INDEPENDENT TERMINAL EVALUATION

Kenya

Strengthening capacity for operation and maintenance with Internet of Things technologies for Olkaria Geothermal Power Station in Kenya (The IOT project)

UNIDO PROJECT ID: 190036

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Contents

Acknowledgements

Abbreviations and acronyms

GHG	Greenhouse gas
IOT	Internet of things
IRPF	Integrated results and performance framework (UNIDO)
JICA	Japan International Cooperation Agency
KenGen	Kenya Electricity Generating Company
M&E	Monitoring and Evaluation
METI	Ministry of Economy, Trade and Industry (Japan)
MTPF	Medium-term programme framework (UNIDO)
O&M	Operation and maintenance
PSC	Project Steering Committee
RBM	Results Based Management
TOC	Theory of change
TOR	Terms of Reference
UNIDO	United Nations Industrial Development Organization

Glossary of evaluation-related terms

Term	Definition
Baseline	The situation, prior to an intervention, against which progress can be assessed.
Effect	Intended or unintended change due directly or indirectly to an intervention.
Effectiveness	The extent to which the development intervention's objectives were achieved, or are expected to be achieved.
Efficiency	A measure of how economically resources/inputs (funds, expertise, time, etc.) are converted to results.
Impact	Positive and negative, intended and non-intended, directly and indirectly, long term effects produced by a development intervention.
Indicator	Quantitative or qualitative factors that provide a means to measure the changes caused by an intervention.
Lessons learned	Generalizations based on evaluation experiences that abstract from the specific circumstances to broader situations.
Logframe (logical framework approach)	Management tool used to facilitate the planning, implementation and evaluation of an intervention. It involves identifying strategic elements (activities, outputs, outcome, impact) and their causal relationships, indicators, and assumptions that may affect success or failure. Based on RBM (results based management) principles.
Outcome	The likely or achieved (short-term and/or medium-term) effects of an intervention's outputs.
Outputs	The products, capital goods and services which result from an intervention; may also include changes resulting from the intervention which are relevant to the achievement of outcomes.
Relevance	The extent to which the objectives of an intervention are consistent with beneficiaries' requirements, country needs, global priorities and partners' and donor's policies.
Risks	Factors, normally outside the scope of an intervention, which may affect the achievement of an intervention's objectives.
Sustainability	The continuation of benefits from an intervention, after the development assistance has been completed.
Target groups	The specific individuals or organizations for whose benefit an intervention is undertaken.

Executive summary

The IOT Project aimed to improve the operation and management efficiency of the Kenya Electricity Generating Company (KenGen) managed Olkaria geothermal power facility. To achieve this, the project installed a state-of the-art system for data monitoring and analysis, which – in combination with an intense programme of institutional capacity development for KenGen – would result in increased energy reliability, reduced greenhouse gas emissions, and reduced energy costs for end users. The project was fully financed by Japan's Ministry of Economy, Trade and Industry (METI). It was delivered as a partnership between KenGen, UNIDO and the Japan International Cooperation Agency (JICA), with technical and contract management support from Kyuden International. Following a tendering process that only permitted bids from Japanese firms, Yokogawa Electric were selected as the main contractor for the project, providing and installing the necessary equipment and systems at Olkaria.

This independent terminal evaluation assessed the entire period of UNIDO's involvement, from the project's design, through its inception in 2019, through to the end of 2021, just in advance of the envisaged completion date of April 2022. The project's overall performance was reviewed against the standard evaluation criteria of relevance, coherence, efficiency, effectiveness, progress to impact and sustainability. A combination of evaluation tools were applied, with the most important being interviews, a site visit to Olkaria, and documentation review. In addition to assessing overall results, the evaluation also aimed to identify recommendations to inform and strengthen UNIDO's future interventions.

The evaluation found that the project's concept was highly relevant to national priorities as it was fully aligned with Kenya's ambitions to both reduce emissions and increase the share of geothermal within the national energy mix. The project was also relevant and timely for KenGen, complementing their existing plans to upgrade technologies and improve data monitoring processes at Olkaria. Equally, the project was highly relevant to UNIDO's objectives. However, it was not clear that the restricted procurement process delivered the most relevant solution for KenGen or for Olkaria.

Several factors delayed project delivery, to the point that the installation was not fully operational by the time of this evaluation. Perhaps most significantly, the coronavirus pandemic delayed and complicated delivery, installation and testing of equipment at Olkaria. However, non-COVID factors also affected project progress. This included Government of Kenya approval processes involving multiple Ministries, delays to UNIDO's procurement decision-making, and an insufficiently detailed scope of work that resulted in several unplanned changes to the project, even after contracts had been agreed. Efficiency could also have been improved had there been a closer relationship with Honeywell, Olkaria's extant provider of control and data management systems. Despite these efficiency challenges, relationships between project counterparts were strong, with UNIDO being singled out by all stakeholders as an effective, professional partner.

Given the project's delays, many results have not yet been achieved. All equipment has been delivered, tested and is almost fully installed, but the system is still not fully connected. Partly as a consequence of these infrastructure delays, the planned programme of capacity development for KenGen is only in its very early stages.

Project counterparts remain very positive about the system's potential, but as the system is not yet operational it has not been possible to assess the extent of improvements to Olkaria's operational and management efficiency, nor the contribution to energy efficiency and reliability.

Equally, it has not been possible to assess impact at this stage. However, several factors were identified as being particularly important for improving the *likelihood* of impact, and for strengthening the sustainability of any impacts. Most critically, there is a need to ensure ownership of the system is well embedded within Olkaria's management: this should include a strategy for maintaining institutional capacity to manage and exploit the full potential of the system's capabilities. There is also a need to develop a clearer strategy for monitoring and assessing the effectiveness of the system, once it is online. Without a clear understanding of the system's technical performance, there is a risk that the project will not be in a position to demonstrate the comparative value of the system and – by extension – will not be in a position to inform or influence other potential interventions in the future. Moreover, the project's longer-term knowledge management and dissemination plans are underdeveloped. There's a risk that learning generated through the project will not be as influential as it could be across the energy sector in Kenya and beyond.

The following recommendations are made in order of priority.

Design and implement an assessment of the system's technical performance
1. A full technical assessment of the system's performance will eventually be required, so as to understand whether the system has been effective. Without that evidence base, the project will not be in a position to credibly promote or influence other actors to adopt the technology.

Develop a strategy for lesson sharing and/or upscaling of the technology
2. Target audiences should be identified, and a knowledge management strategy should be developed to ensure that learning from the project – whether positive or negative – is shared with relevant stakeholders.

Confirm long-term arrangements for sustaining the necessary technical training / capacities within KenGen
3. The upcoming JICA-led capacity development programme will build a solid foundation within KenGen to manage and make the most of the IOT Project infrastructure. However, there is a need to ensure that KenGen can independently maintain and sustain those skills beyond the project's lifetime.

Review application of the restricted procurement process
4. The funding and implementation of the IOT Project was conditional on a restricted procurement process being applied. However, it is not clear that restricted procurement delivered the most appropriate, relevant solution for KenGen. In turn, this raises questions as to whether the application of restricted procurement processes can be reconciled with UNIDO's strategic intention to be a results-orientated institution that delivers that most relevant, efficient support for its Member States.

Test quality assurance processes relating to projects' results orientation
5. The approach to IOT Project monitoring was undermined by some significant flaws. Much has changed within UNIDO since the project's development (not least the introduction of the IRPF), but it is worth testing the new, refined quality assurance systems to validate that weaknesses with the project's results orientation would be identified had the IOT Project been developed today.

1. Introduction

1.0.1   This report documents the terminal evaluation of the *Strengthening capacity for operation and maintenance with Internet of Things technologies for Olkaria Geothermal Power Station in Kenya (The IOT project)*. The report commences with an overview of the project, followed by a description of the evaluation's methodology. Findings are then presented in detail against the six key evaluation questions and criteria. Building on these findings, the project's performance is assessed against UNIDO's evaluation rating scales, conclusions are presented, and recommendations are provided for UNIDO and other project stakeholders.

2. Overview of the project

2.1   Summary

2.1.1   Kenya aims to provide 100% of its population with electricity by 2030. As a signatory to the Paris Agreement, the country is also working to reduce its greenhouse gas (GHG) emissions. Kenya's potential for geothermal power generation offers one channel through which the country can deliver on its electrification target whilst simultaneously avoiding increased GHG emissions. Indeed, Kenya's installed geothermal power generation capacity already accounts for 29.1% of the country's electricity requirements. New geothermal facilities offer one option for increasing the country's low-emission electricity supply, but considerable gains are also possible from *existing* geothermal infrastructure. The Kenya Electricity Generating Company (KenGen) has identified opportunities for significant efficiency gains at its Olkaria geothermal facility. KenGen has set a five-year target to double Olkaria's output while maintaining the current capacity factor, with these output gains to be achieved through enhanced operation and maintenance (O&M) capabilities[1].

2.1.2   Against that background, the IOT Project was developed to strengthen KenGen and Olkaria's O&M capabilities, particularly through the transfer of specific Japanese technologies focused on more efficient monitoring and management of geothermal facility data. Work was also planned to identify possible policy measures to improve the enabling environment for deploying the Japanese technology. The project was delivered as a partnership between KenGen, UNIDO and the Japan International Cooperation Agency (JICA), with technical and contract management support from Kyuden International. Following a restricted tendering process Yokogawa Electric were selected as the main contractor for the project, providing and installing the necessary equipment and systems at Olkaria.

