Innovation in the GEF: Findings and Lessons
Approach Paper
May 4, 2020

Introduction

1. The Global Environment Facility (GEF) seeks to maximize Global Environmental Benefits (GEBs) with limited resources and an acceptable level of risk. Two recent comprehensive evaluations of the GEF (OPS5, 2014; and OPS6, 2018) concluded that in order to play a more transformative role GEF should take higher risks, with potential for higher gains, rather than prioritizing cost effectiveness.

2. "Innovation and the GEF" (Toth, 2018), issued by the Scientific and Technical Advisory Panel (STAP) recommended that the GEF should define its risk appetite, as "the key issue for innovation in the GEF is risk… it is therefore important to question and assess at the strategic level what would be a desirable and acceptable levels of risk in different areas of the investment portfolio. This could involve setting targets for success, recognizing that some innovations will fail".

3. This study will assess GEF's efforts in supporting innovation, the outcomes and sustainability of innovative interventions, the factors that have influenced innovations the GEF, and will identify lessons for GEF-8

Background: Innovation in GEF Strategies and Evaluative Evidence

This section provides an overview of innovation and risk based on GEF strategic and policy documents and the comprehensive evaluations of the GEF.

4. Since the creation of the Global Environment Facility (GEF) as a pilot program in 1991, there was an expectation that the GEF would be an innovative institution in several ways: in its novel institutional arrangements, as a novel mechanism for the implementation of international agreements, in its novel decision-making structure, and in its investments to stimulate new types of interventions to improve the global environment. Innovation has been regarded essential for the GEF to achieve its objectives and catalyze greater environmental benefits (GEF IEO, 2012).

5. The key characteristic of the GEF Pilot Phase (1991-1994) was that GEF was considered innovative as an institution that was expected to do something "novel and additional" with a clear distinction from existing development agencies. The Pilot Phase was the only time when GEF's strategic documents explicitly discussed the definition of innovation; it was broadly interpreted to be both technological and non-technological and applied to a new context. Specifically, the Report by the Chairman to the December 1991 Participants' Meeting (quoted in World Bank, UNDP, UNEP, 1994, p. 46, footnote 25) defined innovation as one that involves:
    (a) Demonstration, on a commercial scale of proven technologies that may offer global environmental benefits;
    (b) The introduction of new approaches of an institutional policy or regulatory nature;
    (c) The application of familiar policies /technologies in a manner that increases their effectiveness;

(d) The introduction of well-tested approaches /technologies that may be new to the developing country concerned or which may be tested in various country social and economic settings;
(e) Studies, technical assistance, and the provision of advice which could ultimately underpin new and innovative reforms or policy measures in a country, as well as strengthen the institutional capacity to manage policy reforms.

6. During the Pilot Phase, innovation was a major selection criterion for GEF funding: in addition to benefiting the global environment, projects were also expected to be innovative and demonstrate the effectiveness of new technologies or approaches. Major barriers for innovative projects identified by the Independent Evaluation of the Pilot Phase (World Bank, UNDP, UNEP, 1994) were institutional settings, such as bureaucratic processes in the implementation agencies.

7. During GEF-1 (1994-1998), the Instrument for the Establishment of the Restructured Global Environment Facility (World Bank, 1994) requested the GEF to provide new and additional funding to meet the incremental costs of measures to achieve global environmental benefits. Further, the Instrument (Ibid.), the GEF Operational Strategy (1995) and Council decisions laid down innovation-related objectives and guidelines for the GEF itself as well as for GEF-supported projects:

    -   to gain experience with a broad range of projects in order to identify highly effective approaches that can be replicated in different settings and regions or serve as demonstration models in the public and private sectors;
    -   to make use of innovative technologies and procedures.

