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INDEPENDENT TERMINAL EVALUATION

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Transfer (LCET) Programme

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Abbreviations and acronyms

GCF	Green Climate Fund
GEF	Global Environment Facility
GHG	Greenhouse gas
LCET	Low carbon low emission clean energy technology
M&E	Monitoring and evaluation
MASEN	Moroccan Agency for Sustainable Energy
METI	Ministry of Economy, Trade and Industry (Japan)
NEDO	New Energy and Industrial Technology Development Organization
NIA	National Irrigation Authority (Kenya)
O&M	Operation and maintenance
PSC	Project Steering Committee
RBM	Results Based Management
SEI	Sumitomo Electric Industries
TOC	Theory of change
TOR	Terms of Reference
ULH-MHP	Ultra-low head micro hydropower
UNIDO	United Nations Industrial Development Organization
VFB	Vanadium flow battery

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 LCET Programme aimed to promote the rapid deployment of specific Japanese low carbon, low emission technologies across a variety of African contexts. In addition to demonstrating technologies, the programme also aimed to develop institutional and individual capacities to operate and maintain those technologies, to strengthen the enabling environment for uptake of the technologies, and to identify and support business models that could benefit from the technologies. LCET was delivered through three sub-component projects in Ethiopia, Kenya and Morocco. In Ethiopia and Kenya, ultra-low head micro hydropower (ULH-MHP) facilities were installed across existing irrigation channels, with these installations supported by a range of institutional and individual capacity development. The programme also aimed to construct two productive use centres in Ethiopia and Kenya, which would host small businesses that in turn would benefit from the ULH-MHPs' electricity supply. In Morocco, a vanadium flow battery (VFB) was installed to support the smoothing and stabilisation of electrical output from an existing concentrated photovoltaic plant, and to test the potential of VFB technology within mini-grids. Finally, in Rwanda feasibility studies explored the potential for advanced mini-grid systems. The \$10.34m programme was conceptualised and funded by Japan's Ministry of Economy, Trade and Industry (METI) and implemented by UNIDO.

This independent terminal evaluation assessed the entire LCET Programme from the design stage, through its inception in 2013, through to the programme's conclusion at the end of 2021. The programme'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, site visits within Ethiopia, Kenya and Morocco, 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 programme was conceptually relevant to the needs, priorities and contexts of all participating countries. The long-term objectives of reduced emissions, increased energy reliability and improved economic opportunities were well-aligned with national ambitions, and the approach of testing low-carbon energy technologies was an appropriate channel through which to contribute to those objectives. The identified solutions were also nominally relevant to each operating context: off-grid micro-hydro was a relevant response for irrigation-dependent communities in Ethiopia and Kenya, whereas grid-level battery technology was appropriate for Morocco. But despite the programme's high-level relevance to national priorities, there was limited alignment with national, local or community-level development plans and activities. Instead, the programme delivered top-down solutions that were driven more by pre-defined technologies than on-the-ground needs. Particularly in Ethiopia and Kenya, there was only a limited degree of engagement with target communities during programme design, which ultimately compromised the coherence of the programme and the depth of local ownership.

Delivery and installation of the primarily technology-focused, UNIDO-led components of the programme (technical infrastructure, technical training) was generally efficient. However, delivery of the partner-led programme components was far less

efficient. Particularly problematic were the delays to the construction of the productive use centre in Ethiopia, and to the mini-grid demonstration facility in Morocco. These facilities were integral to the programme's overall logic, so the failure to deliver them efficiently and concurrently with the energy infrastructure diminished progress towards the programme's targeted results. The inefficient delivery of these facilities was symptomatic of broader gaps in programme planning. In Ethiopia and Kenya, insufficiently defined or resourced plans were in place to operate, maintain and monitor the infrastructure in the long-term. This resulted in inconsistent performance, insufficient maintenance, and – combined with limited local ownership of the work – a decreasing lack of interest amongst the host communities.

While some of the programme-level outputs were delivered, none of the outcomes were achieved, and there is little likelihood that programme-level outcomes will be achieved in the future. There have been some energy benefits, but the anticipated economic benefits have not materialised, and there is only limited evidence of sustained institutional or individual capacities. Within Kenya, the programme has foundered, resulting in a degree of resentment amongst the host community and representing a significant reputational risk for UNIDO. The Ethiopia installation is providing electricity, but the supply is inconsistent and is being operated and maintained on a highly ad-hoc basis. Few benefits have been delivered for local businesses, as the productive use centre has not yet been completed: electricity is being supplied to households and the local school instead. In Morocco the VFB is facilitating renewable electricity integration with the national grid, but the system's capacity for supporting off-grid applications has not been demonstrated. Moreover, the programme did not undertake ongoing, long-run technical monitoring and analysis of system performance or cost effectiveness. Consequently, insufficient data or evidence was developed to demonstrate the effectiveness of the LCETs, meaning there is no credible basis for upscaling or even promoting the tested technologies. Consequently, it is highly unlikely that the programme will deliver a meaningful contribution to longer-term impacts.

Even though the programme has delivered few outcomes, it may still be possible to undertake some measures to improve the sustainability of the outputs that have been delivered, and to minimise reputational risks to UNIDO. The following recommendations are made in order of priority.

Undertake remedial measures in Kenya

1. With the support of independent expertise, UNIDO should urgently undertake a remediation process that closely involves all programme stakeholders. A negotiated, consensus-based agreement could still allow the programme to exit the situation on reasonable terms.

Revisit sustainability strategy in Ethiopia

2. UNIDO and local counterparts should revisit – then either validate or revise – their long-term plans for sustaining, financing and managing the ULH-MHP facility. This joint analysis should be undertaken against a 'clean slate': the LCET Programme is concluding, is unlikely to deliver its anticipated outcomes and – in any case – was based on a design that did not sufficiently take into account local stakeholders' needs and priorities. Consequently, local stakeholders should no

longer be held to the LCET Programme's operating model. Instead, what objectives do the local institutions and community wish to achieve through the facility, and what would be the most appropriate operating model and financing strategy for them?

Consider undertaking detailed testing and analysis in Morocco

3. It is still possible to test the appropriateness of VFB for off-grid applications, so UNIDO should consider providing additional support to MASEN to ensure that relevant, rigorous testing is undertaken on VFB's potential for supporting off-grid applications. This should include analysis of the system's cost-effectiveness. However, any additional testing needs to be based on a recognition that any upscaling of VFB is highly – if not *wholly* – dependent on the commercial prerogative of the technology's intellectual property holder.

Ensure UNIDO's quality standards are applied to all technical cooperation projects

4. UNIDO's quality review and approval processes should be applied to any form of technical cooperation project, including those that are financed on a bilateral basis.

1. Introduction

1.0.1 This report documents the terminal evaluation of the *Low Carbon Low Emission Clean Energy Technology Transfer (LCET) Programme*. The report commences with an overview of the programme, followed by a description of the evaluation's methodology. Findings are then presented against the six key evaluation questions and criteria. Building on these findings, the programme's performance is assessed against UNIDO's evaluation rating scales, conclusions are presented, and recommendations are provided for UNIDO and other programme stakeholders.

2. Overview of the programme

2.1 Summary

2.1.1 To meet the goals of the Paris Agreement, countries around the world are increasingly focusing on reducing their greenhouse gas (GHG) emissions. For many countries, significant GHG reductions can be achieved through the transformation of their energy and electricity sectors. Equally though, countries do not want to undermine economic development or human wellbeing, so are invariably pursuing strategies that integrate economic growth with their emissions reductions efforts. Low carbon, low emission energy technologies are playing a central role in global efforts to both reduce emissions and maintain or even improve economic and human development. Many of these technologies have already been particularly beneficial for countries with limited and/or unreliable national grids, often introducing electricity to previously unconnected or underserved rural communities and small businesses.

2.1.2 Funded by Japan's Ministry of Economy, Trade and Industry (METI) and implemented by UNIDO, the LCET Programme aimed to promote the rapid deployment of specific Japanese low carbon, low emission technologies across a variety of African contexts. In addition to demonstrating specific Japanese technologies, the programme also aimed to develop institutional and individual capacities to operate and maintain those technologies, aimed to strengthen the enabling environment (policy, legislation) for uptake of the technologies, and aimed to identify and support new business models that could benefit from the technologies.

2.1.3 LCET was delivered through three sub-component projects in Ethiopia, Kenya and Morocco. In Ethiopia and Kenya, the LCET Programme installed Japanese ultra-low head micro hydropower (ULH-MHP) facilities across existing irrigation channels. In Ethiopia one ULH-MHP plant was installed, hybridised with photovoltaics; in Kenya two ULH-MHP plants were installed, with a small photovoltaic system subsequently installed to support battery charging. These installations were accompanied by institutional and individual capacity development, with courses delivered in Japan, Ethiopia and Kenya. The programme also aimed to develop two productive use centres adjacent to the two facilities in Ethiopia and Kenya. These centres aimed to host small businesses that would benefit from the electricity supply provided by the new facilities. In Morocco, the LCET Programme installed a Japanese vanadium flow

battery (VFB) to support the smoothing and stabilisation of electrical output from an existing concentrated photovoltaic plant, and to test the potential of VFB technology within mini-grids. Again, capacity development was delivered in both Japan and Morocco. In addition to the three sub-components, the LCET Programme also undertook feasibility studies in Rwanda, looking at the potential for advanced mini-grid systems in the country.