2.1.3   The IOT Project and UNIDO's inputs were primarily focused on the procurement and installation of equipment at Olkaria. However, once the IOT Project is complete JICA will be implementing an extensive programme of capacity building at Olkaria. The JICA programme aims to build and sustain the technical skills and institutional capacities that will be necessary for managing the IOT Project-installed

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[1] To reiterate, this is a KenGen target: the IOT Project was only ever expected to *contribute* to this target.

technology in the long term. So while JICA's programme is administratively and financially separate from UNIDO's IOT Project, the two interventions (and their expected results) are completely interdependent: JICA's work will be based on the IOT Project's technology, and the IOT Project's long-term results will ultimately be dependent on the JICA programme.

2.1.4   The IOT Project also falls under the umbrella of a planned wider UNIDO initiative, namely the *Generating energy capacity from geothermal power generation and its related technologies for sustainable development programme (known as 'The Geothermal Programme')*. Indeed, the IOT Project was not originally conceptualised as a separate project, rather it was to be an integral component of the Geothermal Programme. However, UNIDO management elected to separate the IOT Project from the Geothermal Programme. By the time of this evaluation, no substantive activities had been delivered through the Geothermal Programme.

2.1.5   The IOT Project was initiated in November 2019. UNIDO's involvement was originally expected to conclude by May 2021, but was first extended until December 2021, then further extended to April 2022, largely as a result of delays arising due to the coronavirus pandemic. The project's budget of USD $5.31m including support costs was fully financed through a grant from the Government of Japan.

2.2   Programme theory of change

2.2.1   Theories of change (TOCs) are a common management tool expressing the basic rationale behind an intervention. They describe the results an intervention aims to achieve, the longer term impacts it aims to contribute to, how the intervention works towards those results, and the main assumptions behind the intervention's approach. In turn, TOCs also support the identification of key elements that should – in due course – be evaluated. As such, TOCs are frequently used as the starting point for developing evaluation approaches, and for identifying evaluation questions.

2.2.2   The following TOC was developed for the purposes of this evaluation, following a review of IOT project documentation and through discussion with the project management team.

IMPACT

Sustainable industrialization

Assumption: Increased use of geothermal results in displacement and/or reduction in use of non-clean energy sources

Reduced GHG emissions

Advanced economic competitiveness

PROGRESS TO IMPACT

Increased use of geothermal energy within Kenya

Assumption: Geothermal cost savings are passed on to consumers

Assumption: Reduced barriers to entry attract increased investment

Reduced energy costs for consumers

Lower operational and initial investment costs for geothermal in Kenya

OUTCOMES

Improved energy reliability

Assumption: Trainees practically apply skills gained

Increased generation capacity at Olkaria due to efficiency improvements

Strengthened capacity to operate and maintain geothermal power p[...]

Assumption: KenGen allocate sufficient resources to develop and maintain permanent training programme

ACTIVITIES / OUTPUTS

Assumption: IOT infrastructure performs to initial specifications / expectations

Awareness raising events

Permanent technical training programme sustained by KenGen

Development of policy recommendations

Delivery of technical training programme

Assumption: Current policies / incentives are a barrier to wider geothermal development

Design of technical training programme

Installation of Data Centre

Installation of collection and transmission systems

IOT PROJECT
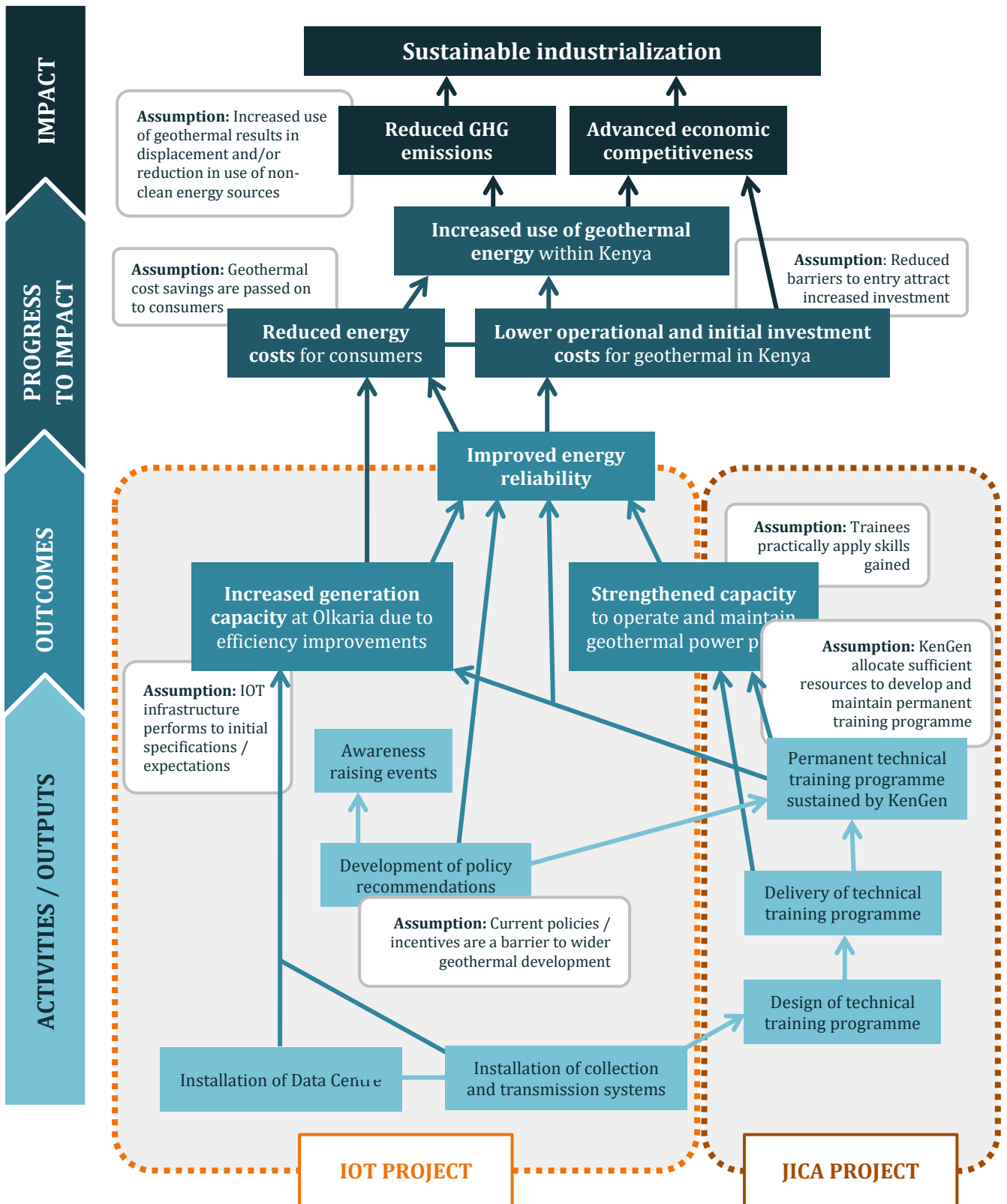
JICA PROJECT

Figure 1: IOT Project theory of change

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3.   Evaluation methodology

3.1   Evaluation purpose, objectives, scope and audience

3.1.1   The overarching **purpose** of the evaluation was **to assess whether the project has achieved or is likely to achieve its main objective**, and **to what extent the project has considered sustainability and scaling-up factors for long term impact**. To achieve this – and as is standard for many evaluations – the evaluation had an **accountability** objective (assessing project performance and results) and a **learning** objective (improving actions).

3.1.2   IOT Project documentation established the intervention's logic, its expected results (impacts, outcomes, outputs), and some indicators that could be used to measure progress against those results. The terminal evaluation aimed to assess progress towards the expected results and – where available – identify any unanticipated results.

Evaluation Objective 1 (accountability / results):
Assess project performance in terms of relevance, coherence, effectiveness, efficiency, sustainability and progress to impact.

3.1.3   While understanding progress towards results was essential for accountability purposes, the assessment of progress was then used as a foundation for **learning** what had worked well (and why) and what hadn't worked so well (and why). To address this objective the evaluation assessed the broader IOT project strategy and processes, exploring elements such as project scope, planning and coordination. This assessment then helped the evaluation to develop an understanding of the project's overall performance.

Evaluation Objective 2 (learning / improvement):
Develop findings, lessons and recommendations for enhancing the design of **new** and implementation of **ongoing** projects by UNIDO.

3.1.4   The evaluation **scope** covered the entire period of UNIDO's involvement, from the project's design, through its inception in 2019, to the time of the evaluation in late 2021.

3.1.5   The primary target **audiences** for the evaluation are:

- **UNIDO management**, particularly those with direct responsibility for the design and implementation of the project, for management of UNIDO's Geothermal Programme, and for UNIDO teams involved in the design and delivery of other related interventions;

- **JICA**, as the implementation partner focusing on capacity development;

- **KenGen**, as the project's primary beneficiary institution;

- Japan's **Ministry of Economy, Trade and Industry (METI)**, the IOT Project's donor.

