

Independent strategic evaluation
**UNIDO's capacity to contribute
to transformational change**



Independent Evaluation Unit
Office of Evaluation and Internal Oversight

Independent strategic evaluation of UNIDO's capacity to
contribute to transformational change



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Abbreviations and acronyms

CIFs	Climate Investment Funds
CSFs	Country Service Frameworks
CP	Country Programme
DTI	Department of Digitalization, Technology and Innovation
EIO	Office of Evaluation and Internal Oversight
EIP	Eco Industrial Parks
ET	Evaluation Team
FS	Food Safety
GCF	Green Climate Fund
GEF	Global Environmental Facility
GEIPP	Global Eco Industrial Parks Programme
ISID	Inclusive and Sustainable Industrial Development
MOPAN	Multilateral Organisation Performance Assessment Network
MTPF	Medium-Term Programme Framework
OECD	Organisation for Economic Cooperation and Development
PCP	Programme for Country Partnership
PSC	Project Steering Committee
PSMs	Programmatic Service Modules
QIVCD	Quality Infrastructure for Value Chain Development
RBB	Results-based budget
RBM	Results-based management
SDGs	Sustainable Development Goals
SES	Social-Ecological Systems
SMEs	Small and medium enterprises
TCLP	Transformational Change Learning Partnership
TEST	Transfer of environmentally sound technology
TOC	Theory of Change
TOR	Terms of Reference
UNDS	United Nations Development System
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. Project context data collected at the intervention's outset.
Coherence	The compatibility of the intervention with other interventions in a country, sector or institution.
Effect	Intended or unintended change directly or indirectly due 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 a project's resources/inputs (i.e. funds, expertise, time) are converted into results.
Impact	Positive and negative, intended and non-intended, directly and indirectly, long term effects that represent fundamental durable change in the condition of institutions, people and their environment brought about by the project.
Indicator	Quantitative or qualitative factors that provide a means to measure the changes caused by an intervention.
Intermediate States	The transitional conditions between a project's outcomes and impacts which must be achieved in order to deliver the intended impacts.
Lessons learned	Generalizations based on evaluation experiences that abstract from the specific circumstances to broader situations.
LogFrame (logical framework approach)	Management tool drawing on results-based management principles used to facilitate the planning, implementation, and evaluation of an intervention. It involves identifying strategic elements (activities, outputs, outcomes, impacts) and their causal relationships, indicators, and assumptions that may affect project success or failure.
Outcome(s)	The likely or achieved short- to medium-term behavioural or systemic effects to which the project contributes, which help to achieve its impacts.
Output(s)	The products, capital goods, and services that an intervention must deliver to achieve its outcomes.
Relevance	The extent to which the intervention's objectives and design respond to beneficiaries, global, country, and partner/institution needs, policies, and priorities, and continue to do so if circumstances change.
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	Specific entities for whose benefit an intervention is undertaken.

Executive summary

This formative evaluation aims at assessing the extent to which UNIDO's thematic approaches and projects are designed and implemented in ways that contribute to transformational goals and objectives for Inclusive and Sustainable Industrial Development (ISID) in the context of the Agenda 2030 for Sustainable Development.

It combines academic evidence with experiences from practical development work. Scientific work related to transformational change, available evaluations, and strategic UNIDO documentation were taken as a basis to contribute to strategic thinking of UNIDO's development cooperation by analyzing, in particular, the plausibility of thematic approaches, and to suggest ways to strengthen them. The evaluation is primarily qualitative in its nature and does not present a historic performance record of UNIDO's contribution to transformational change. Instead, it is a forward looking exercise offering options for improved planning towards development cooperation that contributes to transformations in UNIDO's areas of mandate and expertise. This evaluation supplements the recent Independent thematic evaluation - UNIDO medium-term programme framework (MTPF) 2018-2021 (issued in June 2022). It identifies further areas for improvement and lessons to be considered together with the implementation of the Management Action Plans that were formulated under the MPTF Evaluation.

Key Conclusions:

Thematic programming is yet underdeveloped in UNIDO. There are some signs that the Organization is moving towards more use of programming as an important dimension to ensure transformational contributions to Agenda 2030 and ISID. This includes ongoing work on the strengthened integration of MTPF, IRPF and RBB as well as the development of Programmatic Service Modules. However, so far the tools available are for programming in the geographical dimension, while thematic programming is, if at all, happening on an ad-hoc basis and primarily responding to donor interest and priorities. The guidance provided by existing thematic strategies does not allow project developers to make projects more transformational.

There is wide variation in the extent to which UNIDO's program and project documents integrate system thinking. System analysis applies to all the thematic areas in as far as all intend to contribute to broad system changes that, in the long run, are expected to contribute to ISID transformations. As such, all the thematic areas under review incorporate some aspects of systems analysis. But in general analysis focusses on the project activities and its direct key stakeholders and partners. In most cases, the wider system, including relevant domains in which the projects do not intervene are left out of the analysis. Finances and policy development and implementation are examples of domains that frequently are not sufficiently considered in the thematic approaches. Also, the interactions between different levels of systems are often not taken into account, as in the case of regional institutional development with limited linkage to country systems.

There remains large room for better use of solid evidence to strengthen thematic approaches. Thematic areas vary widely on the extent to which they have developed reliable **diagnostic and data gathering tools**. The evaluation could not find signs of thematic areas interacting or collaborating in the development of such tools.

There is room for improving the use of solid evidence to better understand key assumptions of thematic approaches and to provide guidance to project developers with regard to assessing assumptions based on evidence. The use of evidence to underpin the plausibility of assumptions is weak across all reviewed thematic areas. The important role of assumptions in linking project outputs and outcomes to the expected transformations is generally not documented nor reflected in thematic documents. This includes too generic formulation of assumptions (e.g. "government is committed") as well as non-explicit assumptions (e.g. "carbon fuel prices will remain high") and not-well-founded assumptions (e.g. "more efficient use of natural resources will result in social benefits").

While UNIDO has robust capacities and knowledge on several technical areas, programmes and projects give less attention to local and traditional knowledge. Thematic areas typically make good use of the technical knowledge within their team and the knowledge generated by past UNIDO experience, including results of evaluations. Projects also tend to include stakeholders in steering committee meetings

which helps to incorporate local knowledge and perspectives in project implementation. However rarely do projects systematically incorporate local or traditional knowledge into project design and monitoring.

More explicit planning for broader adoption could increase UNIDO's reach and transformational impact. Despite the claim that UNIDO's interventions seek to contribute to conditions that will advance change beyond the project, there is not much explicit planning for broader adoption. Mainstreaming, replication and partnerships, three mechanisms with high potential for broader adoption are often not approached strategically in thematic approaches and during project design.

Thematic approaches could benefit from the development of thematic partnerships, in particular those that can help to address system elements normally not covered by UNIDO. The evaluation found few cases where thematic approaches leveraged partnerships to increase reach and broader adoption. Some very commendable cases were found of collaboration with other agencies related to methodology development and knowledge generation (e.g. on Eco-industrial parks). While some partnerships exist, these do not go far in leveraging UNIDO's capacities by finding partners who can address key conditions in system domains UNIDO is not involved in (e.g. financing, infrastructure, policy reform). Also, while the different thematic teams have demonstrated an interest in developing methods and tools, the evaluation team found that knowledge management and methods development mostly takes place in the different thematic teams in isolation.

Thematic approaches can be more transformational if coherence is addressed more explicitly. This includes coherence in the national context as well as possible trade-offs across the economic, social and environmental spheres. Projects always make the case for a strong coherence with broad country policies and programs. Yet the evaluation found numerous instances in which existing (or the absence of) policies, programmes or regulations were a key factor obstructing the intended system change. Also, **the absence of trade-off analysis risks transferring the costs of change to disadvantaged populations and undercuts UNIDO's objective of inclusive development.** While thematic areas have a strong focus on the promotion of either the economy or the environment, currently, they do not provide guidance to assess trade-offs between economic, social and environmental spheres in UNIDO's projects.

Adaptive management is a key ingredient of transformational programmes. While there are some good practices conducive to adaptive management in several projects, the thematic approaches currently do not include guidance on systematic adaptive management.

Key areas for improvement:

UNIDO to consider further strengthen and institutionalize thematic programming, as a mechanism to foster a stronger and systematic results/impact approach for all its developmental cooperation.

The assessment framework for transformational change proposed by this evaluation could be a starting point for integration into relevant frameworks and guidelines.

UNIDO to operationalize thematic programming, on the basis of its organizational strategy and its Programme and Budgets. This should consider the following specific suggestions:

- Ongoing work on **Programmatic Service Modules (PSMs)** should be prioritized as a key pillar of thematic programming.
- **Thematic areas should develop guidelines for enhancing results/impact** driven interventions, through system based project design and implementation.
- UNIDO should offer **trainings on system analysis** for development planning and establish a community of practice within UNIDO to exchange knowledge, approaches, lessons, and experiences on the applications of systems thinking to project design and implementation.
- Thematic areas should seek to develop **"thematic partnerships"** with other organizations (e.g. in the areas of finances and policy development) as a means to leverage UNIDO's interventions.

1. Evaluation objectives, methodology and process

1.1 Background and introduction

The Independent Thematic Evaluation of the *UNIDO's capacities to contribute to Transformational Change* was included in the evaluation work plan 2020-2021 of the Office of Evaluation and Internal Oversight (EIO). The evaluation was started in 2021, and carried out over to 2022. It was conducted by an evaluation team composed of Mr. Aaron Zazueta (Team Leader), Mr. Johannes Dobinger (EIO/IED Chief and team member) and Mr. Francesco Cuda (Evaluation analyst and team member) and Mr. Frank Pool (Technical Advisor).

This evaluation aims at assessing the extent to which UNIDO's thematic approaches and projects are designed and implemented in ways that contribute to transformational goals and objectives for Inclusive and Sustainable Industrial Development (ISID) in the context of the Agenda 2030 for Sustainable Development.

For this evaluation, transformational change refers to the systemic changes needed to effectively contribute to the SDGs and to ISID in particular. Systemic change refers to the changes to which interventions contribute (outcomes and behaviors of a given system). Systems have a structure, composed of different parts and relations between these parts, which are characterized by cause and effect. Like most development cooperation (bilateral or multilateral) UNIDO interventions always happen in the context of complex systems; to understand how interventions can actually contribute to transformations it is essential to understand the relevance of the systems, its parts and interactions, and how these can be influenced.

A key underlying hypothesis of this evaluation is that UNIDO's contributions to sustainable and inclusive industrialization are more likely to materialize when design and implementation of interventions consider as much as possible the actual context of the complex systems in which they are embedded, and when relevant trade-offs and co-benefits are understood.

Other key aspects that need to be considered by transformational change are coherence and sustainability. Sustainable transformational change cannot happen when interventions ignore the interconnections and the trade-offs and/or co-benefits between different goals. The importance of this criterion has been further recognized by its inclusion in the list of development evaluation criteria of the Development Assistance Committee of the OECD (OECD DAC)¹ and in *Agenda 2030 for Sustainable Development*² in SDG 17 with a separate target (17.14 Enhance policy coherence for sustainable development). Also in UNIDO efforts have been made to map the interconnections between SDGs. The Global Sustainable Development Report 2019³ also reveals that within Agenda 2030 the SDGs are producing co-benefits as well as trade-offs and both need to be taken into account when transformational change is assessed. For the assessment of UNIDO's capacity to contribute to transformational change this means getting a better understanding of the co-benefits and trade-offs associated with the key lines of UNIDO's activities. For example, the potential negative effects of bio-energy (SDG 7) on food systems (SDG 2) or the potential positive effects of increased industrial productivity (SDG 8, SDG 9) on reduced inequalities (SDG 10). This problem has also been highlighted as "interconnectedness"⁴.

¹ <https://www.oecd.org/dac/evaluation/daccriteriaforevaluatingdevelopmentassistance.htm>

² A/RES/70/1 Transforming our world: the 2030 Agenda for Sustainable Development

³ Independent Group of Scientists appointed by the Secretary-General, [Global Sustainable Development Report 2019: The Future is Now – Science for Achieving Sustainable Development](#), (United Nations, New York, 2019)

⁴ [Translating Sustainable Development Goal \(SDG\) Interdependencies into Policy Advice](#), Anita Breuer, Hannah Janetschek and Daniele Malerba, German Development Institute (DIE), 2019; also M. Patton ([Blue Marble Evaluation](#))

1.2 Conceptual framework of transformational change

It has been already pointed out that the systemic nature of development interventions is the key entry point for this assessment. Hence the evaluation team undertook a review of relevant literature and international experiences to develop a tailor-made set of review criteria for the thematic approaches⁵ currently used within UNIDO. This section describes the key elements

The following discussion of system thinking is not to be understood as an alternative to the use of logical models and related tools, such as theories of change, logical framework approach and the Bennett hierarchy, all of which are in use at UNIDO. Instead, the conceptual framework proposed here is meant to be complementary to the use of such models and tools. For example, while a TOC maps out what kind of, and how changes are supposed to happen, the proposed use of concepts such as domains and conditions helps to identify the key elements of a system (e.g. the finance sector, government subsidies, norms& standards, etc.) that need to be influenced by an intervention.

Among the many approaches to complex systems thinking, the Social-Ecological Systems (SES) proponents have developed a set of concepts to understand and model the interlinked dynamics of social and environmental change. Concepts frequently used by SES scholars to understand large complex systems include system boundaries, system domains and scales, and the interactions of system agents (such as certain institutions, firms, government actors, beneficiary groups) whose adaptive behavior leads to a transformed system, often also referred to as “emergence”⁶. These concepts are also useful to construct theories of change (TOCs), to design, implement, and evaluate development interventions or policies that interact with social-ecological systems to steer development processes in a direction of given policy goals⁷. A similarly relevant approach of system analysis is “Panarchical theory” which describes a structure of adaptive cycles that are linked across different levels on scales of time, space, and meaning. Wieland describes the use of this theory as providing the basis for transformative supply chain management.⁸

The notion that all systems are composed by subsystems that are interconnected helps delimitate the boundaries to the phenomena relevant to the desired policy goals e.g. an intervention can target a value chain which is a subsystem embedded with in the market, which is a broader system. The concepts of **domains** help to further identify the critical overall realms and subsequently the specific conditions that can enable or hamper change in the direction of a given development trajectory. The scientific literature, such as the work carried out on communication of innovations (Rogers & Shoemaker, 1971⁹) and other evaluations have identified domains that are frequently relevant to transformation in a development context including science, technology, finances/markets/production, governance, culture, among others.

Domains can have different **conditions**, e.g. an economic condition that affects the production domain can be few and uncertain links of local producers to the international markets. The concept of domain also provides a framework that helps trace interactions of system elements across different scales of space and time (figure 1).

⁵ In the context of this evaluation, a thematic approach will refer to an area of UNIDOs work that seeks to bring about a change in a specific aspect of a system in the trajectory of ISID

⁶ Kajikawa, Y. (2008). Research core and framework of sustainability science. *Sustainability Science*, 3(2), 215–239.

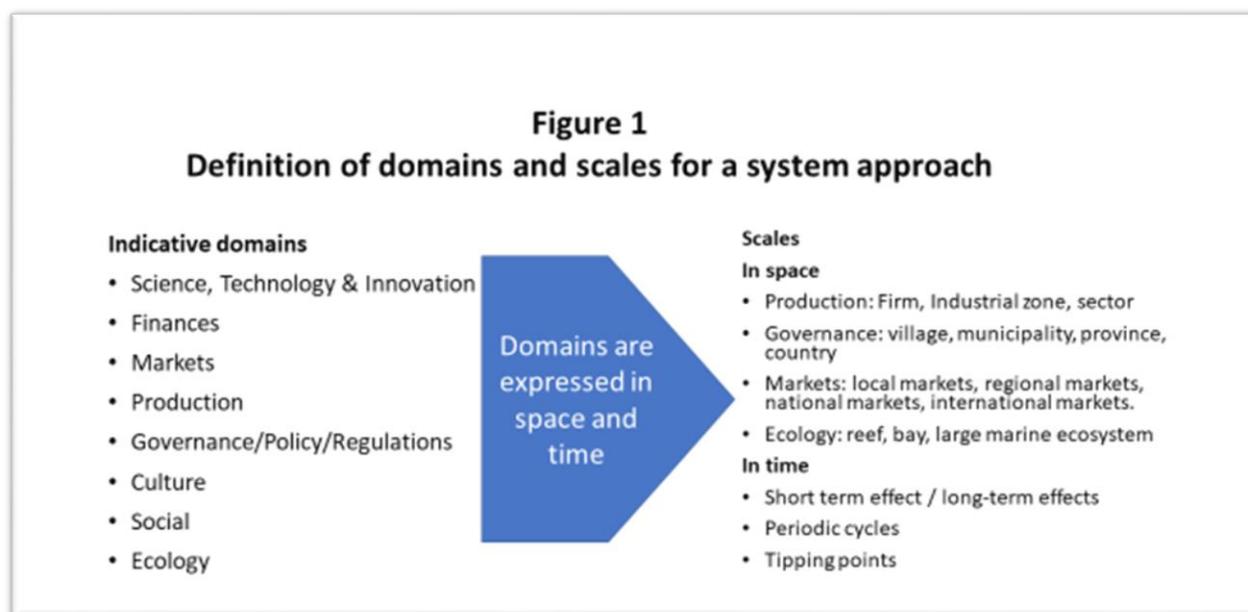
⁷ <https://doi.org/10.1007/s11625-008-0053-1> Zazueta, Aaron E., Nima Bahramalian, Thuy Thu Le, Johannes Dobinger, Eko Ruddy Cahyadi. (2021). “Complex Systems, development trajectories and theories of change” in Van den Berg, Rob D., Cristina Magro and Marie-Hélène Adrien (eds.) *Transformational Evaluation for the Global Crises of our Times*. UK: Exeter, IDEAS. ISBN (electronic): 978-1-9999329-9-2

⁸ Zazueta, Aaron E., Nima Bahramalian, Thuy Thu Le, Johannes Dobinger, Eko Ruddy Cahyadi. (2021). “Complex Systems, development trajectories and theories of change” in Van den Berg, Rob D., Cristina Magro and Marie-Hélène Adrien (eds.) *Transformational Evaluation for the Global Crises of our Times*. UK: Exeter, IDEAS. ISBN (electronic): 978-1-9999329-9-2

⁹ Wieland, Andreas. (2021). Dancing the supply chain: toward transformative supply chain management. *Journal of Supply Chain Management* 2021, 57(1), 58–73, <https://onlinelibrary.wiley.com/doi/epdf/10.1111/jscm.12248>

⁹ Rogers, E. M., & Shoemaker, F. F. (1971). *Communication of Innovations; A Cross-Cultural Approach*. <http://eric.ed.gov/?id=ED065999>

Figure 1 – Definition of domains and scales for a system approach



Source: Authors

Underlying the phenomena that encompasses the system are the actors and their adaptive behavior. SES scholars assume that systems operate through the actions and reactions of the actors (the actors' adaptive behaviour). SES assumes that actors command different resources, that are influenced differently by the conditions in the various domains, that are linked, either directly or through other actors¹⁰¹¹.

Access to financial resources and markets, natural resources, knowledge and links across scales can determine the extent to which actors can pursue their own interest within the system. The types of intersections between domains can also vary, with domain overlaps or matches or mismatches, that can affect the extent of coherence and trade-off across the system (Murphree, 2000)¹². Trade-offs can take place for example, when excessive attention to economic aspects can result in high economic gains but also in important social or environmental costs, such as seeking a rapid increase in economic growth and job creation by expanding carbon-based electricity generation while generating pollution and greenhouse gas emissions. The aggregated adaptive behavior of the actors responding to other actors and to other factors external to the system results in the emergence of system level shapes that can be quite different from the behaviors of the actors. SES assumes that the adaptive behavior of the actors contributes to system unpredictability and non-linearity¹³. It is thus important not to expect that in complex systems levels of outputs or results will correspond to levels of inputs. It follows that complex systems tend to be unpredictable. As a consequence, in the context of complex systems, effective development interventions are those which mimic other actors in the system and adopt adaptive management as the

¹⁰ Anderies, M., Janssen, M., & Ostrom, E. (2004). A Framework to Analyze the Robustness of Social-ecological Systems from an Institutional Perspective. *Ecology and Society*. <http://www.ecologyandsociety.org/vol9/iss1/art18/inline.html>

¹¹ Brugha, R., & Varvasovszky, L. (2000). Stakeholder Analysis: A Review, *Health Policy and Planning* 15.3: 239–46. *Health Policy and Planning*, 15(3), 239–246.; Jenssen, B. M. (2006). Endocrine-disrupting chemicals and climate change: A worst-case combination for arctic marine mammals and seabirds? *Environmental Health Perspectives*, 114, 76.

¹² Murphree, M. W. (2000). Boundaries and borders: The question of scale in the theory and practice of common property management. *Eighth Biennial Conference of the International Association for the Study of Common Property*, 31. <http://dlc.dlib.indiana.edu/dlc/handle/10535/1939>

¹³ Holland, J. (1995). *Hidden Order: How Adaptation Builds Complexity*. Basic Books.; Holland, John. (2006). Studying Complex Adaptive Systems. *Jrl Syst Sci & Complexity*, 19, 8.

approach to steer the development trajectory of the system¹⁴. Despite the unpredictability of complex systems, the dynamic nature of these systems and the interconnectivity of its different elements offer multiple opportunities to influence trajectories towards desired development pathways.