2.1.4 The programme was initiated in August 2013. It was originally expected to conclude by February 2017 but was extended until December 2021. The programme's budget was \$10.34m, comprised of a €10.29m grant from the Government of Japan and €52,870 of co-financing from UNIDO.

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 below TOC was developed following a review of LCET programme documentation and through discussion with the programme management team.

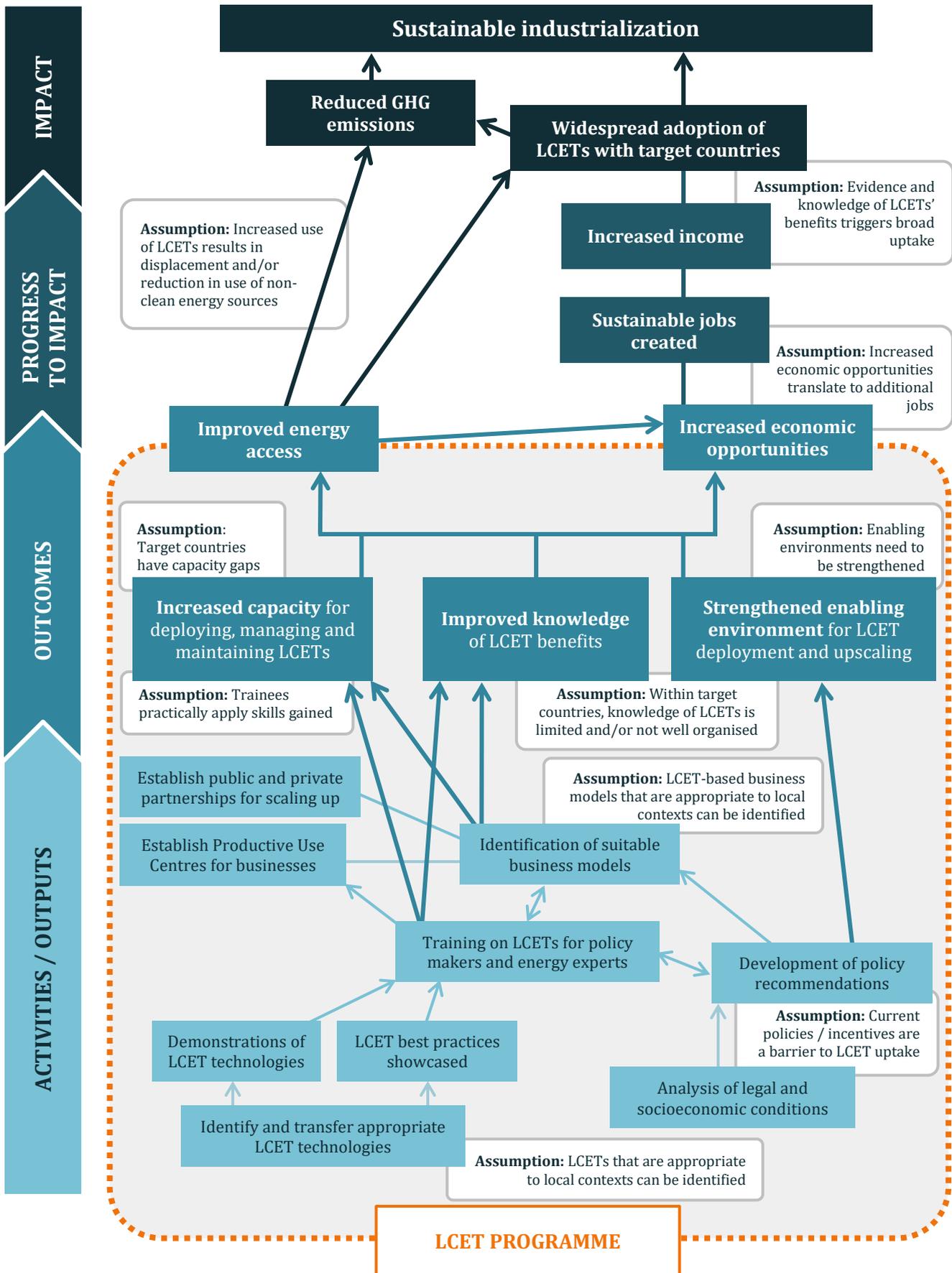


Figure 1: LCET programme theory of change

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 programme has achieved or is likely to achieve its main objective, and to what extent the programme 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 programme performance and results) and a **learning** objective (improving actions).

3.1.2 LCET programme 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 programme 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 LCET strategy and processes, exploring elements such as programme scope, planning and coordination. This assessment then helped the evaluation to develop an understanding of the programme’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 intervention and all its activities, from the programme’s design, through its inception in 2013, to its final stages of implementation in 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 programme, and for UNIDO teams involved in the design and delivery of other related interventions;
- Japan’s **Ministry of Economy, Trade and Industry (METI)**, the LCET Programme’s donor.
- **Beneficiaries / participants**: including small businesses, cooperatives, community groups and individuals that have used or are using infrastructure installed through the programme.

- **Institutional partners:** Government and national bodies that were directly involved in the programme including Ministries, irrigation authorities and academic institutions that participated in programme oversight and delivery.
- **Delivery partners:** Organisations involved in the delivery of the programme infrastructure and activities, including (for example) JAG Seabell and Sumitomo Electric Industries.

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 LCET programme’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 programme to the needs and priorities of the participating countries and institutions?
2. **Coherence:** To what extent was the programme aligned with – and complementary to – other work being delivered within the participating countries?
3. **Efficiency:** How efficient was programme delivery?
4. **Effectiveness:** Did the programme achieve its planned outputs and outcomes?
5. **Progress to Impact:** How likely is it that the programme’s outputs and outcomes will contribute to long-term impacts?
6. **Sustainability:** To what extent are the programme’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:** conducted through a combination of remote meetings (via Zoom) and face-to-face discussions in Ethiopia, Kenya and Morocco.
- **Site visits:** National Evaluation Experts undertook visits to Adama in Ethiopia, Mwea in Kenya, and Ouarzazate in Morocco, observing the programme-supported installations and systems, and interviewing key stakeholders at each site.

- **Desk review:** A comprehensive literature review analysed documentation such as material produced through the programme (including self-assessments, commissioned studies, technical manuals, communications material and Project Steering Committee minutes), and relevant external documentation.
- **Technology assessment:** Technical assessments of each installation were planned, including reviews of actual versus expected performance, and analyses comparing the programme's selected technologies with alternative technologies that have been applied in similar contexts. However, there was no sufficient long-run data available for any of the installations. Each facility underwent some post-commissioning testing, but this was not followed by any systematic monitoring. Consequently, technical assessments of system performance were not possible.
- **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'¹. The programme's ratings are presented in section 5.3 of this report.

3.4 Key informants

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

- **UNIDO:** Addis Ababa, Nairobi, Tokyo and Vienna-based personnel that oversaw the programme's design, development and day-to-day management.
- **Beneficiaries / participants:** including cooperatives and community groups at the two ULH-MHP sites in Ethiopia and Kenya.
- **Institutional and delivery partners:** including – amongst others – the Oromia Water, Energy and Resource Development Bureau, the Kenyan National Irrigation Authority, the Moroccan Agency for Sustainable Energy (MASEN) and Sumitomo Electric Industries (SEI).

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.

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.

¹ See page 24, [UNIDO Evaluation Manual](#), 2019.

3.6 Evaluation team

3.6.1 The evaluation team comprised one independent international team leader and three independent national evaluation experts, all contracted by UNIDO for this specific evaluation. The team received planning support from UNIDO HQ, and from UNIDO's offices in Addis Ababa, Nairobi and Tokyo.

3.7 Challenges and limitations

3.7.1 Beyond the initial post-commissioning testing of each installation, no systematic data collection or monitoring of technical performance was undertaken for any of the installed facilities. In the absence of this data, it has not been possible for the evaluation to undertake technical assessments of system performance or effectiveness, or to undertake rigorous comparative analysis against alternative technologies and approaches.

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 The ongoing coronavirus pandemic prevented the possibility of efficient international travel, and the evaluation team leader was unable to participate in site visits. However, the presence of the national evaluation experts within each country went a long way to mitigating COVID-related difficulties. Always adhering to local restrictions, national experts were able to undertake site visits and were able to undertake face-to-face discussions with programme stakeholders. Where possible, the evaluation team leader remotely joined or observed those country-based discussions.