8. The 1995 Operational Strategy (Ibid.) also defined four types of risk in the GEF portfolio: (i) commercial and technical risk; (ii) additional project risk to address environmental issues; (iii) risk of not materializing benefits or not meeting expectations; (iv) portfolio risk of not achieving overall objectives. Among the means to reduce risks, the 1995 Strategy called for the GEF to develop a diverse portfolio that would involve a range of approaches to address the need for ongoing innovation, experimentation, and demonstration. The Strategy also urged the GEF to help countries reduce their initial financial risk, remove barriers, meet transaction costs, or build markets to lower costs of future application of similar measures to facilitate future action to address global environmental issues by other entities. The GEF was also supposed to support innovative financing approaches to ensure long-term financial sustainability of its activities.

9. Despite the importance given to innovation in the strategic documents during GEF-1, the Study of GEF's Overall Performance (OPS1) noted that no guidelines were developed to streamline innovation in project design (GEF, 1999, p. 90). When discussing innovation in the GEF portfolio, OPS1, did not have a major focus on technological or scientific innovation, and instead reviewed the replicability of innovation, involvement of private financing; as well as removal of social, policy, cultural, institutional or financial barriers for innovation.

10. During GEF-2 (1998-2002) the Second Overall Performance Study (OPS2) noted a "strong continuing commitment" for innovation in the GEF, especially in the Small Grants Program and the climate change focal area. It recommended that the GEF should speed up recognition of success (and therefore readiness to replicate) and more systematically encourage innovation during project design (GEF, 2002b;

quoted in GEF IEO, 2012). OPS2 also noted a general trend in innovative projects shifting from technological development to creating an enabling environment. OPS2 also reported on a variety of financing modalities that GEF used or intended to use to channel innovations or to lower financial, technology, or policy risks faced by other actors when investing in innovations to benefit the global environment.

11. By GEF-3 (2002-2006), the GEF adopted operational programs which provided detailed guidance for the design of initiatives in the focal areas and included considerations on innovation and risk. The Third Overall Performance Study of the GEF (OPS3) observed that innovation and replication were actively promoted as a mechanism for "catalytic effects" (i.e. catalyzing greater benefits) by the GEF's operational programs and strategic priorities. However, there was a tension between proven successful approaches and more innovative ones that involved higher risks which created choices for the GEF in terms of its priorities. OPS3 found that all GEF programs faced this tension of choice between proven successful activities and more innovative and higher risk ones. For example, the operational program 7 (Reducing the long-term costs of low GHG emitting energy technologies) was expected to invest in innovative technologies but was able to support only a limited number of projects due tradeoffs between higher risks innovative interventions and more mainstream lower-risk ones. On the institutional level, the GEF's Resource Allocation Framework (RAF) did not explicitly include the project selection criteria (such as innovativeness, replicability, cost effectiveness) and, as a result, it might have been easier to approve a project with a proven successful approach (such as a protected area project) than create a more innovative, but a potentially riskier project that might in the long run generate greater benefits. In addition, knowledge sharing was relatively ad hoc, which created a barrier to the promotion and replication of successful innovations. The OPS3 concluded that "proper incentives and guidelines were needed to promote the pursuit of higher risk opportunities" (GEF 2005).

12. The focal area strategies in GEF-4 (2006-2010) (GEF, 2006) reflected the priorities outlined in GEF-3 operational programs and strategic directions. Each focal area involved objectives pertinent to the demonstration of innovative technologies and practices. The Fourth Overall Performance Study of the GEF (OPS4) analyzed the catalytic role of the GEF, which included innovation as "demonstration of new approaches" and replication as "investment" in scaling up.   Consistent with the previous overall performance study, OPS4 confirmed that innovation may affect cost-effectiveness and performance in the short term, as a trade-off for longer term and broader impacts once the potential for new markets and technologies is demonstrated. OPS4 also concluded that demonstration of new technologies and approaches fails if it is not supported by institutional and market measures; and that demonstration, innovation, market barrier removal activities fail if there is no follow up through investment or scaling up.

