach and the scoring statements for each of the criteria.

Level	Assessment	Management	Stakeholder Engagement	Stakeholder Support	Outcomes	Conformance/ Compliance
5	Rely on factual, reproducible, and verifiable evidence, full topic understanding, compliance with best practices, and support from necessary research.	Beyond Level 3: necessary management plans and processes are in place.	In addition to Level 3, review of the extent and structure of engagement.	Agreements with nearly all affected communities ensure mitigation, management, and compensation measures.	In addition to Level 3, the project may show improvements to pre-project conditions.	No noncompliances or nonconformances.
4	Beyond Level 3, the assessment may also recognize broader external or regional issues.	Beyond Level 3, management plans show good anticipation and response to emerging issues.	Strong feedback shows that the directly affected stakeholder issues are well considered.	There is support from a large majority of directly affected stakeholder groups for the assessment and planning.	Beyond Level 3, there may be full compensation for the negative impacts.	Minor noncompliances and nonconformances that can be readily remedied.
3	At Level 3, the assessment covers key considerations but remains mainly project-focused.	Management processes are suitable, effective, and show no major gaps.	Suitable, adequate, and effective with no significant gaps.	Communities support the plans, with no major ongoing opposition on issues directly impacting them.	Depending on the topic and project stage, impacts may be avoided, minimized, or mitigated.	No significant non-compliances and nonconformances.
2	A significant gap in assessment processes relative to Level 3.	A significant gap in relative to Level 3.	A significant gap relative to Level 3.	Support amongst some directly affected stakeholder groups for the assessment, planning.	Significant gap relative to Level 3, for example, some deterioration in baseline condition.	A significant noncompliance or non-conformance.
1	Significant gaps in assessment processes relative to Level 3.	There are significant gaps relative to Level 3.	There are significant gaps relative to Level 3.	Low support amongst directly affected stakeholder groups for the assessment, planning.	Significant gaps relative to Level 3.	Significant noncompliances and nonconformances.

Figure 2: Protocol criteria and scoring statements (Hydropower Sustainability, 2019a).

As illustrated in Figure 2, the scoring system follows a graded approach defined as:

- **5 points:** Meets both basic good practice and proven best practice, with no significant gaps.
- **4 points:** Meets basic good practice, but exhibits one significant gap compared to proven best practice.
- **3 points:** Meets basic good practice, yet demonstrates more than one significant gap compared to proven best practice.
- **2 points:** Shows one significant gap relative to basic good practice.
- **1 point:** Contains multiple significant gaps relative to basic good practice.

Assessments within this study rely on objective evidence derived from several key documents, including:

- Internal Reykjavik Geothermal (RG) reports, specifically the Abaya Geothermal Development Environment and Socioeconomic Baseline Study.
- Draft Environmental and Social Impact Assessment (ESIA) Geothermal Utilization Scoping Report (July 2019).
- RG Stakeholder Engagement Plan (Version 01, July 2019) and Stakeholder Engagement Assessment Report (2018).
- Transcripts and documentation of stakeholder engagement meetings for the Abaya Geothermal Development project.

The Theistareykir geothermal project was the first to undergo an assessment using the draft GSAP. The primary objective was to test the protocol's applicability to geothermal projects, while a secondary goal was to evaluate the project's performance and identify opportunities for improvement, both for Theistareykir and future geothermal developments in Iceland. This initial assessment focused specifically on the project's preparation stage, prior to key milestones such as licensing and final investment decisions. In total, 18 sustainability topics were assessed. Two topics (P-14: Resettlement and P-15: Indigenous Peoples) were deemed irrelevant, and topic P-18 (Biodiversity and Invasive Species) was merged with P-8 (Public Health and Safety). The assessment confirmed GSAP's effectiveness for geothermal projects, with Theistareykir receiving high scores across the evaluated topics. Figure 3 illustrates these results, with each topic scored according to the previously outlined five-level scoring scale (from 1 to 5).

Figure 3: Theistareykir sustainability profile.

3. CASE STUDY AND METHODODLOGY BASED ON SUSTAINABILITY CONCEPT

3.1 Objectives

This assessment was conducted as part of the GRÓ-GTP specialized training program, in collaboration with Reykjavik Geothermal. The Abaya geothermal project was selected as a case study due to its early exploration stage, during which the environmental and social impact assessment (ESIA) process is actively underway.