4. Findings

4.1 Relevance

EVALUATION QUESTION 1:

How relevant was the programme to the needs and priorities of the participating countries and institutions?

SUMMARY OF FINDINGS

The programme was conceptually relevant to the needs, priorities and contexts of all participating countries. The long-term objectives of reduced emissions, increased energy reliability and improved economic opportunities were well-aligned with national ambitions, and the approach of testing low-carbon energy technologies was an appropriate channel through which to contribute to those objectives. The identified solutions were also nominally relevant to each operating context: off-grid micro-hydro was a relevant response for irrigation-dependent communities in Ethiopia and Kenya, whereas grid-level battery technology was appropriate for Morocco. The programme was also highly relevant to UNIDO's strategic objectives. However, it was not clear that the restricted procurement process delivered the *most* relevant or appropriate technological solutions for the participating countries.

Programme concept was relevant to participating countries

4.1.1 The LCET Programme was conceptually relevant to the needs and priorities of Ethiopia, Kenya, Morocco and Rwanda. As with other nations, all these countries are looking to reduce emissions, while simultaneously improving energy reliability and ensuring economic growth is sustained or even increased. The testing, adoption and upscaling of low carbon energy technologies clearly offers a potential strategy for these countries to address their energy, environmental and economic needs.

Identified technologies were nominally relevant to operating contexts

4.1.2 There are of course a large range of low carbon energy technologies, and a multiplicity of contexts within which these technologies can be deployed. The LCET Programme identified technological responses that were nominally relevant to the targeted operating contexts. In Ethiopia and Kenya, ultra-low head micro-hydro power (ULH-MHP) systems were identified as being complementary to local geographic conditions, specifically the availability of a constant water flow within irrigation channels. The technology appeared to be particularly timely in Ethiopia, where there was a drive towards increasing the number of low-land irrigation schemes within the country. The absence of connections to the national electricity grid within the identified locations provided another justification for the deployment of ULH-MHP in both Ethiopia and Kenya. In Morocco, a well-developed national grid and a comparatively strong industrial base were the backdrop for the LCET Programme's decision to test vanadium flow battery (VFB) technology. The LCET Programme aimed to support testing of VFB's grid smoothing and stabilisation functions (for Morocco), but also aimed to test VFB's potential as a supply source for small, off-grid mini-systems. If successful, VFB could be offered for broader deployment in rural contexts

across Africa, with Morocco serving as a potential manufacturing and/or marketing base.

4.1.3 Also relevant was the LCET Programme's high-level objective of coupling energy provision with economic opportunities. In Ethiopia and Kenya, productive use centres and business growth activities were planned to both support economic development in the target localities, and to build a user base (i.e. new businesses) for the electricity generated by the ULH-MHP units. In Morocco, a high-level aim was to base any upscaling of VFB on strengthened domestic manufacturing capabilities, with Moroccan companies potentially becoming VFB supply chain participants. Given its comparatively strong, developed energy infrastructure and institutions, Morocco was also seen as an appropriate 'launchpad' for demonstrating and facilitating the upscaling of VFB across Africa.

Restricted procurement may not have delivered the most appropriate solution

4.1.4 While this high-level relevance was evident, it is not clear that the most appropriate, most relevant technological solutions were identified and tested. The Programme was conceived of – and fully financed by – Japan's Ministry of Economy, Trade and Industry (METI). A condition of this financing was that technology procurement would be restricted to Japanese companies. By definition, this restricted procurement process imposed a significant constraint on the range of possible technologies that could have been tested. Again, there would have been no Programme without the condition of restricted procurement. 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.

Highly relevant to UNIDO objectives

4.1.5 Despite being initially conceived by METI, the programme was highly relevant to UNIDO's mandate and was well-aligned with the organisation's objectives and technical competencies. The LCET Programme's design – and even most of its delivery – was largely undertaken prior to the adoption of UNIDO's first medium-term programme framework (MTPF) in 2018. However, it is clear that the LCET Programme concept would be a strong complement to the first (2018-2021) and upcoming (2022-2025) MTPFs. Indeed, the LCET Programme would have aligned with all three of the upcoming MTPF impact dimensions, namely *shared prosperity from industry, economic competitiveness, and environmentally sustainable industry*.

4.2 Coherence

EVALUATION QUESTION 2:

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

SUMMARY OF FINDINGS

Despite the programme's high-level relevance to national priorities, there was limited alignment with national, local or community-level development plans and activities. Instead, the programme delivered top-down solutions that were driven

more by pre-defined technologies than on-the-ground needs. Particularly in Ethiopia and Kenya, there was only a limited degree of engagement with local authorities and target communities during programme design, which ultimately compromised the coherence of the programme and the depth of local ownership. The programme's greater emphasis on technology (as opposed to broader developmental needs and enabling environments) also reduced the coherence and contextual appropriateness of the programme design.

Technology-driven approach reduced overall coherence

4.2.1 The LCET Programme was – of course – a technology-focused intervention. This is not necessarily problematic, and indeed is quite standard for a considerable proportion of UNIDO-managed projects. However, the Programme was more than technology-focused, it was *technology-driven*: some UNIDO staff acknowledged that this was a technology-driven rather than a demand or development-driven programme.

4.2.2 Essentially, technological approaches were identified first, then deployment contexts were identified second. METI-financed feasibility studies were commissioned by the New Energy and Industrial Technology Development Organization (NEDO), but these were again primarily technical and technology-focused, with insubstantial analyses of socio-economic or institutional contexts. Following the feasibility studies, UNIDO facilitated some community-level consultations in Ethiopia and Kenya. However, these consultations were undertaken in the context of both UNIDO and the communities knowing that 'solutions' had already been identified: at best, these consultations could seek assent, and potentially some refinement to the proposals. But to a large extent – and across all countries – the Programme offered pre-defined solutions before any rigorous, shared problem analysis was in place.

4.2.3 The heavy focus on technology and the limited consideration of institutional and socio-economic contexts undermined the coherence of the programme's strategy. Particularly in Ethiopia and Kenya, the programme's broader work (i.e. beyond the technical infrastructure) was also largely pre-defined, with limited scope for local communities to refine or localise – for example – training inputs, long-term operation and maintenance (O&M) approaches, or strategies for attracting businesses capable of purchasing electricity. For example, some stakeholders in Ethiopia noted that the target communities were semi-pastoralist, raising obvious challenges for adopting community-based O&M and ensuring regular fee collection. In Kenya, some interviewees suggested that – partly as a consequence of internal migration – there had never been strong demand within the community for space in the productive use centre. The reality of these local conditions presented significant challenges to the logic and coherence of the programme's approach. Perhaps most critically – and summarising a root problem – many stakeholders in both countries implied that it was ultimately a lack of local ownership of the programme that compromised the coherence and appropriateness of the intervention.

Introduction of grid connection eroded programme rationale in Kenya

4.2.4 The clearest example of compromised programme coherence arose when – within months of the ULH-MHP system's installation in Kenya – the host community of Mwea was connected to the Kenyan national electricity grid. With round-the-clock

access to more reliable electricity, the rationale for the ULH-MHP was severely undercut and the people and businesses of Mwea rapidly lost interest in the system. It is possible that businesses could have still been persuaded to purchase ULH-MHP electricity, had they – for example – been provided with rent-free premises at the programme’s productive use centre. However, the ULH-MHP supply was also becoming increasingly sporadic over time due to technical failures and stoppages relating to irrigation requirements, further damaging any possible business rationale for using the system.

4.2.5 It is plausible that a more rigorous, outward-looking and consultative design process would have identified the possibility (or even likelihood) of an upcoming grid connection to Mwea. But even if a grid connection had not been predictable, there was no substantive response from programme stakeholders once the connection became a reality. No effective measures were taken to make the ULH-MHP more attractive to potential customers, to repurpose the facility as (for example) a purely research-focused system, or to decommission and relocate the facility to another off-grid community or private sector client. It is possible that this lack of adaptability was a symptom of the rigid, pre-defined programmatic model and ‘solution’ that was put in place. Unfortunately, the programme’s lack of adaptability ultimately resulted in the work (in Kenya, at least) losing all coherence and relevance to the local context.

Closer involvement of counterparts in Morocco, but no customisation of technology to programme requirements

4.2.6 In Morocco, the host institution of MASEN was more closely involved in programme consultation and design. MASEN were also well-placed to participate in the programme, possessing considerable technical and institutional capacity, and able to offer a highly appropriate deployment site at Ouarzazate.

4.2.7 However, the implemented solution was again pre-defined. A turnkey, off-the-shelf VFB was installed, without any customisation to the requirements of the LCET Programme, specifically the need to test and demonstrate the technology’s appropriateness for supporting smaller off-grid supplies. Additionally, MASEN staff were not involved in the design and assembly of the VFB. Consequently they were unable to influence any possible customisation, and missed an opportunity to develop their own capacity for design and assembly of VFBs, which in turn limited their potential contribution to the scaling up of VFB across the continent (MASEN did however receive extensive training and experience of *post*-assembly VFB operations).