13. During GEF-5 (2010-2014), focal area strategies reflected the overall GEF shift towards transformational scale-up of activities (GEF 2010). Innovation was included in four out of the six strategic elements in GEF-5 programming, and thus was an important part of the GEF-5 approach. The strategic elements included:

    - pioneering combinations of grant and non-grant instruments to support investments of transformative scale;

- maintaining a focus on innovation, catalyzing (and) supporting cutting-edge technologies and policy reforms with the objective of enabling replication and scaling-up;
- enhancing engagement with the private sector, including small and medium enterprises, and thought the Earth Fund to foster innovation, open and develop markets, and demonstrate the potential for strategic partnerships to greater scale of investment;
- refining focal area strategies to reflect the emerging scientific and policy understandings.

14. The Fifth Overall Performance Study of the GEF (OPS5) analyzed the broader adoption of GEF-supported initiatives through the following mechanisms: sustaining, mainstreaming, replication, scaling up, and market change. An in-depth analysis showed that an impressive 93 percent of completed projects resulted in a chance for the broader adoption of their approaches or direct environmental impact. Given this high percentage of projects, OPS5 concluded that GEF should take higher risks, with potential for higher gains rather than prioritizing proven successful approaches. Although such approach would increase the number of failures, OPS5 affirmed that internationally 25 percent failure rate was acceptable for innovative interventions and programs.

15. In GEF-6 (2014-2018), the 2020 Strategy (GEF 2014a) highlighted a greater need for the GEF to support innovative and scalable activities as means to address the drivers of environmental degradation. The strategy suggested several influencing models for GEF projects, including demonstrating innovative approaches and deploying innovative financial instruments to help de-risk investments by others. The Strategy 2020 also referred to integrated approach pilots (IAPs) as GEF's institutional innovation to identify the most effective ways to reach a higher impact and scale. The GEF-6 Programming Directions and Policy Recommendations (GEF 2014b) also highlighted the integrated approach pilots as an instrument to keep the GEF on the leading edge of innovation and enhance the GEF's responsiveness to regional and global issues. In addition, the programming directions for each focal area referred to innovative approaches, such as piloting innovative solutions (technologies, management practices, supportive policies, and strategies, and financial tools), promoting access to innovative financing, and innovative partnerships.

16. The Sixth Comprehensive Evaluation of the GEF (OPS6) noted that the high percentage of completed projects which had outcomes rated in the satisfactory range, the GEF may have "a rather risk-averse, insufficiently innovative project portfolio". The report commented that "the GEF is well placed to take more risks and play a more innovative and transformative role". (OPS6, p. 15-16) In view of the establishment of the new climate and environmental funding sources. The evaluation also reflected on the sources of comparative advantage for the GEF, including its ability to address interlinkages and synergies across focal areas, implement policy and regulatory reforms in countries to create an enabling environment that attracts investment, implement innovative financing models and risk-sharing approaches, and support lower-income countries and small island developing states.

17. The GEF-7 Strategies and Programming Directions (2018-2022) (GEF, 2018) refer to GEF's comparative advantage in being an innovator, incubator, and catalyst while actively seeking to effect transformational change. The focal area strategies include their own plans to foster innovation, and the new Impact Programs (Food Systems, Land Use, and Restoration / Sustainable Cities / Sustainable Forest Management) are designed to promote and support more innovation. The impact programs aim to

support combinations of innovations, achieve breakthroughs, and emphasize the importance of knowledge sharing and cross learning through various platforms. Furthermore, non-grant instruments are to be used to reduce risk for investors.