Agenda 2030 and its 17 Sustainable Development Goals aim at transforming the world to a sustainable trajectory of economic development, environmental sustainability and social inclusion by changing the ways humans interact with one another and with the environment. Given the complexity of this ambitious systemic challenge it is key to understand how actions to pursue different SDGs interact in different contexts and how these interactions can reverberate across the systems to support achievements across SDGs and prevent or minimize trade-offs with other SDGs ¹⁵¹⁶

Development agencies are well aware of the need to manage the effects of their interventions across SDGs. Agencies are also aware that the achievement of SDGs requires broad changes at multiple scales, they require long-term engagements, attention to multiple conditions and the engagement of multiple stakeholders. The Climate Investment Funds (CIF) in the World Bank has supported in recent years the Transformational Change Learning Partnership (TCLP) which includes many organizations and thinkers seeking to understand how to engage in system transformation. The CIFs most recent report which incorporates much of the knowledge generated in TCLP gives special attention to the opportunities for transformational change derived from the dynamic and interconnected nature of complex systems. For example, when referring to climate action the CIF indicates that “Strategic interventions can contribute to transformational change for climate action by addressing contextually relevant enabling conditions and systemic barriers; supporting scaling pathways; speeding progress; and fostering the robustness and resilience of changes and the systems supporting them. Through attentiveness to transformational change concepts, the design and implementation of interventions can enhance their potential contributions to the transformations needed for climate action”¹⁷.

The Global Environment Facility (GEF) also contends that “Systemic solutions are needed, as isolated sectoral interventions can be annulled by what is happening in other sectors. For example, we know that food production will have to increase to meet growing demands of a larger and progressively wealthier population. But if we focus solely on this objective, in the long haul the problem will worsen through the depletion of soils, wasteful management of water, loss of pollinators, and increase desertification and deforestation”¹⁸. The GEF has thus over the last couple of decades moved from supporting projects that target one focal area (e.g. climate change or biodiversity) to supporting programs with holistic approaches to transformational change in key systems that cut across focal areas (Food Systems, Land Use, and Restoration -FOLUR-; Sustainable Cities; and Sustainable Forest Management). The systems addressed often encompass value chains.

It has also been recognized that system based interventions often require a more diverse range of expertise. The above mentioned GEF programmes are also designed to engage different agencies to carry out complementary roles in system change and to engage with a wide range of stakeholders, enhance knowledge sharing and learning. The approach also acknowledges that such complex challenges require time and ongoing support.¹⁹

¹⁴ Allen, C., & Garmestani, A. (2015). *Adaptive Management of Social-Ecological Systems*. Springer. <http://link.springer.com/content/pdf/10.1007/978-94-017-9682-8.pdf>

¹⁵ Mantlana, K. B., & Maoela, M. A. (2020). Mapping the interlinkages between sustainable development goal 9 and other sustainable development goals: A preliminary exploration. *Business Strategy & Development*, 3(3), 344–355.

¹⁶ Nilsson, M., Griggs, D., & Visbeck, M. (2016). Policy: Map the interactions between Sustainable Development Goals. *Nature*, 534(7607), 320–322.

¹⁷ CIF. (2021). *Transformational Change Concepts. Transformational Change Learning Brief*. (September). Climate Investment Funds.

¹⁸ GEF. 2018. Supporting innovation for transformation: GEF’s new Impact Programs to tackle the drivers of environmental degradation in an integrated way. Blog. October 9, 2018.

¹⁹ GEF 7 Programming Directions. April 3, 2018. <https://www.thegef.org/council-meeting-documents/gef-7-programming-directions>

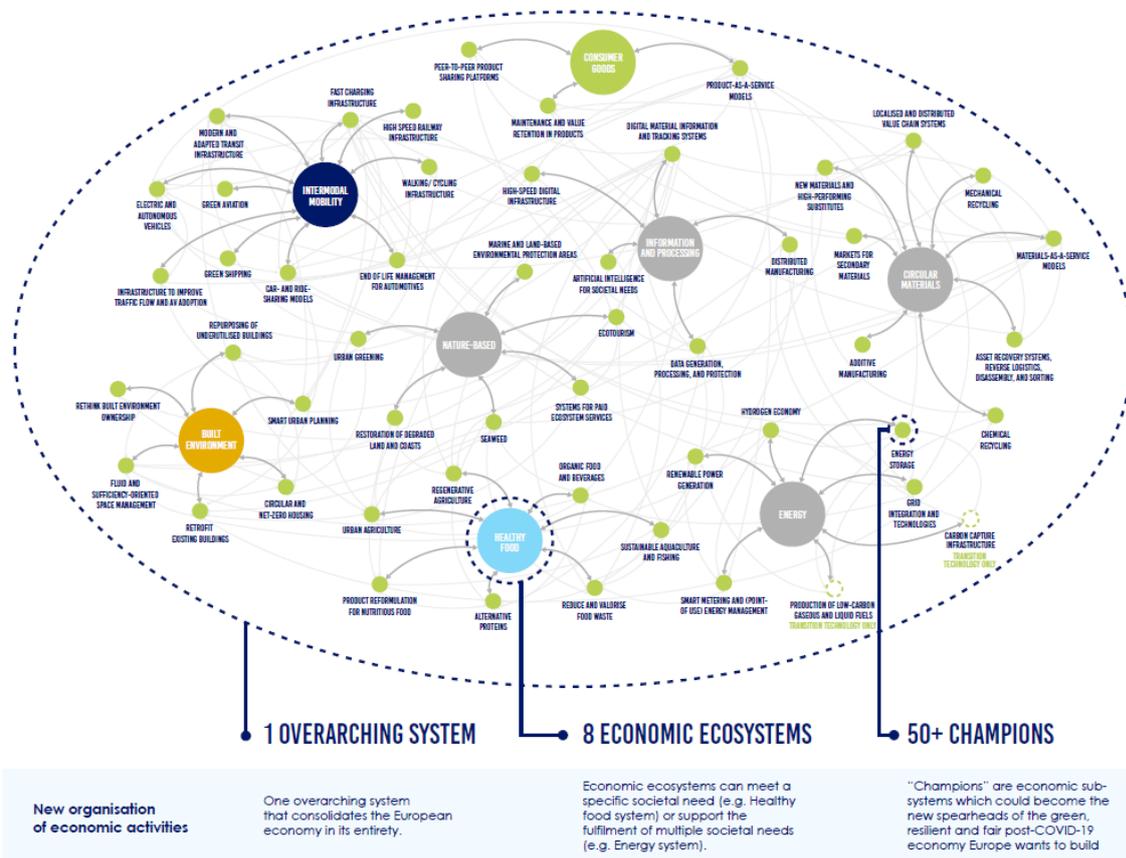
The Club of Rome has also used system thinking to analyse the European “Green Deal”, a major undertaking seeking transformation towards more sustainable economies’²⁰. The system map presented in Figure 2 shows that the overall system is composed of different levels of sub-

systems, some of which have been identified as “champions” that need to be targeted to trigger the trajectory of the overall system systems, some of which have been identified as “champions” that need to be targeted to trigger the trajectory of the overall system.

Figure 2 - A system map for the European Green Deal

SYSTEMS MAP

A framework for optimising the system and applying the System Change Compass



The Green Climate Fund (GCF) also presents itself as an agent of transformational change who has the mandate to promote a paradigm shift towards low-emission and climate-resilient sustainable development pathways in developing countries. The GCF initial investment framework defined this paradigm shift in the GCF context as the degree to which a funded activity can catalyze impact beyond a one-off project or programme investment.²¹ Subsequently documents indicate that paradigm shift takes place when all facets of society are demanding and integrating low-emission and climate-resilient approaches to sustainable

²⁰ The Club of Rome/ Systemiq (2020) A system change compass – implementing the European green deal in a time of recovery. <http://clubofrome.org/wp-content/uploads/2020/10/System-Change-Compass-Full-report-FINAL.pdf>

²¹ GCF.2020. *Updated Strategic Plan for the Green Climate Fund: 2020-2023*

development. The GCF has not come up with an explanation of the processes leading to paradigm shift.²² However, GCF documents use the term widely when referring to enabling conditions that take place over time and lead to low-emissions sustainable development and climate-resilient pathways. Examples of such conditions are improved knowledge-sharing, capacities, the establishment of an enabling environment, and regulatory and policy frameworks.²³ A key assumption of the CCIF, World Bank, GEF and the GCF, as well as other evaluations is that interventions with high likelihood of transformation potential have adopted principles of systems thinking during design and implementation. Table 1 below presents five criteria that are based on the above described current thinking on complex systems and system transformation. Furthermore, the criteria draw from the transformational criteria reported by Patton (2021)²⁴ and CIF (2021) and adapt transformational principles to UNIDO's development cooperation context.

Table 1: Criteria to assess logical models for transformational change	
A: Criteria	B: Key questions for each criteria
1. System based approach	<p>Does the TOC provide clear description of the system and on how the intervention will interact with the system to redirect its development trajectory?</p> <p>Demarcation of system boundaries, system components (key domains and scales) and agents and their interactions</p> <ul style="list-style-type: none"> • Identify the key conditions that influence the system development trajectory in key domains • Design interventions that contribute to the identified key conditions for system change
2. Evidence based	<p>Are the root causes, selection of interventions, and the causality assumptions based on sound evidence?</p> <ul style="list-style-type: none"> • Systematic use of diagnostic tools to identify key conditions • Clarity and plausibility of assumptions linking • Appropriate incorporation of scientific, technical, evaluative, local knowledge in design and implementation
3. Intervention Reach	<p>Does the model identify the levels and mechanisms by which system change is expected to take place?</p> <ul style="list-style-type: none"> • Targeting conditions at the relevant levels (micro, meso and macro) • Mechanisms that reach across time and space (Building capacities and mechanisms to support ongoing broader adoption and scale-up) • Interventions are designed to have integrated - mutually supportive-effects across the system
4. Coherence/interconnectedness	<p>Are projects and thematic approaches aligned with context and opportunities to advance development trajectories towards the ISID?</p> <ul style="list-style-type: none"> • Coherence with country partners initiatives / country situation • Considering trade-offs / and win wins across SDGs
5. Adaptive management and sustainability	<p>Does the approach help build capacities and mechanism to incorporate lessons and adapt to unexpected developments during and beyond the duration of the intervention?</p> <ul style="list-style-type: none"> • Mechanisms for adaptive management in place during the project

²² Puri, J et al. 2021. *Assessing the likelihood for transformational change at the Green Climate Fund*. GCF IEU

²³ GCF. 2020. *Program Manual. An introduction to the Green Climate Fund project cycle and project development tools for full-size projects*.

²⁴ Patton, M.Q. 2021 "Blue Marble Evaluation Perspective: How Evaluations help Solve Global Crises" in Van den Berg, R. et al *Transformational Evaluation for Global Crises of Our Times*. Exter, UK:IDEAS. p19-36.

1.3 Evaluation Scope, Objectives and Methodology

This evaluation aims at assessing the extent to which UNIDO's thematic approaches and projects are designed and implemented in ways that contribute to transformational goals and objectives for Inclusive and Sustainable Industrial Development (ISID) in the context of the Agenda 2030 for Sustainable Development.

It combines academic evidence and thought with experience from practical development work. Scientific work related to transformational change, available evaluations were taken as a basis to contribute to strategic thinking of UNIDO's development cooperation by analyzing, in particular, the plausibility of thematic approaches and to suggest ways to strengthen them.

The evaluation is primarily qualitative in its nature and does not present a historic performance record of UNIDO's contribution to transformational change. Instead, it is a forward looking exercise offering solutions for improved planning towards development cooperation that contributes to transformations in UNIDO areas of mandate and expertise

In terms of scope the evaluation focussed on UNIDO's development (or "technical") cooperation within the past 10 years with a focus on areas of work that have been in use and are likely to be continued in the future.

The chart below summarizes the evaluation process:

Evaluation methodology and process



The following evaluation questions were formulated in the Terms of Reference of this evaluation (see Annex 5) and validated in the inception phase:

- To what extent are UNIDO thematic approaches and project designed to contribute to ISID.
- To what extent are the different UNIDO delivery modalities (CP, PCP, project, thematic approaches, others?) systemic and conducive to transformational change?
- To what extent are the logical models used by UNIDO at different levels (corporate, thematic approaches, projects) coherent.
- Which co-benefits and which trade-offs are associated with UNIDO's work in the context of the indivisibility of the SDGs and policy coherence?
- What are the key assumptions and risks that influence progress towards transformational impact of UNIDO work?

- What are the strengths and weaknesses of UNIDO in contributing to ISID related transformational change?
- Which are good international practices and lessons that UNIDO could learn to enhance contributions to transformational change?
- What needs to be improved to enhance UNIDO's contributions to transformational change.

The selected thematic approaches have been analysed against the matrix in Table 1 above to assess the degree to which they respond to selected criteria for transformation.

A total of four thematic approaches have been selected for the main qualitative assessment, one per each UNIDO technical cooperation department. The selection followed a preliminary screening based on *i*) availability of a well-documented logical model *ii*) availability of specific number of projects designed and implemented under the approach *iii*) approach is in use and it is planned to be used in the future *iv*) availability of sufficient existing project documentation.

The evaluation team undertook a desk review of available documentation using the criteria presented above, then organised matrixes per each approach before interviewing with stakeholders responsible for the design and implementation of the four approaches. Projects were used to assess coherence both between the approach and its implementation and among different approaches. A final validation workshop was also organised to further confirm the findings with the stakeholders involved in the process.

The four selected approaches are²⁵:

- **Quality infrastructure for Value chain development** (*Department of Digitalization, Technology and Innovation – DTI*)
- **Food Safety** (*Department of Agri-Business*)
- **Bio-energy** (*Department of Energy*)
- **Global Eco Industrial Parks** (*Department of Environment*)

The evaluation also included a lighter analysis of four approaches to validate the findings from the first four approaches. This second analysis included desk review of existing strategic documentations, ToC, PSM and a limited number of projects, but it did not involve stakeholders at department level.

The second group of approaches include:

- Small and Medium enterprises clustering (DTI)
- Development of industrial skills (Agri-business)
- Renewable energy for productive uses (Energy)
- Transfer of environmentally sound technology (Environment)

²⁵ See Annex XXX for a list of reference documents used for the analysis of thematic approaches

1.4 Limitations

Due to the forward looking focus on current and partially recent thematic approaches the evaluative evidence of projects under each thematic approach was limited.

2. UNIDO's development cooperation: history and background

Development cooperation has come a long way in trying to overcome fragmentation of the work done by many bilateral, multilateral, private and non-governmental actors.

For the United Nations Development System (UNDS) the Millennium Development Goals marked an important step towards common goals, combined with a renewed drive for results based management (RBM). When the UN General Assembly in 2015 approved the Agenda 2030, including 17 Sustainable Development Goals (SDG) along with 176 agreed targets, the attempt to increase focus of the UN's development work came to a new high.

UNIDO became the custodian of SDG 9 – Industry, Innovation and Infrastructure. This led to increased efforts to demonstrate the relevance and effective contribution of industrial development cooperation to agenda 2030.

The following section provides an overview of UNIDO's development cooperation system.

2.1 Overview of UNIDO's development cooperation

UNIDO can be characterized as a project development and implementing agency as almost 100% of extra-budgetary resources and at least 50% of the regular budget (so all together approx. 85% of total budgetary resources) are linked to projects²⁶.

The main vehicle for project implementation was – and keeps being – the individual projects. Since 1995 the organization introduced Medium Term Programme Frameworks (MTPF) as strategic programme frameworks. However, as has been recently found by the independent evaluation of the MTPF²⁷, this framework is not used to guide development cooperation, as it is not linked to decision making at the project approval stage. Also, the evaluation of UNIDO's formulation, appraisal and approval process in 2020²⁸ found that the project approval process in UNIDO is not used to select and prioritize projects. Generally, as long as a project comes with a clear finance perspective and does not have major deficiencies in terms of quality, projects are approved without specifying the project's contribution to a higher programme or strategic goal²⁹. Thus, UNIDO's way of project planning can, to a certain extent, be described as a "bottom-up" approach, where projects are developed without necessarily taking the strategic priorities of the Organization into account.

This implies limitations to the way how the Organization can strategically orient its contributions to Agenda 2030, which is especially relevant in the context of the discussion about transformational change. This has been recognized by UNIDO management and also highlighted by external assessments such as the UNIDO MOPAN assessment in 2019³⁰.

A way to link individual interventions to higher level objectives is programming. Programming is used by many development cooperation actors to different degrees and in different forms. In

²⁶ Rough estimate based on UNIDO (2022) Annual report 2021: 54% of Regular Budget expenditures are listed under "thematic priorities".

²⁷ UNIDO (2022) Independent evaluation of the MTPF2018-2021 and 2022-2025

²⁸ UNIDO (2020). Independent evaluation of UNIDO's formulation, appraisal and approval process.

²⁹ An example of what is referred to here is the Global Environment Facility's system of collect information on each project's quantitative contribution to agreed global environmental benefits (e.g. GHG reduction in tons of CO2 equivalents).

³⁰ MOPAN 2019 UNIDO. <https://www.mopanonline.org/assessments/unido2019/>

practice the dependence on extra-budgetary resources, which can be easiest mobilized at the project level (“ear marking”), limits UNIDO’s ability to proactively programme resources. What can be done, is the programming of regular budget funds, with certain effects on the programming of voluntary contributions, e.g. through specialized staff in strategic areas that develops projects in that area. While this introduces a high degree of flexibility in UNIDO’s way of responding to requests for technical cooperation from member states, it can also lead to fragmentation of the portfolio where each project is one of its kind, thereby diluting UNIDO’s specialized contributions and reducing the possible transformational impact of UNIDO.

2.2 Programming at UNIDO

UNIDO has been using programme approaches to provide more guidance over project development and intended project results. These can be defined either by the geographical or the thematic dimensions. The former is by far the more widely used programme type in UNIDO.

a) Geographically-defined programmes

Geographically-defined programming as a tool to align the organization’s resources with the needs in a country or a region.

The first major effort to move from projects to programmes were the “Country Service Frameworks (CSFs)”, followed by the so-called “Integrated Programmes (IPs)”. In the period between 2000 and 2010, several evaluations of CSFs and IPs found that the expectations were not met: most programmes remained largely unfunded and as a result the projects remained in the “driving seat”.

The next generation of geographically defined programmes were the “Country Programmes” (CP) which are still in use in 29 countries.³¹ So far there has been no overall evaluation of the effectiveness of the CP modality. From several individual CP evaluations it can be concluded that they can be a useful tool to monitor and manage UNIDO’s interventions in a country. They are less effective in actually defining what the UNIDO portfolio in a certain country will contain.

The most recent programming tool in the geographic category is the “Programme for Country Partnership” (PCP) introduced in 2015 and currently operating in 12 countries. PCP evaluation reports³² indicate they have a stronger country ownership than other types of country level programmes used by UNIDO. This gives PCPs a higher potential to actually contribute to transformational change.

b) Thematic programmes

Thematic programming as a tool to align the organization’s work with internationally defined priority objectives (e.g. the SDGs or ISID).

Thematic programmes have existed in UNIDO for a long time. In almost all cases, the thematic programmes were linked to a thematic partnership with one or several donors. One of the older examples is the UNIDO-UNEP Cleaner Production Programme with Switzerland and Austria as key donors. Another example is the SME Cluster programme with Italy as a key donor. In the more recent past the Industrial Energy efficiency programme and the Persistent organic pollutant programmes were largely developed in partnership with the Global Environment Facility (GEF). Also, the Global Quality and Standards Programme (GQSP) and the Global Ecoindustrial Park Programme (GEIPP) were developed with Switzerland (SECO) as key donor.

³¹ UNIDO (2022) Annual Report, https://www.unido.org/sites/default/files/files/2022-05/UNIDO_AR2021_EN.pdf

³² UNIDO (2017). Independent mid-term evaluation. UNIDO’s Programme for Country Partnership. https://www.unido.org/sites/default/files/files/2018-03/MTE%20UNIDOs%20PCP_ebook.pdf; UNIDO (2020). Independent Evaluation of the PCP Ethiopia. https://www.unido.org/sites/default/files/files/2020-05/PCP%20ETH%20Indep%20Eval%20Report_April%202020_F.pdf

The examples stated above have in common that they are built on a partnership with one or two donors. The programme documents provide clear guidance on the objectives, approach, structure and activities to be included in individual (country-level) projects.

c) Programming and transformational change

Contributions to transformational change can be looked at from two distinct perspectives. First, they can be described by what the respective initiatives intend to achieve, namely to contribute to the transformational objectives of global agenda's such as ISID or the SDGs of Agenda 2030. Second, they can be described by how they are meant to work, namely that they are systemic in nature, going beyond the individual project by setting in motion longer term processes.

Programming tools that are fit for transformational change need to take both aspects into account. First, they need to be aligned with the international agenda and the Organization's agreed strategic priorities. Second, they need to provide clear guidance on what a transformational intervention in a certain country or region needs to take into account in order to effectively contribute to system change. For example, the UNIDO industrial energy efficiency programme is clearly relevant for both, Agenda 2030 and ISID³³. But whether the individual projects will effectively contribute to a sustainable transformation in energy use depends on many factors that are specific to a certain place (or geography) and time. In specific thematic areas, like in the case of industrial energy efficiency, most of these factors are well understood (e.g. the influence of fuel prices on energy saving behaviour) and can be made integral part of a thematic approach. Thematic programming plays a crucial role in providing sufficient guidance to project development in order to maximize contributions to transformational change.