4.3 Efficiency

EVALUATION QUESTION 3:

How efficient was programme delivery?

SUMMARY OF FINDINGS

The delivery and installation of the technology-focused components of the programme (technical infrastructure, technical training) was generally efficient. However, the ‘softer’ programme components – for example institutional strengthening, business model development, market building – were far less

efficient. Particularly problematic were the delays to the construction of the productive use centre in Ethiopia, and to the mini-grid demonstration facility in Morocco. These facilities were integral to the programme's overall logic, so the failure to deliver them efficiently and concurrently with the energy infrastructure diminished progress towards the programme's targeted results. The inefficient delivery of these facilities was symptomatic of broader gaps in programme planning. In Ethiopia and Kenya, insufficiently defined or resourced plans were in place to operate, maintain and monitor the infrastructure in the long-term. This resulted in inconsistent performance, insufficient maintenance, and – combined with limited local ownership of the work – a decreasing lack of interest amongst the host communities.

Initial, technology-focused stages of the programme were delivered efficiently

4.3.1 Early progress across all countries was relatively efficient: while there were some minor bottlenecks, no significant delays were incurred. The delivery, installation and commissioning of all energy infrastructure was efficiently managed, as were the training activities. In Ethiopia and Kenya, a series of supporting research studies and business development proposals were also delivered efficiently, as was a high-level promotional and networking event in Morocco.

Delays with non-technical inputs and activities compromised overall progress

4.3.2 Conversely, there were significant delays in delivering some programmatic elements that were not *directly* related to the installation of the energy infrastructure. Most materially, this included the productive use centre in Ethiopia and the mini-grid demonstration facility in Morocco. Indeed, by the time of this evaluation (end of 2021) these facilities had still not been completed. Yet these facilities were absolutely integral to the programme logic. The productive use centre was meant to demonstrate the economic benefits of business electrification (particularly for agro-processing firms), and was meant to generate a stable, long-term income stream for the ULH-MHP facility. In Morocco, the mini-grid demonstration facility was meant to explore the feasibility of deploying VFB in off-grid contexts across Africa. Without these facilities in place, it has not been possible for the programme to make substantial progress towards the envisaged longer-term outcomes and impacts.

Programme responsibilities caused inefficiencies

4.3.3 The marked divergences in programme efficiency are mostly correlated with roles and responsibilities allocated through the programme's design. In the main, UNIDO led or oversaw the 'efficient' activities (mostly but not exclusively technology focussed: technology installation, technical training) whereas national counterparts led the 'inefficient' activities (productive use centre, VFB off-grid demonstration facility). These responsibilities were also delineated according to whether activities were technologically-focused (primarily UNIDO's responsibility), or developmentally-focused (primarily national counterparts' responsibility). Notably, national counterparts were expected to – and formally *committed* to – financing the activities that they were responsible for delivering.

4.3.4 UNIDO therefore had very limited control over the non-technological – yet absolutely *critical* – aspects of the programme. With no budgetary levers and no formal responsibility for delivering key development-focused activities, there was only so

much facilitation and ‘prompting’ of counterparts that UNIDO could realistically do. Moreover, the national counterparts upon which these critical tasks depended were not that invested in the programmatic process and did not necessarily consider the programme to be an operational or financial priority. In the case of Oromia (Ethiopia), the local government did not deliver their co-financing commitment for the construction of the productive use centre. As previously noted, many interviewees across all countries identified a lack of local ownership as being a shortcoming of the programme. In this instance, that lack of ownership ultimately resulted in significant inefficiencies that compromised programme progress.

Loss of programme momentum resulted in further inefficiencies

4.3.5 Another effect of the split in responsibilities between UNIDO and national counterparts was a considerable loss of programme momentum. As above, the initial energy infrastructure and training-focused activities were delivered relatively efficiently: the activities that UNIDO had direct responsibility for were mostly on schedule. But when the balance of the workplan shifted towards national counterparts (and away from UNIDO’s direct management and control) delays started accruing and momentum was lost. This was the case across all countries, but was especially consequential in Ethiopia and Kenya, where the programme was due to conclude in 2017 yet was still incomplete at the end of 2021. While some delays can be attributed to political unrest in Ethiopia and Kenya, slower than anticipated progress was also a result of national counterparts’ resource constraints and changing priorities.

4.3.6 Unfortunately, the delays and prolonged delivery period also gave rise to ‘cascading’ inefficiencies. For example, as time passed many of the original training participants either moved on, or were unable to put their new skills into practice. Institutional and community-level knowledge was lost, to the point that a considerable amount of UNIDO staff time was spent on refreshing and retraining, and even reintroducing and re-justifying the programme to new local administrations that had come to power during the intervening period. Similarly – and across all countries – UNIDO’s early facilitation of links between African and Japanese companies generated some promising leads, with a number of potential commercial relationships identified (e.g. for building domestic manufacturing capacity, possible licensing deals to support upscaling). Again though, the inefficient and prolonged delivery period also stalled momentum here.

4.4 Effectiveness and Progress to Impact

EVALUATION QUESTION 4:

Did the programme achieve its planned outputs and outcomes?

EVALUATION QUESTION 5:

How likely is it that the programme's outputs and outcomes will contribute to long-term impacts?

SUMMARY OF FINDINGS

While some of the programme-level outputs were delivered, none of the outcomes were achieved, and there is little likelihood that those programme-level outcomes will be achieved in the future. There have been some energy benefits, but the anticipated economic benefits have not materialised, and there is only limited evidence of sustained institutional and individual capacities. Within Kenya, the programme has foundered, resulting in a degree of resentment amongst the host community and representing a significant reputational risk for UNIDO. The Ethiopia installation is providing electricity, but the supply is inconsistent and is being operated and maintained on a highly ad-hoc basis. Few benefits have been delivered for local businesses, as the productive use centre has not yet been completed: electricity is being supplied to households and the local school instead. In Morocco MASEN continue to operate the VFB for their own purposes, but it is unlikely that the mini-grid demonstration facility will be constructed, and there has been no substantive progress towards localisation and upscaling of the technology. Consequently, it is highly unlikely that the programme will deliver a meaningful contribution to longer-term impacts.

Programme delivered some of the planned outputs

4.4.1 A range of programme outputs were delivered across all countries. Most tangibly, all energy infrastructure was delivered at all sites, and – as above – the installation and commissioning of this infrastructure was generally efficient. An extensive and varied programme of training activities was also delivered, both in Japan and within the participating host countries. Also notable was the comparatively wide collection of research studies and written briefings that were delivered within Ethiopia, Kenya and Rwanda. Some of this research also represented milestones along the journey to achieve programme sustainability. For example, research studies included exploration of O&M options (including potential fee structures) for the ULH-MHP facilities, and early business plans for ULH-MHP-supported agro-processing.

Effectiveness of outputs is unclear

4.4.2 However, the *effectiveness* of these outputs is mostly unclear, due largely to the absence of substantive ongoing monitoring data. In some instances though (most clearly in Kenya) the delivered outputs were demonstrably *ineffective*.

4.4.3 Some early analysis was undertaken to assess the performance and effectiveness of the systems. Technical output tests of the ULH-MHP facilities were undertaken in both Ethiopia² and Kenya³; smoothing tests and testing of the VFB in

² Adama Science and Technology Institute, 2018.

³ Kenya Industrial Research and Development Institute / Greenwise Energy Management Consultants, 2017.

mini-grid mode were undertaken in Morocco⁴. But subsequent to these studies, there was no systematic ongoing, long-term data collection, monitoring or analysis of system performance. Consequently, no data was available and no assessment was possible of the systems' technical performance over time. Further, no post-commissioning cost-effectiveness analyses based on real-world performance was undertaken on any of the systems. Given that a core rationale for the LCET Programme was to demonstrate the effectiveness of deployed technologies, the absence of these analyses should be considered a fundamental shortcoming.

4.4.4 While technical data around the ongoing performance of ULH-MHP systems was not available, evaluation interviewees were able to provide their assessments of the ULH-MHP systems, based on their own direct experience. Common themes were evident in both Ethiopia and Kenya, with both systems reported to provide an inconsistent, unreliable supply. Problems with water supply were also reported. Low water levels were experienced due to climactic conditions and/or due to irrigation being prioritised over the turbines. Conversely, water backing-up due to siltation and/or trash was also identified as a problem. Indeed, problems at both sites with siltation and trash management were already being identified by the two post-commissioning output tests. Some interviewees then linked the siltation and trash-related problems to insufficiently systematic O&M, to significant wear-and-tear, and to a correspondingly frequent need for repair or replacement of parts. These accounts suggest that the ULH-MHP systems and the associated O&M arrangements were not as effective as envisaged.