Working definition of innovation

18. For the purpose of this study, based on the literature and document review, innovation is defined as doing something new or different in a specific context that adds value[1].
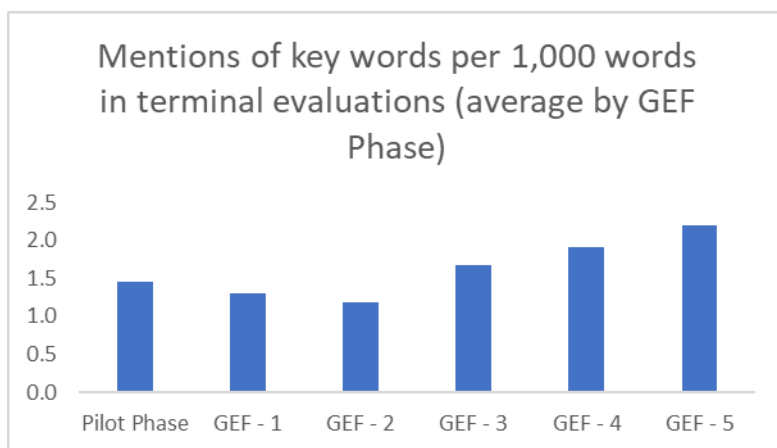
Broadly,

(i)   innovation is new in a specific context;

(ii)   it represents an improvement compared to conventional alternatives (e.g. better quality, scale, efficiency, sustainability, replicability or scalability of outcomes;

(iii)   it catalyzes or produces environmental benefits, and may also result in socio-economic benefits related to the target environmental benefits;

(iv)   it could be associated with risks and higher likelihood of failure.

Innovations in the GEF portfolio

19. STAP (Miller and Swan, 2017; Toth, 2018) identified five innovation domains in the GEF portfolio: technology, finance, business models, policy, and institutions:
    a. Technological innovations are new products and processes and significant technical changes in existing products and processes;
    b. Innovative financing can include any financing approach that helps to generate funds by tapping new funding sources or by engaging new partners, including those that enhance the "efficiency" of financial flows by reducing delivery time and/or costs, and make financial flows more results-oriented;
    c. Business model innovation refers to development of new concepts supporting an enterprise's financial viability, including its mission, and the processes for bringing those concepts to fruition;
    d. Policy innovation refers to an approach, regulation, a practice, or a legislative policy which incorporates or combines multifaceted approach; new regulations or standards to achieve investment objectives; policies to support pricing mechanism;
    e. Institutional innovation often refers to changes in organizations to facilitate greater effectiveness in the management of global environmental benefits. It can also mean changes in informal institutions (values, beliefs, customs), and formal institutions (markets, marriage) which guide the individuals' behavior and their interactions in communities.

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[1] For literature review on innovation, please see Annex B

20. In the absence of a systemic tagging of innovation in the GEF portfolio, the GEF IEO evaluation team quantitatively scanned in R[2] the terminal evaluations (TE) of 1328 completed projects from the PMIS to identify the overall trends through the use of words associated with innovation. While this scan is not a substitute for a portfolio analysis, it provides some information on the trends, and can be used to identify projects/programs for further analysis[3].

21. The quantitative scan was based on 39 key words and word combinations identified from the literature and document review. The most frequently key words associated with innovation in the terminal evaluations were: pilot*, innov*, new_technolog*, experiment*. Please see Annex A for the full list of key words used during this the quantitative scan.

22. The scan shows a gradual increase in the number of mentions of words related to innovation over time. (Since the GEF-6 sample only included two terminal evaluation documents, those were excluded from the analysis.)

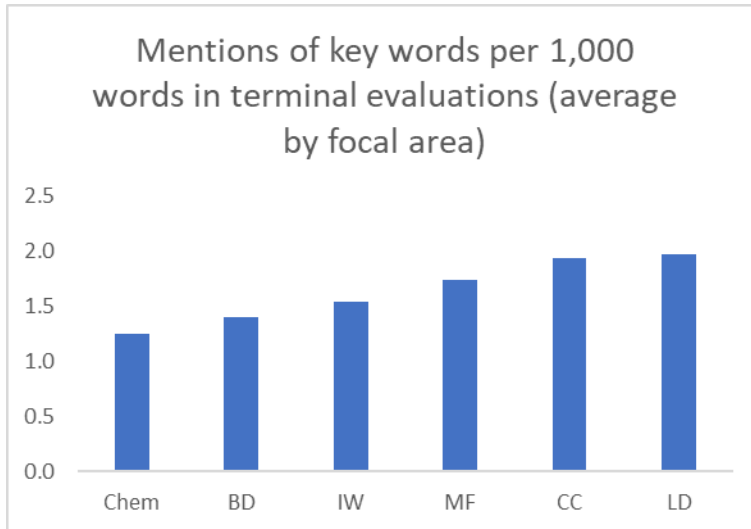Mentions of key words per 1,000 words in terminal evaluations (average by GEF Phase)