3.2 Evaluation framework

3.2.1 The evaluation purpose and objectives, the theory of change, and UNIDO's evaluative requirements (as established within their evaluation policy and evaluation manual) all provided the basis for the **evaluation framework**, which in turn underpinned and guided the whole approach. The framework was structured against the standard **OECD-DAC criteria** agreed for the evaluation (**relevance**, **coherence**, **efficiency**, **effectiveness**, **sustainability**). In line with UNIDO policy and acknowledging the early nature of the IOT project's potential contributions to long-term impact, the OECD-DAC 'impact' criterion was simplified to instead measure '**progress to impact**'.

3.2.2 The framework identified **key evaluation questions**, supported by guiding **sub-questions**. The full framework is presented in annex 1, but figure 2 presents the six key evaluation questions:

1. **Relevance:** How relevant was the project to the needs and priorities of Kenya and KenGen?
2. **Coherence**: To what extent was the project aligned with – and complementary to – other work being delivered within Kenya?
3. **Efficiency:** How efficient was project delivery?
4. **Effectiveness:** Did the project achieve its planned outputs and outcomes?
5. **Progress to Impact:** How likely is it that the project's outputs and outcomes will contribute to long-term impacts?
6. **Sustainability:** To what extent are the project's outputs and outcomes likely to be sustained in the long term?

Figure 2: Key evaluation questions

3.3 Tools

3.3.1 To address the criteria and questions, the evaluation drew on a series of tools to gather and analyse qualitative and quantitative information:

- **Interviews:** 28 individuals participated in interviews, conducted through a combination of remote meetings (via Zoom) and face-to-face discussions in Kenya.
- **Site visit:** the National Evaluation Expert undertook a day-long visit to Olkaria Geothermal Power Plant, observing the project-supported installations and systems, and interviewing key stakeholders within KenGen.
- **Desk review:** A comprehensive literature review analysed documentation such as material produced through the project (including mid-term review, gender analysis, technical manuals, communications material, Project Steering Committee minutes and financial data), and relevant external documentation.
- **Technology assessment:** A technical assessment of the project-supported installation was planned, including a review of actual versus expected performance, and analysis comparing the project's technologies with alternative technologies that have been applied in similar contexts. However, given that the

system was not online by the time of this terminal evaluation, that technical assessment was not possible. Instead, the evaluation provides some initial advice for how such an assessment could be conducted, and what the IOT Project needs to put in place to ensure that assessment is undertaken.

- **UNIDO ratings:** All UNIDO evaluations are required to rate a series of evaluation and project criteria against a six-point Likert scale, ranging from 'highly unsatisfactory' to 'highly satisfactory'[2]. The project's ratings are presented in section 5.3 of this report.

3.4   Key informants

3.4.1   The following groups were the main project stakeholders, and consequently were the main interviewee groups during the evaluation:

- **UNIDO:** Nairobi, Tokyo and Vienna-based personnel that oversaw the project's design, development and day-to-day management;

- **Implementation partners:** Including JICA, Yokogawa Electric Company and Kyuden International Corporation. While not a formal implementation partner, Honeywell International were also interviewed as their systems are integral to the operation of Olkaria.

- **KenGen:** As managers and operators of Olkaria Geothermal Power Plant, KenGen were the primary institutional beneficiary of the project;

- **Government of Kenya:** The project's relevance and potential influence beyond KenGen was discussed with relevant government bodies, including the Ministry of Industrializaion, Trade and Enterprise Development and the Ministry of Energy;

3.5   Analysis and reporting

3.5.1   Data analysis and the development of emerging findings were undertaken collectively by the evaluation team. As far as possible, emerging findings were derived through triangulation of data from multiple sources and tools, helping to ensure the robustness and internal validity of the assessment. Emerging findings were discussed and validated with project stakeholders through remote debriefings.

3.5.2   Report preparation (including development of UNIDO ratings) was also undertaken collectively, but with the initial report drafting led by the evaluation team leader. The draft report was submitted to UNIDO's Independent Evaluation Division, who circulated to key stakeholders and managed the commenting process. The evaluation team then considered stakeholder comments, adjusting the draft report where appropriate, then submitted a final version to the UNIDO Independent Evaluation Division. The Independent Evaluation Division quality assured the final report and solicited UNIDO's management response for inclusion in the final product.

3.6   Evaluation team

3.6.1   The evaluation team comprised one independent international team leader and one independent national evaluation expert, both contracted by UNIDO for this

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[2] See page 24, UNIDO Evaluation Manual, 2019.

specific evaluation. The team received planning support from both UNIDO HQ and the UNIDO office in Nairobi.

3.7   Challenges and limitations

3.7.1   The evaluation's intended scope had to be significantly reduced due to the implementation status of the project. At the time of this evaluation the infrastructure being developed through the IOT Project was still not fully online or in use. Consequently, it was not possible to assess the system's effectiveness, nor its potential contribution to longer term results such as increased energy reliability, or improved O&M efficiency. Perhaps most seriously, JICA's extensive programme of capacity development activities had only just commenced and were not due for completion until late 2023. Although this capacity programme is administratively and financially separate from UNIDO's IOT Project, the two interventions are interdependent. The IOT Project's logic and rationale correctly indicate that the performance of the project is dependent on *both* the technology being installed *and* KenGen's capacities being developed. A comprehensive evaluation of the IOT Project would therefore need to take into account JICA's capacity development programme and its role in – and contribution to – the IOT Project's overall, long-term performance.

3.7.2   The evaluation team collected and analysed quantitative and qualitative data. As with many evaluations, a considerable amount of this (particularly qualitative data) was based on individual perceptions and opinions. To mitigate any subjective bias, findings were – as far as possible – triangulated across sources, and across tools. Where potentially important findings were identified but it was not possible to triangulate (e.g. data/finding provided by a single source) this is explicitly noted within the evaluation report.

3.7.3   As noted within the above theory of change, the IOT Project represented only an early step towards economic and environmental impacts. The UNIDO evaluation criterion of '**progress to** impact' is helpful here, as it recognises the long timescales to impact that are often inherent to UNIDO investments such as this project. In line with this approach – and instead of attempting to identify discrete impacts – the evaluation assessed the extent to which the project laid the **foundations for impact**.

3.7.4   The ongoing coronavirus pandemic prevented the possibility of efficient international travel, so the Evaluation Team Leader was unable to travel to Kenya. However, the presence of the National Evaluation Expert within Kenya went a long way to mitigating COVID-related difficulties. Always adhering to local restrictions, the National Expert was able to undertake a site visit to Olkaria Geothermal Power Plant and was able to undertake face-to-face discussions with many stakeholders. Where possible, the Evaluation Team Leader remotely joined or observed those Kenya-based discussions.

4.   Findings

4.1   Relevance

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EVALUATION QUESTION 1:
How relevant was the project to the needs and priorities of Kenya and KenGen?

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SUMMARY OF FINDINGS
The project's concept was highly relevant to national priorities as it was fully aligned with Kenya's ambitions to both reduce emissions and increase the share of geothermal within the national energy mix. The project was also relevant and timely for KenGen, complementing their existing plans to upgrade technologies and improve data monitoring processes at Olkaria. Equally, the project was highly relevant to UNIDO's objectives and to the organization's medium-term programme framework. However, it was not clear that the restricted procurement process delivered the most relevant solution for KenGen or for Olkaria.

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Highly relevant to national priorities

4.1.1   The evaluation found that the IOT project concept was highly relevant to Kenyan national priorities. By working towards improved efficiency within the geothermal electricity generation sector, the project aimed to increase the availability and reliability of clean energy. In turn, this could underpin an increase in the proportion of clean, geothermal-derived energy within Kenya's electricity sector, potentially displacing dirtier sources of energy and hence reducing the country's greenhouse gas emissions. This ultimate focus on supporting emissions reductions was tightly aligned not just with Kenyan national priorities, but also with international climate efforts.

4.1.2   Also highly relevant was the project's emphasis on using efficiency improvements as a means for reducing the cost of geothermal energy. Most immediately, the project aimed to deliver cost reductions for KenGen. However, by demonstrating how O&M costs could be reduced, the project also aimed to improve the attractiveness of geothermal as an investment, potentially removing barriers for new actors looking to enter Kenya's geothermal sector. Crucially, all this work to reduce O&M and support increased competition was hypothesised to reduce energy costs for consumers: again, another important national priority for Kenya.

4.1.3   This overarching logic was already well-aligned with Kenyan priorities at the time of the project's design in 2017, and the rationale has proven to be increasingly relevant. In 2021 KenGen set a target to double its geothermal capacity by 2030, with President Kenyatta also using a high-profile international summit to highlight investment opportunities within the country's geothermal sector.

Relevant and timely intervention for KenGen

4.1.4   The project timing was fortuitous for KenGen. When UNIDO contacted them to explore potential participation in the project, KenGen were just embarking on internal efforts to improve their own data monitoring and use. With KenGen on board, it was

then possible to ensure that the detailed project design and delivery was fully aligned with KenGen's own plans for strengthening O&M-related data monitoring through technology development and process improvement.