2.3 Processes and guidance for development planning and programming

Development cooperation initiatives, be it projects or programmes, are usually designed following standardized processes and using available guidance and instructions. This is not different in UNIDO. Currently, the key guidance available are the "Technical Cooperation Guidelines"³⁴. These guidelines include guidance for the project cycle as well as for the development and implementation of the geographically defined "integrated programmes" (see above). Since 2020 new technical cooperation guidelines are being developed and can be expected to be finalized soon.

So far, the existing guidelines focus on projects and no guidance exists for the development and implementation of thematic programmes. However, in 2021 management started to work on the preparation of "Programmatic Service Modules" (PSM). A task force was established and currently a number of PSMs have been drafted. The expectation from this exercise, as described in the TOR of the PSM task force, is to produce documents that provide guidance to project developers so that individual projects are better aligned to agreed objectives and also use more standardized approaches, thereby increasing efficiency and facilitating learning for continuous improvement of the entire portfolio.

Theories of Change (TOC) and the Logical Framework are tools used at the project level, with the former becoming more widely used in recent years. This is a good basis for more effective programming as TOCs can be seen as key entry point for system thinking.

In light of the above, there are some signs that the Organization is moving towards more use of programming as an important dimension to ensure transformational contributions to Agenda 2030, ISID. However, so far the tools available are more developed at the geographical dimension, while thematic programming is yet happening on an ad-hoc basis and primarily responding to donor interest and priorities.

³³ UNIDO (2019) Impact evaluation of UNIDO's industrial energy efficiency programme. <https://www.unido.org/sites/default/files/files/2019-11/E-Book%20IEE%20Impact%20Evaluation.pdf>

³⁴ UNIDO (2006) [Guidelines for the Technical Cooperation Programme and Project Cycle](#)

3. Evaluation findings

3.1 Are thematic approaches based on a system approach?

Key Findings:

UNIDO's thematic areas seek to contribute to broad system changes leading to ISID transformations. However, thematic areas vary on the extent to which they incorporate aspects of system analysis in the design and implementation of the interventions.

The guidance offered by thematic approaches on ways to carry out system analysis and on how to manage system change varies greatly across thematic areas reviewed.

Most projects reviewed clearly define the boundaries of the systems they seek to change while also addressing multiple domains. However, the system boundaries sometimes lack sufficient range of scale and/or depth in domains. This hampers project design ambition and constrains the potential contributions towards a transformational development trajectory.

Domains typically considered by thematic area strategies, programmes and projects are related to technology, human and institutional capacities, and economy (often in the form of value chain development). Other domains (such as finances and policy), while also addressed are less prominent or are domains that have proven to be more challenging to UNIDO.

An important assumption of UNIDO's work is that while ISID transformations take place in the long-term, shorter-term changes can steer the development trajectory in the direction of ISID as it can be visualized in a Theory of Change (ToC). While long term transformational goals such as ISID imply processes that are complex and difficult to predict, the system approach is well suited to identify and understand the relevant factors that influence the trajectory towards a long-term objective and to guide the design of interventions likely to contribute to such long-term processes. Failure to understand the system that is targeted implies a high risk that interventions will not significantly contribute to system change, or in a worst case scenario that interventions will contribute to undesirable changes.

Systems thinking seeks to understand how different parts or elements interact to make a whole that is different from the sum of its parts. A systems approach to planning and implementation of development interventions starts by modeling the system that is likely to contribute to the desired long-term objectives. This includes demarcating the boundaries of the system that is targeted for change, including the identification of components and elements that interact within the system, the system component conditions likely to influence the system development trajectory, and indicating how the intervention will interact components to contribute to conditions that are likely to lead to change. This section examines the extent to which thematic areas under review apply such criteria (see text box above).

Key aspects of the system approach criteria

- A. Demarcation of system **boundaries**, system **components** and their interactions
- B. Identify the **key conditions that influence the system development trajectory**
- C. Design **interventions that contribute** to the identified key conditions for system change

A. Demarcation of system boundaries, system components and their interactions

Finding: UNIDO's thematic areas under review seek to contribute to broad system changes leading to ISID transformations. However, guidance for project development on ways to carry out system analysis and on how to manage system change varies greatly across thematic areas reviewed. Only one thematic area guides projects to define the boundaries and to identify conditions across domains and levels likely to contribute to broad system changes. Limitations in two of the thematic areas reviewed in particular, provide insufficient guidance on system boundaries and system components contribute constraints design ambition and limits projects contributions to change.

One of the first steps in system analysis is defining system boundaries by identifying the key domains to be taken into account. Domains, in the context of system analysis, are social sub-systems that influence the transformations within the targeted system. While the promotion of inclusive and sustainable industrial development takes many different forms, with widely varying immediate objectives, the domains are similar. Table 1 shows seven key domains and how they are considered in the four thematic approaches analysed.

Table 1 – How domains are addressed in UNIDO thematic approaches

Domain	Examples of key conditions within the domain ³⁵	QIVCD	Food Safety	EIP	Bio-energy
Science, Technology & Innovation	Local viability of technology solutions, Cost of technology, Technology management capacities	Not a key part of system analysis but actors in standardization and quality relevant	Not part of system analysis	Not part of system analysis	Key entry point
Production	Competitiveness, Business organisations, Investment capacities	Part of value chain analysis	Not part of system analysis	At park level	Not part of system analysis
Finance	Access of SMEs to loans, Existence of local investors	Not part of system analysis			
Market	Trade regime, Competition, Market access, Exchange rates	Market access and trade regimes part of analysis	Market access and trade regimes part of analysis	Not part of system analysis	Potential market for ethanol analyzed
Governance/Policy/ Regulation	Subsidies, Taxes, tariffs, environmental legislation and enforcement, public institutional infrastructure	Relevant government policies and institutional infrastructure key part of system analysis	Some government policies and institutional infrastructure part of system analysis	Some government policies and regulations	Some government policies
Social	Minimum wages Work force Education levels Informality	Not part of system analysis			
Nature	Natural resource endowment. Disaster risks and resilience	Not part of system analysis			
Culture	Public opinions, common beliefs and values	Key element of the system analysis	Not part of system analysis		

³⁵ The key elements of the domain have a direct influence on system trajectory and possible contribution to a transformation. E.g.

The thematic areas under review all indicate that they seek to contribute to durable changes that lead to ISID. The definition of boundaries, components, and interactions among system components greatly influence the extent to which an intervention will target the conditions that are likely to enable a meaningful contribution in the trajectory of ISID.

Among the thematic areas under review the **Quality infrastructure for Value chain development (QIVC)** thematic area presents a clear identification of system boundaries and system components necessary for QI systems to contribute to an ISID development trajectory. The QI thematic strategy seeks to improve productivity and competitiveness in the economy/industrial sector through well-functioning quality systems that also contribute to shared prosperity and good environmental management. The strategy guides projects to focus on the integration of Quality Infrastructure System (QIS) in value chains as the systems targeted for change. A QIS is defined as “a system that combines initiatives, institutions, organisations (public and private), activities and people. It includes the policies, relevant legal and regulatory framework, and practices needed to support and enhance the quality, safety and environmental soundness of goods, services, and processes”³⁶. The boundary of the system considered includes the full range of the value chain, going from the level of the enterprise at the micro level to the country or world market at the macro level. The integration of QISs and value chains requires changes in multiple domains that include policy and regulations, the economy/private sector, science and technology, institutions, human and organizational capacities, and social cultural dimensions.

The **Global Eco-Industrial Parks (GEIP)** thematic area seeks to demonstrate the transition from traditional industrial parks or zones to eco-industrial parks (EIP). The main reference system of the GEIP is the EIP itself, i.e. it targets the system change within one or several industrial parks. The approach considers aspects internal to the park and contextual conditions. Aspects internal to the park are related to park management, park environmental performance, park social performance and park economic performance. The contextual factors are related to policy and regulations, finances, and institutions.

Focus on the EIP is a significant step forward from previous UNIDO resource efficiency and cleaner production projects that focused on the adoption of cleaner technology, which targeted individual businesses for system change. Yet, in order to make a contribution to the transformation towards sustainable industrial development, targeting the program to the wider “EIP system at the country level is likely to make a more substantial contribution to ISID. Targeting the county EIP system would encompass EIPs demonstrations as one of several components of a broader and long-term strategy to develop a country eco-industrial park system, including the definition of possible interventions (e.g. policy for feed-in tariffs to make EIPs investments in renewable energy more viable) but also the identification of necessary preconditions and external factors in different system domains that are considered of importance. The latter could, for example, include a certain level of enforcement capacities for environmental regulations, without which motivation of companies might be too low to buy into the EIP concept or it might remain at the level of “low hanging fruits” that do not have major environmental effects.

The current EIP thematic approach could benefit from a better understanding of its overall “country level system”. Such system mapping and analysis could effectively guide the design of country level interventions and improve their contributions to the transformation towards sustainable industry.

Also the **Bioenergy Programme Strategy** indicates the intention to bring about system changes that support an ISID development trajectory. It presents considerable background information useful to understand the development of bioenergy. Similar to other thematic areas under review, the Bioenergy strategic frameworks indicates that relevant phenomena take place at various levels (micro, meso and macro, pointing out the need to simultaneously address barriers in multiple domains (technology policy and regulatory frameworks, awareness, and institutions)³⁷. The Bioenergy projects examined during this evaluation focus on the elimination of barriers to the adoption of specific bioenergy technologies. The barriers considered typically cut across several domains which often includes policy and regulations, market, finances, technology institutions and social innovation. However, the thematic approach does not provide clear guidance for the demarcation of system boundaries that should be targeted to make durable contributions to the desired development trajectory. Thus, projects under this thematic area vary on the breadth of the targeted system and the depth to which domains, scales, levels and stakeholders are addressed. Having as a project objective the promotion of a given bioenergy technology as the starting point,

³⁶ UNIDO 2020 Global Market Access Programme (GMAP) 2020-2024.

³⁷ UNIDO. Bioenergy programme strategy (draft, internal document).

project preparation runs the risks of narrowly focusing on the identification of barriers to the adoption of the chosen technology without necessarily considering the fit of the chosen technology in the broader energy system. This approach is more restrictive than others with regard to the options available to achieve the long-term objectives of access to energy and energy decarbonisation. By implication, the thematic approach has an even higher need to analyse and understand the relevant energy system in which the new technology is embedded. From the evidence of project evaluations³⁸ it can be concluded, that not all partner countries have energy systems with the necessary conditions for bio-energy development to trigger system change by means of technology demonstrations and trainings.

The **Food Safety (FS)** thematic area also indicates the intention to bring about system changes supportive to ISID. The FS strategic frameworks highlights that the phenomena relevant to food safety take place at various levels (micro, meso and macro – including country and regional) and point out the need to simultaneously address barriers in such domains as technology, policy and regulatory frameworks, awareness, and institutions³⁹. The guidance for the Food Safety thematic area identifies the 3 key pillars to build food systems each of which include several conditions conducive to system change⁴⁰. However, as in the case of the Bioenergy Program Strategy, this thematic area does not provide clear guidance on how to conduct an analysis of the relevant “food safety system”, its boundaries and key domains that should be targeted to make durable contributions to the desired development trajectory, which focuses on increased trade in (safer) food products. The projects reviewed under this thematic area also vary on the extent to which they incorporate relevant domains and stakeholders.

B. Identification of enabling conditions and interactions likely to contribute to the desired transformational change.

Finding: Enabling conditions considered by thematic area strategies, programmes and projects are typically closely related to the innovation/s projects introduce. This includes conditions pertaining to domains related to technology, human and institutional capacities, and business models). Other domains, (such as finances and policy) while also present are less prominent and few times focus on the necessary mechanisms for system change.

Among the thematic areas analysed *Quality infrastructure for Value chain development (QIVC)* provides the clearest guidance for the identification of enabling conditions and system interactions likely to contribute to broad system change. The QIVC identifies specific sub- systems that perform specific functions within a QIS, such as the National Standardization Body (NSB), the National Accreditation Body (NAB) and the National Metrology institute (NMI). In addition effective QISs require service providers that include calibration laboratories, testing laboratories, inspection bodies, certification bodies and enterprises. A QIS “can only function properly as a whole. The absence or weakness of any one of the institutions will compromise the effectiveness, and ultimately the efficiency, of the whole system”⁴¹. Yet, while each of these elements have a role in ensuring that the QIS works, these elements also exhibit various degrees of autonomy. Thus, in a well-structured QIS, functions are carried out by institutions or authorities that are autonomous from one another, but when properly coordinated contribute to the overall objective of economic growth through trade and ISID.



Objectives influence system boundaries

While food safety contributes to several SDGs, including primarily health (SDG 3) and hunger (SDG 2), the expected key contribution of the UNIDO thematic area is to foster development through increased trade in agro-industrial products (SDG 8 and 9). This has implications for the system the FS approach targets. For example, if the ultimate goal is to have a significantly and sustainably increased trade volume in food products, the relevant system would have to include the environmental domain as environmental effects (e.g. increased use of water) could be expected. Food safety as a means to better (consumer) health would be different as it does not imply an expansion of production.

³⁸ UNIDO. Thematic synthesis of independent evaluations of UNIDO renewable energy projects from 2016-2020 (April 2021).

³⁹ UNIDO. Food Safety Approach. Safer Food for Sustainable and Resilient Businesses; Food Safety Matrix - Bennet Hierarchy.

⁴⁰ The three key pillars of the Food Safety approach are: 1) enabling sustainable businesses through effective food safety capacity building; 2) enabling a favorable food safety environment through integrating food safety into the wider context of regulatory frameworks, national quality and food safety policies as well as infrastructure development; 3) fostering food safety advocacy and partnerships through enabling the engagement of the private sector in local, regional and global partnerships and advancing multi-stakeholder food safety dialogue and interventions.

⁴¹ UNIDO 2020 Global Market Access Programme (GMAP) 2020-2024.

The existence of certain institutions, such as a metrology institute, an accreditation body, testing laboratories are key conditions of the system that need to be in place for an intervention of UNIDO to achieve its objectives. These are clearly identified in the thematic approach. On the other hand, the thematic approach does not elaborate on key conditions in some other domains, such as the finance sector (e.g. access of SMEs to loans to invest in quality improvements) or the trade regime (e.g. viability of market access for quality products in the medium term). Such conditions would be important to take into account when conducting system analysis for a new intervention⁴².

GEIP's approach assumes a holistic perspective in which the system elements interact. GEIP fully consider the interactions among conditions affecting the development trajectory at the level of the eco-industrial park. The GEIP approach seeks to identify the multiple conditions needed to demonstrate the change from traditional industrial parks and zones to EIPs. E.g., in addition to the identification of RECP or industrial symbiosis opportunities, the approach gives attention to business models for park management as well as financial constraints and regulatory changes that would allow adoption of the identified innovative opportunities, such as permission to exchange industrial by products (an important factor to enable industrial symbiosis). However, as explained in the context of system boundaries above, while likely to demonstrate change in the system it targets (the eco-industrial park) this approach is less likely to contribute to significant change beyond the park if conditions related to broader policy incentives, governance, financing mechanisms and capacities of technological development are not in place. The role of eco-industrial parks in the transformation of industry towards environmental sustainability in a given country will depend to a large extent on the share of industrial output produced in parks or zones, either currently or in the medium term. Demonstrating the conversion of a traditional industrial park into an EIP in a country where few other parks or zones exist will leave the intervention necessarily at a large distance of system change. This key condition could be used as guidance for the development of country-level projects. A programmatic approach that is committed to impact would probably suggest not to target such a country for a GEIP intervention⁴³.

Although the Food Safety approach advocates a comprehensive and holistic approach to system change it does not specify or map the interactions among conditions, nor does it provide projects with guidance for analysis and project planning. The projects reviewed during this evaluation concentrate on the removal of specific food safety barriers to trade or on building capacities on specific technologies. While projects can touch on several domains, the boundaries of the phenomena reached typically include aspects closely related to food safety and don't extend or reach deep into broader contextual conditions seeking.

The need to take broader system requirements into account has also been highlighted in a relevant World Bank study⁴⁴: "In many countries, concerted action on domestic food safety has been sporadic and reactive, coming in the wake of major outbreaks of foodborne disease or food adulteration scandals. Yet what is needed are sustained investments in prevention, including ones that build countries' core competencies to manage food safety risks, and motivate and empower many different actors, from farm to fork, to act responsibly and with consumer health in mind.

The Bioenergy thematic area seeks to contribute to the universal access to energy and the decarbonization of energy systems by supporting the development of biofuel industry and value chains. Yet, the strategy does not establish the link between decarbonization of energy systems and universal access to energy. Such links need to be established at the level of each intervention and are closely related to the fit of the technological choice given contextual conditions. Yet, the thematic area document (programme strategy) does not provide explicit guidance to project developers on the conditions under which this link might exist and or on how to establish such link.

Another important aspect that needs to be taken into account for initiatives that focus on a particular technology choice is the fit within the broader system and with the social and cultural context, which determines the way technologies can be expected to be widely adopted.

⁴² See for example: [UNIDO Independent Terminal Evaluation: Smart-fish programme.](#)

⁴³ See for example: Independent mid-term evaluation. Global eco-industrial parks programme (GEIPP) (UNIDO project No. 170222). December 2021

⁴⁴ World Bank Group: The Safe Food Imperative

B. Guidance for interventions designed to target enabling conditions for system change

Finding: The way projects define the boundaries of the systems they seek to change and the key enabling conditions for system change (or change barriers) directly influences the design of interventions. Those thematic approaches that guide projects to develop a holistic model of the system results in projects that more thoroughly target the conditions that are likely to contribute to the desired system change.

QIVCD projects typically reach broad across domains well targeted to interact and bring about change in value chains. QIVCD projects also seek to establish or strengthen institutions to develop key quality infrastructure institutions across one or more value chains. As indicated earlier this includes institutions such as the National Standardization Body (NSB), the National Accreditation Body (NAB) and the National Metrology institute (NMI). In addition, QIVCD projects also seek to build capacities among service providers that include calibration laboratories, testing laboratories, inspection bodies, certification bodies and enterprises. A QIS can only function properly as a whole. The QI thematic area continuously expands the adoption incorporated systems analysis in project planning and implementation. Recent QIVCD projects in Indonesia and Vietnam have been experimenting with methods to map the interactions among elements of the system to develop more precisely hypotheses on the conditions that lead to system change. However, the QIVCD guidance document has not been updated to incorporate lessons from the recent practice. The programme document presents a conceptual model that guide the planning of projects to mostly linear interventions that concentrates three pillars: Also, despite project planning having a deep reach across domains and levels, guidance in QIVCD still focus on three aspects: QI Systems, enhanced SME compliance capacity and strengthened quality culture. The consideration of other domains for project level system analysis, for example the finance or the social domains are not yet part of the QIVCD system approach.

Current good practices of system analysis

*One example of a **good practice** in the Bioenergy thematic area is the **Biogas agro-industrial project in Parana Brazil**, which began with a **sound analysis of the broader energy system** in which biogas agro-industrial value chains are embedded. During project identification (before design) it was determined that the State of Parana had the conditions to introduce agro-industrial biogas value chains at a broad scale. Such conditions considered requirements directly related with the production and supply of energy, as well as to the **risks of environmental and social trades-offs** through deforestation and land competition with food production. The project addressed factors that converged in the strengthening of biogas agro-industrial value chains in the state of Parana. Yet to arrive there, the project first established that the technology choice was consistent to the contextual conditions in the state of Parana. During planning the project also gave much **attention to the broader system and contextual conditions** likely to enable the successful introduction of biogas agro-industrial value chains in the state of Parana.*

The GEIP provides clear guidance on the system that the program targets and the changes it seeks to bring about (demonstration of the change from industrial zone change to eco-industrial park). The approach also provides clear guidelines on the domains projects need to address. Yet, as indicate earlier GEIP is likely to make more substantial contributions to ISID if system change would be targeted at the level of the national eco-industrial park system. To illustrate this Figure 3 above presents an example of the GEF support to national protected area systems in four countries. While not directly related to industrial development, this example illustrates a focus on the national park systems that targets from the start the conditions likely to contribute to broader adoption at a higher level – beyond specific parks. The key difference is the adoption of a broader system perspective in problem analysis and design of interventions. This typically means that interventions will seek to reach deeper into the relevant domains (the contextual sectors and institutions).⁴⁵

Figure 3
Types of GEF interventions
at the protected area system level

Intervention	Colombia	Mexico	Namibia	Uganda*
Policy development		x	x	x
Technical support		x	x	
Consultations/meetings		x	x	
Research			x	x
Financial and human resource systems		x	x	x
Establishment of new PAs/improved representativeness of ecosystems	x	x	x	x
New management approaches	x	x	x	x
Sustainable financing mechanisms	x	x		x
New administrative bodies		x	x	x
Monitoring system (biological outcomes, management effectiveness)	x	x	x	
Vehicles/equipment/infrastructure		x	x	x
Community participation/benefits		x	x	x

For example, when addressing financial conditions, the UNIDO’s park level approach turned to the development of guidelines that EIPs and enterprises could use to identify and access EIP financing. While this might prove to be useful for some enterprises, in other cases this will not enable them to overcome existing barriers of the national financial system (e.g. interest rates for loans may be too high). By contrast, the country parks system approach illustrated in the GEF example focused on the development of financial mechanisms to support protected areas. This required changes in the existing (or the creation of new) financial institutions, new regulatory frameworks, and the eventual expansion of the national budget to cover the costs of operation of parks. Also in the park systems example, the parks that were targeted for demonstrations were selected not only considering the extent to which park conditions were conducive to a successful demonstration, but also by considering broader country criteria such as the representation of the country of biodiversity values.

