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Evaluation of the GEF Support for Technological Innovations

Concept Note, October 30, 2024

Why technological innovations are important:

1. Technological innovations, as defined by the Scientific and Technical Advisory Panel (STAP) of the Global Environment Facility (GEF), refer to "new products and processes and significant technical changes in existing products and processes" (Miller and Swann 2017; Toth 2018). Embracing technological innovations offers important tools to address environmental degradation and to support related social and behavior change, accelerating transformation towards environmental sustainability.

2. Recent years, as noted by Klaus Schwab in his publication on the Fourth Industrial Revolution (Schwab 2016), are characterized by rapid technological advancements and a "fusion of technologies that is blurring the lines between physical, digital, and biological spheres". These technologies are "evolving at an exponential rather than a linear pace" and have the potential to transform entire human and environmental systems (Schwab 2016). Against the backdrop of the increasing scale and complexity of global environmental challenges, these novel technologies – if managed within a sustainability framework – can revolutionize the effectiveness of environmental management including significant reduction of greenhouse gas emissions, efficient natural resource management and pollution reduction, and improved agricultural productivity (World Economic Forum 2017, 2020, 2021).

3. The importance of technological innovations in addressing global environmental challenges has been increasingly recognized in recent scientific and policy reports. The Global Tipping Points report (Lenton et al. 2023) views technological innovations among the key enablers of positive tipping points that can trigger exponential progress towards climate, biodiversity, and sustainable development goals. By creating cascading effects, changes enabled by technologies in one sector can catalyze rapid transformation across multiple sectors (Lenton et al. 2023). Similarly, the most recent Force for Good reports conclude that technology is a critical change agent in building a sustainable future and one of the most important factors determining whether the Sustainable Development Goals (SDGs) will be met. Technology has the potential to reduce the funding gap for achieving SDGs by up to US$55 trillion and address about 40% of the SDG targets. Technologies at the heart of the Fourth Industrial Revolution (4IR) and other technological developments offer immense potential to accelerate transition to sustainability. These include, among others, artificial intelligence, big data analytics, Internet-of-Things, smart grids, renewable energy (notably green hydrogen), energy storage, blockchain, drones, nanotechnology (Force for Good Foundation 2023, 2024).

4. Several evaluations by the Independent Evaluation Office of the GEF (GEF IEO) have noted connections between technological innovations and transformational change, as well as with other benefits. Transformational change refers to "a deep, systemic, and sustainable change with large-scale impact in an area of a major environmental concern" (GEF IEO 2018). The GEF IEO Evaluation of GEF Support for Transformational Change highlighted that cutting-edge technology and technological advancements played a significant role in approaches used by GEF-supported interventions to achieve transformational change (GEF IEO 2018). Other GEF IEO evaluations found that new technologies serve as powerful catalysts that substantially increase efficiency of GEF support, and ensure a broader, more sustainable impact (GEF IEO 2021, 2022, 2024b).

GEF support for technological innovations:

5. The GEF has a long-standing commitment to supporting innovation, including novel technologies. Since its inception, the GEF has been intended to be an innovative mechanism facilitating the deployment of solutions that can deliver global environmental benefits at scale. As observed by the GEF IEO, technological innovations have been an integral part of the GEF portfolio, together with policy, institutional, financial, and business model innovations (GEF IEO 2021).

6. In recent years, particularly in preparation for and during the GEF-7 and GEF-8 replenishment cycles[1], STAP issued several publications advising the GEF partnership on leveraging technological innovations for transformational change. These publications were developed in the context of rapidly evolving technologies, including those associated with the Fourth Industrial Revolution (Schwab 2016).

7. For instance, in its report to the 7th Assembly titled "Catalyzing transformational change through GEF investment", STAP noted that "current trends tracked by the scientific literature reinforce the need for GEF-8 to deliver more, enduring, global environmental benefits and to do so in ways that help transform global systems" (STAP 2023). The same report named "technological revolution, including the suite of technologies that make up the Fourth Industrial Revolution" as one of the enablers of transformation to sustainability. STAP also noted that technologies – if not intentionally geared towards sustainable transformation – may also pose risks, such as increased use of natural resources, greenhouse gas emissions, social inequality, and data misuse. Through strategic investments, capacity building, and engagement with innovation communities, the GEF can play a role to ensure that technological advancements align with environmental and sustainability goals and catalyze transformational change (STAP 2023).

8. Moreover, several other recent STAP documents provide guidance to the GEF on harnessing technological innovations, including, inter alia, publications on novel entities (STAP 2018b; Bierbaum et al. 2020), Earth observation (STAP 2019a; Dean 2020), blockchain (STAP 2019b), technology critical elements (STAP 2020a & b), agrivoltaics (STAP 2024), as well as reports on circular economy: how to design (STAP 2021a), climate mitigation (STAP 2021b), plastics (STAP 2018c), and food systems (STAP 2018a).