Well-aligned with UNIDO's objectives

4.1.5 The project was very well aligned with UNIDO's strategic objectives and technical competencies. While the design phase predated UNIDO's 2018-2021 medium-term programme framework (MTPF), it is clear that project implementation represented a tight fit with UNIDO's work. The IOT Project was strongly aligned with the two MTPF strategic priorities of *safeguarding the environment* and *strengthening knowledge and institutions*, and indirectly contributed to a third strategic priority, namely *advancing economic competitiveness*. The IOT Project has not yet concluded and will continue to be implemented during the period of UNIDO's next MTPF (2022-2025). Again though, the project's relevance will continue to be strong, being closely aligned with the impact dimension of *environmentally sustainable industry* and the enabling outcome of *strengthening knowledge and institutions*.

Restricted procurement may not have delivered the most appropriate solution

4.1.6 The project's overarching logic and objectives were highly relevant to Kenya, to KenGen and to UNIDO. However, the relevance and appropriateness of the project's operating model – specifically the approach of restricting procurement to Japanese firms – was not clear.

4.1.7 The project was financed by Japan's METI, with implementation conditional on a restricted procurement process: the project would not have been delivered without that condition. Against that background, the selected operating model was indisputably better than the alternative, which would have seen no project delivered, therefore no support provided for KenGen. Moreover, the inputs and support provided by the selected technology provider – Yokogawa Electric Company – were routinely praised by all stakeholders.

4.1.8 But some core stakeholders also questioned whether a more appropriate, efficient alternative could have been delivered had the procurement process been open to non-Japanese firms. Some core stakeholders noted that Honeywell International installed and continued to support Olkaria's existing control and data systems: those core stakeholders felt that Honeywell would have been a more logical choice of provider, and should certainly have been invited to tender. Beyond Honeywell, there are several non-Japanese firms that would have been capable of delivering similar – and potentially more contextually appropriate – products and services.

4.1.9 This issue is perhaps a moot point: again, a restricted procurement process was a condition of project financing and implementation. But the issue does highlight the tension between UNIDO's *ability* to apply restricted procurement, and UNIDO's *strategic intention* to be more results-orientated and to deliver the most relevant, efficient support for Member States.

4.2 Coherence

EVALUATION QUESTION 2:

To what extent was the programme aligned with – and complementary to – other work being delivered within Kenya?

SUMMARY OF FINDINGS
Beyond the immediate institutional counterparts, the project had limited interaction with other organisations and initiatives in Kenya. This was understandable: the pilot-based nature of the project and the highly technical, targeted objectives meant that the project was tightly focused on working exclusively with KenGen and Olkaria. Moreover, there are only a limited number of actors in Kenya (and even regionally) that operate in the geothermal sector. Post-implementation, the project has tentative plans to share project learning with relevant external stakeholders. However, these longer-term knowledge management and dissemination plans are underdeveloped. There's a risk that the learning generated through the project will not be as influential as it could be across the energy sector in Kenya and beyond.

Limited engagement with other organisations and initiatives

4.2.1   The project's tight, highly technical focus on one institution (KenGen) and one facility (Olkaria) meant that there was limited interaction with other organisations and initiatives beyond the work's immediate scope. Project conceptualisation, design and implementation were almost exclusively directed towards tailoring and delivering the technological solution identified for Olkaria. No substantive engagement or alignment with other institutions or programmes was envisaged, at least during project implementation.

Influencing and awareness raising plans are under-developed

4.2.2   The project's limited engagement with external organisations during the main phase of implementation was understandable. KenGen is the only major operator of geothermal facilities in Kenya, and even on a regional basis there are only a limited number of other actors operating within the geothermal sector. However, the project logic and design highlighted the potential longer-term influence of the work. The project's concept was based on a premise that – if shown to be successful at Olkaria – the technologies could be upscaled across KenGen, across Kenya, and even across the region. To support this, activities were planned to identify possible policy and regulatory recommendations that could improve the enabling environment for the technologies, thereby supporting broader uptake. Additionally, there was an intention to develop awareness raising products / publications that would share project learning with relevant audiences. However, by the time of this terminal evaluation no substantive work had been undertaken to develop policy or regulatory recommendations, and no formal planning had been undertaken for longer-term knowledge management, awareness raising or lesson sharing.

4.2.3   The limited progress on these externally-focused elements was partly a function of the limited progress of the project more broadly. As the technology was not fully operational, no data or evidence was available around system performance. Without any data on system performance, success factors and/or problems, little progress was possible on – for example – identifying appropriate policy refinements or identifying lessons that could influence the work of other energy-focused initiatives.

4.2.4   But even during an intervention's early stages it is invariably possible to at least identify key stakeholders and target audiences that could eventually benefit from an intervention's learning. However, the IOT Project did not undertake any substantive stakeholder mapping, with no analysis undertaken of – for example – who the project should seek to influence, or which institutions or initiatives within Kenya could benefit from insight into the project's performance. Given that – through its parent Geothermal Programme – the project ultimately aimed to support the uptake of the technology across Kenya's geothermal sector (and beyond), the absence of stakeholder and contextual analysis should be considered an oversight. There's a risk that this lack of external analysis and planning could undermine the project's influence and coherence with existing and planned work across Kenya's energy sectors.

4.3   Efficiency

EVALUATION QUESTION 3:
How efficient was project delivery?

SUMMARY OF FINDINGS
Several factors delayed project delivery, to the point that the installation was not fully operational by the time of this terminal evaluation. Perhaps most significantly, the coronavirus pandemic delayed and complicated the delivery, installation and testing of equipment at Olkaria. However, non-COVID factors also affected project progress. This included Government of Kenya approval processes that involved multiple Ministries, delays to UNIDO's procurement decision-making, and a relatively open scope of work that resulted in several unplanned changes to the project, even after contracts had been agreed. Project efficiency could also have been improved had there been a closer relationship with Honeywell, Olkaria's extant provider of control and data management systems. Despite these efficiency challenges, relationships between project counterparts were strong, with UNIDO being singled out by all stakeholders as an effective, professional partner.

Implementation and completion undermined by coronavirus
4.3.1   As with many initiatives that were operational during 2020, the IOT Project's delivery was significantly compromised by the coronavirus pandemic. Equipment installation and testing were all seriously delayed, which of course had a knock-on effect to the overall project timeline. By the time of this terminal evaluation in Nov/Dec 2021 the installation was still not fully operational, which has further delayed delivery of the critical, JICA-led institutional capacity development work. But while coronavirus exacerbated progress, other factors also undermined project efficiency.

Government-level approval processes resulted in significant delays
4.3.2   Much of the non-COVID delay can be ascribed to the required approval processes for the importation, installation and operation of project equipment. Some of the project's processes and equipment necessitated approvals from multiple bodies across the Government of Kenya. Some stakeholders identified a significant bottleneck arising where approvals were required from the Communications Authority of Kenya. It was noted by some interviewees that the project's main governmental counterparts – the Ministry of Industrialization, Trade and Enterprise and the Ministry of Energy –

were separate in the governmental hierarchy from the Communications Authority, so there was limited scope for UNIDO's governmental counterparts to expedite the approval process. Additionally, some interviewees noted that the momentum of approval processes was often dependent on individuals, both within the governmental body providing approval, and within UNIDO. So if the responsible individual within *either* government *or* UNIDO was absent, the approval process sometimes did not progress as quickly as it could have.

4.3.3 Some interviewees also felt that approval processes could have been simpler and quicker had procurement been more efficient. Specifically, it was suggested that less delays would have arisen if the project's equipment had been imported in less batches, or even in a single batch. Delays also arose when UNIDO's monthly internal Procurement Committee was rescheduled at a critical point in the project's delivery, resulting in some procurement decisions and approvals not being made on time.

Insufficiently detailed project specification

4.3.4 Several interviewees linked some delays to a comparative lack of detail within the project's technical specification document. The technical specification was developed prior to the tendering process for the contractor. While sufficient for supporting that initial tendering process, the technical specification was never developed further. Stakeholders on both 'sides' of the contract (i.e. providers *and* clients) agreed that the specification was not sufficiently defined. This led to differing expectations, changes to the scope of work, and – in some instances – additions and alterations that resulted in cost and time implications for the work. Moreover, stakeholders noted that many of these changes could have been foreseen had there been a more rigorous planning process, accompanied by a more detailed technical specification.

Relationship with Olkaria's existing provider could have been stronger

4.3.5 As above, Olkaria's existing control and data systems were installed and continue to be supported by Honeywell International. Some work was necessary to ensure compatibility between the existing Honeywell systems and the Yokogawa infrastructure delivered through the IOT Project. All stakeholders noted that this was a common, relatively straightforward procedure and not technically onerous. However, there were again delays experienced during this process and complete alignment between the two systems took considerably more time and resources than anticipated.

4.3.6 But interviewees noted that the difficulties were not technical in nature, rather the delays were more due to communication and potential 'diplomacy' issues between the project, Olkaria / KenGen, and Honeywell. Some stakeholders were concerned that Honeywell were possibly apprehensive about one of their competitors (Yokogawa) gaining a foothold with a key client (KenGen). But other stakeholders noted that – despite Honeywell's critical role at Olkaria – the company had never been formally involved in the IOT Project's design.