In addition to demonstrating models of park management, the country system approach also included the development of a robust central administrative body (often a new institution) that had the legal authority and responsibility to manage and promote the protected areas system. This led to the institutionalization of human resource practices across the system -reaching beyond the protected areas initially included in the GEF projects- and to the establishment of formal and informal mechanisms for the exchange of knowledge and lessons across the protected areas system. The key point is not that the GEIP approach ignores contextual issues, it is that the GEIP approach addresses contextual issues from the perspective of what is needed for a successful EIP demonstration, which does not necessarily encompass the full set of conditions that are needed when targeting system change at the broader the country level.

Projects from the Food Systems thematic area illustrate how projects with a narrow focus can produce concrete results - in this case the elimination of specific barriers to trade - while such projects are likely to have a limited effect with regards to system change. The twin projects ARAC and SAFE are a case in point. The ARAC objective is “an internationally recognized regional cooperation on accreditation as key driving force for regional trade integration to enhance health and safety, protect the environment, and provide consumer protection”.⁴⁶ The projects included strengthening of ARAC as a regional organization and its interaction with 17 member Arab countries. The Project mostly targeted the regional

⁴⁵ Global Environment Facility Independent Evaluation Office (GEF IEO), Impact Evaluation of GEF Support to Protected Areas and Protected Area Systems, Evaluation Report No. 104, Washington, DC: GEF IEO, 2016. Page 71

⁴⁶ Support the Arab Accreditation Cooperation (ARAC) to be sustained, effective and internationally recognized as key driving force for regional trade integration. UNIDO 2018. SAFE overall objective was to drive harmonization at regional level for food safety measures that will largely contribute to the operationalization of the regional free trade agreement and thus enhance regional trade potential. UNIDO 2020 Arab Safety for Trade Facilitation (SAF) Final report January 2014 – July 2020.

harmonization of food safety standards. Its reach was confined to the regional and country levels. The terminal evaluation concluded that the project helped to strengthen ARAC as a regional institution and to build on the achievements of a previous UNIDO project. Yet, the terminal evaluation also pointed out that many factors linked to the ultimate objectives of the project were not addressed and that the impact of potential project were mostly assumed.⁴⁷ While not enough time has passed to assess the impacts of the project, it is likely that the reach of the project (in domains, levels and time) did not go deep enough to make significant contributions to upgrading of quality infrastructure in the member countries or for a successful trickle down of standards agreed by ARAC to the national level.

The INDEXPO Food Safety project intended the recovery and expansion of Sri Lanka's cinnamon international markets by building capacities to comply with international food safety requirements. The project focused largely on the support of training institutions for good manufacturing practices (GMP) and the promotion of the certification of the Pure Ceylon Cinnamon (PCC) mark.⁴⁸ The CAPFISH project's objective is to upgrade the Cambodia private sector postharvest practices to meet EU requirements. Its focus was mostly on strengthening the regulatory post-harvest system⁴⁹. INDEXPO and CAPFISH differ from ARAC and SAFE in so far as the former targeted producers and midlevel institutions (micro and meso phenomena) while the latter address mostly phenomena at the macro level. Unlike ARAC and SAFE, INDEXPO and CAPFISH are likely to result in changes in production among those engaged in the targeted value chains. However, as in the case of ARAC, the contributions to system change of INDEXPO and CAPFISH remain highly uncertain as projects targeted very specific conditions (producers capacities to comply with international food safety requirements) without addressing other aspects such as quality infrastructure, financial needs of producers and labor regulations.

The limitation generated by the lack of sufficient project guidance to demarcate the systems that are targeted by interventions and to select the approach of technology best suited to local conditions can be illustrated by the case of the project promoting ethanol value chains in Tanzania.⁵⁰ While the project considers barriers directly related to ethanol (e.g. supply chain of stoves and ethanol safety standards), other conditions in the broader context that affect the spread of bioethanol value chain are not fully considered. The evaluation found no evidence that project preparation addressed key questions pertaining to the broader conditions affecting the domestic fuel energy markets in suburban Tanzania. In particular, the consideration of other energy options did not seem to be considered during preparation. Other key issues pertaining the interaction between the intervention and the system in which the technology is embedded that seem to be missing in the analysis are: (a) how the current uses of molasses in Tanzania compares with its use in bioethanol production including for potable ethanol for beverages (currently 12 million litres/year of ethanol for one company in Tanzania) and for export (as occurred for 600 tons of molasses in 2016 to Kenya)⁵¹ (b) the likelihood of continued bioethanol subsidies in periods of low international oil prices, and (c) the planned expansion of natural gas pipelines in urban areas for domestic use of Tanzania's abundant indigenous natural gas supplies available in Dar es Salaam since 2015.⁵² Also, project design did not seem to draw on the pertaining knowledge on domestic fuel management in Africa. E.g., the experience in Kenya is that affordable and accessible fuel supply can be the key success factor, rather than the enhanced supply of ethanol stoves which is the primary focus of the Tanzania ethanol project. A system-based strategy seeking energy de-carbonization and energy access in Tanzania would start by understanding the domestic fuel management system in Tanzania's urban neighbourhoods considering aspects such as trends in country energy policy, technology options to consumers, market trends of relevant raw materials, institutional capacities, and consumer preferences. Having developed a good understanding of the system, design would subsequently assess the best suited technology or combination of technologies and approaches to contribute to the long-term goal of de-carbonization and universal energy access. Instead, the Tanzania project seemed to have adopted the opposite approach, first to determine the technology to be introduced and second to identify the barriers to adoption in the targeted domestic fuel management system. Better guidance of a bio-energy approach might leave the technology choice open. But if a certain technology (such as ethanol cooking stoves) is pre-defined, it would be

⁴⁷ UNIDO 2021. Independent Terminal Evaluation Support the Arab Accreditation Cooperation (ARAC) to be sustained, effective and internationally recognized as key driving force for regional trade integration

⁴⁸ SIDF. 2016 Enhanced Compliance, Productive Capacities and Competitiveness of the Cinnamon Value Chain in Sri Lanka, Final Report. October; UNIDO 2016 Enhanced Capacity in the Cinnamon Value Chain 343 <https://www.standardsfacility.org/>

⁴⁹ CAPFISH Capture – Post Harvest Fisheries Development, UNIDO project ID 180039

⁵⁰ Promotion of Ethanol as Alternative Clean Fuel for Cooking in the United Republic of Tanzania, UNIDO project ID 150208

⁵¹ [Tanzania Molasses being Exported to Mumias Sugar in Kenya to fill supply gap from cane shortage Bio.pdf](#)

⁵² [Tanzania plans to extend its gas pipeline network \(gasprocessingnews.com\)](#)

important to include guidance for a deeper analysis of necessary conditions in different domains, such as the social and cultural factors that might inhibit wider technology adoption.

3.2 Use of evidence

The review of the use of evidence criterion pertains to the extent to which the thematic approaches ensure that project analysis and selection of interventions are based on sound evidence. Three aspects considered in this criterion are: a) the extent to which thematic approaches have developed adopted and tested reliable diagnostic and data gathering tools; b) the plausibility of assumptions that links interventions and long term objectives; and c) extent to which approaches draw on a sound mix of scientific, technical evaluative and local/traditional knowledge in project design and implementation.

Finding: The plausibility of assumptions is weak across all reviewed thematic areas.

Finding: Thematic areas vary widely on the extent to which they have developed reliable diagnostic and data gathering tools. The QI team and to some extent the EIP team have been the most active in the development of such tools which also is reflected on more comprehensive analysis during project design in these two thematic areas. The evaluation could find no signs that thematic areas interact or collaborate in the development of tools for data gathering and analysis.

Reliable diagnostic and data gathering tools

The QI team has developed various tools to assess and benchmark country conditions, identify needs and design country interventions.⁵³ For certain aspects of QISs they also have developed specific standardized diagnostic and development tools⁵⁴. Project preparation under GQSP includes a systematic assessment of QIS in the context of the relevant value chain or system in which the QIS operated. System is characterized as interaction of different conditions, scales, and stakeholders. Particularly in the last project interventions the QI team has developed and tested methodologies to systematically identify the most influential conditions conducive to system change. The Global component of the GMAP programme includes a component to develop tools to help guide the diagnosis and the formulation of theories of change. The thematic area team has also developed several support documents that explain the components of QI systems and their interactions.⁵⁵ These are used during project preparation to identify initial system conditions and to design interventions. The QI team also manages the “Quality Infrastructure Index for Sustainable Development, a survey to measure countries” a global database through which countries report the level of development of their national quality infrastructure system.

Project preparation under GEIP include a systematic assessment of starting conditions and policies of EIP using the criteria and methods included in *An International Framework for EIP* an Joint UNIDO/ World Bank/GIZ publication that to benchmarking parks conditions⁵⁶ and the *UNIDO EIP Handbook*. These diagnostic tools primarily guide work at the level of individual parks. There is no adequate tool to assess the state of the country-level EIP system. For example, there is no tool to determine the required number and types of EIPs. Or to trace the portion of the country industrial production taking place in EIPs. Both

⁵³ Examples area Quality Infrastructure for Value Chain (QI4VC); Culture for Quality Survey (C4V);Quality Infrastructure Index for Sustainable Development, Standards Compliance Analytics ((compares countries on their compliance capacity during an index developed by UNIDO)

⁵⁴ Examples are the following: Quality Infrastructure for Value Chain (QI4VC); Culture for quality survey (C4Q) and the Trade facilitation toolkit ; Boosting competitiveness with quality & standards: UNIDO tools and methodologies.

⁵⁵ https://www.unido.org/sites/default/files/2016-05/UNIDO_Quality_system_0.pdf ; https://www.unido.org/sites/default/files/files/2018-08/UNIDO_QI_CASE_FINAL_ONLINE_2.pdf

⁵⁶ *United Nations Industrial Development Organization; World Bank Group; Deutsche Gesellschaft für Internationale Zusammenarbeit. 2021. An International Framework for Eco-Industrial Parks, Version 2.0. World Bank, Washington, DC. © World Bank, United Nations*

of which are important considerations to assess and plan for the broader adoption of EIP innovations.

The Food Safety thematic area uses tools prepared by FAO and WHO (with UNIDO inputs) to guide data gathering and project preparation and which include a systematic assessment of conditions affecting food safety in specific value chains. However, the current description of the thematic approach does not make clear references to these tools and to the importance of diagnosis in general. The Bioenergy thematic area has not developed tools to guide project preparation or to carry out systematic assessment of prior project interventions. While in some cases individual projects have done an excellent analysis during project preparation, as indicated with respect to the Parana Bioenergy project in Brazil, the programme strategy does not offer a diagnostic tool, nor does it identify generic key conditions to guide project development. This gap has resulted in important evidence omissions during project preparation. This is especially relevant for programmes that are based on a pre-defined technology choice, where the likelihood of broader adoption of such technology could be assessed using a number of indicators derived from existing studies. A case in point is the fact that mass scale up of bioethanol for cooking is largely unproven. UNIDO also produced the *publication The Role of Bioenergy in the Clean Energy Transition and Sustainable Development (2021)* which is an excellent compilation and analysis of lessons learned in bioenergy in developing countries. However, the bioenergy strategy does not cite or mention this document or its content.

The different thematic teams are very actively engaged in developing and testing new tools and approaches. While some tools are designed to address needs of specific thematic areas, other tools or ways by which tools are being developed could be highly applicable across all the thematic areas. However, there is little exchange and learning taking place across thematic approaches.

Plausibility of assumptions

The use of verifiable evidence related to assumptions is overall not very strong. Only in rare cases are assumption sufficiently well-defined and plausible⁵⁷ to allow the use of evidence. For example, if the overall assumption for a project to become effective is “sufficient political will to support the project”, this cannot be measured, nor can scientific studies be found that would determine a certain level of “political will” that is required. Instead, would the assumption be that “a government subsidy exists that reduces the investment cost for solar energy by at least 20%”, this would be an assumption that could be both, related to relevant scientific findings and measured/monitored.

- **Quality Infrastructure for Value Chain Development (QIVCD)**

In the case of QIVCD assumptions are defined but are not fully supported by evidence or generic. A key assumption is that when incorporating QIS into value chains and key stakeholders improving competitiveness in global markets, social and environmental benefits can be derived. Yet for this to happen there are many other conditions which need to be in place. Another of QIVCD key assumption, which stems from its systems approach, is that the identified conditions and their interaction will enable the desired development trajectory. This is a general assumption that is best presented as a set of postulates to help guide project interventions, but which needs to be revised in the light of information generated during implementation. Another common assumption, on which UNIDO has little control and which is met occasionally, is that country governments will make available resources to support replication in other value chains.

- **Food Safety**

Food Safety, GEIP and Bioenergy assume that the elimination of barriers will be sufficient for system change. However rarely do the strategies provide evidence that supports the assumption that elimination of the barriers identified is sufficient to result in broader adoption of the innovations supported by the projects. In the case of ARAC, a Food Safety project, project document does not present evidence supporting the assumption that a regional food safety regime among the 17 countries and the liberalization of trade among

⁵⁷ “The quality in an argument, statement, etc., of seeming reasonable or probable; appearance of reasonableness; believability, credibility” (Oxford English Dictionary)

the participating countries will enhance health & safety, protect the environment, and provide consumer protection.⁵⁸ There is also a mismatch between the strategy focus on specific barrier removal and the project document contention that there are many factors at play for projects to bring about system change⁵⁹.

- **Bioenergy**

The bioenergy program strategy does mention that depending on the local context bioenergy might not produce the expected results. But the strategy does not provide guidance on how to determine contextual conditions that are likely to lead to or obstruct the expected results.

The Bioenergy Program Strategy seeks to contribute to the universal access to energy and the decarbonization of energy systems by supporting the development of biofuel industry and value chains. Yet, there is no direct link between decarbonization of energy systems and universal access to energy. These two objectives are likely to require different approaches.



Evidence on EIP Success

There is considerable published research on Eco-Industrial Parks¹, and there are numerous examples of specific Eco-Industrial Parks that have delivered environmental and other benefits. However, it is clear that the effectiveness of an Eco-industrial Park is not guaranteed. For example, one key conclusion of a 2021 World Bank study was that “The evidential basis that justifies park-level investments and policy reforms is not definitive, especially when these investments entail innovative technologies, and vary according to the local contexts and available resources and waste to be reused.”

(Source: Circular Economy in Industrial Parks - Technologies for Competitiveness, World Bank Group 2021 (See Annex 3 for more details)

Moreover, such links are case specific and need

to be explored at the level of each intervention. For example, while it can be argued that the introduction of bioenergy technologies in small community that are not linked to the grid contribute to expanding the access to energy, the contributions of these initiatives to de-carbonization are likely to be relatively small. Which brings into question the extent to which such intervention can be considered to make a significant contribution to the long-term goal of energy decarbonization. In the Bioenergy approach the claim of GHG emission reduction can vary widely depending on the energy matrix of a country and the development of alternative energy sources. But the approach does not indicate good evidence that could help in determining the GHG reduction potential of a bioenergy project in a specific context. For example, relevant studies confirm the need to carefully determine the climate effectiveness of ethanol from sugar molasses⁶⁰.

- **GEIP**

In the case of GEIP a key assumption is that the incentives will be sufficient for businesses to move to the EIP, cooperate, pay for EIP services, and adopt "community coherence". Moreover, even if funding would be available to SMEs. But is it realistic to assume that businesses will invest in RECP, industrial symbiosis or EIP as opposed to expanding their business-as-usual operations? Such assumptions so far have not materialized in some countries.

⁵⁸ UNIDO 2021. Independent Terminal Evaluation Support the Arab Accreditation Cooperation (ARAC) to be sustained, effective and internationally recognized as key driving force for regional trade integration

⁵⁹ In fact other studies underline that while it is important to have food policy frameworks these should be matched by the appropriate food quality infrastructure and investments see Jaffe, S., et al. 2019 *The Safe Food Imperative: Accelerating Progress in Low-and Middle-Income Countries*. The World Bank.

⁶⁰ https://theicct.org/wp-content/uploads/2021/06/EU-molasses-ethanol-emissions_ICCT-working-paper_27092017_-vF.pdf

Incorporation of scientific, technical, evaluative evidence and local knowledge in design

Finding: Thematic areas typically make good use of the technical knowledge within their team and the knowledge generated by past UNIDO experience, including results of evaluations. Projects also tend to include stakeholders in steering committee meetings which helps to incorporate local knowledge and perspectives in to project design and implementation. However, rarely do projects systematically address the relevance of local or traditional knowledge into project design and monitoring.

and implementation

Projects in all the thematic areas examined typically draw on sound technical knowledge, this is to say the technological solutions and innovations that UNIDO implements work. This is attested by UNIDO's decades of experience. The best aquacultural practices introduced by SMARTFish in Indonesia increased the quality and quantity of pangasius production. RECP innovations improve resource use, reduce waste, and reduce pollution in many countries. QIS and GEIP approaches, and increasingly the Food Safety approach, consistently draw on their experience and on the experience of the organization and on the state-of-the-art knowledge and practices in their fields⁶¹. There is little scientific information to assess the validity of some pathways proposed by QIVCD. For example, how will the value chain quality work with a small number of companies be up-scaled to a larger share of the sector? What is the level at which subsidies influence the adoption of new technology? However, the approach builds on UNIDO Experience and state of the art practice in QIS.

Programme documents and strategies of thematic areas also draw on findings and recommendations from evaluations. For example, all the

thematic areas reviews have incorporated theories of change that are very consistent with those developed during independent evaluations. There are other cases in which recommendations are acknowledged in programme documents, but no specific actions are adopted.⁶² The extent to which donors expect action to evaluate recommendations and lessons is often a factor, for example many projects financed by SECO incorporate evaluation findings and conclusions to the design of new programmes or projects. While there is a mechanism for management response to evaluation in UNIDO,

Use of evidence on expected bioenergy results

UNIDO has undertaken a wide range on one-off bioenergy projects and could now focus on one or two thematic approaches where UNIDO can utilise similar approaches in multiple industry sectors in multiple countries.

The UNIDO draft Bioenergy Strategy argues that bioethanol for cooking should be the preferred UNIDO bioenergy focus. But it is not clear that the current UNIDO bioethanol for cooking pilots in Tanzania, Kenya and Ethiopia will scale up to a viable thematic approach going forward.

More work appears to be needed on what UNIDO's comparative advantages - such as an SME scale agro-industry focus - are, where UNIDO could find promising niches (that are not already too crowded by other development partners) for a scaling up approach based on what can be learned from previous one-off pilot projects, and where promising underlying financial fundamentals are likely to be found.

(See Annex 3 for more details)

⁶¹ This is attested by the expansion of joint work and cooperation between GEIP and the World Bank on the generation of knowledge and approaches for EIP and increasing collaboration and interactions between the Food Safety team and FAO.

⁶²For example, the terminal evaluation of the EIP project in Vietnam indicated three specific regulations that hampered industrial symbiosis. The GEIP picked up on this recommendation. However, there is no evidence that the project has actually concentrated efforts on this regulatory changes.

this system focuses exclusively on recommendations. Lessons learned are similar to recommendations, but refer to issues that can be applied beyond the evaluated project, so they are of wider use. Interestingly UNIDO does not follow up on these lessons and how management uses them.

The Food Safety thematic area is based on solid scientific evidence that is presented in documents prepared by FAO, WHO and the World Bank. However, the evidence pertaining to specific interventions is limited. There is some scientific evidence to support some contributions to SDGs claimed by the thematic areas. One example in the case of GEIP is the potential of industrial energy efficiency to contribute to climate change mitigation and the potential of cleaner production practices to reduce the materials footprint of industry. However, as mentioned in the section addressing project assumptions, broad level scientific findings need to be related to the specific conditions under which projects are implemented. Projects don't always present the scientific evidence to determine the extent to which the move of SMEs to EIPs will make significant contributions compared to the baseline scenario in terms of pollution or climate.

Engagement of stakeholders in project steering committees (PSC) helps to integrate local knowledge and diverse perspectives into planning and implementation. Local and traditional knowledge is rarely taken into account in UNIDO's projects and are not mentioned in the thematic programme or thematic strategies. While UNIDO main line of work is related to upgrading industrial technology and processes, more attention to local knowledge would be useful when considering strategies and pathways for broader adoption or when defining avenues to build knowledge or in awareness raising. The evaluation encountered at least one example in which local or traditional knowledge proved to be critical to a project. ARAC was designed under the assumption it would introduce the western science-based food safety systems into the Arab region. This turned out not such a straightforward process as the system requested by countries required the harmonization with the Halal food safety system which is based on cultural criteria. In Indonesia, SMARTFish project also introduced food safety principles that had to be harmonized with the Halal system. The thematic areas largely don't make use of social science tools or frameworks such as Complex Adaptive Systems (CAS) or the Unified Theory of Acceptance and Use of Technology Utility (UTAUT), which in the absence of scientific evidence can be useful tools to incorporate scientific methods to planning and implementation.⁶³

3.3 Intervention reach

Intervention reach refers to the extent to which an intervention explicitly identifies the necessary mechanisms that accelerate progress in a given development trajectory. System change that contributes to transformation is likely to take longer and to spread wider than the duration and reach of a specific project or program. This requires that interventions take place in ways that build commitment and ownership by those affected by change. Projects also need to ensure the capacities and mechanism to continue or accelerate system change once a project conclusion. This section assesses thematic areas on their balance between reach and depth, approach and mechanisms to reach across time and space (broader adoption), integrated interventions, and building partnerships.