The primary objectives of the assessment are to:

- Evaluate the suitability of the draft GSAP for use by both developers and government authorities in Ethiopia, within the context of national legal and regulatory frameworks;
- Identify opportunities for improving the project's sustainability performance during its preparation phase;
- Determine data requirements essential for robust sustainability management;
- Highlight examples of good and best practices from current and future geothermal projects in Ethiopia; and
- Encourage dialogue among developers, stakeholders, and working groups to support more sustainable geothermal project development.

Selecting a project at the preparation stage offers the greatest potential for influencing sustainability outcomes. Since the Abaya project is in its formative phase, this assessment provides a valuable opportunity to inform sustainability considerations before progressing to implementation and operation.

3.2 Project description

The Main Ethiopian Rift, forming the northernmost segment of the East African Rift System, is a region characterized by active extensional tectonics and significant volcanic activity. Within this geologically dynamic zone lies the Abaya geothermal prospect, situated approximately 275 kilometers south of Addis Ababa (see Figure 4).

The broader Abaya geothermal area spans roughly 2,500 km², while the area under Reykjavik Geothermal's current license covers about 520 km². Administratively, the project site extends across parts of the Wolayita and Sidama zones within the Southern Nations, Nationalities, and Peoples (SNNP) Regional State. Specifically, it includes the Woredas of Humbo and Damot Weyde in Wolayita, and Dale in Sidama. The Abaya geothermal development represents Ethiopia's third licensed concession for geothermal power generation and is slated for development by Reykjavik Geothermal (RG, 2018).

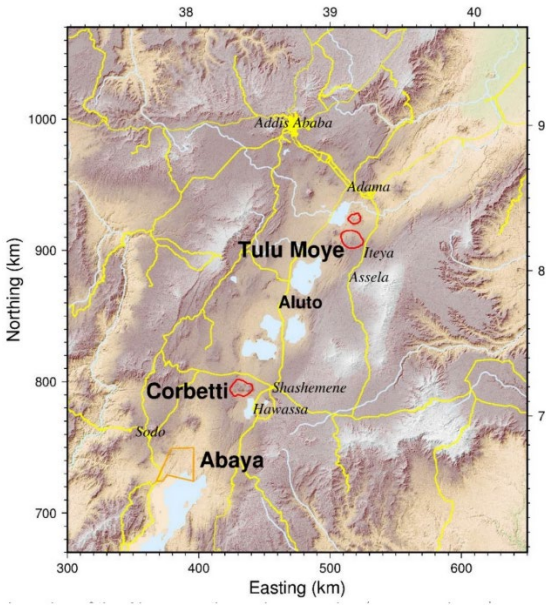

Figure 4: Location map of the Abaya study area and other potential projects nearby (RG, 2019).

Major regulations, guidelines and proclamations applicable to the geothermal energy development projects are listed in Table 1 (JICA, 2015).

Table 1: Major regulations, guidelines and proclamations applicable to the geothermal energy development projects.

No.	Title	No.	Date of issue
1	Geothermal Resource Development Regulation	453	July 22, 2019
2	Geothermal Resource Development Proclamation	981	September 16, 2016
3	Ethiopia Energy Regulation	447	January 28, 2019
4	Energy (Amendment) Proclamation	1085	June 8, 2018
5	Ethiopian Energy Authority Establishment Council of Minsters Regulation	308	May 22, 2014
6	Public Private Partnership Proclamation	1076	February 22, 2018
7	Environmental Impact Assessment Proclamation	299	December 31, 2002
8	Environmental Pollution Control Proclamation	300	December 03, 2002