23. Terminal evaluations of land degradation and climate change projects had the greatest number of mentions of innovation- related key words per document, while the TEs in the chemicals and waste and biodiversity focal area had the fewest.

Mentions of key words per 1,000 words in terminal evaluations (average by focal area)

Objectives, Scope, and Key Questions

24. The objective of this study is to assess GEF's efforts in supporting innovation, the outcomes and sustainability of innovative interventions, the factors that have influenced innovation in the GEF, and to identify lessons for GEF-8. A framework for evaluating innovation will be developed drawing on the existing literature.

25. The study will focus on exemplary innovations identified via a call to GEF Agencies and GEF Secretariat and analysis of documents to reflect the diversity of innovations and themes with the highest learning potential relevant to the GEF-7 and GEF-8. The study will coordinate with the joint GEF-UNDP Evaluation of the Small Grants Program (SGP) and the Evaluation of the Role of the Medium-Sized Projects (MSP) in the GEF Partnership, the Formative Review of the GEF Integrated Approach to Tackle the Drivers of Environmental Degradation, and other ongoing IEO evaluations to identify cases relevant to different funding modalities, current strategic priorities, and operations. The attention will be paid to identification of both successful and failed innovations[4].

26. Specifically, the study aims to answer the following questions:

    1. How has the GEF Partnership supported innovation since it was established?

    2. What can be learned from the effectiveness, and sustainability of GEF's support for innovation?

        a. In what manner and to what extent do external and internal factors influence GEF support for innovation and its outcomes?

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[4] Paragraph 18 of this approach paper provides a working definition of innovation. A failed innovation is the one that does not achieve its intended outcome, including, for example, changes in quality, scale, efficiency, sustainability, replicability/scalability of environmental and related socio-economic benefits attributable to innovation.

b. What is the effectiveness and sustainability of innovative interventions supported by GEF?

3. What are the lessons and implications for future policy, strategy, and management decisions to further enhance innovations in the GEF?

Methods

27. The study will use a mixed methods and multi-case design approach with a purposive sample of innovations with the highest learning potential for GEF-7 and GEF-8 (Yin 2018; Stake 2006).

28. Document and literature review to summarize definitions, characteristics, pathways, and conditions associated with GEF support for innovation and risk management in GEF strategic and policy documents, evaluations and broader literature with the emphasis on environmental innovations and management or risks.

29. Key informant interviews. Members of the GEF will be interviewed on their experience on the GEF support for innovation and management of risks, on the GEF and GEF Agencies' risk management and innovation approaches, and their impact on outcomes.

30. Identification of exemplary innovations in the GEF portfolio with the highest learning potential for the current and next GEF replenishment. Since GEF projects and programs are not tagged on innovation, in the cases will be identified from several sources: (a) request to GEF Agencies and GEF Secretariat to nominate innovative interventions; (b) review of GEF IEO evaluations; (c) text mining of project and program documents. From the initial list, 12 to 15 case studies will be selected for in-depth review and analysis to represent diversity of innovations types, focal areas, programs, and funding modalities with the highest learning potential relevant to the GEF-7 and GEF-8.

31. Case study analysis. For a selected sub-set of completed and ongoing GEF innovative interventions, an in-depth case study analysis will be undertaken through document reviews (project implementation forms (PIFs), project proposals, terminal evaluations, post-completion evaluations, as available), interviews with project implementation staff and client counterparts, and as necessary field visits.

