

# A Hundred and Fifty Shades of Green: A Foresight-Driven Playbook for Sustainable Innovation Governance

**Rafael Popper\***

Adjunct Professor <sup>a</sup>; Honorary Senior Lecturer <sup>b</sup>; Visiting Professor <sup>c</sup>; Adjunct Professor <sup>d</sup>;  
International Director and Professor of Practice <sup>e</sup>; Director <sup>f,g</sup>; Rafael.Popper@futuresdiamond.com

**Monika Popper**

Expert <sup>e,f,g</sup>; monika.popper@futuresdiamond.com

**Guillermo Velasco**

Expert <sup>f,g,h</sup>; guillermo.velasco@upm.es

**Mattia Martini**

Associate Professor <sup>i</sup>; mattia.martini1@unimib.it

**Angela Rizzo**

Postdoctoral Researcher <sup>i</sup>; angela.rizzo@unimib.it

<sup>a</sup> Faculty of Mechanical and Industrial Engineering, Warsaw University of Technology, 02-524 Warsaw, Poland

<sup>b</sup> Alliance Manchester Business School, The University of Manchester, Oxford Rd, Manchester M13 9PL, United Kingdom

<sup>c</sup> Faculty of Management Engineering, Bialystok University of Technology, Wiejska 45A, 15-351 Białystok, Poland

<sup>d</sup> Turku School of Economics, University of Turku, Rehtorinpellonkatu 3, 20500, Turku, Finland

<sup>e</sup> CFI-Barcelona, La Salle — Ramon Llull University, Sant Joan de La Salle 42, 08022, Barcelona, Spain

<sup>f</sup> CFI-Poland, Technology Partners Foundation, Włodarzewska 68/3, 02-384 Warsaw, Poland

<sup>g</sup> Futures Diamond Ltd., 9 Bold Street, Warrington, WA1 1DN, Manchester, United Kingdom

<sup>h</sup> Vice Rectorate for Research, Polytechnic University of Madrid, Moncloa-Aravaca, 28040 Madrid, Spain

<sup>i</sup> Department of Business and Law, University of Milano-Bicocca, Piazza dell' Ateneo Nuovo, 1, 20126 Milano MI, Italy

## Abstract

This paper introduces the Hundred and Fifty Shades of Green Playbook – an evidence-based, foresight-driven instrument for assessing and managing Sustainable Innovation (SI). Building on the CASI Project (2014–2017) and its successor applications in the BOLERO Project (2022–2025), with further implementation in the CASI-BIO project (2026–2030), the Playbook proposes a sequenced, action-oriented approach for multi-actor collaboration. It integrates stakeholder engagement, critical-issues analysis, and foresight-based planning into ten interlinked governance aspects encompassing 150 meta-tasks that guide sustainability-oriented decision-making across government, business, academia, and civil society. The BOLERO experience, particularly the MOBBI service innovation in Lombardy,

exemplifies the framework's transferability from EU-level to regional implementation, demonstrating its adaptability to diverse institutional and socio-economic contexts. Reflecting a decade of progress in the governance and management of sustainable innovation, the Playbook's Action Roadmap and Strategic Framework link strategic foresight with participatory governance and sustainability assessment. Together, they offer a replicable model for building resilient, impact-driven innovation ecosystems that directly support the Sustainable Development Goals (SDGs) and align with Environmental, Social, and Governance (ESG) principles. Future research will deepen longitudinal evaluation and continuous learning to ensure that sustainable innovation practices continue to evolve and shape the future.

**Keywords:** sustainable innovation; sustainability assessment; innovation management; foresight; action roadmapping; ecosystem resilience

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\* Corresponding author.

## Introduction

The EU-funded CASI project (2014–2017) developed the Common Framework for the Assessment and Management of Sustainable Innovation (CASI-F) to address societal challenges such as climate change and resource efficiency. Over 500 innovations were analysed through this framework, generating rich evidence that refined its methodology and digital tools (Popper et al., 2020a). Although the project formally ended in 2017, the CASIPEDIA platform continues to expand, currently documenting over 700 sustainability-oriented cases.

A defining strength of CASI-F is its quadruple-helix approach – co-creating solutions among government, business, academia, and civil society. This participatory model underpins both the web platform and the analytical instruments that map innovations, identify critical issues, and generate actionable improvements. CASI defines sustainable innovation as change that promotes positive environmental, economic, and social transformation without compromising the needs of future generations (Popper et al., 2017a). The concept was validated through a survey of 1,300 experts, demonstrating the value of integrating environmental, social, and financial considerations into innovation management.