4.4.5 In Morocco, post-commissioning tests were used to measure the effectiveness of VFB's voltage smoothing functionality. These tests successfully validated the VFB's capability to smooth the supply of solar-generated electricity, thereby facilitating its integration into national grid-level infrastructure. However, a core rationale for deploying VFB in Morocco was to demonstrate the technology's ability to support off-grid supplies, where the capacity to deal with demand load shifting is just as important as voltage smoothing. While a one-off load-shifting test was carried out at the time of commissioning, this did not test variations in load and demand (which would correspond to normal operating conditions). Consequently, VFB's capacity for supporting off-grid applications has not yet been fully demonstrated. In addition to limitations with the technical data around load shifting, there was also a lack of cost-effectiveness data for the VFB, despite concerns and repeated requests from various stakeholders. The VFB installer and intellectual property owner (Sumitomo Electric Industries) provided some cost analysis, but this was based on a desk review of existing literature, rather than on real-world data gathered through the actual VFB in Morocco.

4.4.6 After the energy infrastructure, the most resource-intensive outputs were the wide-ranging training activities delivered through the programme. These activities were clearly documented, and often gathered some basic on-the-day feedback from participants. Again though, there was an absence of longer-term data and analysis of the effectiveness of this work. It was unclear as to whether and how the training contributed to the broader effectiveness of the programme. Only limited examples were available of participants actually applying the knowledge and skills obtained, with training most clearly being put into practice by individuals having responsibility for infrastructure O&M. Instead, several stakeholders (particularly in Ethiopia and

⁴ Sumitomo Electric Industries, 2019.

Kenya) were concerned that the prolonged programme delivery period would have resulted in many of the original trainees moving to other positions, institutions, or sectors.

4.4.7 As above, a number of critical outputs were beyond UNIDO’s direct managerial and financial control. Of most importance were the ULH-MHP productive use centres and the VFB test mini-grid. But the productive use centre in Ethiopia and the VFB mini-grid in Morocco were not delivered within the programme timeframe. The productive use centre in Kenya was delivered, but only after UNIDO took control of the funding and construction process in a justified effort to rebuild momentum within the community.

Outcomes and impact have not been achieved, and are not likely to be achieved

4.4.8 The LCET Programme logframe defined two outcomes and one impact statement:

PROGRAMME RESULTS	
Impact	New low carbon and low emission clean energy technologies, products, services and systems (L2CETs) are rapidly deployed to reduce GHG emissions
Outcome	L2CETs successfully demonstrated, deployed and transferred in the targeted countries
Outcome	Favourable market conditions for L2CETs investment strengthened in targeted countries

Country-level logframes were also developed for Ethiopia, Kenya and Morocco, with these frameworks also defining country-level outcome and impact statements:

ETHIOPIA RESULTS	
Impact	Application replicated, supply chain available, service hub built for MHP/RE and policy document available supported to complement universal access plan in Ethiopia
Outcome	Local capacity developed for providing ULH-MHP based innovative energy solutions for productive uses in rural areas

KENYA RESULTS	
Impact	Ultra-low head micro hydro systems adapted to the local condition with strengthened industrial local industrial value chain for replication in Kenya
Outcome	Scaling up market for ULH-MHP technology for productive uses catalyzed in the country

MOROCCO RESULTS	
Impact	VFB system adapted to local conditions supporting renewable energy generation smoothing into grid and isolated mini-grid with strengthened supply chain for replication in Morocco and other African countries
Outcome	Awareness raised and capacity built of VFB system

4.4.9 With the possible exception of the Morocco ‘outcome’, none of these results were achieved. In any case, all outcome and impact statements – both at programme and country level – were not framed according to internationally accepted definitions

as developed by the OECD⁵, and as applied by UNIDO. Instead of identifying the desired *changes* that the programme would bring about (e.g. improved energy access, increased economic opportunities), the statements tended to describe the underlying processes and activities. Consequently, the logframes did not express the overarching logic and rationale of the LCET Programme.

4.4.10 But the programme's logic *was* clearly understood and expressed by programme personnel, and could be readily inferred from programme documentation. To support an assessment of progress towards results, a theory of change (page 3, above) was reconstructed for the purposes of this evaluation. The following diagram provides a summary assessment of progress towards each of the theory of change's elements.

⁵ *Glossary of Key Terms in Evaluation and Results Based Management*, OECD, 2002.

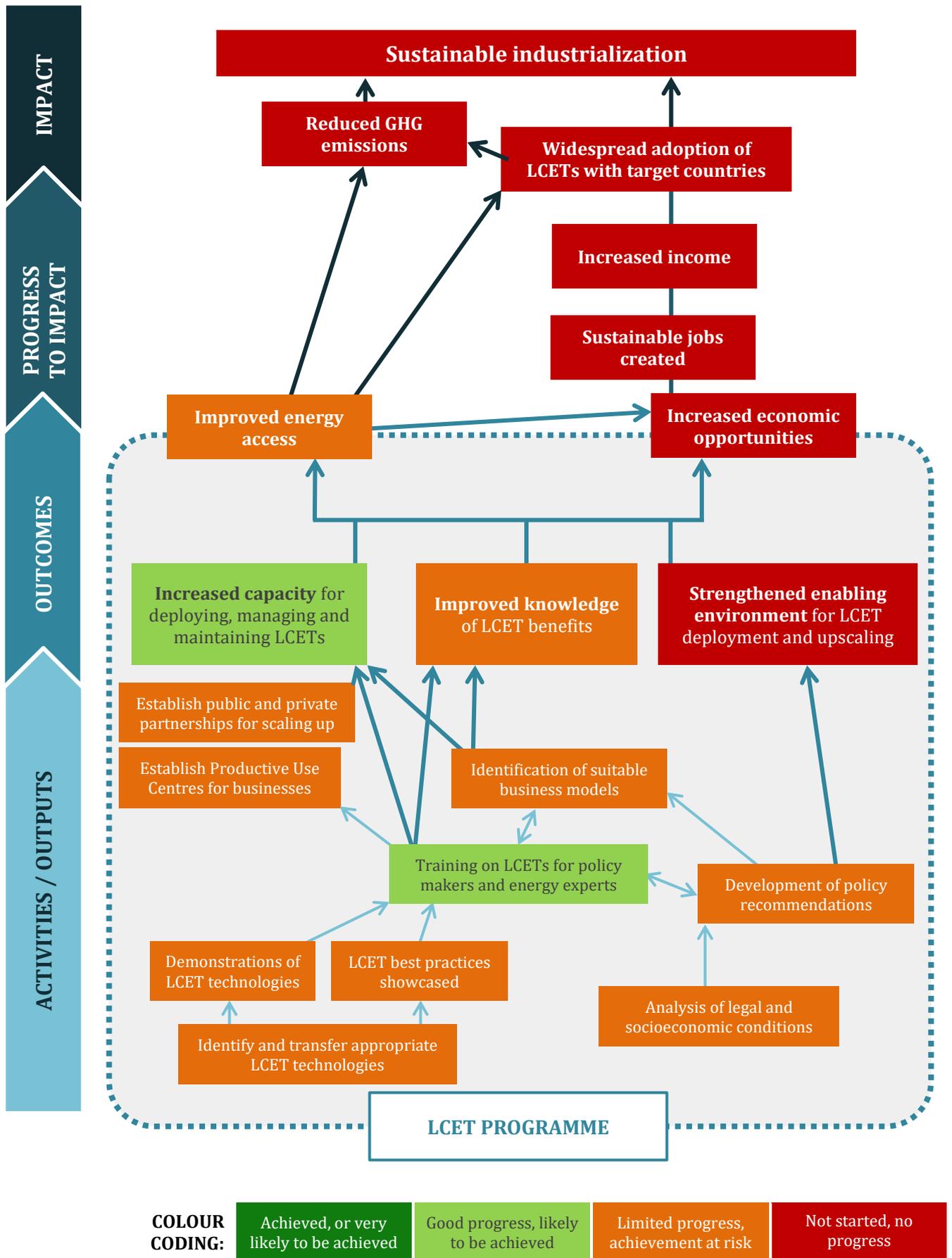


Figure 2: Assessment of progress against theory of change

4.4.11 In summary, very limited progress has been made towards any outcomes. Even where activities and outputs were delivered – technology demonstration, training, business model development – there is limited or no data on the effectiveness of this work, and little evidence that the work contributed to the programme’s expected outcomes or impact.

4.4.12 The programme rationale was largely premised on assumptions that ‘appropriate’ technologies would be deployed, that businesses would benefit from improved energy access, that ‘best practices’ would be identified (the effectiveness of the technologies would be demonstrated), and that upscaling and impacts would then follow. But the appropriateness and effectiveness of the technologies has not been demonstrated in the targeted contexts. Rather, the evidence suggests that the technologies – and the manner in which they were deployed – were *not* appropriate and were *not* effective. In Ethiopia and Kenya the unreliable, inconsistent supply from the ULH-MHP system was not an attractive proposition for businesses. Exacerbating this, the productive use centres did not provide a sufficient incentive for businesses to use or pay for ULH-MHP electricity. In Morocco, VFB’s potential for supporting off-grid electricity has not been demonstrated. No analysis of real-world cost-effectiveness has been undertaken for any of the systems. Consequently, the programme’s central anticipated condition for delivering outcomes and impact – the demonstration of effective, appropriate, economically attractive and business-friendly LCETs – was not established.