32. Cross-case analysis and triangulation of the qualitative and quantitative information gathered will be conducted at the completion of the data gathering and data analysist to determine trends and identify main findings, lessons, and conclusions.

Limitations

33. In the absence of a common understanding of innovation across the GEF partnership, innovative interventions have not been systematically tagged or tracked. This makes it impossible to identify a complete portfolio of innovative interventions supported by the GEF. Thus, the study will not

address the extent to which the GEF has or has not pursued innovation, but instead will review a purposive sample of representative examples to derive lessons for GEF-8.

Resources and Quality Assurance

34. The study will be conducted by a team led by the Knowledge Management Officer with overall guidance from the Chief Evaluation Officer of the GEF IEO. The team will include consultants, including senior consultants with expertise in evaluation of innovation and global environmental issues.

35. An internal reviewer (a GEF IEO Senior Evaluation Officer) and an external reviewer (a recognized international evaluation professional with the subject matter knowledge of innovation) will provide feedback on the design and results of the study. They will be consulted on the study design, activities, and changes. Other IEO staff will be given the opportunity to review and offer inputs to the approach paper, preliminary findings, and the report.

Stakeholder engagement and Dissemination

36. Stakeholder engagement will be thought throughout the study, with the following objectives: 1) to improve the relevance and accuracy of the study; 2) to promote the utility of the study, by facilitating learning and dissemination of the study results.

37. The study's findings will be presented in a report to the GEF Council, and disseminated to members of the GEF Partnership, as well as a broader public audience. A knowledge product that will summarize key findings will be produced and disseminated. A learning event, including a face-to-face session, and a webinar, will be organized to share the main findings.

Timeline

Task	2020												2021		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Concept note															
Document and literature review	X	X													
Concept note preparation	X	X													
Data gathering and analysis															
Request to GEF Agencies and Secretariat to nominate exemplary innovations			X												
Design framework for analysis; develop protocols for interviews, template for screening cases, steps to select case studies, template for case study analysis			X	X	X										
Review and text mining of evaluations and projects documents to identify exemplary innovations with the highest learning potential for GEF-7 and GEF-8			X	X	X										
Screening and selection of cases for in-depth analysis					X	X									

Task	2020												2021		
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar
Key informant interviews							X	X	X	X					
Overview on the evolution of GEF approaches to innovation and risk management in the GEF							X	X	X	X					
Case study analysis							X	X	X	X					
Country case studies field visits (TBD, as possible)									X	X					
Cross-case analysis and triangulation											X	X			
Gap filling											X	X			
Report writing															
Draft report												X	X		
Due diligence (gathering feedback and comments)													X	X	
Final report														X	X
Presentation to Council in SAER															->
Dissemination and outreach															->

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Annex A

Key words and word collocations on innovation for quantitative text scan of project and program documents, including terminal evaluations

pilot*; innov*; new_technolog*; experiment*; improv_product*; improv_institut*; new_law*; new_institut*; frontier*; new_product*; improv_technolog*; new_market*; improv_legal*; new_model*; patent*; improv_market*; forefront*; improv_process*; new_legal*; new_partner*; improv_law*; new_process*; improv_model*; improv_organiz*; new_organiz*; new_bill*; new_organis*; improv_organis*; improv_bill*; diffus_model*; diffus_technolog*; demonst*; improv_partner*; diffus_institut*; new_polic*; diffus_process*; diffus_market*; diffus_partner*; diffus_organis*

Annex B Literature review

Background and Definition

The essential role of innovation in preserving the environment and in the context of sustainability was recognized in the seminal Club of Rome's "Limits to Growth" report (Meadows et al. 1972, referenced in Horbach et al. 2018). Since then the research on eco-innovation has evolved substantively stemming from various policy, business, and academic disciplines ranging from environmental policy, environmental economics, evolutionary economics, industrial ecology, the corporate environmental strategy literature among others.