Good relationships between project counterparts

4.3.7 Notwithstanding the project's relationship with Honeywell, stakeholders indicated that relations and communications between the formal project partners

were strong. Progress reporting was clear, decision-making was transparent, and the Project Steering Committee was well organised. While some interviewees felt that KenGen could have undertaken more rigorous preparatory work and could have been more responsive to communications and information requests, this was not a universally held view. However, there was consensus across all interviewees as to UNIDO's performance: UNIDO were consistently identified as a professional, focused partner with some stakeholders indicating that UNIDO were considerably easier to work with than other comparable public sector partners / clients.

4.4 Effectiveness

EVALUATION QUESTION 4:
Did the project achieve its planned outputs and outcomes?

SUMMARY OF FINDINGS
Given the project's delays, many results have not yet been achieved. All equipment has been delivered, tested and is almost fully installed, but the system is still not fully connected. Partly as a consequence of these infrastructure delays, JICA's planned programme of capacity development for KenGen has not started. Project counterparts remain very positive about the system's potential, but it has not been possible to assess the extent of improvements to Olkaria's operational and management efficiency, nor the contribution to energy efficiency and reliability. Moreover, no clear plans are in place to measure system effectiveness in the future.

Project effectiveness unclear at this stage
4.4.1   An assessment of effectiveness was not possible at the time of this evaluation, as the project had not been completed. While the infrastructure had been fully delivered, tested and mostly installed, the system was not yet online or in use. Consequently, it was not possible to assess the project's most important expected outcomes such as improved O&M efficiency, improved energy reliability, or improved generation capacity. Moreover, as the system was not online JICA's programme of institutional capacity development had not commenced, so it was not possible to assess the installed technology's contribution to management and institutional capacity at Olkaria.

Limited plans in place for future assessments of effectiveness
4.4.2   Project counterparts were confident that the system will be fully online and in use by April 2022, and that institutional capacity development will commence shortly thereafter. At that point it will be possible to assess the project's effectiveness. With the system online, counterparts will be in a position to measure the IOT Project technology's contribution to – for example – Olkaria's O&M processes, to the facility's generation capacity, and to the facility's reliability.

4.4.3   However, no substantive plans were in place to undertake any assessment of the system's effectiveness. Without a clear, objective assessment of the system's effectiveness, there is a significant risk that UNIDO and project counterparts will not have generated sufficient evidence to support their planned work on influencing other actors and upscaling the technology beyond Olkaria and KenGen.

4.4.4 There are several common metrics and approaches for measuring the performance of systems such as those being installed at Olkaria. For example, Yokogawa typically use *steam consumption performance* to analyse a facility's performance and to compare system efficiency before and after any 'treatment' or installation. Considering effectiveness from another angle, KenGen's own records could provide the basis for another assessment: for example, what was the length of O&M-associated downtime before and after the installation? Regardless of the metrics and processes to be applied, there is a pressing need for the IOT Project to generate data, evidence and analysis that is capable of demonstrating whether and how the installed system is effective.

Overall project monitoring was weak

4.4.5 The absence of plans for an analysis of system performance and effectiveness was indicative of broader weaknesses with the project's monitoring strategy. While a logframe was developed, the 'outcomes' were not framed correctly. Instead of identifying the desired *changes* that the project would bring about (e.g. improved energy reliability, strengthened institutional capacity), the 'outcomes' only described processes and activities (e.g. Outcome 1: "*data centralization, accumulation and security through the use of the IOT technologies*"). The logframe therefore did not support results monitoring, and potentially perpetuated a misunderstanding that the project should just focus on *activities* such as installing technologies, rather than the *changes* that those activities should bring about.

4.4.6 Rather than having a result focus, project monitoring was instead used for ensuring that contractual and procurement milestones were met. Monitoring these milestones was of course vital for contract management purposes, but it was not sufficient to meet UNIDO requirements. All UNIDO projects are required to monitor progress towards results: the qualitative changes and differences that an intervention aims to deliver. In the case of the IOT Project, this would have involved – for example – monitoring and measurement of changes to Olkaria's efficiency, changes to the reliability of energy produced by Olkaria, and changes to KenGen's institutional capacity. As above, no clear plans were in place to measure these potential results, and the project's logframe was not orientated towards the monitoring of these results.

4.4.7 These shortcomings with project monitoring were largely a function of the IOT Project's overall design, which mainly emphasised output-level results: the project document focused mostly on technology procurement and installation, with little discussion or resources allocated towards outcome or impact-level results or *changes* such as capacity development. It is possible that this lack of results-orientation was a consequence of the IOT Project being separated from its parent Geothermal Programme (recall that the IOT Project was not originally a standalone intervention, rather it was originally conceived of as an integral component of the Geothermal Programme). The IOT Project design's near-exclusive focus on technology procurement and installation also failed to reflect the importance of JICA's capacity development work. Arguably, the IOT Project's long-term success and sustainability is largely – if not *wholly* – dependent on JICA's upcoming inputs. The performance of the IOT Project can only be fully assessed once JICA's work is completed. But the boundaries of the IOT Project's design means that its monitoring strategy does not extend to or even acknowledge the project's interdependence with JICA's work.

4.5 Sustainability and Progress to Impact

Sustainability and *Progress to Impact* are two separate evaluation criteria linked to two separate questions, but during the evaluation it became clear that there was considerable overlap between the related findings. Consequently, both criteria are addressed together within the following section.

> **EVALUATION QUESTION 5:**
> How likely is it that the project's outputs and outcomes will contribute to long-term impacts?

> **EVALUATION QUESTION 6:**
> To what extent are the project's outputs and outcomes likely to be sustained in the long term?

SUMMARY OF FINDINGS

The limited delivery of results to date means that any assessment of impact is not possible at this stage. However, several factors were identified as being particularly important for both improving the likelihood of impact, and for strengthening the sustainability of those impacts. Most critically, there is a need to ensure ownership of the system is well embedded within Olkaria's management. Crucially this should include a strategy for maintaining institutional capacity to manage and exploit the full potential of the system's data capabilities. There is also a need to develop a clearer strategy for monitoring and assessing the effectiveness of the system, once it is online. Without a clear understanding of the system's technical performance, there is a risk that the project will not be in a position to demonstrate the comparative value of the system and – by extension – will not be in a position to inform or influence other potential interventions in the future.

4.5.1   The project was delivered within a single facility, involving a comparatively limited set of stakeholders. During the project's short timeframe there was never an intention to deliver impact (long-term social, economic and environmental changes). However, the project did aim to lay the foundations for improving the efficiency of Olkaria's O&M processes and – in doing so – to demonstrate proof-of-concept and identify how the approach could be upscaled and deployed in other contexts. It was hypothesised that any wider deployment would deliver impact through decreased energy costs, increased energy availability, and decreased greenhouse gas emissions.

4.5.2   The theory of change (page 3, above) summarised this long-term rationale. It is instructive to apply the evaluation's findings to the theory of change and – in turn – to identify where the project has most clearly contributed to long-term changes, but also where most attention will be required in the future. The following diagram provides summary assessments of progress towards each of the theory of change's elements. The presence of several elements that are assessed as 'red' (not started / no progress) should not necessarily be interpreted as a shortcoming of the project. Rather, the theory of change describes the *long-term* pathway to impact. Given that the project represented an early step in that process, it is expected that *many* elements will have not yet been delivered or even initiated. However, the remainder of this section

considers which theory of change elements could be most influential on the long-term sustainability of the project's achievements.