Reputational risks for UNIDO

4.4.13 The lack of progress towards outcomes and impact was most evident in Kenya. As within the other countries, the initial (UNIDO-led) outputs were all delivered in Kenya: the ULH-MHP facility was commissioned, extensive training was undertaken, and several research studies were completed. However, O&M procedures were not systematically applied and the ULH-MHP was unreliable from the outset. The system was also causing a degree of irritation amongst a portion of the community, as on occasion the trash blockages at the hydro facility would raise the water level in the canal, which in turn disrupted irrigation water levels.

4.4.14 These early difficulties were compounded when – within a matter of months of commissioning – the system was essentially made redundant, as the host community was connected to the Kenyan national grid. Businesses and households now had access to round-the-clock and more reliable electricity than was being offered through the ULH-MHP.

4.4.15 Theft now became an issue, as some within the host community felt that at least some benefit could be gleaned from the system if its constituent components could be sold, even as scrap. The turbines’ motors were stolen, as was much of the cabling that linked the turbines to the productive use centre. Acting to control the situation, the Chairman of the community-based organisation tasked with managing the system requested support from the National Irrigation Authority (NIA) to remove the facility. However, the NIA was faced with considerable resistance from the community, who felt that the property (and its potential resale value) belonged to them (even though, legally, the NIA had ownership of the facility). The NIA did eventually manage to remove the remains of the facility and place it into storage, although this was achieved under cover of night and with police protection.

4.4.16 Against that background, discussion of whether the LCET Programme delivered its outcomes or made progress towards impact becomes a distraction. Most seriously, the situation has ultimately caused considerable resentment and even some distress within the host community. Regardless of how the shortcomings in Mwea arose, and regardless of which institution has legal liability for the situation, UNIDO is – and will continue to be – inextricably linked with the intervention. Obvious reputational risks have arisen for UNIDO in particular, but also for the programme’s other counterparts.

Some positive, unplanned outcomes

4.4.17 Although the LCET Programme’s planned outcomes and impacts were not delivered, some unplanned but positive outcomes were achieved. Most notably, the ULH-MHP system in Ethiopia has supplied – and continues to supply – electricity to households⁶ and a local school. Local stakeholders expressed great appreciation for this, with one interviewee noting that *“once [the community] are exposed to such conditions, they want to continue”*.

4.4.18 But this achievement also helps to illustrate a central shortcoming of the programme’s top-down approach and the lack of local ownership of the design process. The clear intention of the LCET Programme was to demonstrate how LCET’s could be used to benefit businesses: the provision of electricity to the general public was not in the Programme’s scope. However, the local authorities and host community in Ethiopia identified households and education as *their* priority for electrification. So once ownership of the ULH-MHP facility was transferred to local authorities – and in agreement with the Project Steering Committee – local decisionmakers acted on their own priorities, rather than those that were originally defined by the Programme. Clearly, the Programme’s top-down, pre-defined solution was not aligned with local preferences.

4.4.19 Despite this positive outcome and the gratitude of the community, local frustrations with the system are growing. Supply of electricity continues to be sporadic, the productive use centre is still to be completed, and a planned water purification centre has not been delivered by the local authority. The unreliable supply can partly be attributed to the informal management arrangements: fees are still not being collected, with day-to-day O&M being undertaken by on a voluntary basis. In line with the above-noted division of responsibilities, day-to-day management and ownership of the system lies with the local authorities and is outside of UNIDO’s direct financial and managerial control. However, the system was of course established through UNIDO’s support and UNIDO will always be associated with it: if the facility continues to cause frustration for the community UNIDO could again be faced with considerable reputational risks.

4.4.20 A positive, secondary outcome was also achieved in Morocco. The VFB provides MASEN with a new tool to smooth and facilitate the integration of renewable electricity with the national grid. It is plausible that this has improved reliability of electricity supply, and has potentially delivered cost efficiencies for MASEN. Given that they have been operating the VFB since 2019, there is now also a degree of VFB-related institutional capacity and knowledge within MASEN. Should VFB gain traction within

⁶ Programme documentation reports that this is 92 households, but local accounts suggest 20 households

Africa, this institutional capacity could help to position MASEN as a key facilitator and resource for other stakeholders on the continent.

4.5 Sustainability

EVALUATION QUESTION 6:

To what extent are the programme's outputs and outcomes likely to be sustained in the long term?

SUMMARY OF FINDINGS

Even though the programme has delivered few outputs or outcomes, it may still be possible to undertake some measures to improve the sustainability of the work that has been delivered, and to minimise reputational risks to UNIDO. Most immediately, there is a need to work with Kenyan counterparts to either remove or reallocate the decommissioned infrastructure. Work should also be undertaken with Ethiopian counterparts to finalise and implement viable options for sustaining the micro-hydro infrastructure in the long-run. In Morocco MASEN continue to operate and sustain the VFB for their own purposes, albeit with none of the LCET Programme's intended benefits for off-grid users across Africa. Furthermore, the prospects for upscaling VFB across Africa remain uncertain, as the wider deployment of the technology is essentially dependent on Sumitomo Electric Industries' own strategy and commercial decisions.

No basis for upscaling ULH-MHP

4.5.1 The programme's original vision was to demonstrate the effectiveness of ULH-MHP as a reliable, economically attractive source of electricity for rural businesses across Africa. Once demonstrated, the technology could then be upscaled and deployed for the benefit of rural economies across Ethiopia, Kenya and beyond. However, the programme has *not* demonstrated that the technology is effective or appropriate when deployed within the contexts targeted by LCET, nor when supported by the institutional arrangements applied through LCET. Instead, the real-world experience and assessments of the facilities' users suggests that the technology is unreliable, and that the programme's approach to deployment was inappropriate. Moreover, insufficient data was gathered to support a robust assessment of long-run technical or cost performance. Consequently, the programme has *not* built an evidence base that supports upscaling or continued promotion of the technology.

Sustainability measures could mitigate some of the reputational risks

4.5.2 While upscaling can no longer be justified as part of the programme's sustainability strategy, there may be opportunities to ensure that some of the delivered outputs are sustained in the long-term. Indeed, taking measures to ensure the longevity of the Ethiopian facility and to remediate the situation in Kenya could not only support sustainability, it could also help to mitigate some of the reputational risks that programme partners are currently exposed to.

4.5.3 In Ethiopia, there is at least a functioning facility that continues to deliver positive benefits for households and the local school. Moreover, there are active local institutions that oversee the facility and day-to-day O&M is undertaken, albeit on a

voluntary basis. Additionally, there are strategies in place for sustaining the facility in the long-run. However, those strategies are mostly based on an assumption that sufficient income for the facility's O&M will be generated from fee-paying businesses, with those businesses to be housed in the productive use centre. But the productive use centre is still to be completed, and the distribution lines to the productive use centre need to be reinstalled, as the original telegraph poles have been destroyed by termites. So although there are some foundations in place for a sustainable ULH-MHP system, the situation is precarious and the community is becoming increasingly impatient with the system's unreliability. To strengthen the system's sustainability it may now be beneficial for programme counterparts to take a step back, review the current status, revisit the original financing assumptions, and validate or revise their strategy for the post-programme management of the facility.

4.5.4 In Kenya, there is no system to sustain. As such, sustainability considerations are perhaps secondary to the need for remediation measures and the management of reputational risks. Most pressingly, the remaining parts of the decommissioned facility are being held by the local office of the NIA. While the NIA are the legal owners of the facility, they are awaiting guidance from UNIDO regarding next steps, given UNIDO's foundational role in the programme. Urgent consultation and decisions are therefore required on how to deal with the decommissioned facility: for example, should the facility be redeployed at another off-grid community, or would it be better to identify public or private entities that would benefit from a ULH-MHP facility? If so, how can the cost of necessary equipment repair and parts replacement be funded? Given the local tensions, any decisions here should be based on transparent, open consultation and could benefit from dedicated facilitation / remediation expertise. A negotiated, consensus-based agreement could still allow the programme to exit the situation on reasonable terms. In turn, that could help to mitigate any damage that may have been done not just to the local reputation of the programme partners.

4.5.5 In Morocco, MASEN continue to operate and sustain the VFB facility for their own purposes. However, the nominal responsibility for promotion and upscaling of VFB rested with Sumitomo Electric Industries (SEI). The VFB was SEI's product, so SEI hold the intellectual property for much of the technology and processes required to manufacture and operate the VFB. Consequently, any upscaling strategy to localise the product and/or build Moroccan capacity to manufacture components is largely dependent on SEI's own strategy, priorities and commercial decisions. But by the time of this evaluation SEI had not made any decisions around whether to work with Moroccan manufacturers, or whether to upscale the deployment of their VFB technology in Africa. Consequently, the prospects for upscaling VFB across Africa remain uncertain.