While many definitions of eco-innovation exist (see, for example, Kemp and Pearson 2007; Schiederig et al. 2011; Tariq et al. 2017), the distinctive feature of eco-innovation is the environmental performance. Essentially, eco-innovation is any innovation that leads to reduction in the use of natural resources, decrease in the release of the harmful substances across the whole lifecycle, and a wider change with systemic implications for the economy and society in relations to the environmental benefits (Eco-Innovation Observatory 2011).

The literature uses several terms to describe innovations that produce environmental impacts: "green", "eco", "environmental", and "sustainable". Some authors distinguish between the first three terms and the "sustainable" innovation, as the former embrace the ecological and economical aspects of sustainability, while the latter also includes social aspects (Horbach 2018; Diaz-Garcia et al. 2015; Schiederig et al. 2012.). At the same time, other authors use all four terms interchangeably (Tariq et al. 2017).

There are several characteristics that distinguish eco-innovation from general innovation. Rennings (2000), identified three such characteristics: *the double externality problem, the regulatory push/pull effect, and the increasing importance of social and institutional innovation*. First, the double externality problem implies that in addition to knowledge externalities faced by general innovations, eco-innovations face the negative externality of pollution. The double externality reduces incentives for development and adoption of eco-innovation, and therefore requires coordination between innovation and environmental policy measures. Next, the regulatory push/pull effect means that the regulatory framework has a strong impact on eco-innovation compared to traditional technological innovations (such as microelectronics and telecommunications). Lastly, Rennings notices that social innovations (e.g. changes in lifestyle and consumer behavior), as well as institutional innovations (ranging from local networks to global organizations) are increasingly important forms of eco-innovation in view of the global environmental challenges (Rennings 2000).

Horbach et al. (2012) in their analysis of one of the most well-known definitions of eco-innovation by Kemp and Pearson (2007) identify the following important characteristics of eco-innovation: 1) it is based on a subjective view of innovation (i.e. innovation is new to the organization/user (developing or adopting it), and therefore the *emphasis is on the adoption and diffusion*; 2) it considers implemented innovations, rather than planned activities (i.e. it *emphasizes the results rather than the motivation*). This approach avoids the discussion whether the innovation was initiated/adopted as a result of environmental motivation – it does not matter of the initial motivation for the uptake is environmental. (Carlillo-Hermosilla et al. 2010); 3) it relates environmental impacts to the state of the art (i.e. it *results in improved environmental outcomes compared to the relevant conventional alternatives*).

Rationale for supporting innovation: market failure and system failure perspectives

Traditionally, in discussing the rationale for the public and international support for innovation, the literature examines market failures, such as the inefficient allocation of resources in markets when innovators fail to capitalize the benefits of innovations due to the public good nature of knowledge and environment (Chamsuk 2018). Therefore, fostering innovation implies the need to address market failures though support measures, such as market instruments that put a price on environmental externalities, as well as support for knowledge exchange and cooperation (OECD 2011).

At the same time, innovation can be viewed from the system perspective, where innovation is situated in conditions that enable and hinder the creation, storage, and transfer of technologies, practices, products, and services (Chamsuk 2018). In this case, the rationale for the support for innovation may stem from the need to address system failures that reduce the overall effectiveness of the innovation effort. For example, Arnold (2004, quoted in OECD 2011) identified the following types of system failure:

- Capacity failures (such as managerial deficits, or lack of learning or technical knowledge to use the externally generated innovation)
- Institutional failures (failures to reconfigure universities and research centers to ensure their effective work within the innovation system)
- Network failures (problems in interactions between actors in the innovation system)
- Framework failures (deficiencies in regulatory framework and in other background conditions, such as cultural and social values).

Mazzucato (2016, 2017) argued that successful public support for innovation should address both market and system failures.

Types

While there are many different types of eco-innovations, their classifications can be grouped by the scale of change and by the object of change.