Key aspects of the "Intervention Reach" criteria

- A. Targeting the **relevant levels**.
- B. Approaches and **mechanisms** that reach across **time and space**
- C. Building **partnerships**

A. Targeting conditions at the relevant levels (micro, meso, and macro)

Finding: One factor that has affected the reach of UNIDO interventions is the level at which boundaries are set for the system that is targeted for change. Yet focusing on higher levels (macro) without sufficient attention to relevant lower levels (meso and micro) or vice versa, can also weaken the likelihood of change.

As explained in the section III.I for System Based Design a critical first step is to delineate the boundaries of the system that is targeted for change and to identify the domains relevant to that system. This will provide a reference point to identify the key internal and contextual conditions affecting system change and to identify the conditions a project or programme chooses to intervene. As all projects and programmes have

⁶³ The QIS team has recently experimented in applying these methods with very positive results, but these methods have received little traction among other teams.

to operate within given resource constraints, not all levels can be addressed comprehensively. More importantly, system conditions differ from country to country. For example, in one country the necessary policies and legislation might already be in place whereas the technology capacities and/or the access to finance might be bottle necks for broader adoption of an approach. Finally, some important conditions might be addressed already by other interventions and programmes of the Government, the private sector or other cooperation initiatives. As illustrated with the GEIP strategy, targeting the EIP (the park) level instead of the enterprise (the target earlier RECP approach) for system change has a higher potential to accelerate the ISID development trajectory. In the same way targeting the Country EIP System further increases that potential.

Yet the opposite also holds, focusing interventions exclusively at macro levels and assuming a trickledown effect of the intervention to the lower levels also can be risky. This was apparent in the ARAC food safety project which targeted interventions and contributed to system change at the regional level. However, there are little indications that changes trickled down to the meso or micro levels. This raises the question of the need of follow up interventions that address lower-level conditions that a macro approach did not contemplate.

By contrast the Biogas agro-industrial project in Parana Brazil is an example of an intervention that has a good balance in scale and depth across domains. This project addresses the various components of the biogas value chain, including its interaction with other aspects of the country energy system (including possible interactions with other energy options and energy policy trends), the electrical grid and the agricultural industries which would supply electricity. The project also includes aspects related to the demand and supply of energy in the state and the conditions affecting the price and availability of raw material for the generation of electricity. In addition to aspects directly related with the demonstration of biogas value chains (choice of technology, business models, human and institutional capacities), the project engaged different ministries to analyse and propose policy and regulations to strengthen the national biogas technology chains.

As the examples above demonstrate, targeting the right level depends on how well the functioning of the “reference system” of the giving thematic approach is understood. Investing heavily in policy development might not make sense if in the foreseeable future no resources (either public or private) for implementation are available at the country level. Equally the investment in a technology demonstration might be in vain if the necessary policy conditions (e.g. feed in tariffs for decentralized renewable energy generation) are not going to happen within a reasonable time span.

B. Approaches and mechanisms to reach across time and space

Findings: Programmes and projects often target conditions that are likely to expand the reach of interventions in time and space by supporting broader adoption. Yet at the level of thematic approaches there is no guidance on mechanisms that should be considered when developing a project. Mainstreaming, replication and partnerships, three mechanisms with high potential for broader adoption are not approached strategically during project design.

This evaluation identified several UNIDO initiatives that were particularly valuable to support broader adoption.

The EIP handbook and tools developed jointly with other key players is also a good practice that can increase reach through a normative effect. As the EIP guidance materials were developed together with key actors, the international recognition is strengthened and the use of EIP approach is not anymore limited to the UNIDO project or programme. Such normative power can increase reach over time significantly. An example for this is the UNIDO Manual for the preparation of industrial feasibility studies, developed by UNIDO in 1991 it has been regarded for decades a reference document by many investment actors in the developing world⁶⁴.

⁶⁴ UNIDO (2010) Independent Evaluation. UNIDO Compute Model for Feasibility Analysis and Reporting. https://www.unido.org/sites/default/files/2010-12/Comfar_0.PDF

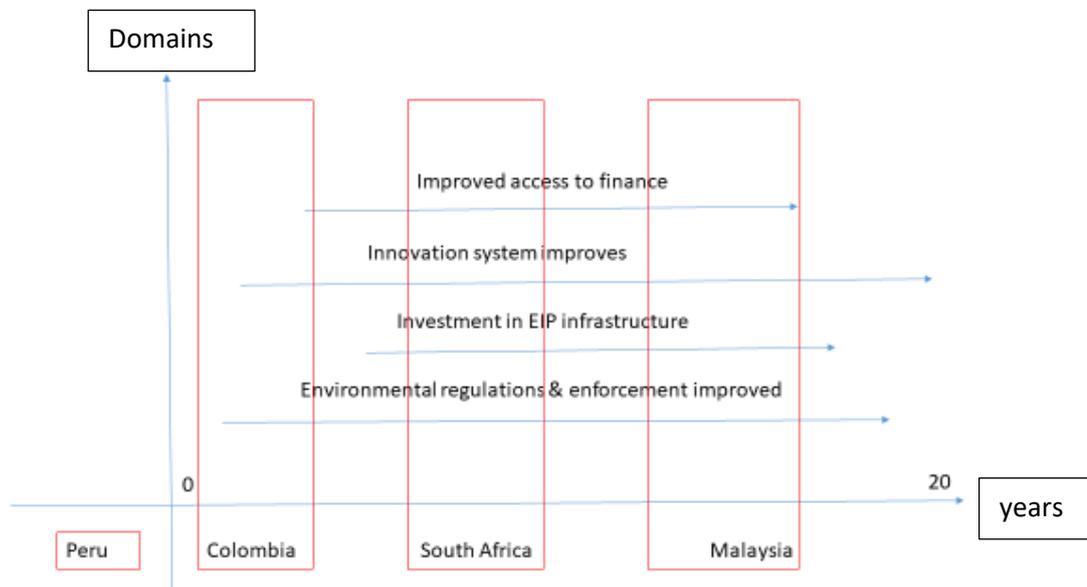
The role of time in a thematic approach

Transformation needs time. It can be safely assumed, based on many documented cases of project evaluations, that the trajectory towards system changes requires more time than is usually available for technical cooperation projects. The contribution projects or programmes make to transformational change, thus also depends on the “when”.

To illustrate this aspect a simplified example can help. Let’s assume that the transformation towards a modern system of eco-industrial parks in a certain country takes approximately 20 years. The assumed starting point is a situation where existing industrial parks show low environmental performance. The system, described by the relevant domains and actors, will have to move towards improved conditions. This includes an improved environmental regulatory regime, improved incentives for EIPs, improved finance and investment for EIPs, improved support to innovation and technology development (e.g. through university – enterprise cooperation), development of relevant norms and standards, increased capacities of enterprises and their employees, among others.

These changes do not happen simultaneously, nor are they independent from other influences, such as political and economic changes that affect the country’s people and institutions. More importantly, it is not feasible for a standard development cooperation project to analyse in detail each condition and try to forecast the development. However, a rough estimate of the current status and future trends (based on available information) can help to understand the potential and barriers of a project under a certain thematic approach. If the thematic approach identifies the key conditions and provides some guidance on indicators (e.g. on the innovation system on the inclusiveness of the financial system) this can inform the decision on where most transformational impact can be expected. Individual projects in different countries can then be thought of entering the expected system change at different “moments” of the trajectory (see Figure 4 below).

Figure 4 – Positioning an intervention along the time scale



Source: Authors

Interventions can increase their reach through time and space by deliberately planning for broader adoption. Projects can enhance **mainstreaming** of innovations by supporting ongoing initiatives, processes

or institutions with roots that preceded the intervention and have a formal mandate or have a strong stake in system change. The question is to what extent are information, lessons learned or specific results of the project incorporated into broader stakeholder mandates and initiatives such as laws, policies, regulations and projects? This can be achieved by involving the key actors as closely as possible in the projects. For example, projects in QIVCD and GEIP typically work closely with the relevant authorities in the identification of demonstration sites. Projects also have national authorities chair Project Steering Committee (PSC) meetings. PSC meetings also take place at short intervals (typically every six months) and function as instruments for joint decision making. PSC meetings are also attended by other project stakeholders which helps to build ownership of project objectives. In the case of SMART Fish Indonesia, the project directly worked through government extensions when supporting the pangasius value chain. The engagement of such stakeholders helped to mainstream best aquacultural practices in the localities where the project operated. The case of ARAC illustrates a situation in which mainstreaming the intended change into country standards was unlikely largely due to a limitation of the reach of the project.

Replication takes place with the initiatives supported by UNIDO are reproduced in another geographical area or region. As indicated earlier it is common for projects to assume that the resources will be in place to replicate the initiatives once they demonstrate results. This is a frequent assumption of GEIP and Bioenergy projects. Projects typically carefully document procedures and methods and plan to support replication of interventions as part of the project – typically including information dissemination and technical assistance (as it is the case with several GEIP). In most cases the strategies for replication are not developed explicitly and the pre-conditions for replication not analysed.

Previous RECP interventions also invested considerable resources and time in the establishment of RECP support centers. Nevertheless, despite nearly two decades invested in such efforts businesses have been slow in adopting RECP practices. Adoption often extends to “low hanging fruits” or “good housekeeping” practices that do not require major investments or changes in the production process and are primarily motivated by the cost saving potential. On the other hand, in countries where the government has shown a strong resolve to introduce and enforce regulations are more likely. For example, in China, pressure to address smog in Beijing resulted in the closing of all cement plants (5) in the Beijing region. Only a couple were allowed to resume operations, but only after they had agreed to install technology that controlled pollution and that also fixed dioxins into cement. The approach was so successful that the cement company decided to introduce such technology in other cement plants anticipating the stiffening of pollution regulations across the country⁶⁵.

Expanding reach into all relevant domains

Finding: The examined programmes and projects typically identify areas of need in diverse domains and levels. While UNIDO projects tend to concentrate on barrier removal related to technology demonstrations and human and institutional capacity development, insufficient attention is given to aspects related to finance and policy, which limits the reach of some projects.

Integration refers to the timely implementation of the right mix of interventions that is likely to lead to system change. A system's approach - in addition to targeting conditions in different domains and scales - also aims at identifying the combination of conditions that are most likely to lead to the desired system change. All the thematic areas under review have identified conditions that affect the desired change. However, some projects tend to define too narrowly

the system or miss some of the necessary conditions for change. For example, we have indicated how the Food Safety thematic area projects often target one or few specific barriers to food safety despite

⁶⁵ UNIDO. Independent Evaluation of Compliance with the Stockholm convention

acknowledging food systems are affected by many factors. In the case of the Bio-energy, the Ethanol project in Tanzania focused on the conditions directly related to the ethanol value chains.

However, the boundaries of the system affecting adoption of ethanol cooking extended to include the country energy policies and particularly subsidy trends and price of competing of domestic fuels. Thus while the project might help putting in place the targeted elements of the ethanol value chain, the likelihood of broader adoption of ethanol stoves will remain low unless ethanol prices are competitive.

The strengths and weaknesses UNIDO (including the capacities, training, and outlook staff), which are a result of the organizations history, are also a major factor determining the extent to which projects are designed and implemented in ways that reach the full set of key conditions leading for system change.

Terminal evaluations of UNIDO's projects frequently show major contributions in aspects related to the selection and demonstration of technologies and human and institutional capacity development. These are two domains in which UNIDO has developed robust internal capacity. Achievements pertaining other key domains such as financing and policy (policy understood as broader policy making as well as the development of standards and regulations) while not necessarily ignored by UNIDO's projects, tend to either get less attention or have lower accomplishments. For example, The QI projects, SMART Fish, was quite successful in demonstrating ways to increase productivity across the seaweed and tuna value chains through the introduction of good practices and improving market articulation. Yet, it was not able to influence Indonesia's export regulations that were crimping the national seaweed industry by allowing massive exports of unprocessed seaweed or to make allowances to



Best practice – use of system analysis tools for expanded reach

Food Safety systems, bioenergy systems and other systems targeted by UNIDO are affected by multiple factors. A key challenge is to identify the most influential conditions that when simultaneously addressed have a high likelihood to provoke the desired system change. Recently the QI team has applied methodologies to more systematically identify conditions in different domains and scales and to elucidate how conditions interact with one another to bring about system change. QI projects in Vietnam and Indonesia with the help of diverse stakeholders identified the necessary conditions for system change in key domains. Conditions were subsequently linked on basis of their influence among one another. Then the team using mathematical models and network analysis identified the most influential conditions in the system (those which had the highest potential to cause cause-effects that contributed to the desired system change). Following, the team identified the causal and effectual conditions which were used to design the project interventions ¹. In this process the project teams used specific conceptual frameworks and methods with included Complex Adaptive Systems (CAS), network analysis and DEMATEL, and the Unified Theory of Acceptance and Use of Technology Utility (UTAUT). However recent innovations have not been mainstreamed into the thematic area does nor have they been incorporated into the thematic guidance.

¹ See: Holland, John. 2006. "Studying Complex Adaptive Systems." *Jrl Syst Sci & Complexity* 19; Si, S.-L., X.Y. You, H.C. Liu et al. 2018. DEMATEL technique: A systematic review of the state-of-the-art literature on methodologies and applications. *Mathematical Problems in Engineering* 2018: 1–33. <https://doi.org/10.1155/2018/3696457>; Williams, M.D., N.P. Rana and Y.K. Dwivedi. 2015. The unified theory of acceptance and use of technology (UTAUT): A literature review. *Journal of Enterprise Information Management* 28 (3): 443–88.

distinguish between pole and line fishing methods and other environmentally harmful fishing methods when establishing fishing bans.⁶⁶

The *Eco Industrial Park PSM* strategy to address financial conditions include bankable proposals, facilitating linkages with financial institutions financing, and promoting government incentive schemes. However, work so far has focused the development of tools for enterprises and EIPs to prioritise and identify financing, while the policies influencing the availability of incentives and credits are given less attention.

The Vietnam Eco-industrial project included the engagement of country financial institutions in SME financing, yet the process turned out to be too burdensome for SMEs and by the time of the terminal evaluations administrative burdens had prevented any loans even to SMEs that had qualified for loans.⁶⁷

C. Building partnerships

Finding: There have been few examples of cases in which UNIDO has leveraged partnerships to increase the reach of its support. The cases found by this evaluation tend to focus on aspects related to methodology development and knowledge generation. While important, most of these partnerships exhibit low ambition and don't go far in helping overcome UNIDO's limitations in the areas of financing and policy reform. The thematic approaches do not use partnerships as a strategic tool to ensure broader adoption.

Given the complexity of the socio-economic systems targeted no single development actor can realistically reach all relevant domains and conditions alone. This is also a matter of resource constraints and different specializations and expertise. Partnerships can be an important tool to leverage the UNIDO intervention and increase reach to scales or domains in which UNIDO lacks technical or convening capacity.

Several thematic areas have established ongoing collaborations with other institutions that help leverage UNIDO's capacities. For example, in the Food Safety thematic area UNIDO has joined FAO in adopting and further developing diagnostic tools. Similarly, the GEIP thematic area has a long-standing collaboration with the World Bank and GIZ in knowledge generation for EIP development. Together they have developed a framework to benchmarks EIPs which provide guidelines to assess key barriers to EIP change in the domains of policy and regulations, technology and socio-economic conditions and institutional and organizational capacities.⁶⁸ These tools are used to determine the starting- and expected conditions in EIPs. The framework touches on some aspects related to country context, and includes criteria for the identification of industrial zones that have a potential to transition to EIP. Yet, most of the emphasis is on the conditions at the level of EIPs and firms.

The QIVCD and the GIEP thematic area teams have established donor partnerships that have allowed UNIDO to engage longer in specific countries, build on previous accomplishments and expand the systemic reach of interventions. These partnerships can help to overcome the transformational limitations of individual projects. The thematic evaluation of UNIDO's partnerships with donors⁶⁹ highlighted the positive effects of such partnerships and recommended establishing a UNIDO partnership strategy.

⁶⁶ UNIDO. 2029 *Independent Evaluation of the Programme Smart Fish Indonesia*. https://www.unido.org/sites/default/files/files/2020-01/120110_Indonesia_SMART%20Fish_Terminal%20evaluation.pdf

⁶⁷ UNIDO. 2019. *Independent Evaluation of Implementation of Eco-Industrial Park Initiative for Sustainable Industrial Zones in Viet Nam*. https://www.unido.org/sites/default/files/files/2019-12/GEF%20ID-4766_GFVIE-100052_TE%20Report_2019.pdf

⁶⁸ "United Nations Industrial Development Organization; World Bank Group; Deutsche Gesellschaft für Internationale Zusammenarbeit. 2021. *An International Framework for Eco-Industrial Parks, Version 2.0*. World Bank, Washington, DC. © World Bank, United Nations Industrial Development Organization, Deutsche Gesellschaft für Internationale Zusammenarbeit. <https://openknowledge.worldbank.org/handle/10986/35110> License: CC BY-NC 3.0 IGO."

⁶⁹ UNIDO (2017) *Independent evaluation of UNIDO's partnerships with donors*. https://www.unido.org/sites/default/files/files/2018-02/DonorsReport_e-book_2018.pdf

While these partnerships have proven to be valuable their focus is on improving the cooperation between UNIDO and a particular donor. As a result they don't go far in addressing some of UNIDO's major limitations with regard to contributions to system change, by - for example - bringing in other national and international actors to work with multiple partners on other key domains such as financing and policy reform. An example of UNIDO efforts in this direction are the partnerships with development finance institutions (DFIs)⁷⁰. However, the thematic approaches and projects reviewed for this evaluation did not provide evidence of DFI partnerships.

It should be mentioned here, that the UNIDO "Programme for Country Partnerships (PCP)" was not within the scope of this evaluation, which only covers thematic areas and programmes as opposed to geographically defined programmes (PCPs and Country Programmes). The case of the PCPs (see for example evaluation of PCP Ethiopia⁷¹) clearly demonstrated the high potential of multi-stakeholder partnerships with regard to systemic and transformational change.

3.4 Coherence

Extent of analysis of coherence with national policies

Finding: Projects always make the case for a strong coherence with broad country policies and programs. Yet the evaluation found numerous instances in which the policies or regulations were a key factor obstructing system change and especially broader adoption of project innovations. This is because coherence with broad policies does not guarantee coherences at the levels relevant for the project. Yet, the thematic areas do not provide guidance to assess the extent to which such coherence transfer to conditions relevant to the project.

Projects always highlight the high level of coherence with county partner programmes and policies. Yet, the supportive analysis is typically quite superficial and refers to broad policy objectives. Rarely project preparation digs deeper how a given policy applies to different implementation options. While there might be broad agreement and coherence with key stakeholders, an insufficient analysis of the conditions needed for system change can hide specific incoherence's that limit project impacts. For example, the Food Safety area seem to focus on conformity to international standards as a contribution to eliminating barriers to access international markets. With no further analysis of other benefits - largely non-economic -- such as health, nutrition, environmental health. While it is certainly plausible that under some conditions such benefits can materialize, there is no analysis on what those conditions are and if such conditions are met. In the Bio-energy project in Tanzania, while the project was highly coherent with the national policy to expand access to the grid, there were mismatches between the project emphasis on ethanol and the government policies to expand the liquefied gas network to the same type of suburban neighbourhoods targeted by the project. Similar issues were found in several project evaluations, where the expansion of the national grid to communities UNIDO had worked with on renewable energy applications rendered the projects irrelevant and ineffective⁷². The GEIP thematic approach does not provide guidance to identify possible coherence issues, for example the dimension of spatial planning, highlighted in the EIP toolbox, is not mentioned in the GEIPP programme document even though EIPs often compete with other land uses. Using EIPs as an element of spatial planning would require a stronger engagement with municipalities and city authorities.

⁷⁰ UNIDO Partnership Strategy with Development Finance Institutions. https://www.unido.org/sites/default/files/2014-02/UNIDO_and_financial_institutions_0.pdf

⁷¹ UNIDO, 2020. Independent Evaluation of the PCP Ethiopia. https://www.unido.org/sites/default/files/files/2020-05/PCP%20ETH%20Indep%20Eval%20Report_April%202020_F.pdf

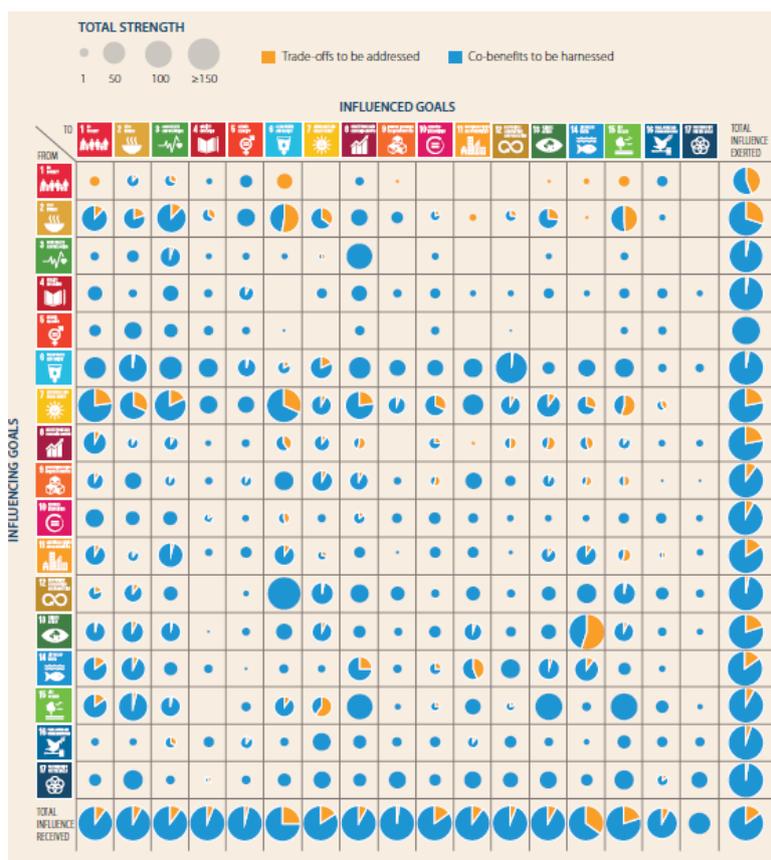
⁷² UNIDO (2013). Independent country evaluation Kenya.