4.6 Gender mainstreaming

4.6.1 The original project proposals (both for the overall programme, and for the country-level initiatives) all included references to gender. These references expressed an ambition to ensure gender balance across project activities, particularly capacity development. Beyond that though, there was no substantive analysis of gender, gender roles within the target communities/institutions, or the potential influence gender considerations could have on the programme's design or implementation. Once the

programme was under implementation, progress reports did not deepen the consideration of gender any further. This absence of substantive consideration or analysis of gender was – at least in part – another consequence of the technology-driven nature of the design, and of the technically-focused feasibility studies.

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 programme's design, delivery and management.

5.1 Performance of partners

UNIDO and Delivery Partners

5.1.1 Within the constraints of the programme design and the imposed funding conditions, UNIDO and its execution partners delivered the agreed outputs relatively efficiently. Indeed, there was a clear discrepancy between the relative efficiency of UNIDO-led activities and the relative inefficiency of activities that were led by national counterparts.

5.1.2 However, the efficient delivery of outputs did not translate to outcomes or impacts, and it is unlikely that outcomes or impact will be achieved. While this is largely a consequence of a somewhat imposed programme design and inappropriate partner responsibilities, UNIDO and its execution partners could have done more to improve the programme's performance. At the very least, systems should have been developed to ensure monitoring and analysis of the long-run technical performance and effectiveness of the installed infrastructure. The absence of this analysis means that there is no credible basis for upscaling or even promoting the tested technologies. Perhaps most materially though, programme partners – and certainly UNIDO – could have done more to ensure an appropriate programme design that was based on meaningful consultation with the intended beneficiaries, and on analysis that took into account socio-economic and institutional factors, rather than just technological considerations.

National Counterparts

5.1.3 When considering the performance of national counterparts, it is essential to recall the limited extent of ownership that these counterparts had over the programme's design. If only the *programme's* priorities are taken into account, national counterparts have performed poorly: neither the Ethiopian productive use centre nor the Moroccan test mini-grid have been constructed, and the Kenyan component has foundered. But once the various LCET facilities were commissioned, their ownership was essentially passed over to national counterparts: indeed, UNIDO no longer had any financial or directive control over the infrastructure at the point of handover.

5.1.4 Once ownership of the ULH-MHP facility was transferred to local authorities – and in agreement with the Project Steering Committee – local decisionmakers acted on their *own* priorities, rather than those that were originally defined by the Programme,

and used the facility to electrify households and a school, rather than businesses: this resulted in one of the few positive outcomes arising from the programme. In Morocco, MASEN are using the VFB facility to facilitate the management of renewable electricity flowing into the national grid and -as an institution – could be well-positioned to lead any eventual upscaling of VFB in Africa.

Donor

5.1.5 Beyond conceptualisation and financing, METI’s involvement in the day-to-day implementation of the programme was minimal. However, some of METI’s decisions and processes may have undermined the coherence, appropriateness and potential effectiveness of the programme.

5.1.6 The METI-financed, NEDO-commissioned feasibility studies were technology-driven with limited consideration of institutional and socio-economic factors. On their own, such studies were a completely insufficient basis for the design of a programme targeting development results. Additionally, METI’s request to restrict the programme’s procurement to Japanese firms (and UNIDO’s agreement to that request) may have compromised the programme’s relevance and results orientation.

5.2 Factors facilitating or limiting the achievement of results

5.2.1 Within the programme’s logframes (top-level and country-level), outcome and impact statements were not correctly framed against the internationally accepted definitions, as applied by UNIDO. Instead of identifying the desired changes that the programme would bring about (e.g. improved energy access, increased economic opportunities), the statements tended to describe the programme’s underlying processes and activities. Consequently, the logframes did not express the overarching logic and rationale of the LCET Programme. The logframes therefore did not provide a sufficient basis for monitoring or reporting progress towards results, or for results-based management.

5.2.2 Another significant results-related oversight was the absence of monitoring and analysis of the long-term technical performance of each LCET system. While the two ULH-MHP systems benefited from output testing shortly after commissioning, no subsequent data was collected and no subsequent analysis was undertaken. Voltage smoothing and load shifting tests were undertaken on the Moroccan VFB after commissioning, but there was no subsequent longer-term, ongoing testing. Further, no post-commissioning cost-effectiveness analyses based on real-world performance was undertaken on any of the systems. Without these analyses, the real-world effectiveness and technical performance of the systems could not be ascertained. Consequently, the programme did not generate an adequate evidence base for informing decision-makers, or for promoting or upscaling the technologies.

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.

Project element		Summary assessment	Rating
A	PROGRESS TO IMPACT (OVERALL)	No outcomes were achieved, and are unlikely to be achieved. Any impact is correspondingly unlikely.	Highly unsatisfactory (1)
B PROJECT DESIGN (OVERALL)			Highly unsatisfactory (1)
1	Overall design	The top-down, technology-driven design resulted in an inappropriate approach to deployment, and a strategy that at times was incoherent.	Highly unsatisfactory (1)
2	Logframe	The logframes failed to express outcomes or impact correctly, and could not provide a basis for results monitoring or RBM,	Highly unsatisfactory (1)
C PROJECT PERFORMANCE (OVERALL)			Unsatisfactory (2)
1	Relevance	The programme was nominally relevant to the needs and priorities of the participating countries.	Moderately satisfactory (4)
2	Effectiveness	While some outputs were achieved, none of the envisaged outcomes were achieved.	Unsatisfactory (2)
3	Efficiency	Initial programme delivery was relatively efficient, but became inefficient when the balance of workload passed to national counterparts.	Moderately unsatisfactory (3)
4	Sustainability of benefits	Some sustainability measures can still be undertaken, but the focus should be on remediation measures and the minimisation of reputational risk.	Unsatisfactory (2)
D CROSS-CUTTING PERFORMANCE (OVERALL)			Highly unsatisfactory (1)
1	Gender mainstreaming	Beyond an expressed ambition to ensure gender balance in programme activities, no substantive gender analysis was undertaken.	Unsatisfactory (2)
2	M&E	Progress reporting was sporadic, and focussed on activities and outputs, rather than results. No systems were in place to measure the technical performance or cost effectiveness of the LCET 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 unsatisfactory (3)
1	UNIDO and Delivery Partners	UNIDO and partners delivered their outputs efficiently. However, more could have been done to strengthen programme design, the non-technical aspects of the work, and local ownership.	Moderately unsatisfactory (3)
2	National Counterparts	National counterparts did not deliver some critical components. However, they also had weak ownership over programme design and delivery.	Moderately unsatisfactory (3)
3	Donor (METI)	METI provided the finance, but the feasibility studies they financed were inappropriate, and the request to restrict programme procurement to Japanese firms may have compromised the programme's relevance and results orientation.	Moderately unsatisfactory (3)
F OVERALL ASSESSMENT			Unsatisfactory (2)

6. Conclusions and recommendations

6.0.1 The LCET Programme was a conceptually relevant intervention, aiming to demonstrate and upscale the use of low-carbon energy technologies across Africa. In doing so, the Programme aimed to support national and international efforts to increase energy availability and improve energy reliability, yet simultaneously reduce emissions and demonstrate how low-carbon technologies could stimulate economic and business growth.

6.0.2 Despite this conceptual relevance, the LCET Programme's approach was inappropriate, inefficient and ultimately ineffective. The top-down and technologically-driven programme design paid little attention to socio-economic or institutional factors. 'Target' institutions and communities had limited involvement in the programme's design, resulting in a marked lack of ownership of the programme and its eventual outputs. Programme efficiency and effectiveness were also undermined by the allocation of partner responsibilities. UNIDO focused mostly (but not exclusively) on delivering the technology-focused aspects, and these tended to be delivered efficiently. However, the delivery and *financing* of non-technological, development-focused – but absolutely *critical* – activities were mostly the responsibility of national counterparts. Yet these counterparts were understandably not very invested in the programmatic process and did not necessarily consider the work to be an operational or financial priority.

6.0.3 Some positive results were achieved. In Ethiopia the installed system continues to provide electricity (albeit intermittently) to households and a school. In Morocco, the installed facility is helping to facilitate the integration of renewable electricity with the national grid. But in Kenya the programme foundered, to the point that – in order to avoid the community selling the facility for scrap – the system had to be removed under police protection.

6.0.4 While some of the programme-level outputs were delivered, none of the outcomes were achieved, and there is little likelihood that those programme-level outcomes will be achieved in the future. The anticipated economic benefits have not materialised, and there is only limited evidence of sustained institutional or individual capacities. The programme also neglected to undertake ongoing, long-run technical monitoring and analysis of system performance or cost effectiveness. Consequently, no evidence base was developed to demonstrate the effectiveness of the LCETs within the targeted contexts, meaning there is no credible basis for upscaling or even promoting the tested technologies.