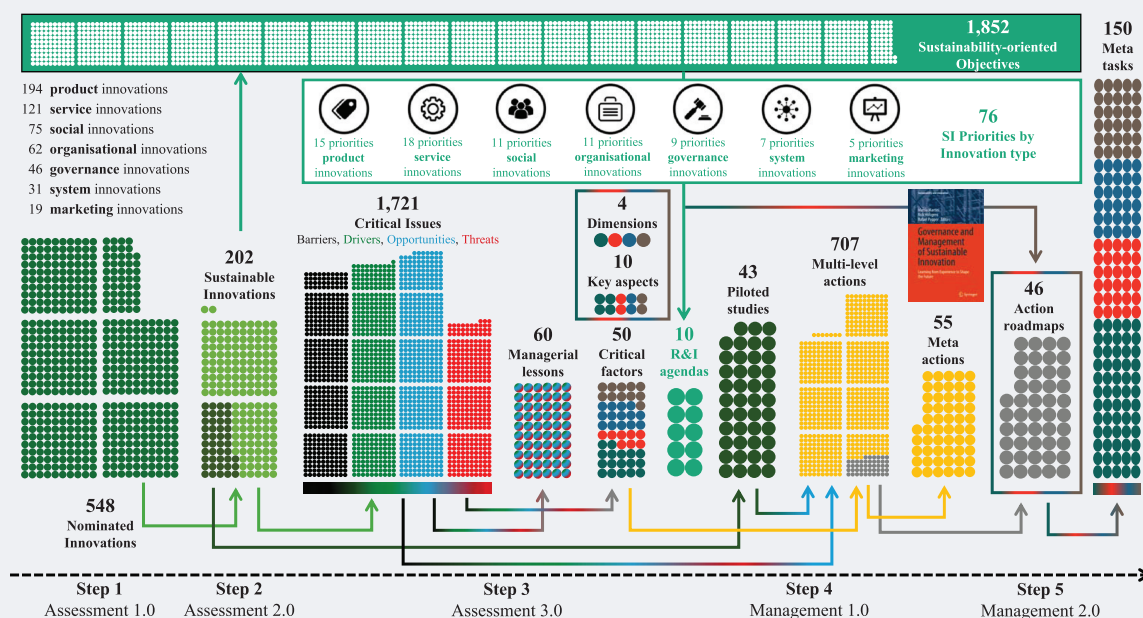
Building on these achievements, the BOLERO initiative – led by the University of Milano-Bicocca (Italy) and Futures Diamond Ltd (UK) – adapted CASI-F for regional and national contexts. Focusing on SMEs in Lombardy, Italy, BOLERO applies the framework through an interactive platform that maps and evaluates sustainable innovations in fields such as mobility, manufacturing, and digital health. Both CASI-F and BOLERO use an inductive, five-step process – scanning innovations, assessing sustainability impacts, mapping critical

issues, formulating strategic actions, and co-creating action roadmaps – to align stakeholder insights with practical management strategies.

The frameworks’ collaborative architecture distinguishes them from other sustainability instruments, including the Innovation for Sustainability (I4S) and Sustainable Development Goals (SDGs) frameworks, which remain more generic (LeBlanc, 2015). While I4S focuses on business-model design and the SDGs set global targets, CASI-F and BOLERO emphasise context-specific, participatory governance and continuous feedback loops. As Sachs (2012) reminds us, the SDGs challenge all countries to act collectively for global wellbeing; similarly, CASI-F operationalises this call by embedding multi-actor cooperation into innovation practice. In this sense, the frameworks complement the integrative approaches described by Hacking and Guthrie (2008) for embedding sustainability across levels of governance.

A central outcome of CASI-F is the catalogue of 150 universal meta-tasks, structured under ten aspects of sustainable innovation management such as Momentum, Foresight, and Resources. Derived from hundreds of case analyses, these actions translate abstract sustainability goals into operational guidance for organisations. Since 2017, CASIPEDIA and BOLERO have continued testing and validating these meta-tasks across contexts. Within BOLERO, the MOBBI service-innovation initiative in Lombardy illustrates how CASI-F principles can be transferred from EU-level frameworks to regional ecosystems, confirming their adaptability beyond specific funding schemes. The case demonstrates how structured collaboration enhances stakeholder engagement and governance capacity – an essential aspect for effective, integrated implementation (Elder et al., 2016; Martini et al., 2020).