9	Environmental Protection Organs Establishment Proclamation	295	October 31, 2002
10	Expropriation of Landholdings for Public Purposes and Payment of Compensation Proclamation	455	July 15, 2005
11	Rural Land Administration and Land Use Proclamation; Proclamation	456	July 15, 2005
12	Ethiopian Water Resource Management Proclamation	197	March 9, 2000
13	Ethiopian Water Resource Management Regulations	115	March 29, 2005
14	Solid Waste Management Proclamation	513	February 12, 2007
15	Environmental Impact Assessment Procedural Guideline Series I		November, 2003
16	Draft EMP for the Identified Sectoral Developments in the Ethiopian Sustainable Development & Poverty Reduction (ESDPRP)		May 01, 2004
17	Investment Proclamation	280	July 02, 2002
18	Council of Ministers Regulation on Investment Incentives and Investment Areas Reserved for Domestic Investors	84	February 07, 2003
19	The FDRE Proclamation, ''Payment of Compensation for Property Situated on Landholdings Expropriated for Public Purposes''	455	Y2005
20	Council of Ministers Regulation, ''Payment of Compensation for Property Situated on Landholdings Expropriated for Public Purposes''	135	Y2007
21	Oromya Regional Administration Council Directives, ''Payment of Compensation for Property Situated on Landholdings Expropriated for Public Purposes''	5	Y2003
22	Investment (Amendment) Proclamation	373	October 28, 2003

3.3 Assessment process and methodologies

The assessment methodology was guided by practical considerations such as limited time, data availability, and the current stage of the project. Priority was given to topics that are particularly relevant to the local context of the Abaya geothermal project and align with Ethiopia's national development needs. Topic selection also reflected geographical and demographic considerations—for instance, while the "Indigenous Peoples" and "Resettlement" topics were not applicable in the Theistareykir project in Iceland, the "Resettlement" topic is highly relevant in the densely populated Abaya project area.

The selected topics for this assessment were:

- **P-1**: Communications and Consultation
- **P-3**: Demonstrated Need and Strategic Fit
- **P-4**: Siting and Design
- **P-5**: Environmental and Social Impact Assessment and Management
- **P-6**: Integrated Project Management
- **P-7**: Geothermal Resource

Each topic was evaluated against up to six GSAP criteria: assessment, management, stakeholder engagement, stakeholder support, conformance/compliance, and outcomes. However, not all criteria were applicable to every topic—stakeholder support, for example, was not relevant for any of the selected topics.

The scoring process followed a structured, step-wise approach:

1. **Start with Level 3**: Determine whether the project meets all Level 3 (basic good practice) criteria.
2. **If one significant gap exists at Level 3**, assign a score of **2**.
3. **If more than one significant gap exists at Level 3**, assign a score of **1**.
4. **If all Level 3 criteria are met**, evaluate against Level 5 (proven best practice).
5. **If one significant gap exists at Level 5**, assign a score of **4**.
6. **If more than one significant gap exists at Level 5**, assign a score of **3**.
7. **If all Level 5 criteria are met**, assign a score of **5**.

Table 2 presents a summary of the assessment criteria applied to each selected topic. It is important to note that not all six GSAP criteria were applied uniformly across all topics; their inclusion was determined based on the relevance of each criterion to the specific topic and the availability of supporting data.

Table 2: Criteria applied for each chosen topic.

	Topics					
Criteria	**P-1**	**P-3**	**P-4**	**P-5**	**P-6**	**P-7**
Assessment	x	x	x	x		x
Management	x		x	x	x	x
Stakeholder engagement	x	x	x	x		
Stakeholder support						
Conformance/ compliance	x					
Outcomes		x	x	x	x	

4. RESULTS

The GSAP assessment of the Abaya geothermal project was conducted using available written evidence, including RG internal reports, the ESIA scoping report (2019), the stakeholder engagement plan and transcripts from stakeholder consultations. Due to time and data constraints, the evaluation was limited to six sustainability topics.

Each topic was scored against relevant GSAP criteria. The scores indicate that five of the six topicsP-1, Communications and Consultation, P-3 Demonstrated Need and Strategic Fit, P-4 Siting and Design, P-5 Environmental and Social Impact Assessment and Management, and P-6 Integrated Project Management, met the basic good practice level (Level 3). One topic, P-7 Geothermal Resource, was scored at Level 2, indicating a significant gap in meeting basic good practice, mainly due to limited test drilling and data availability.

Figure 5 and Table 3 present a visual and tabular summary of the topic scores. The results reflect that while the project demonstrates solid foundational practices across most areas, improvements, particularly in geothermal resource data and validation, are essential for advancing toward best practice.

Table 3: Overall score for each of the criteria assessed relative to basic good practice (Level 3).