9. The GEF strategies, in particular in GEF-7 and GEF-8, recognize the role of novel technologies. The GEF-8 Strategic Positioning Framework underscores the role of innovation,

[1] GEF-7: July 1, 2018 – June 30, 2022; GEF-8: July 1, 2022 – June 30, 2026.

including new technologies, as a lever for addressing unprecedented environmental challenges and achieving transformational change (GEF 2022). While technologies are referenced across almost all focal areas and programs in GEF-7 and GEF-8 Programming Directions, the private sector engagement section in GEF-8 Programming Directions explicitly highlights the importance of technologies of the Fourth Industrial Revolution (GEF 2018, 2023). These technologies "offer the opportunity to create wide-reaching environmental benefits through the application of data, the connectivity of devices through the [Internet-of-Things] IoT, artificial intelligence and machine learning" (GEF 2023). Furthermore, the GEF-8 Innovations Window has been designed to invest in innovation, including technological innovations (GEF 2023).

10. The GEF has recently taken steps to deliberately manage risks in pursuit of transformational change. In 2024, the GEF Council approved the Risk Appetite Statement and Framework (GEF 2024), which establishes the risk appetite levels for the GEF portfolio across three dimensions: context (substantial), innovation (high), and execution (moderate). Notably, the high-risk appetite for innovation reflects the GEF's commitment to support novel technologies along with other forms of innovation to achieve greater environmental impact. At the same time, the 2024 GEF IEO Evaluation "Assessing Portfolio-Level Risk at the GEF" found that historically the GEF portfolio had a low to moderate risk profile and noted that there are opportunities to take more deliberate risks in pursuit of transformational outcomes (GEF IEO 2024a). This evaluation will build on these developments and findings to explore how the GEF can better leverage innovative technologies while managing potential risks.

The objective and key questions:

11. Given the recent rapid technological advancements offering important tools to address environmental degradation – as recognized by GEF strategies, STAP advisory documents and broader literature – this evaluation will assess the GEF partnership's efforts and readiness to leverage technological innovations for the environment. Building on previous GEF IEO evaluations on transformational change, innovation, and risks (GEF IEO 2018, 2021, 2024a), the evaluation will identify lessons from the GEF support for technological innovations for GEF-9. The evaluation will contribute to the Eighth Comprehensive Evaluation of the GEF (OPS8).

12. Key questions will include:

1. Relevance to the GEF mandate and priorities: What are the main technological innovations supported by the GEF in GEF-6, GEF-7, and GEF-8? Are there any missed opportunities based on what has been tried and tested?
2. Effectiveness: What outcomes are associated with technological innovations supported by the GEF in GEF-6 and GEF-7, and what are the expected outcomes in GEF-8?
3. Efficiency: How has the GEF supported technological innovations in GEF-6, GEF-7, GEF-8, including both direct support and creation of enabling environment? What are the enablers and barriers for the GEF to support for technological innovations?

Scope:

13. **GEF phases**: The evaluation will focus on GEF-7 and GEF-8 replenishment cycles which have an explicit emphasis on harnessing technological innovations in STAP advisory documents and GEF strategies. The evaluation will also include GEF-6 projects and programs in portfolio review and

case studies to provide insights from more mature interventions.