Figure 1. An Inductive Approach to Sustainable Innovation Assessment and Management



Source: compiled by the authors

Table 1. Classification of types of innovations that contribute to sustainable development

Dimension of innovation	Definition
Product and service	Goods or services that are new or substantially improved in terms of consumer characteristics or intended areas of use
Social	New ideas (products, services and models) to meet social needs, reformat social relations, change forms of cooperation
Organizational	Changing the way you do business or organize your work processes to improve productivity
Governance	New models of governance, formats for providing public services, ways of involving different segments of the population in socio-political initiatives
System	Radical transformations of socio-technical structures through changes in components and architecture
Marketing	New methods of marketing that influence design, logistics, pricing.

Source: compiled by the authors based on materials from: (OECD, 2015; 2018; European Commission, 2013; Hartley, 2005).

### Definitions and Key Concepts in Sustainable Innovation

*Sustainable Innovation (SI)* refers to innovations that deliver environmental, social, and economic benefits simultaneously (Ketata et al., 2015; Juntunen et al., 2019). It aligns with the principles of Sustainable Development, integrating the three pillars of environment, society, and economy into long-term decision-making. By contrast, eco-innovation and green innovation typically focus on environmental improvements such as reduced risks or resource efficiency, while Environmental Innovation highlights ecological impact without necessarily addressing broader social or economic effects. SI thus represents a more comprehensive and balanced paradigm.

*Responsible Sustainable Innovation (RSI)* (Popper et al., 2017b; 2020a) extends this paradigm by embedding responsibility, ethics, and foresight within a smart quadruple-helix (S4H) framework. RSI supports incremental and radical transitions across environmental, economic, social, governance, and infrastructure systems through participatory, learning-oriented processes. This approach aligns with Köhler et al. (2019), who emphasise that sustainability transitions require systemic shifts in both technology and social practice. As Geels (2004) explains, socio-technical systems are shaped by the norms and roles of human actors, reinforcing the need for behavioural as well as technological transformation.

Table 1 above outlines key types of innovation, contextualising Sustainable Innovation (SI) within a broader framework. These innovations span various domains, from goods and services to social, organisational, governance, and systemic changes, each playing a key role in advancing sustainability goals.

Responsible Sustainable Innovation integrates these innovation types into a coherent model that balances environmental stability with socio-economic well-being. As Pinkse et al. (2023) note, organisations must design business models that simultaneously address social, environmental, and economic pressures while enabling innovation. Frameworks such as CASI-F and BOLERO operationalise these principles through multi-actor engagement and iterative learning, echoing Griggs et al. (2013) and Nilsson et al. (2016) in their call for frameworks that reconcile planetary stability with human development.

Together, these concepts establish the foundation for a foresight-driven, multi-systemic approach to sustainable inno-

vation governance – one that the next section will further contextualise through the relevant academic literature.

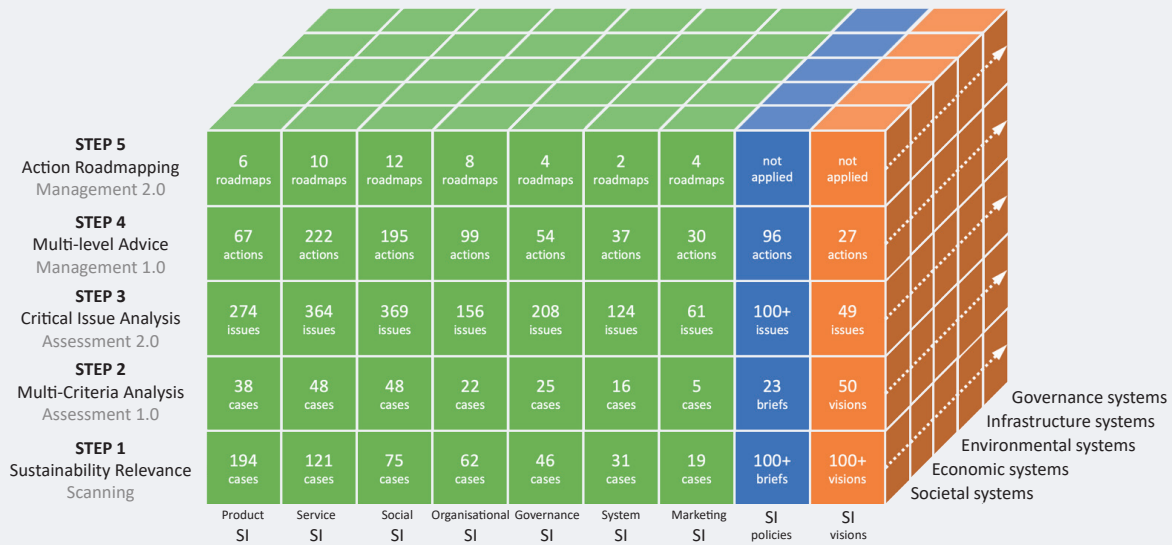
### Literature Review and Policy Trajectory: From Sustainability Transitions to an Action-Oriented Playbook