6.0.5 Based on the evaluation's findings, the following recommendations are made in order of priority.

Undertake remedial measure in Kenya

6.0.6 The unsuccessful programme in Kenya has resulted in resentment and even some distress in the host community. UNIDO and project counterparts are also now exposed to obvious reputational risks.

Recommendation 1

UNIDO should urgently undertake a remediation process that closely involves all programme stakeholders. UNIDO should appoint dedicated, independent facilitation / remediation expertise to support the process.

Given the local tensions, any decisions here should be based on transparent, open consultation. Consultation and decisions are required on how to deal with the decommissioned facility. Resolutions are required on issues including:

- Removal of the facility from the NIA's storage
- Possible reinstallation of the facility at another location; this should include consideration of alternative off-grid communities, or alternative public or private entities that could benefit from a dedicated ULH-MHP facility
- Repair of the equipment and replacement of stolen parts

Revisit sustainability strategy in Ethiopia

6.0.5 The facility in Ethiopia continues to deliver positive benefits for households and a local school. However, the community is becoming increasingly impatient with the system's unreliability, day-to-day O&M is highly ad-hoc, and some infrastructure promised by local counterparts (productive use centre, water treatment facility) are incomplete. Given the amount of time that has passed since the programme's original design – and given the serious flaws with that design – it would be beneficial to entirely revisit the long-term plans and sustainability strategy for the facility. Are the original assumptions still valid? What is the current demand for the productive use centre, and will it generate the required income to sustain the facility? Are there alternative income sources and/or alternative management models for the facility that could be applied?

Recommendation 2

UNIDO and local counterparts should revisit – then either validate or revise – their long-term plans for sustaining, financing and managing the ULH-MHP facility.

This joint analysis should be undertaken against a 'clean slate': the LCET Programme is concluding, is unlikely to deliver its anticipated outcomes and – in any case – did not sufficiently take into account local stakeholders' needs and priorities. Consequently, local stakeholders should no longer be held to the LCET Programme's operating model. Instead, what objectives do the local institutions and community wish to achieve through the facility, and what would be the most appropriate operating model and financing strategy for them?

Consider undertaking detailed testing and analysis in Morocco

6.0.6 VFB may be an appropriate technology for wider deployment in Africa, but at this stage there is insufficient data or analysis upon which to base an informed decision. However, the VFB facility is still very much operational in Morocco, so detailed performance testing against international standards – particularly with respect to off-grid applications – is still absolutely possible. The real-world cost effectiveness of the facility could also be ascertained, with the potential to explore both

VFB's application in Morocco and its cost effectiveness when supporting off-grid applications across Africa.

6.0.7 But it is critical to note that – even if testing is undertaken and demonstrates VFB's viability – the potential upscaling of the technology is almost entirely dependent on the tested technology's intellectual property holder, Sumitomo Electric Industries (SEI). Ultimately, it is SEI's own strategy and commercial decisions that will determine whether the tested VFB can be deployed more widely.

Recommendation 3

UNIDO should consider providing additional support to MASEN to ensure that relevant, rigorous testing is undertaken on VFB's potential for supporting off-grid applications. This should include analysis of the system's cost-effectiveness.

However, any additional resource allocation and testing needs to be based on a recognition that – even if very positive test results are generated – the upscaling of the technology is highly dependent on Sumitomo Electric Industries' own strategy and commercial prerogative.

Ensure UNIDO's quality standards are applied to all technical cooperation projects

6.0.8 The LCET Programme's top-down, technology driven-approach contradicted decades of well-documented, highly visible development experience, practice, and research. Had the programme been submitted to international funders such as the GEF or the GCF, it is improbable that it would have been approved, given the limited consultation, involvement and ownership of the institutions and communities that the programme aimed to support. It is equally improbable that the programme would meet UNIDO's recently refined quality standards, given that these standards are largely informed by the 'red line' requirements of international funders.

6.0.9 Bilateral technical cooperation projects are of course an entirely appropriate vehicle through which UNIDO can deliver its mandate. In addition to programmes and funding, bilateral relationships can also deliver significant diplomatic, political and promotional benefits for UNIDO. But this should not come at the expense of quality, results-orientated, needs-driven programming.

Recommendation 4

UNIDO should ensure that all technical cooperation projects are subjected to quality review, and that all project proposals are only approved when all quality standards are met.

UNIDO's quality review and approval processes should apply to any form of technical cooperation projects, including those that are financed on a bilateral basis.

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 LCET programme'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 programme to the needs and priorities of the participating countries and institutions?	1.1 To what extent was the programme relevant to the national priorities and strategies of the participating countries?
	1.2 To what extent was the programme relevant to UNIDO's mandate?
	1.3 How were participating countries and institutions involved in problem analysis, identification of solutions, and programme design?
COHERENCE	
2. To what extent was the programme aligned with – and complementary to – other work being delivered within the participating countries?	2.1 How did the programme identify and coordinate with other LCET-focused interventions in each country?
	2.2 How did the programme identify and coordinate with other relevant enabling environment-focused work in each country?
	2.3 To what extent was the programme aligned with each country's UNFCCC Technology Needs Assessment?
EFFICIENCY	
3. How efficient was programme delivery?	3.1 Was the programme's plan clear, appropriate and realistic?
	3.2 How efficient and effective were the programme's management arrangements? Were roles, responsibilities and accountabilities sufficiently clear?
	3.3 How effective were the programme's monitoring processes?
	3.4 How cost- and time-efficient was the programme?
EFFECTIVENESS	
4. Did the programme achieve its planned outputs and outcomes?	4.1 To what extent did the programme improve energy access within participating countries?
	4.2 What was the selected technologies' actual performance compared to expected performance?
	4.3 To what extent did the programme increase economic opportunities within participating countries?
	4.4 How effective was the programme at building the capacities and knowledge required to deploy, manage and maintain the identified LCETs?

Key evaluation questions	Guiding sub-questions
	4.5 To what extent did the programme strengthen enabling environments for LCET deployment and upscaling?
PROGRESS TO IMPACT	
5. How likely is it that the programme's outputs and outcomes will contribute to long-term impacts?	5.1 To what extent have the LCETs and business models promoted through the programme been scaled up?
	5.2 What emissions reductions has the programme delivered?
	5.3 Did the programme contribute to any unintended impacts, positive or negative?
SUSTAINABILITY	
6. To what extent are the programme'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 programme's results?
	6.2 What gaps and needs were not addressed by the programme?
	6.3 How were gender dimensions incorporated within programme design and delivery?

8. Annex 2: Interview participants

UNIDO

Ceban, Alexandru
Dadi, Tadesse
Haile, Mesfin Shimelis
Irungu, Doreen
Muchai, Maryanne
Oishi, Hiroshi
Torii, Naoki
Woubie, Helina

Ethiopia

Balcha, Shiferaw Feyissa (Adama Science and Technology University)
Gelashe, Tilahun Gemechu (Ministry of Industry)
Gudata, Lema Edae (General Contractor)
Hawas, Tadesse (Oromia East Showa Zone Water, Energy Office)
Iteffa, Eng. Habtamu (Oromia Water, Energy and Resource Development Bureau)
Mohamed, Mitfa (Oromia East Showa Zone Water, Energy Office)
Seboka, Yeshak (Ethiopian Rural Energy Development and Promotion Centre)
Sisay, Yemisrach (Ethiopian Women in Energy Association)
Soressa, Tesfaye (Oromia Water, Energy and Resource Development Bureau)
Taye, Yonas (Oromia Water, Energy and Resource Development Bureau)
Woldehanna, Frehiwot (Ministry of Water, Irrigation and Energy)
3 x End Users of ULH-MHP facility

Kenya

Ariemba, Innocent (National Irrigation Authority)
Ayieko, Joseph (Kenya Industrial Estates)
Chelule, Kenneth (Kenya Research and Development Institute)
Kinoti, Eng. (National Irrigation Authority)
Kithuka, Justus (Kenya Research and Development Institute)
Mageto, Victor (Ministry of Industry and Enterprise Development)
Maina, Francis (Mwea Community Group)
Murunga, Chris (National Irrigation Authority)
Mwangi, Hezron (National Irrigation Authority)
Mwenga, Lydia (Ministry of Industry and Enterprise Development)

Morocco

Akherraz, Amal (AlSolen)
Bouzekri, Hicham (MASEN)
Djdiaa, Abdelali (MASEN)
El Kharrazi, Mohammed (MASEN)
El Qaaraoui, Tariq (MASEN)
Himdi, Abdelkader (MASEN)
Nagano, Hiroshi (Sumitomo Electric Industries)
Moriguchi, Masao (Sumitomo Electric Industries)

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