Attention to trade-offs across the economic, social and environmental spheres

Finding: Thematic areas have a strong focus on the promotion of prosperity. Yet, typically they provide little guidance on the ways to assess possible trade-offs between economic, social and environmental spheres. Absence of trade-off analysis risks transferring the costs of change to, and undermining the prosperity of disadvantaged populations, which undercuts UNIDO’s objective of inclusive development. Similarly there is a risk that environmental impacts of economic development are not sufficiently taken into account. None of the thematic approaches provides guidance on how to address these issues.

Another dimension of coherence pertains to the extent to which projects generate co-benefits or trade-offs across the economic, social and environmental spheres. The Global Sustainable Development Report 2019 analyses the positive and negative interactions between SDGs (see Figure 5 below)⁷³. While this analysis is generic in nature, it clearly demonstrates the challenge that comes with the “indivisibility” of the SDGs that form Agenda 2023. It can serve as a starting point for the different development actors to improve overall coherence.

Figure 5: Interactions among Sustainable Development Goals



Source:

Global Sustainable Development Report 2019 “The Future is Now – Science for Achieving Sustainable Development”

⁷³ Also UNIDO has produced a mapping of SDGs related to UNIDO mandate and work.

All thematic areas and projects present an argument for the generation of such benefits and point out their contributions to several SDGs. Yet no evidence or analysis is presented to substantiate how such contributions are likely to take place. More concerning is that only projects in the Bio-energy thematic area address trade-offs across the economic, social, and environmental spheres. The project in Parana Brazil presents a sound evidence-based analysis of the potential environmental and food production trade-offs of Bio-energy projects in the agro-industrial sector and explains how the proposed project will not produce such trade-offs. The ethanol project in Tanzania implies the substitution of charcoal for ethanol which inevitably would displace charcoal merchants from the value chain. The project sought to mitigate this trade off by engaging charcoal merchants in the stoves and ethanol value chains. While this project component has yet to materialize, project design address this as a significant social trade off.

While the GIEPP addresses risks there is no analysis of possible trade-offs. So far participating business and parks have been self-selected and probably come from enterprises and EIPs with optimal characteristics. Reasons for non-participation could shed light on the perceived trade-offs to businesses and identify likely negative effects such as increased traffic in the neighbourhood of the EIP, increased pollution if the EIP park concept is only loosely implemented or after initial efforts the environmental commitments of companies are abandoned.

In principle the QIVCD thematic approach promotes the economy and specifically it promotes the adoption of standards to eliminate non-tariff barriers to trade and to improve value chain efficiencies. Such approach has implications and possible unintended consequences in the social or environmental spheres.

The introduction of standards might lead to exclusion of smaller enterprises who are not in a condition to meet these standards. For example, the British standard body BSI has established the following definition of an inclusive standard: “An inclusive standard is one which has explicitly considered diverse needs and direct and indirect impacts of the standard and proactively ensured that all stakeholders’ / people’s needs are met in the standard and that no stakeholders / people are excluded or disadvantaged by the use or implementation of the standard.”⁷⁴ The evaluation has not found evidence of such considerations in the QIVCD or the Food Safety thematic approaches, both of which promote the use of standards in different value chains.

Another example is the relationship between increased exports and the impact on natural resources in exporting countries. All economic activities produce environmental effects. Moreover, UNIDO has been active in supporting value chain development in sectors with particular environmental risks such as beef or fish. Successful export promotion over time leads to the consolidation of production in larger farms with increased environmental impacts. Quality standards might be introduced to meet environmental provisions of the importing countries such as the EU, but might not consider sufficiently the local environmental consequences of the increase of production in exporting regions, which could lead to water shortages or other side effects.

The QIVCD thematic approach lacks guidance to screen for such possible effects and to identify mitigating actions that would ensure that change in one sphere does not happen at the expense of another. The Food Safety thematic approach also promotes economic growth and is subject to similar conditions as interventions in the QI thematic approach which require a proactive awareness of possible unintended consequences in the social or environmental spheres.

⁷⁴ BSI. “Inclusive as Standard”. <https://www.bsigroup.com/globalassets/documents/about-bsi/nsb/standards-makers/inclusive-as-standard-v2.pdf>

3.5. Adaptive management

Finding: While there are some good practices conducive to adaptive management, adaptive management is not approach systematically in thematic areas and projects.

Adaptive management is a form of management that tests predictions (hypothesis) against observations through iterative learning and recalibration of actions that reduce uncertainty over time.⁷⁵ The midterm evaluations of the QIVCD and the GEIPP represent good practices conducive to adaptive management as management very actively discussed and used the learning derived from the evaluation to adjust the programs midway.

At the project level, the Project Steering Committee is commonly used as a tool for adaptive management. PSC meetings take place at short intervals (typically every six months) and function as instruments for information sharing and joint decision making. PSC meetings also foster co-learning as they are attended by project stakeholders. SMARTFish introduced result-oriented monitoring (ROM) as a component of the project M&E. ROM missions were conducted by an independent international consultant following the standard OECD evaluation guidelines. ROM missions provided timely short, standardized reports to 10 PSC meetings, one report every six months. ROM provided timely independent information and recommendations to the PSC. A well-informed PSC that also had a broad decision-making authority helped to adapt the project interventions to unexpected circumstances and to manage a complex process effectively⁷⁶. Building on this positive experience of SMART fish, the QIVCD team also included a ROM function in the ongoing project in Indonesia of the GQSP. The Vietnam and Indonesia GQSP projects, during PSC meetings, are also revising and calibrating the theories of change that were formulated during project inception. Thus, sharpening their understanding of how conditions interact with one another and in so doing adapting the project to unexpected changes. In Indonesia ROM detected early the impact of COVID19 on the international value chains for pangasius and seaweed. This timely information allowed to project to redirect its attention to the further development of national markets thus mitigating the immediate impact of the COVID 19 pandemic across the value chain.

Except for the cases of GQSP Indonesia and Vietnam, PSC meetings support to adaptive management is for the most part *ad-hoc*. Thematic approaches do don't provide guidelines or methods that ensure a recurrent, systematic, and timely information (such as that provided by ROM in Indonesia, or the calibration of the project theory of change in Vietnam). Projects typically do a good job at monitoring the delivery of activities and results (for example results in reduction of pollutants or savings of water, energy or other resources); thematic areas do not provide guidance for monitoring of relevant contextual trends and conditions.

⁷⁵ Williams, B. K. (2011). Passive and active adaptive management: Approaches and an example. *Journal of Environmental Management*, 92, 1371–1378

⁷⁶ *Independent Evaluation of the Programme Smart Fish Indonesia*. 2019. Independent Evaluation Division. Office of Evaluation and Internal Oversight. United Nations Industrial Development Programme. Vienna.
https://www.unido.org/sites/default/files/files/2020-01/120110_Indonesia_SMART%20Fish_Terminal%20evaluation.pdf

4. Conclusions and recommendations

4.1 Conclusions

Thematic programming is yet underdeveloped in UNIDO. There are some signs that the Organization is moving towards more use of programming as an important dimension to ensure transformational contributions to Agenda 2030 and ISID. This includes ongoing work on the strengthened integration of MTPF, IRPF and RBB as well as the development of Programmatic Service Modules. However, so far the tools available are for programming in the geographical dimension, while thematic programming is, if at all, happening on an ad-hoc basis and primarily responding to donor interest and priorities. The guidance provided by existing thematic strategies does not allow project developers to make projects more transformational.

UNIDO as a specialized agency has a lot to gain from applying a system thinking approach, fostering thematic approaches in recognized areas of expertise and to develop innovative lines of work. Several international development actors have worked on using systems thinking as a way to make contributions from projects more transformational.

There is wide variation in the extent to which UNIDO's program and project documents integrate system thinking. System analysis applies to all the thematic areas in as far as all intend to contribute to broad system changes that, in the long run, are expected to contribute to ISID transformations. As such, all the thematic areas under review incorporate some aspects of systems analysis. But in general analysis focusses on the project activities and its direct key stakeholders and partners. In most cases, the wider system, including relevant domains in which the projects do not intervene are left out of the analysis. Finances and policy development and implementation are examples of domains that frequently are not sufficiently considered in the thematic approaches. Also, the interactions between different levels of systems are often not taken into account, as in the case of regional institutional development with limited linkage to country systems.

There remains large room for better use of solid evidence to strengthen thematic approaches. Thematic areas vary widely on the extent to which they have developed reliable **diagnostic and data gathering tools**. The evaluation could not find signs of thematic areas interacting or collaborating in the development of such tools.

There is room for improving the use of solid evidence to better understand key assumptions of thematic approaches and to provide guidance to project developers with regard to assessing assumptions based on evidence. The use of evidence to underpin the plausibility of assumptions is weak across all reviewed thematic areas. The important role of assumptions in linking project outputs and outcomes to the expected transformations is generally not documented nor reflected in thematic documents. This includes too generic formulation of assumptions (e.g. "government is committed") as well as non-explicit assumptions (e.g. "carbon fuel prices will remain high") and not-well-founded assumptions (e.g. "more efficient use of natural resources will result in social benefits").

While UNIDO has robust capacities and knowledge on several technical areas, programmes and projects give less attention to local and traditional knowledge. Thematic areas typically make good use of the technical knowledge within their team and the knowledge generated by past UNIDO experience, including results of evaluations. Projects also tend to include stakeholders in steering committee meetings which helps to incorporate local knowledge and perspectives in project implementation. However, rarely do projects systematically incorporate local or traditional knowledge into project design and monitoring.

More explicit planning for broader adoption could increase UNIDO's reach and transformational impact (integration and scale up). Despite the claim that UNIDO's interventions seek to contribute to conditions that will advance change beyond the project, there is not much explicit planning for broader adoption. Mainstreaming, replication and partnerships, three mechanisms with high potential for broader adoption are often not approached strategically in thematic approaches and during project design.

Thematic approaches could benefit from the development of thematic partnerships, in particular those that can help to address system elements normally not covered by UNIDO. The evaluation found few cases where thematic approaches leveraged partnerships to increase reach and broader adoption. Some very commendable cases were found of collaboration with other agencies related to methodology

development and knowledge generation (e.g. on Eco-industrial parks). While some partnerships exist, these do not go far in leveraging UNIDO's capacities by finding partners who can address key conditions in system domains UNIDO is not involved in (e.g. financing, infrastructure, policy reform). Also, while the different thematic teams have demonstrated an interest in developing methods and tools, the evaluation team found that knowledge management and methods development mostly takes place in the different thematic teams in isolation.

Thematic approaches can be more transformational if coherence is addressed more explicitly. This includes coherence in the national context as well as possible trade-offs across the economic, social and environmental spheres. Projects always make the case for a strong coherence with broad country policies and programs. Yet the evaluation found numerous instances in which existing (or the absence of) policies, programmes or regulations were a key factor obstructing the intended system change. Also, **the absence of trade-off analysis risks transferring the costs of change to disadvantaged populations and undercuts UNIDO's objective of inclusive development.** While thematic areas have a strong focus on the promotion of either the economy or the environment, currently, they do not provide guidance to assess trade-offs between economic, social and environmental spheres in UNIDO's projects.

Adaptive management is a key ingredient of transformational programmes. While there are some good practices conducive to adaptive management in several projects, the thematic approaches currently do not include guidance on systematic adaptive management.

4.2 Areas for Improvement and Lessons learned

Since this area in UNIDO is at its inception, this formative evaluation highlights some further areas for improvement and lessons, suggested for consideration within the implementation of the Management Action Plans emanated from the recent Independent thematic evaluation of UNIDO Medium-Term Programme Framework (MTPF) 2018-2021 (June 2022).

- **UNIDO to further strengthen and institutionalize thematic programming**, as a mechanism to foster a stronger and systematic results/impact approach for all its developmental cooperation. The assessment framework for transformational change proposed by this evaluation could be a starting point for integration into relevant frameworks and guidelines.
- **UNIDO to operationalize thematic programming, on the basis of its organizational strategy (MTPF) and its Programme and Budgets.** This should consider the following specific suggestions:
 - Ongoing work on **Programmatic Service Modules (PSMs)** should be prioritized as a key pillar of thematic programming.
 - **Thematic areas should develop guidelines for enhancing results/impact** driven interventions, through system based project design and implementation.
 - UNIDO should offer **trainings on system analysis** for development planning and establish a community of practice within UNIDO to exchange knowledge, approaches, lessons, and experiences on the applications of systems thinking to project design and implementation.
 - Thematic areas should seek to develop **"thematic partnerships"** with other organizations (e.g. in the areas of finances and policy development) as a means to leverage UNIDO's interventions. UNIDO should consider using fully developed and approved **thematic approaches** in the appraisal process for new projects. Directorates could internally appraise and approve the "fit" of a project with a certain thematic approach. Targets could be set, e.g. by 2025 50% of project approvals should be linked to approved thematic approaches.

EIO will follow-up on this areas for improvement within the implementation of the MAPs for above mentioned the evaluation of the MTPF 2018-2021, as well as within new related strategic evaluations or audits to be considered for EIO Work plans for 2023 and beyond.

Annex 1: Stakeholder/interviewee list

- Mr. Ali BADARNEH, UNIDO Chief (Sustainable Food Systems)
- Mr. Nima BAHRAMALIAN, UNIDO Industrial Development Expert (Quality Infrastructure and Smart Production)
- Mr. Cesar BARAHONA ZAMORA, UNIDO Project Coordinator, (Industrial Resource Efficiency)
- Mr. Tareq EMTAIRAH, UNIDO Director, (Energy)
- Mr. Samuel GODEFROY, UNIDO Senior Expert, (Sustainable Food Systems)
- Ms. Christina HEFEL, UNIDO Project Officer, (Sustainable Food Systems)
- Mr. Steffen KAESER, UNIDO Chief, (Quality Infrastructure and Smart Production)
- Mr. Kolade ESAN, UNIDO Project Coordinator, (Energy)
- Mr. Gabor MOLNAR, UNIDO Project Officer, (Sustainable Food Systems)
- Mr. Christian SUSAN, UNIDO Industrial Development Officer, (Industrial Resource Efficiency)
- Mr. Klaus TYRKKO, UNIDO Chief Technical Advisor, (Industrial Resource Efficiency)
- Ms. Petra SCHWAGER, UNIDO Chief, (Energy)
- Mr. Jossy THOMAS, UNIDO Industrial Development Officer, (Energy)

Annex 2: Assessment matrixes of eight selected approaches

Four main approaches

<i>Criterion</i>	Quality Infrastructure for VC development	Food Safety	Eco-Industrial Parks	Bioenergy
1.Characterization of the system				
Transformation sought / development trajectory	Integrate Quality Infrastructure and support services in value chains that include SMEs	Sustainable and resilient food and agro-industrial systems.	High consistency between strategy, GEIPP, and projects seeking to demonstrate EIP as an option for ISID.	Universal access to energy and decarbonization of energy systems.
1.1 System change (clarity of targeted)	The intended change is systemic. The interventions aim at a trajectory towards an economy/industrial sector that is more productive and competitive through a well-functioning quality system. The individual interventions are taking the targeted system trajectory as a common basis.	The intended change is mostly systemic. The FS approach describes the desired system change well, including linkages between agriculture, trade and health. Not all the individual interventions take the system change as a basis. Some focus on meeting quality standards for exports only. All changes take place around removing barriers for trade, which are assumed good for environment and society. Parameters of change at the system are not always clearly defined.	Multiple changes expected (reducing an industrial park's environmental footprint; increase efficiency gains; providing better access to finance and technical support; and enhancing business competitiveness), but MTE found it uncertain that conditions are likely to achieve such ambitious objectives. There is also lack of clarity of some objectives, for example enabling community cohesion is a parameter that is too broad and difficult to assess.	Universal access and decarbonization are quite different objectives and could imply different trajectories. The programme strategy does not clearly demonstrate where the two converge.

Criterion	Quality Infrastructure for VC development	Food Safety	Eco-Industrial Parks	Bioenergy
1.2 Defines the boundaries of the system that is targeted for change	The boundaries of the system directly targeted are well defined. The directly targeted system is the quality system, which is well defined with clear boundaries, stakeholders and relationships between these stakeholders.	The directly targeted system is only partially well defined. The thematic approach focuses on describing the key pillars of the programme, but does not clear describe the elements of the food safety system (e.g. standard setting bodies, firms, health authorities, ministries, etc.)	The boundaries of the system directly targeted (Eco-industrial park) is formally defined by administrative regulations. However, the individual park as boundary is too narrow of a focus. A more appropriate boundary for transformation is a country system of EIPs. Key characteristics of such a system would be the number of existing parks as potential target group, the strictness and effectiveness of environmental regulations, the access to finance for firms to invest in improvements and/or to move to parks, etc.	While projects seek to define boundaries of the systems they intend to change, the strategy does not provide guidance on how to define the system boundaries to be targeted for change. The programme strategy describes the system largely based on the technology domain. It lists known possible barriers to technology adoption. System boundaries vary from the livestock farm in Cambodia to a provincial grid in Brazil. Projects that encompass broader system boundaries and link with other domains seem to be more likely to address conditions for trajectory change -- specifically noticeable is the Brazil Parana project.

<i>Criterion</i>	Quality Infrastructure for VC development	Food Safety	Eco-Industrial Parks	Bioenergy
1.3 I. D. key conditions in domains, scales, agents that are relevant to achieving the stated objectives	The system analysis in thematic guidance is not based on the analysis of the interaction of conditions in different domains, which weakens the possibility to use the thematic approach as tool to assess the relevance of the programme for a particular country context. Is the access to finance for SMEs good enough to undertake the necessary investments in improved quality?	The system analysis in thematic guidance is not based on the analysis of the interaction of conditions in different domains, which weakens the possibility to use the thematic approach as tool to assess the relevance of the programme for a particular country context. System defined mostly at the macro and meso levels, also in defining the system targeted mostly concerned with aspects related to standards, other relevant domains such as science, technology and finances are not prominent. Relevant stakeholders considered are too limited. Exception in CapFish Cambodia	While the programme and project documents mention different domains and their importance, they are not used for a system analysis purpose as they do not define key conditions necessary for the intervention to be effective. For example, which incentives need to be in place so that industrial symbiosis solutions can be scaled up once demonstrated at a demo park?	Insufficient attention to broader contextual conditions. No systematic guidance for the assessment of preconditions needed for the project to make a significant contribution to system change. For example, while it is recognized that subsidy schemes are necessary, no guidance is provided on minimum conditions of these subsidies for the project to become effective. Non-availability of government funding for continued subsidies seems to be a high risk.

Criterion	Quality Infrastructure for VC development	Food Safety	Eco-Industrial Parks	Bioenergy
<p>1.4 Identifies interactions among key conditions to detect inflection points affecting the system development trajectory</p>	<p>Most recent applications begin by describing the system that is targeted in order to identify the key inflexion points. Initially system considered to 3 overall conditions directly related to QI (strong quality infrastructure, SME compliance and strong quality culture). During the application on specific projects from 2017 to 2021 the model expanded boundaries to also consider contextual conditions in other domains affecting QI. The Smart Fish II project model identified 27 conditions in six domains. The model considered from the start multiple spatial scales and stakeholders, with the expansion of domains, the number of stakeholders considered was also expanded. However, this has not yet been mainstreamed into the thematic approach as part of standard methodology.</p>	<p>Interactions are not analysed but are assumed. Some key conditions, e.g. the existence of sustainable food safety competence in the enterprise domain, are implicit in the programme strategy. However, no analysis of how these conditions depend on others, So far identification of interactions between conditions and inflection points is not part of the thematic approach.</p>	<p>While the thematic approach does not adopt a linear logic, the interactions between the specific conditions not indicated or analyzed. The key conditions or inflexion points leading to trend change are also not well defined. For example, when is a critical mass of sustainably operating parks reached, so that the conversion of the remaining parks is only a matter of time and continued government action?</p>	<p>Interactions with broader/ contextual conditions for selection of the bioenergy option not fully explored. For example: assuming that the possibility to be competitive vis-à-vis carbon based fuels, what is the condition (e.g. price of natural gas) that is needed for ethanol to be accepted by consumers?</p>

2.Evidence based				
2.1 Systematic use of diagnostic tools to identify key conditions	Project preparation include a systematic assessment of QIS in the context of the relevant value chain or system in which the QIS operated. System characterized as interaction of different conditions, scales and stakeholders. Particularly in the last project interventions seek to address inflexion points.	The thematic area has developed guides to carry out assessments. Project preparation include a systematic assessment of conditions affecting food safety in specific value chains. The diagnostic tool prepared by FAO and WHO is being used to some extent. The current description of the approach, however, does not make clear references to these tools and to the importance of diagnosis in general. Typically the diagnosis identify barriers and enabling conditions mostly focused on regulatory frameworks, training and awareness raising.	Project preparation includes a systematic assessment of starting conditions and policies of EIP. It uses <i>An International Framework for EIP</i> (IFC/UNIDO) to benchmarking parks and <i>UNIDO EIP Handbook</i> . These important guidance documents and diagnostic tools used are primarily guiding the work at the level of individual parks. There is no adequate diagnostic tool to assess the actual state of the system with regard to the feasibility of an "EIP development project", i.e. one that can be used by UNIDO to diagnose the "EIP system" in a country, taking into account, for example, the actual and expected number of EIPs, the actual and expected fraction of the industrial sector located in EIPs. Without these considerations, the transformational impact of an EIP intervention is very unclear and "outliers" like Peru can happen easily. Nevertheless, the use of the EIP handbook and tools is a good practice within UNIDO and an important element of a transformational thematic approach.	Project preparation does not include a systematic assessment of prior project interventions and broader system conditions. While in some cases individual projects identify key conditions, the programme strategy does offer a diagnostic tool nor does it identify generic key conditions for the programme.