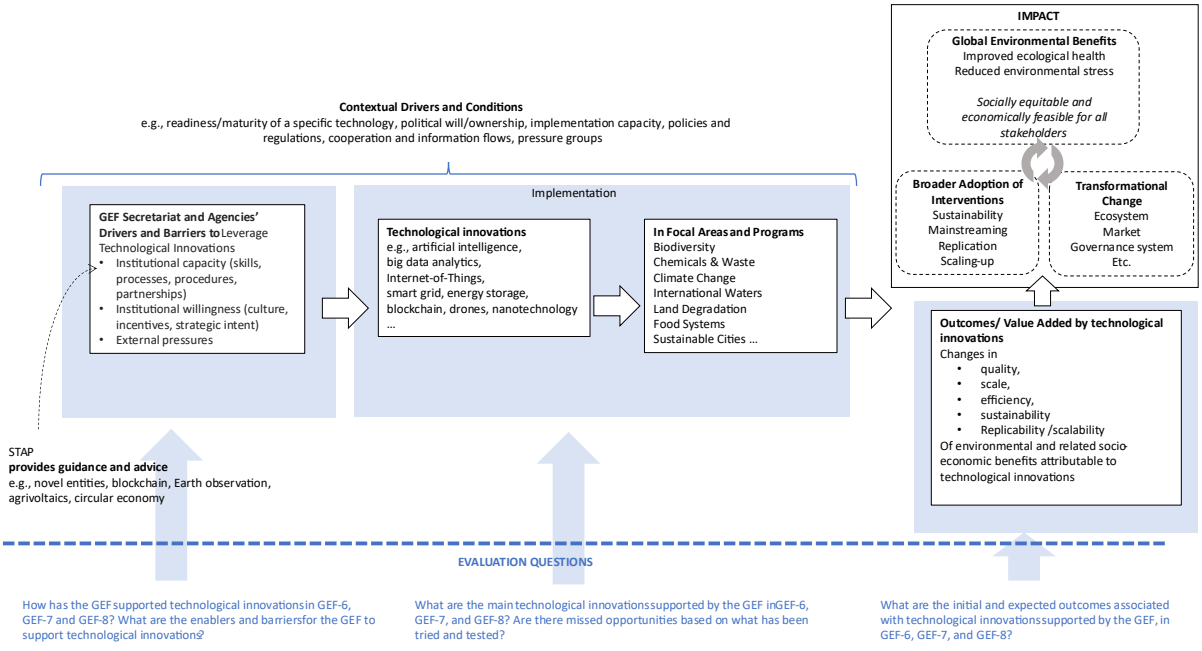
14. **Types of technological innovations**: The evaluation will focus on technological innovations explicitly mentioned in GEF strategies and STAP advisory documents. This list may be complemented by key technological innovations included in recent publications on the role of technologies in transformational change and progress towards environmental and sustainable goals. The primary focus will be on technological innovations, including the developments comprising the Fourth Industrial Revolution, such as artificial intelligence (AI) and blockchain, as well as other new technologies recommended by STAP, such as e-DNA and bio-based materials.

15. Annexes I and II of this concept note provide more information on GEF-funded interventions in GEF-6, GEF-7, and GEF-8 replenishment cycles and illustrate examples of how technological innovations could be mapped against GEF programming.

Methodological Approaches:

16. The evaluation will answer the key questions by assessing GEF activities at three levels: the portfolio level, the level of specific technological innovations, and the strategic/partnership level (also known as the institutional level). Figure 1 presents the conceptual framework of the evaluation.

Figure 1. Conceptual Framework of the Evaluation. Leveraging Technological Innovations by the GEF.



17. **Document and literature review** provides foundational information for the evaluation and includes a review of GEF-7 and GEF-8 strategy documents, GEF policies and guidelines, STAP advisory documents, GEF IEO evaluations focused on innovation, transformational change, and risk; as well as rapid review of broader literature on the role of technological innovations in transformational change and progress towards environmental and sustainable

goals.

18. A **portfolio review** will examine projects and program framework documents (PFDs) funded from GEF-6 onwards to identify and classify technological innovations across focal areas and programs in relation to GEF strategies, STAP advisory documents, and broader literature on technological innovations for the environment. The evaluation team will use machine learning and text analytics to identify and classify GEF-funded projects and PFDs that explicitly support technological innovations. Given the increased emphasis on integrated approaches in the GEF, the results of machine learning and text analytics will be complemented by a manual document review of impact and integrated programs (including PFDs and child projects), as well as projects identified with machine learning and text analytics.

19. More specifically, with the help of the portfolio review, the evaluation team will analyze whether relevant technological innovations mentioned in STAP advisory documents and GEF strategies are supported through the GEF focal areas and programs. The evaluation will also assess whether there are similar projects in the portfolio that could have used these technological innovations but have not done so. Furthermore, the evaluation will identify other technological innovations being applied in environmental projects outside the GEF, which the GEF has not yet applied and could potentially benefit from. The document review of impact and integrated programs will also classify technological innovations used by these programs by the level of their innovativeness/maturity.

20. **Technology-focused case studies**. Based on the portfolio review, the evaluation team will conduct a closer examination of up to 6 specific innovative technologies, followed by in-depth case studies on 2-3 specific technologies. The selection of technologies will be guided by the following criteria:

- GEF Relevance: The technology has been explicitly mentioned in STAP/GEF documents as relevant to the GEF's mandate.
- Proven Potential: There is evidence demonstrating that the selected technologies are market-proven, scalable, and applicable to GEF programmatic activities. This applicability should extend across several focal areas and integrated programs.

Potential candidate technologies for in-depth case studies (subject to the portfolio review) include blockchain, biological engineering, remote sensing, and AI. The case studies will examine the application of these technologies with the GEF support, potential missed opportunities, enablers and barriers to the use of new technologies, and outcomes (where information is available). Furthermore, the case studies will review the role of partnerships (including the private sector), approaches to knowledge and learning, monitoring and evaluation, and mechanisms used to manage risks associated with these technologies. The case studies will be prepared primarily through the desk review and interviews, with the potential of conducting up to two field visits.