First, the literature distinguishes innovation by the *scale of change*. Carillo-Hermosilla et al. (2010), OECD (2011), Eco-Innovation Observatory (2011; 2012) distinguish between *incremental and radical (or systemic) innovation*. Incremental innovations lead to gradual modifications in the existing systems. In contrast, radical innovations generate discontinuous changes and seek to replace existing components of a system or replace the entire system. Although some authors identify *disruptive* as a special type of innovations [5], the literature often uses disruptive and radical (systemic) innovations interchangeably (Horbach et al. 2018; OECD 2011; Kemp 2011).

Second, innovations can be classified by the *object of change*. Kemp and Pearson (2008) identified the following types: environmental technologies; organizational innovation for the environment; products and service innovation offering environmental benefits (including financial products); green system innovations (e.g. biological agriculture, and renewable-based energy system). Miller and Swan (2017) in

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[5] For example, Smith (2009, quoted in OECD 2011) defines disruptive innovations as the ones that change "how things are done or specific technological functions are fulfilled, without necessarily changing the underlying technological regime itself". An example of such innovation is the change from incandescent to fluorescent lighting.

their paper "Financing Innovation: Opportunities for the GEF", analyzed five domains of innovation: technology, finance, business models, policy, and institutions.

Drivers/Barriers

The analysis of drivers and barriers for development, adoption, and implementation of eco-innovations is one the most frequent themes in the literature (Horbach et al. 2018; Diaz-Garcia et al. 2015). However, the studies are often inconclusive, due to lack of evidence, and due to diversity of factors that affect innovation.

In general, there is a consensus that some drivers are more important in fostering eco-innovation compared to other innovations. Some of these are: public policies, cooperation, and internal capabilities of organizations that adopt eco-innovation (del Rio et al. 2016).

There is an agreement in the empirical studies *that policy and regulation* are prominent drivers of eco-innovation, as they help overcome the double externality problem, foster development and adoption of eco-innovations (Horbach 2008; Horbach 2012; del Rio et al. 2016; Diaz-Garcia et al. 2015). OECD (2011) concluded that support for environmental and green innovation requires a comprehensive approach that considers the full spectrum of policies from creation, to diffusion, to application of knowledge that cover both the supply and demand sides. With regards to effectiveness of policies and regulations in driving environmental innovation, the literature concludes that policy interventions are more effective when designed in a mix of policy instruments (see Diaz-Garcia et al. 2015).

Cooperation and information flows play an important role in fostering eco-innovations. Involvement in networks, knowledge transfer mechanisms provide essential support for diffusion and adoption of eco-innovations (del Rio et al. 2016; Diaz-Garcia et al. 2015).

Internal characteristics of organizations that adopt innovation (such as top-level leadership commitment to environmental issues, organizational strategy, organizational resources and capabilities) tend to affect the innovation process (del Rio et al. 2016, Diaz-Garcia 2015). Access to finance, including functioning venture capital markets is important, especially for SMEs (OECD 2011).

There is a mixed evidence of the *market demand* and market-based instruments as drivers of eco-innovation. The role of the market demand varies depending on the type of eco-innovation and levels of consumer environmental awareness (del Rio et al. 2016). Kemp and Pontoglio (2011) also found that the use of traditional market instruments (such as pollution taxes and emissions trading systems) is more effective in stimulating incremental innovations, but less so for radical/systemic innovations.

Closely linked to the market demand are *external pressures* from equipment and input suppliers, financial institutions, competitors, civil society organizations (Diaz-Garcia et al. 2015; del Rio et al. 2016).

Radical innovations depend on complex and interrelated drivers compared to incremental innovations, as the former aim for a system-level change (OECD 2011; Carillo-Hermosilla et al. 2010) Radical innovations often require institutional framework changes, as well as adaptation at the supply and demand side; they require longer period of development and investment; and require involvement of many actors (Kemp 2011).

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