	Topics					
Criteria	**P-1**	**P-3**	**P-4**	**P-5**	**P-6**	**P-7**
Result	3	3	3	3	3	2

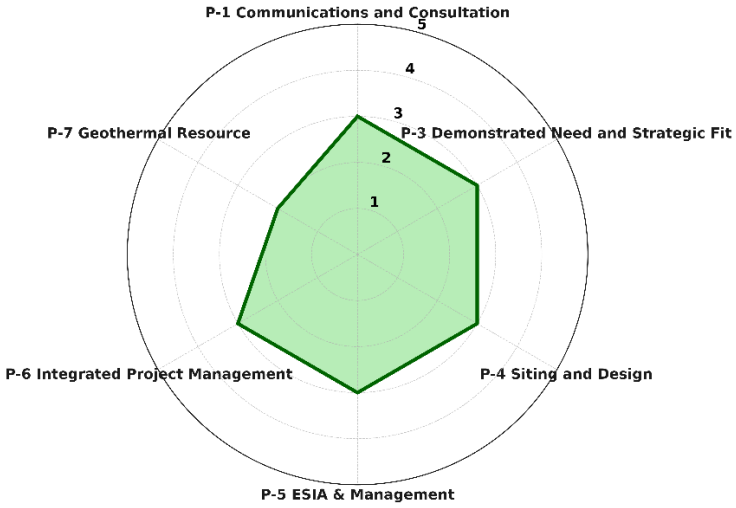

Figure 5: Abaya sustainability topic scores.

P-1 Communications and consultation

This topic evaluates how effectively the project identifies and engages stakeholders. Reykjavik Geothermal has undertaken extensive stakeholder mapping and implemented structured communication plans, including grievance mechanisms. Engagement has been timely, two-way, and inclusive of both directly and indirectly affected parties. There are no major gaps in practice, and all key criteria are met, resulting in a score of **3**, indicating compliance with basic good practice.

P-3 Demonstrated need and strategic fit

This topic assesses how well the project aligns with identified energy needs and policy objectives. The Abaya project demonstrates strong alignment with national and regional energy strategies, particularly for direct-use geothermal development under Ethiopian law. Relevant assessments have been conducted and publicly disclosed, and stakeholder engagement reflects regional economic priorities. All criteria are met without major gaps, resulting in a score of **3**, indicating compliance with basic good practice.

P-4 Siting and design

This topic evaluates how siting and design decisions consider technical, environmental, and stakeholder inputs. Reykjavik Geothermal has conducted early-stage analyses using technical, environmental, and regulatory data, and has engaged with relevant authorities and communities since 2008. The siting and design process incorporated optimization and two-way stakeholder communication. While the Environmental Impact Assessment is still in progress, current practices align with basic good practice, resulting in a score of **3**.

P-5 Environmental and social impact assessment and management

This topic evaluates how the project identifies, assesses, and manages environmental and social impacts. Reykjavik Geothermal has aligned its Environmental and Social Impact Assessment (ESIA) with both Ethiopian legal requirements and international standards, including those of the IFC. Since 2008, the company has engaged a wide range of stakeholders at national, regional, and local levels, including community representatives, NGOs, and development partners.

A robust baseline study was established, and comprehensive environmental and social management plans are in place, covering waste, air quality, noise, and rehabilitation. Engagement has been timely and inclusive, and mechanisms for feedback and issue resolution are operational. With no major gaps identified, this topic meets basic good practice, earning a score of **3**.

P-6 Integrated project management

This topic assesses the developer's ability to coordinate all aspects of the project, including construction and future operations. Reykjavik Geothermal has established an integrated project management framework that addresses construction-phase risks and includes guidelines aligned with international geothermal drilling standards, such as those from New Zealand and the African Union Commission.

The management plan outlines procedures for contractors and includes environmental health and safety measures. Although some implementation details remain pending, existing structures are robust and align with basic good practice. Therefore, this topic receives a score of **3**.

P-7 Geothermal resource

This topic evaluates the understanding and assessment of the geothermal resource, including predicted production capacity and efficiency. Reykjavik Geothermal has conducted initial assessments using geophysical and geochemical data and developed models to evaluate resource availability and reliability. Plans for generation operations are in place and account for a range of technical and environmental factors.

However, the absence of test drilling means that the resource's behavior remains uncertain, representing a significant gap in confirming production capacity. As a result, while foundational work is solid, the topic falls short of basic good practice in one key area, resulting in a score of **2**.