IMPACT

PROGRESS TO IMPACT

OUTCOMES

ACTIVITIES / OUTPUTS

Sustainable industrialization

Reduced GHG emissions

Advanced economic competitiveness

Increased use of geothermal energy within Kenya

Reduced energy costs for consumers

Lower operational and initial investment costs for geothermal in Kenya

Improved energy reliability

Increased generation capacity at Olkaria due to efficiency improvements

Strengthened capacity to operate and maintain geothermal power plants

Awareness raising events

Permanent technical training programme sustained by KenGen

Development of policy recommendations

Delivery of technical training programme

Design of technical training programme

Installation of Data Centre

Installation of collection and transmission systems

IOT PROJECT

JICA PROJECT

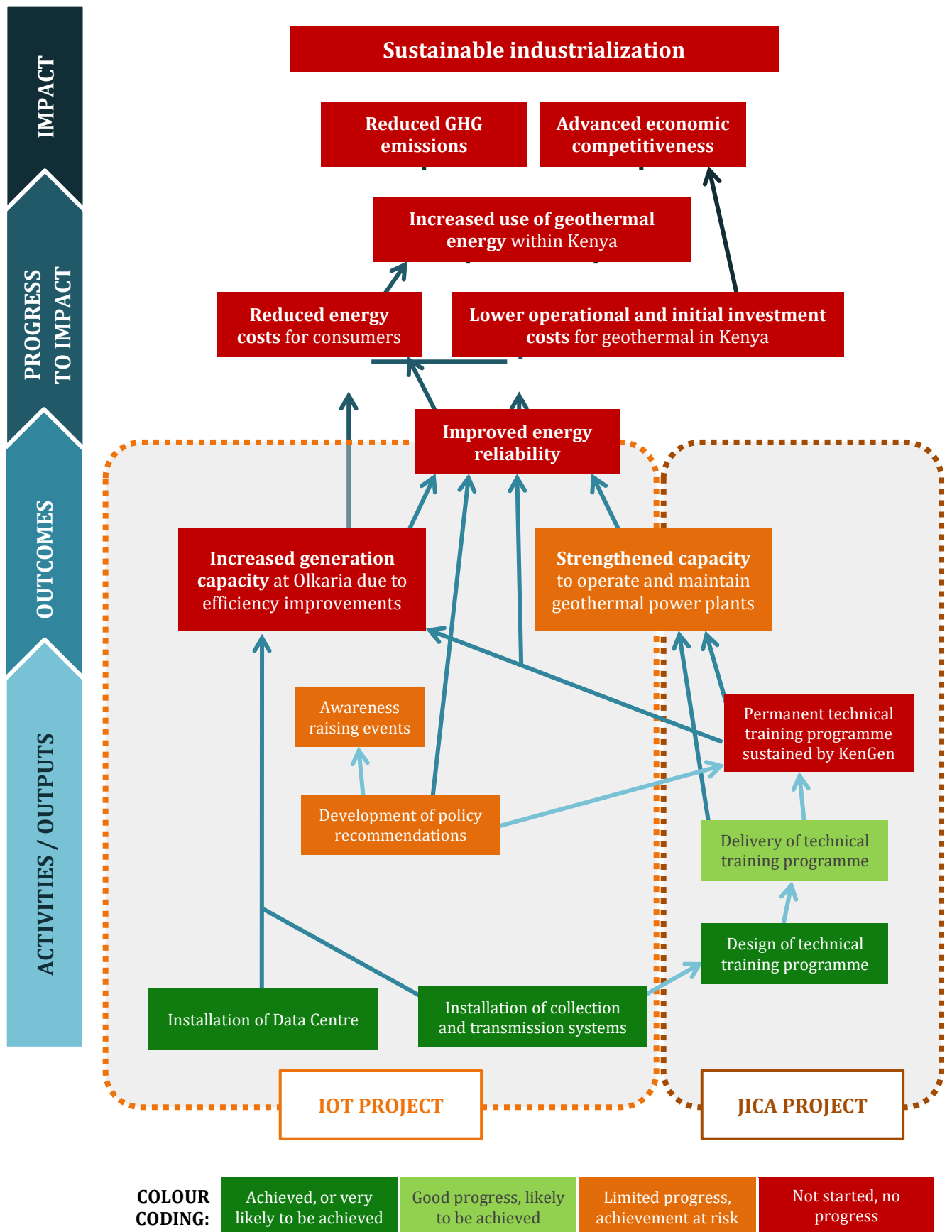| COLOUR CODING:	Achieved, or very likely to be achieved	Good progress, likely to be achieved	Limited progress, achievement at risk	Not started, no progress

Figure 8: Assessment of progress against theory of change

Strong ownership of the system within KenGen

4.5.3   An encouraging foundation for the project's sustainability is the extent of ownership demonstrated by KenGen and the management team at Olkaria. It is clear that the infrastructure installed by the IOT Project will be an integral part of Olkaria's processes for the foreseeable future. Moreover, KenGen are planning to use the knowledge and experience gained through the system to inform and strengthen their broader consultancy and contracting work. If KenGen goes ahead with these plans, there is potential that the IOT Project's inputs will indirectly support and influence actors – and potentially impact – beyond KenGen and Kenya.

4.5.4   However, some stakeholders were concerned about potential future costs associated with the system. KenGen have not yet allocated any of their own financial resources towards the system, but in the short-term this is not necessarily a problem. The project-installed technology and software is accompanied by perpetual licences. Additional subscriptions (and hence costs) will only be required if KenGen choose to expand the installed system beyond its current scope. Moreover, Yokogawa will continue to provide Olkaria free technical support to resolve any snagging issues for a 2-year period following the finalisation of the installation. At the end of the snagging period though, some interviewees noted that it is possible – perhaps *likely* – that KenGen will need to enter longer-term contractual relationship with Yokogawa to ensure the system is correctly maintained and does not become obsolete. This will clearly have cost implications for KenGen. But it is also possible that JICA's capacity development programme will develop sufficient institutional capacity within KenGen for them to maintain the system independently.

4.5.5   However – and as discussed below – KenGen's ownership of the system could be further strengthened with a clear plan to ensure that the requisite skills for managing the system are completely embedded and sustained within KenGen.

Capacity development for institutional sustainability not yet delivered

4.5.6   The IOT Project will be followed by an intensive programme of capacity development for KenGen, with this work managed by JICA and delivered by Kyuden International. The training programme will be grounded in the technologies being installed by Yokogawa, the data analyses those technologies will support, and the O&M actions that can be taken in response to the improved understanding that the technologies will afford. But the training programme focus extends well beyond the IOT Project infrastructure, aiming to develop KenGen's capacities for geothermal facility and reservoir management more broadly.

4.5.7   At the time of this terminal evaluation some preliminary online training had been conducted. However, the substantive programme (involving face-to-face training in both Olkaria and Japan) was yet to commence, as the completed installation of IOT Project infrastructure at Olkaria is a prerequisite for the training activity. The capacity building programme is now due for completion in the latter half of 2023.

4.5.8   The breadth and depth of the capacity development programme represents an intensive intervention. It's delivery and success will be critical for the sustainability and impact of the technology delivered through the IOT Project, and – with its focus on geothermal facility and reservoir management more broadly – has the potential to significantly strengthen the institutional capacity and competence of KenGen beyond

just Olkaria. But as the substantive training programme was only just getting underway at the time of this evaluation, it is far too early to assess the training's contribution to the sustainability or impact of the IOT Project, or its contribution to KenGen's broader institutional capacity.

4.5.9 Even at this preliminary stage though, there are already some evident risks to sustainability. No formal planning has been undertaken to incorporate JICA's training into KenGen's permanent programme of workforce development. As the original Project Document made clear, the sustainable, ongoing operation of IOT Project infrastructure will be largely dependent on KenGen being able to independently train staff on the use of IOT Project equipment, and the processing and analysis of the data generated by that infrastructure. Without a plan for training beyond the lifetime of the IOT Project, there's a risk that any skills development will not be sustained within Olkaria or KenGen.

4.5.10 JICA's training programme was only just commencing as the IOT Project concluded.. No baseline of institutional capacity was in place, and the metrics against which the training programme performance will be assessed were yet to be confirmed (although work is being conducted to confirm these metrics). Given the intensity of the planned capacity development programme, it is plausible that JICA's training activities could be *at least* as influential (potentially *even more* influential) on the IOT Project's expected impacts than the actual technologies being installed. A more developed approach to long-term monitoring could help to disaggregate and compare the relative contributions to impact of (i) the technology as provided through the IOT Project and (ii) the training as provided through JICA's capacity development programme.

Limited basis or plans in place for upscaling the technology

4.5.11 A central driver of the IOT Project's logic and the parent Geothermal Programme's logic was the assumption that – if demonstrated to be effective at Olkaria – the tested technology could be upscaled across KenGen, Kenya and beyond. Wider use of the technology would increase the likelihood of more discernible impacts on energy costs, greenhouse gas emissions and ultimately sustainable industrialisation.

4.5.12 However, there is a significant risk that upscaling of the technology – and hence achievement of the project's (and Geothermal Programme's) long-term impacts – will not be delivered. The above noted absence of plans to monitor, measure and analyse system effectiveness means that there is not currently an evidence base (or plans for an evidence base) upon which a case can be made for the broader use of the technology. Without data and comparative analyses in place, the project will not be in a good position to persuade or influence other actors to adopt the technologies installed at Olkaria.

4.5.13 The project's potential impact has been placed at further risk due to underdeveloped plans for upscaling. Even if an evidence base on system effectiveness had been developed, only limited informal discussions have been undertaken on where and how the technology could be promoted and deployed next. There are not yet any substantive agreements or formal plans to roll-out the technology further, or even to broaden the testing of the system beyond Olkaria.

4.6   Gender mainstreaming

4.6.1   The project document included some consideration of gender dimensions, with this initial discussion implying that the most tangible route for addressing gender would be through the planned capacity development activities. But the extent to which gender will be addressed across training activities is not yet clear, given that the capacity building programme had only just commenced at the time of this evaluation.

4.6.2   More concretely – and as planned for within the project document – a full gender assessment of the project was undertaken in 2020. The report came to a well-argued, logical conclusion that addressing gender meaningfully and sustainably was far more dependent on the institutional efforts of KenGen, rather than the IOT Project. To that end, the assessment provided an action plan for the project, but also a more substantial action plan for KenGen. The action plan for KenGen was built around several recommendations, however it is clear that the recommendations for KenGen are well beyond the mandate of the IOT Project. The gender assessment is a useful document, but it also underlines the limitations of what a one-off intervention (such as the IOT Project) can realistically achieve on gender, particularly when that intervention is based within a far larger, established institution such as KenGen.

5.   UNIDO Project Evaluation Ratings

5.0.1   In addition to the main assessment against the evaluation criteria (relevance, coherence, efficiency, effectiveness, progress to impact, sustainability), evaluations of UNIDO-supported work routinely assess specific aspects of an intervention's delivery. The following section summarises (and restates, where appropriate) the evaluation's findings on **performance of partners**, and on **factors facilitating or limiting the achievement of results**, particularly with regards to M&E and results-based management. The section concludes with a table (standard to all UNIDO evaluations) that summarises performance ratings for each component of the project's design, delivery and management.