<p>2.2 Clarity and plausibility of assumptions linking interventions to long term objectives</p>	<p>The assumptions are defined but are partially generic and not always plausible. The key assumption is that the identified conditions and their interaction will enable the desired development trajectory. Other assumption is when incorporating QIS and key stakeholders improving competitiveness in global markets social and environmental benefits can be derived.</p>	<p>The approach does not specify assumptions. It mentions key barriers but does not provide a good basis for the effective use of assumptions in project design. ARAC and SAFE are very focused on regional standards the thematic strategy acknowledges that many factors are at play and that projects cannot address them all to bring about the system change.</p>	<p>Assumes the elimination of barriers will be sufficient for system change. Not having an analysis of the interaction of barrier removal with other conditions integrates much uncertainty on the sufficiency of barrier removal. Another key assumption is that the incentives in place will be sufficient for key stakeholders to move to EIP, cooperate, Pay for EIP services and adopt "community coherence". This assumption so far has not materialized in many places. Also, it broadly assumes that resource efficiency induced by the project will translate into environmental, social and economic contributions to SDGs.</p>	<p>The bioenergy programme strategy does not specify assumptions. It mentions the existence of important possible challenges and that depending on the local context bioenergy might not produce the expected results. While these challenges are more concrete and plausible than the generic assumptions of the GEIPP, the strategy does make this an integral part of project development.</p>
<p>2.3 Appropriately incorporates scientific, technical, evaluative and local / traditional knowledge in design and implementation</p>	<p>Little scientific evidence is used to assess validity of proposed pathways and the link between external factors (assumptions) and project interventions. For example, how will the value chain quality work with a small number of companies be up scaled to a larger share of the sector? What is the influence of subsidies? However, the approach builds on UNIDO Experience and state of the art practice in QIS. Evaluative evidence is consistently integrated. Incorporation of stakeholders particularly in the last phase integrates local knowledge into planning and implementation.</p>	<p>The diagnosis carried out initially identified the key conditions for change but project could only address aspects directly related to a food safety system as a mostly in relation to requirement for regional or international recognition. Some projects have considered traditional food systems (Halal). 3 Overall the approach seems to be based on solid scientific evidence (in particular documents prepared by FAO, WHO and World Bank). The use of evidence to assess local context and tailor interventions to the local needs is limited though.</p>	<p>The evidence base to support the claimed contributions to SDG is not well established. Good scientific evidence exist to demonstrate the potential of industrial energy efficiency to contribute to climate change mitigation and the potential of cleaner production practices to reduce the materials footprint of industry. However, how much can the move to EIPs actually contribute compared to the baseline scenario in terms of pollution or climate? No mention of local knowledge.</p>	<p>The strategy and the Ethanol Tanzania project not aware of important experiences and lessons in promoting bioenergy. No guidance ex-ante assessment of bioenergy approaches when compared with other energy options. The bioenergy field is rapidly evolving and innovative. It benefits from a vast body of scientific and evaluative evidence, which is not being used effectively. The good lessons learned document is not referred to in the programme strategy.</p>

3. Intervention reach				
3.1 Interventions targets key conditions to provoke cause-effect cascades that accelerate change towards the desired development trajectory.	<p>Since 2017, the approach has sought to address the key conditions to achieve long-term objectives. In the SF II project, modeling was used to identify 10 conditions that appear to be inflexion points for cause effect cascades across the system. Recent methodological development not yet integrated into strategic guidance. Good progress has been made testing tools for application in specific interventions. It is not yet clear if and how these tools will be integrated as good practice in the thematic approach.</p>	<p>The team does not claim that they are necessarily addressing all conditions or the key conditions to overcome barriers to trade. The team indicated that in all countries there is need to improve some aspect of the FS system. UNIDO contribution seems to be opportunistic areas for which it can get resources. The role of UNIDO FS interventions within the wider FS system is not clearly understood, thus the targeting of key conditions is not possible at this stage. The complexity of the system and the fact that other actors play more important roles than UNIDO (e.g. FAO) are considered as barriers for system-based approaches. However, this situation is not different from other thematic approaches and could be well addressed by proper system analysis.</p>	<p>The approach includes guidelines to identify barriers and design interventions that help overcome such barriers. The team has developed the EIP Handbook and other tools to define activities to overcome barriers to EIPs. However, focus on barriers only might preclude identification of inflexion points that have more causal reach across the system. The focus on barriers is an important first step. However, moving from barriers to understanding the interaction between key conditions is essential for improving transformational reach of the interventions. If a certain level environmental regulation is needed to motivate companies to move to EIPs, this needs to be discussed in the thematic approach and then analysed in each country context.</p>	<p>While incorporating many aspects of systems thinking, projects adopt a LogFrame model. Absence of a systematic analysis of links between the targeted system and with broader systems (in particular the country energy system) precludes attention to key contextual conditions. Absence of analysis of the interactions among conditions further limits the root cause analysis and the identification of inflexion points.</p>

<p>3.2 Engages key stakeholders</p>	<p>GQSP provides guidance to identify and to engage the key stakeholders. Stakeholders include different ministries, social sectors involved in production, research and training institutions. Participation of stakeholders in the project steering committee enables ongoing participation. SF II incorporates stakeholders in system definition and monitoring. The thematic approach does not identify key roles of stakeholders as partners in the trajectory towards system change.</p>	<p>The strategy provides guidance to identify and to engage the key stakeholders. Stakeholders include different ministries, social sectors involved in production, research and training institutions. Participation of stakeholders in the project steering committee enables ongoing participation. No identification of key roles for key stakeholders.</p>	<p>Identifies key stakeholders at different levels. Focusing on the key domains and conditions that need to be changed. Tools have been developed to guide identifying stakeholders and to engage stakeholders in project implementation through the participation in the project steering committee meetings. Stakeholders typically include different ministries, business associations, EIP management, enterprises and research and training institutions. Participation of stakeholders in the project steering committee enables ongoing participation. It is unclear how labor and relevant communities are engaged in the approach. The mid-term evaluation of the GEIPP highlights the importance of partnerships to increase likelihood of transformational change.</p>	<p>For the most part projects seek to identify and to engage the key stakeholders. The thematic approach does not identify key roles of stakeholders as partners in the trajectory towards system change.</p>
<p>3.3 Intervention identifies the relevant conditions at the macro, meso and micro levels</p>	<p>Projects consider conditions at all three levels directly related to the system they target. Links to broader systems (world markets) systematically considered.</p>	<p>The Thematic approach identifies three levels- macro, meso and micro with specific changes that will enable behavioral conditions conducive system change. The extent of reach regarding scales depend on the expected contribution of the project. IN the case of SAFE the project contributed to stablish systems at the regional level to support national level. Projects dealing with value chains address all levels from micro to macro (firms to national and international markets).</p>	<p>The projects reviewed allotted budgetary resources to address conditions and engaged stakeholders at the macro, meso and micro levels. Considerable resources are allocated to address contextual conditions outside the EIP (such as policy, institutional capacities and awareness). However, the mere inclusion of policy components is not always effective. The necessary conditions for system change are not always identified.</p>	<p>Projects consider conditions at all levels directly related to the system they target. Links to broader systems not systematically considered.</p>

<p>3.4 Interventions builds capacities and mechanisms to support ongoing broader adoption (scale up) and to adapt to unexpected conditions after the programme ends (This pertains to the intervention's reach across time and the temporal mismatch between intervention and system response)</p>	<p>It places much emphasis on the development of tools and capacities to continue expansion of QISs. Adopt strategies to build local capacities (twinning local/foreign experts), train trainers and ensure relevance to the private sector. Scalability of pilots was a criterion for country selection at the country level seeks to coordinate with networks as a tool for replication. The QI thematic approaches places strong emphasis on the strengthening of existing institutions (e.g. Standards bodies, metrology institutes). This in itself can be considered a pathway to broader adoption as such institutions are likely to keep operating more effectively after project end. Some key conditions are clearly determined (e.g. the need to obtain accreditation status). Broader adoption mechanisms are less clear for the work with SMEs and value chains. The QI interventions usually produce a number of relevant technical publications in English and other languages. The QOSP global component also produces tools and offers them to all stakeholders. Webinars have also reached out to a large number of stakeholders. These mechanisms contribute towards wider reach and broader adoption. While many elements to support broader adoption are taking place, there is no set strategy at project exit.</p>	<p>Includes capacity development, building momentum of adoption for a critical mass of countries to adopt regulations, etc. The food safety thematic approach places strong emphasis on strengthening FS institutions, which can be a good mechanism to increase reach of interventions. Interventions are usually not considering clear exit strategies and provisions for broader adoption after project end.</p>	<p>Institutional development is part of the approach but not a key component. Interventions are usually not considering clear exit strategies and provisions for broader adoption after project end. Key publications were developed together with other key players and are widely disseminated - good practice.</p>	<p>Projects incorporate conditions and mechanisms for broader adoption, scaling and projection through time. Yet this is not done in a systematic way. The approach does not take into account likely trajectory of key trends that will affect conditions in the future -- programmes and plans projected pertaining energy such as the expansion of natural gas pipelines into neighborhoods targeted.</p>
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<p>3.5 Interventions designed to have integrated - mutually supportive- effects across the system.</p>	<p>While the strategy initially adopted a "subsidiary logical framework approach, assumes interventions are mutually supportive. The interaction between the quality infrastructure institutional support and the SME quality support are not clearly developed from a systems perspective. Can support to a few companies realistically increase the demand for quality services provided by laboratories? The SF2 project fully considers interactions of conditions across the system. Guidance on integration not yet integrated into strategy.</p>	<p>Strategic documents refer to the interrelation between conditions. Project tend to address those conditions but in most cases, they remain aspects directly related to food safety. Project dealing with value chains tend to be more holistic than projects focusing on regional regulations. The ARAC project shows certain disconnect between the work with regional institutions on one hand and the work at country level on the other. If regional institutions are a core element of the thematic approach, this could be better addressed to increase effects across the system</p>	<p>TOC adopts a systems approach in which broad conditions are assumed to interact to contribute to desired development trajectory. The model does not reach specific conditions.</p>	<p>While integration is implied, there are no indications of the specific interactions among key conditions and there is no guidance in the strategy as to the integration of interventions.</p>
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4.Coherence/ Inter- connectedness				
4.1 Coherence with country partners initiatives / country situation	Links results to contributions to SDGs. Full coherence with country partners and stakeholders. Approaches are also consistent with other institutions.	The overall approach in this thematic area seem to focus on conformity to international standards as a contribution to eliminating barriers to access international markets. Other - non economic -- benefits such as health, nutrition, environmental health while a likely result, are derivative.	Links results to contributions to SDGs. Full coherence with country partners and stakeholders. Approaches are also consistent with other institutions. While no coherence issues brought up in the documents, but the thematic approach does not provide guidance to identify possible coherence issues, for example the dimension of spatial planning, highlighted in the EIP toolbox, is not mentioned in the GEIPP programme document. Using EIPs as an element of spatial planning would require a stronger involvement of municipalities and city authorities.	While there might be broad agreement and coherence with key stakeholders, an insufficient analysis of the conditions needed for system change can hide specific incoherence that limit project impacts. For example, there are several cases documented in evaluations, where local provision of renewable energy was not coherent with the national expansion of the grid. In addition, there seems to be a coherence issue between the promotion of renewable energy and the actual community needs for development.

<p>4.2 Considers tradeoffs / and win wins across SDCs (particularly between competitiveness, prosperity and sustainability)</p>	<p>While projects often highlight win/wins in project preparation, less attention is given to the systematic assessment of tradeoffs (tradeoffs between economy, environment and health are more likely to be address than tradeoffs with other social conditions). It is noticeable that the GQSP Colombia introduced the normative impact assessment in the national quality and standards system. This mechanism makes the involvement of possibly affected stakeholders a mandatory requirement before a new norm is approved. This can be regarded an example of good practice to address possible adverse effects. In principle, the QI thematic approach promotes the economy and as such should be aware of possible unintended consequences in the social or environmental spheres. The introduction of standards might lead to exclusion of smaller enterprises who are not in a condition to meet these standards. Another example is the relationship between increased exports and the existing environmental regulations in a particular country. Successful export promotion of, for example Avocados, might meet environmental provisions of the EU, but lead to water shortages or other side effects. The proactive screening for such possible effects needs to be included in any thematic approach to ensure transformation in one sphere does not happen at the expense of another.</p>	<p>The FS Strategy and tools provide guidance on how to identify barriers and do analysis of conditions necessary for Safe Food systems to meet international standards. This analysis also typically highlight win/winds. There is no analysis of tradeoffs or risks of engagement in international trade or on development of safety nets or mitigation strategies risks posed by international markets. In principle the FS thematic approach promotes the economy and as such should be aware of possible unintended consequences in the social or environmental spheres. The introduction of standards might lead to exclusion of smaller enterprises who are not in a condition to meet these standards. Another example is the relationship between increased exports and the existing environmental regulations in a particular country. Successful export promotion of, for example Avocados, might meet environmental provisions of the EU, but lead to water shortages or other side effects. The proactive screening for such possible effects needs to be included in any thematic approach to ensure transformation in one sphere does not happen at the expense of another.</p>	<p>While projects often highlight win/wins in project preparation, less attention is given to the systematic assessment of trade-offs particularly when considering any possible impact in microenterprises, labor or communities. So far participating business and EIPs have self-selected and provably are a segment of resourceful enterprises or have specific characteristics not present in other entities, the impact or reasons for non-participation could shed light on tradeoffs to businesses.</p>	<p>The programme strategy does mention the existence of tradeoffs, in particular the fact that biofuels sometimes compete with food for arable land in the case of first generation biofuels, which is not the case for bioethanol from sugar molasses. However, the alternative uses of molasses and the possible effects on those who currently use molasses for non-energy products is not mentioned. In addition, possible unintended social effects are not systematically taken into consideration. For example, the programme strategies mentions that biofuels can replace charcoal, but does not refer to effects on the people involved in charcoal production when they are forced out of business.</p>
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5. Adaptive management				
5.1 Mechanisms/ approaches for adaptive management during the project	Initially adaptive steering committee was the main mechanisms to ensure adaptive management, without any specific tools for the purpose. SFII adds the use of causal models and specific change indicators as specific tools to apply in conjunction to PFC. The Midterm evaluation of the GQSP was done independently as per donor request. The findings were very actively discussed and used to adjust the programme. Programme implementation would benefit from a higher degree of flexibility for the use of resources (shift between countries).	Steering committee's function as mechanisms to ensure adaptive management. But no specific tools developed for this purpose beyond monitoring of outputs.	The Project steering committee is the main mechanisms for adaptive management, no specific tools or methodological guidelines provided for this purpose. Project monitoring seems to focus mostly on outputs and no systematic monitoring of contextual conditions or trends is reported. The Midterm evaluation of the GEIPP was conducted independently as per donor request. The findings were very actively discussed and used to adjust the programme.	While projects include PSC which typically support adaptive management, for the most part adaptive management is ad hoc and not systematic. No specific methodology provided by the strategy for this purpose. No monitoring of relevant contextual conditions or trends.

Additional four approaches

<i>Criterion</i>	Transfer of Environmentally Sound Technology – TEST	Small and Medium Enterprises (SMES) Clustering	Development of industrial skills	RE for productive uses - rural transformation
1.Characterization of the system				
1.1 System change (clarity of targeted)	The change envisaged by the approach is systemic and the targets are well defined.	The change is systemic and the targets are well defined. All the system-changing parameters are highlighted and barriers are analysed.	The overall objective is not systemic and targets are not clearly presented.	The change envisaged by the approach is systemic due to the potential to help countries becoming less dependent on energy imports, create jobs and mitigate climate change.
1.2 Defines the boundaries of the system that is targeted for change	Boundaries are well defined with a clear focus on SMEs. The system directly targeted is also well analysed, including stakeholders and relations among these.	Boundaries and well analysed and the interactions among actors and conditions are also well highlighted. Most of the specific characteristics of the system to be targeted are also analysed, although briefly.	Boundaries are not clearly defined. This approach is mostly the summatory of several projects with no yet clearly defined methodology - in particular LKDF, TVET, others.	System boundaries change due to the different technologies used. Lack of overarching strategy assessing conditions for transformation.
1.3 Identifies key conditions in domains, scales, agents that are relevant to achieving the stated objectives	Stakeholders and key conditions are clearly mapped.	Key conditions and adverse barriers are identified. The approach benefits from a longstanding tradition of similar projects in UNIDO and seems to be pretty well defined and therefore accurate.	Key stakeholders are identified and conditions to be in place are also analysed.	Key conditions and barriers are well identified. Lack of a systemic tool to assess upfront the best technology to be used in the specific context.
1.4 Identifies interactions among key conditions to detect inflection points affecting the system development trajectory	Interactions among key SHs are not analysed.	Conditions are identified and well explained, some of the casual nexuses among conditions are not carefully analysed though.	Interactions are identified and the role of different actors are defined. Growing importance of PPDPs.	Interactions are not fully explored at the programmatic document level.

2.Evidence based				
2.1 Systematic use of diagnostic tools to identify key conditions	Several diagnostic tools are foreseen. Interestingly, the diagnostic phase is slightly delayed according to the SPM and doesn't take place at the very beginning.	Several tools are designed, including cluster mapping - identification of existing clusters-, diagnostic - to develop an understanding of the socioeconomic and institutional environment of the clusters- and an action plan.	Standard diagnostic methods are foreseen to assess the format, data are collected from previous TVETs.	Not a great level of detail is provided on which tools to be used for diagnostic. Screening toolkits are mentioned but not analysed.
2.2 Clarity and plausibility of assumptions linking interventions to long term objectives	The long-term objectives are linked to the success of training and information sharing; therefore, they appear a bit generic and not too well structured upfront.	Assumptions are plausible and valid, long-term objectives on the other hand seem to be disconnected and linked to the macro level that the approach targets only marginally and at a later stage in time.	The long-term objectives are strongly linked to the success of the VTs and the skills improvement; therefore, these are plausible but subject to several conditions.	Assumptions are plausible and valid and long-term objectives are linked to the success of creating an enabling policy and market environment to increase renewable energy deployment within the target country
2.3 Appropriately incorporates scientific, technical, evaluative and local / traditional knowledge in design and implementation	Scientific tools are used to define the state-of-the-art technologies to be transferred. No references to local knowledge.	This approach benefits from many existing projects and in-house expertise. Traditional knowledge and local diversities are taken into particular account in this approach.	Unclear from the existing material. Scientific materials and tools are to be incorporated at the training level, unclear how the conformity/quality assessment is done.	Several specific references to local technologies and traditions are present. No reference to scientific tools.

3. Intervention reach				
3.1 Interventions targets key conditions to provoke cause-effect cascades that accelerate change towards the desired development trajectory.	The idea of the approach is to strengthen the national capacities of service providers offering TEST/RECP support and therefore develop the local market for sustainable production services to local industries.	Key conditions are targeted and a draft ToC is also presented to explain interactions among different actors.	Interventions aim at enhancing industrial and recently digital skills in order to close skill gaps and create employment. The approach works both bottom up to create individual skills and top-down to assist training centers and similar institutes.	Lack of a systematic analysis of links between the targeted system and the broader context in which the system operates.
3.2 Engages key stakeholders	Key SHs seem to be engaged and a second phase of SH mapping is foreseen.	Several key SHs are engaged and different interactions are expected to take place among different actors, including coordinators, cluster development agents, cluster commission and SCs.	A wide range of key SHs is engaged, mostly coming from private sector.	Key SHs seem to be engaged both at the meso and macro level.
3.3 Intervention identifies the relevant conditions at the macro, meso and micro levels	Relevant conditions are identified both at micro and meso levels. Policy support and institutional strengthening on the macro level are, instead, briefly mentioned only.	The approach targets mostly micro and meso level, while cluster policy development is expected to happen at the macro level.	Conditions are identified mostly at micro and meso levels. At macro, governments are only expected to adopt new frameworks for TVET strategies.	Conditions are mostly addressed for the micro and meso levels. At the macro, policy support is also expected to happen provided the preliminary conditions are in place.