5. DISCUSSION

The GSAP assessment of the Abaya geothermal project focused on six sustainability topics, evaluated against the Level 3 (basic good practice) benchmark. The results indicate that five of the six topics met this standard, while P-7: Geothermal Resource received a score of Level 2 due to a significant gap related to the absence of test drilling. No topics achieved Level 5 (proven best practice). However, the findings suggest that with a dedicated and experienced working group, and by using the protocol as a guide, the project has strong potential to improve and reach higher sustainability performance levels in future stages.

Several challenges were encountered during the assessment:

Assessor experience – A full GSAP evaluation requires experienced assessors to ensure reliability and depth.

Time constraints – Limited time restricted the number of topics analyzed and prevented comprehensive engagement with developers and stakeholders.

Data availability – As the project is still in its early stages, much of the data necessary for in-depth evaluation was not yet available.

These limitations mean the assessment results should be viewed as indicative rather than definitive. Despite this, the GSAP has proven to be a robust framework for identifying key sustainability issues and providing structured guidance for improvement.

Moreover, the protocol fosters social acceptance by incorporating broad stakeholder perspectives and promoting inclusive, transparent communication among project developers, government bodies, communities, and investors. It creates a strong foundation for responsible project planning and encourages regular re-evaluation and adaptive management.

While stakeholder consultation could not be fully implemented in this assessment due to time constraints, future use of the GSAP should emphasize inclusive dialogue to raise performance to best practice standards. It is important to note that the protocol does not assign a "pass" or "fail" judgment, nor does it certify sustainability. Instead, it offers a consistent, evidence-based mechanism to track and enhance sustainability performance over time.

6. CONCLUSION

The Geothermal Sustainability Assessment Protocol (GSAP) has demonstrated its applicability within the Ethiopian context, offering a structured and adaptable framework to support sustainable geothermal development. It aligns well with national legal and regulatory frameworks and contributes meaningfully to the achievement of Ethiopia's Sustainable Development Goals.

By addressing key environmental, social, and technical themes, the protocol identifies areas for improvement and helps developers implement more sustainable practices. As a management tool, GSAP not only promotes alignment with international standards and best practices but also enhances transparency, accountability, and stakeholder trust.

Importantly, GSAP contributes to building social acceptance by encouraging inclusive stakeholder engagement and supporting community development. Its use can significantly improve the long-term viability and sustainability of future geothermal projects in Ethiopia and beyond.

REFERENCES

ESIA, 2019: Draft ESIA geothermal utilization scoping report. VSÓ Consulting, July, 129 pp.

Ethiopia Energy Authority, 2017: Energy sector regulatory capacity building project, draft. Ethiopia Energy Authority, report, 15 pp.

Ethiopia National Energy Policy, 2015: Draft 2015. Ethiopia National Energy Policy, 17 pp.

ISSN 2703-4275

Green Sober Environmental Management Consultant, 2019: Abaya geothermal development environment and socioeconomic baseline study. Green Sober Environmental Management Consultant Ethiopia, May, 187 pp.

GSAP, 2018: The draft GSAP preparation stage. Geothermal Sustainability Assessment Protocol, April.

JICA, 2015: Master plan on development of geothermal energy in Ethiopia. Japan International Cooperation Agency, report, 131 pp.

Hydropower Sustainability, 2019a: website, www.hydrosustainability.org, Sept.

Hydropower Sustainability, 2019b: website, www.hydrosustainability.org/hydropower-sustainability-assessment-protocol/phase1-protocol development-(2007-2010).aspx, Sept.

Landsvirkjun, 2017: Theistareykir preparation assessment report. Landsvirkjun, report, 133 pp.

Landsvirkjun, 2019: Information on Landsvirkjun. Landsvirkjun, National Power Company, website: www.landsvirkjun.com,

ON, 2018: Hellisheidi operation assessment report. IN - Orka Náttúrunnar, report, 131 pp.

RG, 2018: Abaya geothermal development project transcription and detail of stakeholder engagement meetings. Reykjavik Geothermal, report, November, 25 pp.

RG, 2019: Stakeholder engagement plan version-01. Reykjavik Geothermal, report, July 2019, 89 pp.

World Commission on Dams, 2000: Dams and development: A new framework for decision-making. Earthscan Publications Ltd, UK and USA

ISSN 2703-4275