21. The **strategic/institutional-level assessment** will examine the GEF partnership's readiness to leverage technological innovations for transformational change towards environmental sustainability. This assessment will analyze both the institutional capacity

(skills, processes, and procedures) and institutional willingness (culture, incentives, and strategic intent) of the GEF partnership. The assessment will include an online survey and interviews with GEF Secretariat, GEF Agencies, country focal points, GEF CSO Network, GEF Gender Partnership, GEF Advisors: STAP, Indigenous Peoples Advisory Group (IPAG), and academic and private sector advisors.

Resources and quality assurance:

22. The evaluation team will be led by a GEF IEO Evaluation Officer with oversight from the Chief Evaluation Officer and the Director of the GEF IEO. A GEF IEO Senior Evaluation Officer will provide an internal peer review. The team members will include a senior expert in technologies for the environment, a senior expert in evaluation of innovation, institutional change and readiness, a data scientist, and portfolio analysts. Local country consultants may support the field verification missions.

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Annex I. GEF-6, GEF-7, and GEF-8 Interventions*

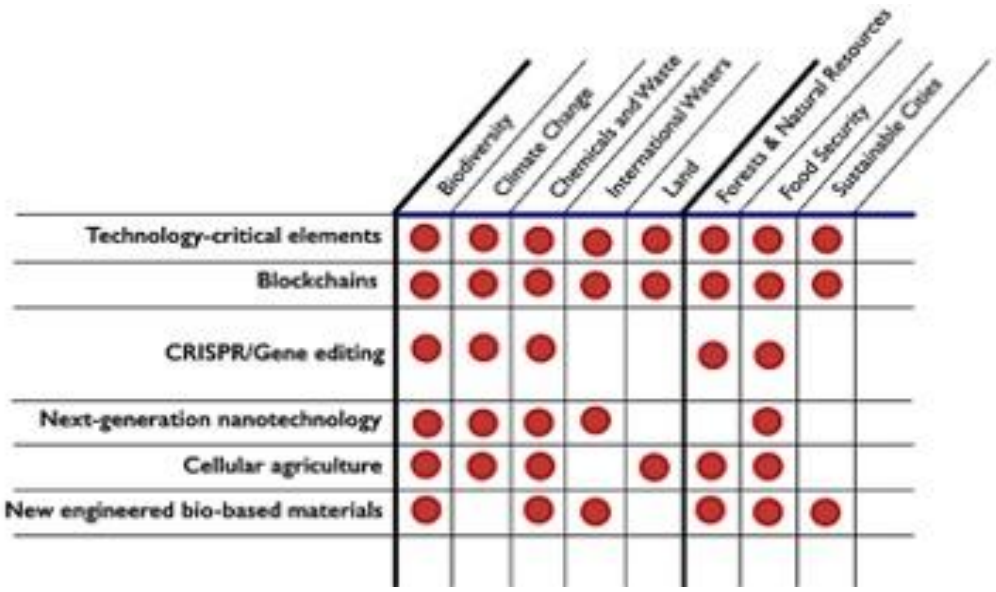
GEF Phase	CEO approved/endorsed projects	Program Framework Documents (PIF approved)	Total
GEF-6	592	15	607
GEF-7	678	15	693
GEF-8	19	25	44
Total	1289	55	1344

* Source: GEF Portal. Cut-off date: 2024/06/30. Excludes: Enabling Activities (EA), Small Grants Program (SGP); Global Biodiversity Framework Fund (GBFF); dropped and cancelled interventions.

Annex II. Potential use cases for technological innovations versus actual use cases in GEF programming

This annex presents two matrices that the team will use and refine further as starting points to analyze GEF support to technological innovations in its programming. Matrix A shows potential use cases for technological innovations, as identified by STAP (2018b) and Bierbaum et al. (2020). It maps six key technological innovations and novel entities against GEF programmatic areas, indicating where these technological innovations could potentially be applied. Matrix B provides an initial template for capturing actual uses of technological innovations across the GEF portfolio. Both matrices are presented for illustrative purposes only - the technological innovations shown are examples rather than an exhaustive list. The evaluation will identify and analyze technological innovations across all focal areas and programs using document, literature, and portfolio review.

Matrix A. Potential Use Cases for Technological Innovations in GEF Programming*



*Source: STAP (2018b) and Bierbaum et al. (2020)

Matrix B. Actual Use Cases**

	Biodiversity	Climate change	Chemicals and Waste	International Waters	Land Degradation	Sustainable Cities	…
Blockchain	0	1	0			2	
Sensors, Radio Frequency Identification (RFID)	3	0	0		1	0	
Drones						1	
AI, LLMs				3			

	Biodiversity	Climate change	Chemicals and Waste	International Waters	Land Degradation	Sustainable Cities	…
Bio-Engineering						3	
Nanotech		1					
…							
…							

**Source: GEF IEO evaluation team, to be refined further. This matrix is provided for illustration only, not based on the portfolio review.