5.1   Performance of partners

UNIDO and Delivery Partners
5.1.1   The core delivery partners involved in the installation of infrastructure – UNIDO, Yokogawa, Kyuden International – were regularly identified by evaluation stakeholders as being efficient, effective and responsive. Many of the factors that caused project delays were largely or even entirely outside these partners' direct control. The three organisations worked well together, with clear lines of communication.

5.1.2   As noted above, there was consensus across all interviewees as to UNIDO's performance: UNIDO were consistently identified as a professional, focused partner with some stakeholders indicating that UNIDO was considerably easier to work with than other comparable public sector partners / clients.

5.1.3   However, delivery would have benefited from the closer involvement of Honeywell International in project steering and decision-making processes. The centrality of their systems to Olkaria's management – and the close, obvious relationship between Honeywell's systems and the infrastructure installed by the IOT Project – warranted at least a stronger informal relationship with Honeywell.

National Counterparts
5.1.4   KenGen and the Olkaria management team demonstrated clear ownership of – and enthusiasm for – the IOT Project system. Some stakeholders felt that, during project implementation, KenGen could have undertaken more rigorous preparatory work and could have been more responsive to communications and information requests, but this was not a universally held view. However, the sustainability of the project is partly dependent on KenGen developing a plan for sustaining the requisite skills for managing the IOT Project infrastructure independently.

Donor
5.1.5   Beyond financing, METI's involvement in the detailed design and day-to-day implementation of the project was minimal. However, METI's request to restrict the project's procurement to Japanese firms (and UNIDO's agreement to that request) may have compromised the project relevance and results orientation.

5.2   Factors facilitating or limiting the achievement of results

5.2.1   Paragraphs 4.4.5-7 provide the main analysis of the project's performance with regards to monitoring, evaluation and results-based management. In summary, project results monitoring was extremely weak. This started with a very poorly formulated logframe that did not support the monitoring of actual *results* (i.e. the substantive *changes* that the project aimed to support). Concerningly, the project does not have in place any clear plans to measure and assess the effectiveness of the system installed at Olkaria. Without an evidence base for whether and how the system performs at Olkaria, there can be no objective basis for promoting or upscaling the technology beyond Olkaria. This evidence gap risks undermining many of the envisaged longer-term outcomes and impacts.

5.3   Performance ratings table

5.3.1   Evaluations of UNIDO-supported work routinely provide performance ratings for each component of an intervention's design, delivery and management. Performance is assessed against UNIDO's six-point rating scale, which ranges from 'highly unsatisfactory' (score 1) to 'highly satisfactory' (score 6).

5.3.2   Based on the foregoing findings and analysis, the following presents ratings and summary assessments for each of the UNIDO performance components. **It is important to note that many of the lower ratings ('*moderately unsatisfactory*' and below) are largely – sometimes *entirely* – a function of the premature stage at which this evaluation has been conducted**.

Project element		Summary assessment	Rating
A	**PROGRESS TO IMPACT (OVERALL)**	Given that the infrastructure is not yet online and the (essential) capacity building work has only just started, there has been very little progress towards impact.	Unsatisfactory (2)
B	**PROJECT DESIGN (OVERALL)**		Unsatisfactory (2)
1	Overall design	Design was not results-orientated: the 'separation' of UNIDO's (technological) work from JICA's (capacity) work is illogical - they are both integral to the project.	Unsatisfactory (2)
2	Logframe	Logframe was very poor and was not capable of supporting the monitoring of results.	Highly unsatisfactory (1)
C	**PROJECT PERFORMANCE (OVERALL)**		Moderately unsatisfactory (3)
1	Relevance	Concept was highly relevant to Kenya and KenGen's needs and priorities. However, restricted procurement raises concerns as to whether the most appropriate solution was selected.	Moderately unsatisfactory (3)
2	Effectiveness	Project infrastructure is not yet online, so effectiveness cannot be assessed. However, the absence of plans to measure or assess system performance risks undermining *future* understanding of effectiveness.	Moderately unsatisfactory (3)
3	Efficiency	Many delays were due to COVID, but some delays were a result of an overly general design specification, and potentially avoidable bottlenecks with government approval processes.	Moderately unsatisfactory (3)
4	Sustainability of benefits	Sustainability and upscaling of benefits are at risk due to the absence of plans to measure or assess system performance, and the absence of a plan for KenGen to sustain technical capacity in the long-term.	Moderately unsatisfactory (3)
D	**CROSS-CUTTING PERFORMANCE (OVERALL)**		Unsatisfactory (2)
1	Gender mainstreaming	Informative gender assessment undertaken, with a logical conclusion that 'true' gender mainstreaming was highly dependent on KenGen, rather than the project.	Satisfactory (5)
2	M&E	Monitoring mostly focused on contract management. No systems developed to monitor or assess the actual performance of the installed infrastructure.	Highly unsatisfactory (1)
3	Results-based management	Given the logframe's lack of outcomes and the broader lack of outcome monitoring, 'true' RBM was not feasible.	Highly unsatisfactory (1)
E	**PARTNER PERFORMANCE (OVERALL)**		Moderately satisfactory (4)
1	UNIDO, JICA, Kyuden, Yokogawa	Partners have worked well together, with UNIDO often singled out for praise. However, Honeywell should have been more involved in project processes, even if on an informal basis.	Moderately satisfactory (4)
2	National Counterparts (KenGen)	KenGen demonstrate clear ownership of and enthusiasm for the system. However, there's a need to develop a clear plan for sustaining technical capacity within KenGen beyond the project lifetime.	Moderately satisfactory (4)
3	Donor (METI)	Involvement limited to financing.	Moderately satisfactory (4)
F	**OVERALL ASSESSMENT**		Moderately unsatisfactory (3)

6. Conclusions and recommendations

6.0.1 The IOT Project is on track to provide the KenGen-operated Olkaria geothermal power plant with a state-of-the-art system for data monitoring and analysis. This infrastructure has the potential to increase O&M efficiency at Olkaria, which in turn could support an increase in the reliability of energy produced by the facility, and could reduce energy costs for end users. KenGen are enthusiastic about the system's potential. Aside from the immediate benefits to Olkaria, KenGen believe the experience they will gain through operating the system will influence and strengthen their institution more broadly, including the advisory and consultancy services that they provide to other energy authorities beyond Kenya.

6.0.2 The project has been delivered in a challenging context, with the coronavirus pandemic undermining the efficiency of the system's design and installation. Bureaucratic and approval bottlenecks have also delayed progress. But the project partners have worked well together and – despite these challenges – the infrastructure is on the verge of being operational.

6.0.3 However, the project is far from complete. Because the system is not yet online, the planned programme of institutional capacity development has not fully commenced: it will be at least two more years until this capacity work has been delivered. And given the centrality of this work to the project's longer-term results, it will not be possible to assess the effectiveness of the IOT Project until the capacity development programme is complete. Consequently, this 'terminal' evaluation is somewhat premature.

6.0.4 Nevertheless, the evaluation has identified a number of gaps and risks that – if addressed – could strengthen the sustainability of the project's work, and in turn improve the likelihood that the originally envisaged outcomes and impacts are delivered. Beyond the IOT Project, the evaluation has also identified some potential measures that UNIDO should consider at an institutional level. Based on the evaluation's findings, the following recommendations are made in order of priority.

Design and implement an assessment of the system's technical performance
6.0.5 The IOT Project was based on a premise that – if the system being installed and tested at Olkaria proved to be successful – the technology could be applied and upscaled throughout Kenya and beyond. In turn, this would help to multiply the project's envisaged impacts such as improved energy reliability, reduced energy costs, and reduced greenhouse gas emissions. Given that the system is not yet operational, it is not yet possible to assess the system's technical performance. But of significantly more concern, there are *no substantive plans in place* to measure the system's technical performance. Without a robust, objective technical assessment of system performance, the project will not be able to understand whether the system has been effective, and the project will not be in a position to credibly promote or influence other actors to adopt the technology.

Recommendation 1

UNIDO and its project partners should design and implement a comprehensive assessment of the system's technical performance. This should include at least:

1. **A before-and-after analysis of O&M efficiency at Olkaria**

2. **A comparative analysis of the Olkaria system's performance against similar, existing deployments of the technology**

3. **A comparative analysis of the Olkaria system's performance against *alternative* technologies for data monitoring and analysis**

Latest estimates indicate that the system will become fully operation in March/April 2022. But most – perhaps all – *preparatory* work for a technical assessment can be undertaken prior to that date. Metrics can be identified, assessment processes can be developed and a series of comparator facilities / deployments can be identified, against which Olkaria performance can be benchmarked. The assessment need not be independent; indeed it is likely that Yokogawa or Kyuden are in the best position to design and undertake the work. However, the assessment should be based on commonly used metrics and objectively verifiable data that external stakeholders – including potential adoptees of the technology – can interpret and relate to their own work and/or facilities.