Annex 3: Evidence base of thematic approaches – sample analyses

Evidence base review 1: Eco-industrial Parks

Eco-Industrial Park Concept Development

The concept of Industrial Ecology was initially associated with the article “Strategies for Manufacturing,” written by Frosch and Gallopoulos and published in 1989 in *Scientific American*. However, historically, indirect references to the concept of industrial ecology date back to the ecology movement of the early 1970s. The concept of industrial ecology involves taking a systems view to optimize the total materials cycle from virgin material, to finished material, to component, to product, to obsolete product, and to disposal. Factors to be optimized are resources, energy and capital. This is analogous to biological systems. Industrial ecology was promoted as an approach to close industrial production loops and reduce waste, thereby making better use of resources and preventing the overuse of raw materials.

The main tool for operationalizing industrial ecology concepts was the cleaner production concept. Life cycle analysis (LCA) is then a management tool to analyze the interaction between industry and the environment. The technical approach, on the other hand, involves implementing new process and product design techniques such as resource efficiency and cleaner production and the circular economy. The interaction of resource efficiency and cleaner production, industrial symbiosis, and life cycle analysis then leads to realizing the goals of industrial ecology. The eco-industrial parks concept is one approach, where efforts are operationalized within industrial parks

Early EIP Examples

The concept of eco-industrial parks was first practiced in the city of Kalundborg, Denmark from 1961, where the waste product of one process in one industry was used as the input for another process in another industry, initially involving various water fractions and energy carriers such as heat, steam, and gas, and later including the exchange of bio-resources⁷⁷.

By the mid 1990’s, the Eco-industrial Parks (EIP) concept had been crystalized in publications including one for the US EPA in 1995 and various examples of EIPs and EIP handbooks etc in Asia from the mid-1990’s⁷⁸. By 1999, the State Environmental Protection Administration of China (SEPA) initiated the pilot construction of eco-industrial demonstration parks, and a Standard for the Construction and Management of Eco-Industrial Parks was established in 2006. The first EIPs were approved by SEPA from 2001. There were two types of EIPs in China, those that were converted from existing industrial parks—called “reconstructed parks”—and new parks or what might be called purpose-built or greenfield eco-industrial parks⁷⁹. By June 2016 there were 229 known Eco-Industrial Parks in place worldwide⁸⁰.

UNIDO Involvement in EIPs

⁷⁷ Ina Korner in *Industrial Biorefineries and White Technology*, 2015, page 295-340, Elsevier

⁷⁸ *Eco-Industrial Park Handbook for Developing Economies in Asia* - Lowe for ADB, October 2001

⁷⁹ *Eco-Industrial Parks in China* - *The Encyclopedia of Earth*, August 2008

⁸⁰ *Industrial Ecology*, Category;EcoIndustrialPark

UNIDO's work promoting RECP (Resource Efficient and Cleaner Production) from around 1994 led to UNIDO's involvement in promoting EIPs. In 2013, the UNIDO RECP Global Network (RECPnet) reviewed the achievements, good practices, policy frameworks and lessons learned of 33 eco-industrial parks or similar parks in 12 countries. By 2014, UNIDO had undertaken specific pilot initiatives to implement eco-industrial parks in selected countries and industrial zones. From 2015 UNIDO cooperated with development partners (such as GIZ and UNEP) and standardization bodies (such as BSI and ISO) to develop a review of standards on eco-industrial parks⁸¹. In 2015 a UNIDO publication on Economic Zones in ASEAN, covered two Eco-Industrial Parks amongst 100 economic zones in the ASEAN region⁸². In 2016 UNIDO published a Global Assessment of 33 Eco-industrial Parks in Emerging and Developing Countries⁸³. Since 2017 there have been numerous UNIDO Eco-Industrial Park Handbooks, International Frameworks, Practitioners Handbooks, and Toolboxes, some of which were collaborations with WBG, GIZ, and MOTIE (Korea).

UNIDO implemented a successful GEF, SECO (Switzerland) and UNDP supported \$4.4 million funded Eco-industrial Park Initiative for Sustainable Industrial Zones in Viet Nam project from 2015 to 2019 that led to \$11 million of investments in RECP options and \$2.7 million in Industrial Symbiosis (IS) projects. The project benefitted by an appropriate legal framework (Decree 82) and the results are now being replicated in the 173 industrial zones in Viet Nam, (which had an average of 90 companies in each zone in 2013)⁸⁴.

Since 2019 UNIDO has also implemented a EUR 15.5 million SECO funded Global Eco-Industrial Park project (GEIPP) covering Peru, Columbia, Ukraine, Viet Nam, Egypt, Indonesia and South Africa. The 2021 Mid-Term Evaluation (MTE) of this project⁸⁵ was generally positive at the individual country activity and Industrial Park level, but the value of the global level activities was less clear. A key conclusion was that tangible impacts are realised at the individual SME level within a given industrial park. These SME impacts were found to critically depend on the costs of just dumping wastes, access to financing for investments, and the existence of supportive and negative policies and regulations. There appears to be a wide range of suitable global tools available to support actions in Eco-Industrial Parks and by their constituent SMEs. However, the likelihood for achieving transformative change – broader adaption of the EIP concept – was assessed as still uncertain. There was a strong interest from parks beyond the selected pilot parks to participate in the programme.

Evidence of Success of the Eco-Industrial Park Concept

To mitigate the negative impacts of the massive growth in industrial production underway, the Chinese government initiated the eco-industrial parks programme in 2001. Enterprises within eco-industrial parks sought to reduce resource consumption and waste/pollution generation by reusing and recycling material and energy by-products. *However, a 2020 study of eco-industrial parks in China found that the actual sustainability outcomes of eco-industrial parks development*

⁸¹ UNIDO Eco-Industrial-Parks - RECP-20 Years, 2014

⁸² Economic Zones in ASEAN – Industrial Parks, Special Economic Zones, Eco-Industrial Parks, Innovation Districts as Strategies for Industrial Competitiveness, UNIDO Country Office in Viet Nam, August 2015

⁸³ Global Assessment of Eco-industrial Parks in Developing and Emerging Countries – Achievements, Good Practices and Lessons Learnt from Thirty-Three Industrial Parks in Twelve Selected Emerging and Developing Countries, ISID, UNIDO, November 2016.

⁸⁴ Independent Terminal Evaluation, Eco-industrial Park Initiative for Sustainable Industrial Zones in Viet Nam, UNIDO Project No: 100052, November 2019

⁸⁵ Mid Term Evaluation, Global Eco-Industrial Parks Programme (GEIPP), UNIDO Project ID:170222, Dec 2021

and operation were still not clearly known and that Eco-Industrial Parks do not always have better performance than conventional industrial parks⁸⁶.

A 2021 study by the World Bank Group (WBG)⁸⁷ stated that there were over 5000 industrial parks worldwide, of which 438 were identified as Eco-Industrial Parks. More than half of the surveyed Eco-Industrial Parks operated in countries of the Organisation for Economic Co-operation and Development (OECD), with the largest number present in Europe and the East Asia and Pacific region (34 percent and 50 percent, respectively). Of the 438 EIPs, approximately 67 percent were owned and managed by public operators, 23 percent were privately owned and managed, while the remaining 10 percent were initiated and maintained through public-private partnerships (PPPs). More than 80 percent of EIPs had an on-site park management entity, regardless of the ownership type (public, private, PPP, or state owned). 227 of the EIPs (51.8 percent of the total number of EIPs) had deployed renewable energy technologies, and 248 EIPs (56.6 percent) used waste treatment technologies (figure 2.8). Adoption of waste treatment and renewable technologies was higher among the surveyed EIPs than resource efficiency (41.3 percent), industrial symbiosis (45.9 percent), and water efficiency (47.5 percent) technologies. The increase in the number of Eco-Industrial Parks has slowed down in all regions since 2017.

There is considerable published research on Eco-Industrial Parks⁸⁸, and there are numerous examples of specific Eco-Industrial Parks that have delivered environmental and other benefits. However, it is clear that the effectiveness of an Eco-industrial Park is not guaranteed. Eco-industrial Parks can work well, but equally they may not always work well, for myriad reasons. For UNIDO going forward, the Eco-Industrial Park concept is a promising framework for achieving environmental benefits in the industrial park context. But the success of the Eco-Industrial Park concept depends on many factors and RECP and similar concepts are clearly still valuable outside the specific industrial park context of Eco-Industrial Parks.

⁸⁶ Eco-industrial parks in China: Key institutional aspects, sustainability impacts, and implementation challenges, Hongru Hong and Alexandros Gasparatos, Journal of Cleaner Production, Elsevier, Volume 274, 20 November 2020

⁸⁷ Circular Economy in Industrial Parks - Technologies for Competitiveness, Word Bank Group 2021

⁸⁸ Eco industrial Parks 20210815 Trends in global research on industrial parks/ A bibliometric analysis from 1996–2019 - ScienceDirect

Evidence base review 2: Bioenergy strategy

Bioenergy context

Bioenergy use can usefully be divided into: “traditional” and “modern”.

“Traditional” bioenergy fuels and use refers to wood and agricultural byproducts, animal waste (dried dung) and charcoal fuels – and burned in open fires or in basic stoves for cooking or heating.

“Modern” bioenergy includes first generation biofuels such as ethanol produced from sugar cane, corn and other starch/sugar plant sources and residues; biodiesel produced from vegetable oils, used cooking oils or animal fats; second generation biofuels produced from non-food feedstocks, biogas produced through anaerobic digestion of wet organic residues/wastes; automated wood chips/pellets and agricultural wastes; and other technologies such as gasification, pelletization of charcoal dust, briquetting of sawdust and rice husks etc.

About three-quarters of the world’s renewable energy use involves bioenergy, with more than 50% consisting of the use of traditional biomass fuels.

Bioenergy accounted for about 10% of total final energy consumption and 1.9% of global power generation in 2015⁸⁹.

Humans have relied on biomass energy since the earliest “cave men” used wood fires for cooking or for keeping warm. Biomass is still widely used as fuelwood (in rural areas) and as charcoal (in urban areas) for cooking and for commercial and industrial fuel uses in developing countries. Three billion people worldwide rely on solid fuel such as wood, charcoal, or coal for cooking⁹⁰. In almost all developing countries where fuelwood and charcoal are used, its production is unsustainable and its use also leads to dangerous levels of indoor air pollution, which particularly negatively affects women and children.

There are many technical options available to reduce fuelwood and charcoal use such as the deployment of clean cook stoves, more efficient charcoal production techniques, the wider use of piped natural gas, bottled LPG or electricity for cooking, the use of agroindustry wastes (often as in pellets or briquettes) in efficient woodstoves and energy efficient building approaches where fuelwood is used for space heating. However, with: (1) fuelwood being a “free” resource for poor rural populations (not counting the time and risks, usually by women and girls, of gathering fuelwood) and as a source for local rural charcoal production for use in urban areas; (2) fuelwood and charcoal market supply chains being primarily informal; (3) the low incomes of many users - deploying even well-proven and low-cost clean cookstoves and other technical option can be a major challenge, even with the use of carbon credits and/or micro-financing support.

There are multiple development agencies promoting the deployment of fuelwood and charcoal clean cookstoves. Clean cookstoves are often manufactured by local artisans from mud, cement or sheet metal, manufacturing is generally local as the technology is well developed, transport in rural areas can be a challenge, and clean cookstoves are usually very low priced so cannot support expensive marketing, branding or transport. Charcoal production is usually informal and often undertaken in low conversion efficiency traditional earth ovens. Various designs of improved charcoal kilns are available, but deployment is low.

Dry biomass can be used via combustion or gasification processes for power generation, industrial process heat, and in cogeneration mode for district heating networks and for industrial process heat. The dry biomass can be fuelwood or chips or pellets or briquettes from forests, forestry logging and processing waste, crop straw, rice and other husks, and industrial and municipal wastes. Key applications include the burning of sugar cane waste (bagasse) and other agro-industrial wastes such as rice and other husks or waste straws in modern high temperature/pressure boilers for cogeneration of process steam and electricity for self-use and export. Gasification can be used for thermal uses but poses major gas cleanup challenges when the producer gas is burned in reciprocating engines. For the successful export of surplus

⁸⁹ <https://www.irena.org/bioenergy>

⁹⁰ <https://www.fmo.nl/clean-cookstoves-evaluation>

electricity to the grid, preferential feed-in-tariffs or suitable pricing, and suitable accessible interconnection and electricity market access rules and technical requirements are required.

In terms of bioenergy based liquid fuels (biofuels), the main biofuels are bioethanol and biodiesel. First generation bioethanol is already produced internationally at scale by the fermentation of the sugars and starch in biomass (primarily sugar cane and corn) and the bioethanol is primarily used as a petrol substitute via an ethanol-petrol blend. Most modern petrol engine vehicles can use 10% ethanol (E10), while in some markets such as Brazil 100% ethanol (E100) is available and can be used in locally manufactured E100 compatible flex-fuel vehicles. Bioethanol is also used for human alcoholic drinks consumption. Ethanol has been promoted for decades as a cooking fuel⁹¹, has had various successful trials and demonstrations⁹², but without mass scale uptake to date (Koko Networks promotion of bioethanol in Kenya is a promising approach but is still at an early stage). Ethanol has well established niche applications for cooking in camping and refugee camp applications. Bioethanol using local small-scale feedstocks can be used as a cooking fuel as it does not require the purity required for use in vehicles or for human consumption.

First generation biodiesel is produced at scale (in the EU, US, Indonesia, Argentina, Brazil and some other countries) from the transesterification of vegetable oils (from soya beans (USA, Argentina and Brazil), palm oil (SE Asia), or rapeseed (Europe)), used cooking oils and animal fats (tallow). Biodiesel is usually blended with fossil fuel derived diesel, but 100% Biodiesel (B100) can be used in compression ignition engines designed for this fuel. Palm oil (and soya beans in Latin America) as a biodiesel feedstock have negative environmental implications from rainforest clearing. The use of edible oils (primarily rapeseed in Europe and soybean in the US, Argentina and Brazil) as a biodiesel feedstock competes with human and animal feed uses and can be regarded as an indirect way to provide industrial farming product price support via an apparent “green fuel”.

There are various second-generation biofuel (also known as advanced biofuels) feedstocks under development including lignocellulosic biomass or woody crops, agricultural and forestry residues or wastes, municipal solid wastes, as well as dedicated non-food energy crops grown on marginal land that is unsuitable for industrial scale crop production. There are various second-generation biofuel production routes that have been proposed and/or demonstrated, however the technologies involved are generally expensive and hence second-generation biofuels are not yet in commercial production (although large plants with various subsidies are under construction) and are not yet competitive with fossil fuel derived diesel. A niche application is aviation biofuel or Sustainable Aviation Fuel (SAF) as the e-mobility (electrification) option is much more of a challenge for long-haul aviation than it is for cars and trucks as the world moves towards (carbon) net-zero by 2050. However, SAF is more expensive than fossil fuel derived jet fuel.

With wet organic food and vegetable wastes, and concentrated animal manure feedstocks, simple anaerobic digestion systems can readily produce biogas – which is generally used for cooking or power generation. Biogas can be upgraded to be blended with pipeline natural gas or compressed and used in vehicles as an alternative to CNG. Biogas has been successfully introduced in countries with large wet organic food or vegetable waste or animal manure streams, provided it is not competing with inexpensive piped natural gas or subsidized LPG.

For first-generation bioethanol and biodiesel there are major concerns about competition of the farmed feedstocks with arable land use for food production.

Biofuels generally need ongoing political support (usually as tax incentives or biofuel blending obligations) to be able to be profitable to produce against fossil fuel derived petrol and diesel, particularly in periods where petrol and diesel prices drop with lower international crude oil prices.

Some evidence related to UNIDO's possible involvement in Bioenergy

⁹¹ <https://www.ctc-n.org/technologies/ethanol-cook-stoves>

⁹² https://energypedia.info/wiki/Alcohol_Stoves#Experiences_of_Cooking_with_Ethanol_Stoves

UNIDO has undertaken a wide range of one-off bioenergy projects, including with GEF funding, covering solid biomass, waste to biogas, gasifiers/cogeneration, and bioethanol. This includes fifteen Global Environmental Facility (GEF) funded projects implemented by UNIDO to 2021⁹³ and other GEF financed projects, including a GEF solid biomass project in Pakistan⁹⁴.

Bioethanol

The UNIDO draft Bioenergy Strategy of February 2022 proposes that bioethanol for cooking should be the preferred application that could be or should be the key thematic bioenergy focus by UNIDO - on the basis of some early-stage pilot bioethanol projects in Tanzania, Ethiopia and Thailand. However, as above, realising clean cooking options to scale is a highly complex area where there are multiple donors, development agencies, NGOs and for-profit companies, many of whom have been working in the area for decades. One part of the private sector is represented by the 32 large companies in the multi-donor supported Clean Cooking Alliance (CCA), and these companies account for around \$30 million of revenue per and are dominated by biomass stoves at 69% of revenue in 2020, while ethanol (let alone bioethanol) stoves were cooking in urban areas⁹⁵. However, the underlying profitability of KOKO Networks is unclear and most IT focused venture capital funded new companies in traditionally low-tech areas do not survive to become the global dominant force that is envisaged. In any case, if KOKO Networks have indeed developed a sustainable business model, then it is not clear what UNIDO could offer of significant value to KOKO Networks nor that UNIDO could successfully foster competing business models if KOKO Networks is indeed profitable and sustainable going forward. And, any bioethanol produced has a high alternative value for human consumption or as a petrol extender in vehicles.

Given UNIDO's strong involvement in agro-industries, it could also be argued that UNIDO should focus on finding niches of more commercial scale bioenergy technologies and applications that are not being pursued on a systematic basis by other development agencies or by large private sector players. Examples of such options might include:

Agro Industry Dry Wastes for Co-gen

Utilising SME agro-industrial dry organic wastes (ideally self-generated from low value or discarded process waste - as using imported wastes leads to complex supply chain issues) for self-cogeneration and also potentially for export of surplus electricity via modern boilers and small-medium backpressure steam turbines. This option was proved in the Pakistan GEF Biomass Project, where gasification was not successfully introduced in spite of strong attempts but instead a modern biomass cogeneration system was successfully supported in a leading textile plant. As another example of suitable applications, sugar cane bagasse cogeneration systems are common in many sugarcane producing countries. However, the utilisation of sugar cane bagasse is still not common in some countries due to the export of electricity to the grid often being constrained by low electricity export prices or by non-technical barriers such as seasonal electricity exports not

⁹³ The Role of Bioenergy in the Clean Energy Transition and Sustainable Development – Lessons from Developing Countries, UNIDO April 2021 [highlighting the lessons learned from 15 projects of the Global Environmental Facility (GEF) implemented by UNIDO].

⁹⁴ *Promoting Sustainable Energy Production and Use from Biomass in Pakistan*, UNIDO-GEF, January 2020, https://www.unido.org/sites/default/files/files/2020-09/GEF%20ID-3921_GFPAK-100333_TE%20Report_2019.pdf

⁹⁵ <https://www.bloomberg.com/news/articles/2022-03-22/koko-expands-into-rwanda-in-bid-to-replace-charcoal-with-ethanol>

being possible. This could be an area where UNIDO could add value across multiple countries, especially for smaller scale sugar processing plants.

Agro Industry Wet Wastes for Biogas

There would seem to be a possible niche for UNIDO in facilitating utilising SME agro-industrial wet wastes for medium scale biodigesters to produce biogas for process thermal self uses, or power generation or cogeneration using scrubbed biogas in reciprocating engines.

Agro Industry Dry Wastes for Charcoal Briquettes

UNIDO has experience in utilising SME agro-industrial dry wastes to produce charcoal briquettes for urban cooking use. Clean charcoal is an area where there are multiple smaller players, but potentially a lack of systematic focus by an organization of the technical focus of UNIDO.

Conclusion

There is a strong argument that UNIDO has now undertaken a wide range on one-off bioenergy projects and could now focus on one or two thematic approaches where UNIDO can utilize similar approaches in multiple industry sectors in multiple countries.

It is argued in the UNIDO draft Bioenergy Strategy of February 2022 that bioethanol for cooking should be the preferred UNIDO bioenergy focus. As above, it is not clear that the current UNIDO bioethanol not significant enough to have their own CCA category of stove revenue⁹⁶. As far as ethanol as a cooking fuel is concerned, this has been pursued by multiple donors in multiple countries for around 20 years with generally only modest ongoing sustainability results.

There is now a major private sector bioethanol for cooking company, the venture capital funded and IT focused East Africa-India company KOKO Networks⁹⁷, who since late 2019, have been operating in Kenya at scale, and who have apparently attracted \$25 million of venture capital funding to expand into Rwanda as the next step in their 60-country global expansion vision for household scale clean for cooking pilots in Tanzania, Kenya and Ethiopia will scale up to a viable thematic approach going forward. It is also not clear if the IT-focused and venture capital funded KOKO Networks approach currently underway in Kenya and planning to expand into Rwanda is a sustainable model, but if it is, then it is not clear where that leaves UNIDO in pursuing less commercial and smaller scale bioethanol for cooking alternatives.

What is recommended, based on the summary as above, is that more work appears to be needed on what UNIDO's comparative advantages (such as an SME scale agro-industry focus) are, where UNIDO could find promising niches (that are not already too crowded by other development partners) for a scaling up approach based on what can be learned from previous GEF (and possibly other) funded one-off pilot projects, and where promising underlying financial fundamentals are likely to be found.

⁹⁶ <https://cleancooking.org/wp-content/uploads/2022/05/CCA-2022-Clean-Cooking-Industry-Snapshot.pdf>

⁹⁷ <https://kokonetworks.com>

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Annex 5: Terms of Reference

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