Develop a strategy for lesson sharing and/or upscaling of the technology

6.0.6 Assuming that the Olkaria system proves to be effective and – in comparison to alternative solutions – is confirmed as a promising, viable approach for broader application, the IOT Project should embark on its originally envisaged work to promote and upscale the technology. Even if the system is *unsuccessful*, the project will have valuable lessons to share with other energy sector stakeholders: it is just as important to communicate what *doesn't* work as what *does* work. However, plans for promotion, upscaling and/or lesson sharing are underdeveloped at present. This is perhaps understandable given that the system is not yet operational (so no evidence base for its effectiveness exists). Nevertheless, preparatory work could be undertaken now.

Recommendation 2

UNIDO and its project partners should develop a knowledge management strategy to ensure that learning from the project – whether positive or negative – is shared with relevant stakeholders.

In the first instance, a mapping exercise should be undertaken to identify stakeholders (in Kenya and beyond) that will have an interest in the project's experience. This should be a reasonably straightforward exercise, given the relatively few actors operating in the geothermal sector both in Kenya and regionally. Once the effectiveness (or otherwise) of the system is ascertained, the project will then be a position to develop targeted messages and recommendations for relevant audiences.

Confirm long-term arrangements for sustaining the necessary technical training / capacities within KenGen

6.0.7 The project logic and the original project document indicated that system effectiveness and the sustained, long-term operation of the installed infrastructure would be largely dependent on KenGen being able to independently train their staff on the use of the IOT system, and the processing and analysis of the data generated by the system. While the imminent, JICA-led capacity development programme will build a solid skills foundation within KenGen, no formal planning has yet been undertaken to ensure that those skills are maintained beyond the project lifetime.

Recommendation 3
As part of the upcoming capacity development programme, JICA and KenGen should ensure that a plan is developed to sustain the necessary skills and training within KenGen beyond the project's implementation period.
Ideally, this long-term capacity / training plan should allow KenGen to maintain the requisite institutional knowledge and skills indefinitely, with no (or at least minimal) external support.

Review application of the restricted procurement process

6.0.8 Reiterating a central evaluation finding, the IOT Project was highly relevant to Kenya and KenGen needs and priorities. However, the universe of potential solutions was tightly constrained: with one exception only Japanese companies were able to offer a response to the problem.

6.0.9 UNIDO's processes indisputably allow for restricted procurement, and the IOT Project certainly adhered to the relevant UNIDO policies and regulations. Moreover, there would not have been an IOT Project unless restricted procurement had been applied. But it is not clear that the project delivered the most appropriate, relevant solution for KenGen. In turn, this raises questions as to whether the application of restricted procurement processes can be reconciled with UNIDO's strategic intention to be a results-orientated institution that delivers that most relevant, efficient support for its Member States.

Recommendation 4
UNIDO's Office of Evaluation and Internal Oversight should review the extent to which restricted procurement is applied within UNIDO, the potential impact the process has on institutional effectiveness, and the extent to which the process supports UNIDO's shift towards being a results-orientated institution.

Test quality assurance processes relating to projects' results orientation

6.0.10 From a results perspective, several aspects of the IOT Project were concerning. Most tangibly, the project logframe was entirely inadequate. Results and indicators were often poorly linked to the project's strategy and activities. Additionally, the logframe's 'outcomes' were incorrectly formulated, measuring processes and/or

activities rather than the changes that the project aimed to deliver: the logframe simply did not provide a basis for results monitoring. The above-noted absence of a plan for assessment of the system's technical performance should also be considered a significant gap in the project's monitoring strategy and results orientation.

6.0.11 Perhaps most consequentially though, UNIDO documentation framed the IOT Project as being almost exclusively focused on technology, with project completion considered to be the point at which the IOT infrastructure is installed and brought online. That milestone may represent the nominal completion of *UNIDO's* inputs, but it is a comparatively early milestone for the broader intervention at Olkaria. JICA will now embark on an intensive, lengthy programme of capacity building for KenGen. Despite JICA's work being a nominally 'separate' project, the capacity development work is absolutely integral to the IOT Project logic: without the capacity development work it is implausible that the IOT Project's envisaged longer-term outcomes and impacts (e.g. strengthened O&M, increased energy reliability, reduced energy costs) will ever be achieved. It is also entirely possible that – given its intensity – the capacity work will actually deliver a greater contribution to O&M efficiency at Olkaria than the IOT infrastructure. From a results perspective the framing of the IOT Project's boundaries and end date is problematic for several reasons:

- It implies that the capacity development work was not critical, and that UNIDO's technological intervention was sufficient to achieve the envisaged results

- It implies a lack of understanding of project logic models and results pathways

- It has triggered a terminal evaluation (i.e. *this* evaluation) at far too early a point in the project's journey towards results

6.0.12 The project's design and approval pre-dates the adoption of UNIDO's integrated results and performance framework (IRPF) and the organisation's recent, substantial shift towards becoming a results-focused institution. But in many respects the project provides an illustration of how *not* to develop a results-focused intervention.

Recommendation 5
UNIDO's Office of Strategic Planning, Coordination and Quality Monitoring should consider using the IOT Project to 'stress test' the new project quality assurance processes that have been refined since the IRPF was introduced.
Undertaking a stress test could help to confirm whether and how UNIDO's new, post-IRPF systems would have identified the problems with the IOT Project's approach to results.

7.   Annex 1: Evaluation Framework

The evaluation purpose and objectives, theory of change, and UNIDO's evaluative requirements all provided the basis for the **evaluation framework**, which in turn underpinned and guided the whole approach. The framework was structured against the standard **OECD-DAC criteria** agreed for the evaluation (**relevance**, **coherence**, **efficiency**, **effectiveness**, **sustainability**). In line with UNIDO policy and acknowledging the early, foundational nature of the IOT project's potential contributions to long-term impact, the OECD-DAC 'impact' criterion was simplified to instead measure '**progress to impact**'.

The framework identified **key evaluation questions**, supported by guiding **sub-questions**. The framework was also informed by a set of indicative questions presented within the evaluation TOR: all those indicative questions were incorporated accordingly.

Key evaluation questions	Guiding sub-questions
RELEVANCE	
1.How relevant was the project to the needs and priorities of Kenya and KenGen?	**1.1** To what extent was the programme relevant to Kenya's national priorities and strategies?
	1.2 To what extent was the programme relevant to UNIDO's mandate?
	1.3 How were the Government of Kenya and KenGen involved in problem analysis, identification of solutions, and project design?
COHERENCE	
2.To what extent was the project aligned with – and complementary to – other work being delivered within Kenya?	**2.1** How did the project identify and coordinate with other geothermal-focused interventions in Kenya?
	2.2 How did the project identify and coordinate with other relevant energy policy-focused work in Kenya?
	2.3 How did the project ensure alignment with KenGen's existing workplans, including capacity development activity?
EFFICIENCY	
3.How efficient was project delivery?	**3.1** Was the project's plan clear, appropriate and realistic?
	3.2 How efficient and effective were the project's management arrangements? Were roles, responsibilities and accountabilities sufficiently clear?
	3.3 How effective were the project's monitoring processes?
	3.4 How cost- and time-efficient was the project?
EFFECTIVENESS	
4.Did the project achieve its planned outputs and outcomes?	**4.1** What is the new infrastructure's actual performance compared to expected performance? How has the infrastructure affected Olkaria's power generation capacity?
	4.2 To what extent has the infrastructure improved energy reliability?
	4.3 How effective was the project at building the capacities required to operate and maintain the new infrastructure?
	4.4 To what extent did the programme identify and strengthen the enabling environment for application of IOT technology in geothermal management?

Key evaluation questions	Guiding sub-questions

PROGRESS TO IMPACT

5. How likely is it that the project's outputs and outcomes will contribute to long-term impacts?	**5.1** To what extent has the project lowered operational and initial investment costs for geothermal energy in Kenya?
	5.2 What emissions reductions has the project delivered?
	5.3 Did the project contribute to any unintended impacts, positive or negative?

SUSTAINABILITY

6. To what extent are the project's outputs and outcomes likely to be sustained in the long term?	**6.1** What are the key factors that will affect (negatively or positively) the sustainability and uptake of the project's results?
	6.2 What gaps and needs were not addressed by the project?
	6.3 How were gender dimensions incorporated within project design and delivery?

8. Annex 2: Interview participants

UNIDO
Irungu, Doreen
Kanegae, Masataka
Kashio, Chiaki
Muchai, Maryanne
Muna Munga, Zacharia
Torii, Naoki

KenGen
Keter, Eng, Harrison
Kimani, Eng. Samson
Olkaria 5 Chief Engineer
Olkaria IT Manager
3 x Olkaria Unit 5 Staff

Ministry of Industrialization, Trade and Enterprise Development
Mageto, Victor
Mwenga, Lydiah
Okeyo, Hezekiah

Ministry of Energy
Mavisi, Richard
Njoroge, Patrick

JICA
Miyata, Chiyoko
Njafwa, Kevin
Njenga, Evanson
Wakamura, Takashi

Yokogawa Electric Company
Suzuki, Takeshi

Kyuden International
Handa, Kazunori
Tsukimoto, Kiyotaka
Shirakubo, Hiroto

Honeywell International
Mahomeddi, Ridhwaan

9. Annex 3: Documents reviewed

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