The evolution of sustainable innovation (SI) thinking shows a clear shift from technological fixes to systemic, participatory, and policy-integrated approaches. To situate this study within that trajectory, this section reviews six interrelated strands of literature. It begins with the theoretical bases of sustainability transitions and innovation ecosystems, then traces how these ideas have been institutionalised through successive European framework programmes and the Green Deal. It next addresses legitimacy, finance, and equity before outlining the methodological lineage behind the CASI-F, CASIPEDIA, and BOLERO frameworks. The section concludes by introducing the Hundred and Fifty Shades of Green Playbook as an actionable synthesis that translates systemic insight into operational guidance for sustainable innovation governance.

*Sustainability transitions: systems, pathways, and governance:* Sustainability transitions are long-term, multi-actor reconfigurations of socio-technical systems shaped by governance, power, and methodology (Köhler et al., 2019). We adopt the multilevel perspective (MLP) as the core framework—niche experimentation, regime dynamics, and landscape pressures—together with transition-pathway logics explaining diverse routes to change (Geels & Schot, 2007). This moves analysis beyond technological substitution toward co-evolutionary shifts in markets, infrastructures, institutions, and user practices. Sustainable innovation (SI) is therefore socio-technical by design, progressing through coordinated value-chain actors and complementary assets across organisational and policy layers (Markard, Truffer, 2008). Evidence from the Finnish pulp and paper industry further shows how such transitions reconfigure value-creation logics toward circular bioeconomy pathways (Laakkonen et al., 2023). This systems lens underpins our focus on managerial playbooks and governance instruments that orchestrate learning across diverse stakeholders.

*Innovation-ecosystem logics: coordination, complements, and timing:* To operationalise system change, we adopt an innovation-ecosystem view: a set of interdependent actors and artefacts aligned to a shared value proposition, linked by

Figure 2. 3D matrix of the CASI-F model



Note: Figure 2 illustrates the multi-layered structure of the CASI-F rubric across five methodological steps (from scanning to management) and seven types of sustainable innovation. The green layer visualises over 500 empirical cases that underpin the framework, while the blue and orange extensions represent two complementary analytical tracks introduced in CASI – policy briefs and citizen panel-driven visions. These additions enabled the integration of institutional and societal perspectives, linking bottom-up aspirations with top-down governance mechanisms. Together, the three layers capture how CASI-F systematically connects micro-level innovations, meso-level policies, and macro-level visions, thereby reinforcing its value as a comprehensive and transferable framework for managing sustainability transitions.

Source: adapted by the authors based on (Popper et al., 2017a).

complementary knowledge, assets, and institutions (Gransrand & Holgersson, 2020). Outcomes hinge on complements and bottlenecks, as well as the relative pace of substitution versus improvement in adjacent components – core reasons to sequence actions and manage timing (Adner, Kapoor, 2010; 2016). Network orchestration therefore becomes a first-order capability: boundary-spanning roles, convening routines, and interface standards enable cross-organisational coordination (Aarikka-Stenroos, Ritala, 2017). Recent foresight research on the forest bioeconomy illustrates how horizon scanning and weak-signal interpretation can inform such orchestration (Mauno et al., 2023; Bengtson et al., 2024). Remarkably, ecosystems are not only emergent – they can be designed and engineered through governance and meta-organising mechanisms (Oh et al., 2016). These insights legitimise the move from static “architectures” to an actionable Playbook that specifies roles, milestones, and feedback loops mapped to a ten-aspect structure.

*EU policy evolution: From FP5 to Horizon Europe and the Green Deal:* European framework programmes have progressively mainstreamed sustainable innovation (SI) assessment and management, evolving from thematic experimentation to systemic governance. FP5–FP7 first introduced sustainability concepts and participatory assessment mechanisms, including citizen engagement and the seven innovation types later consolidated in CASI-F. Horizon 2020 deepened this orientation by embedding foresight, stakeholder co-creation, and sustainability assessment across its challenge-based structure. These developments marked a shift from project-level initiatives to integrated, mission-driven systems aligning science, policy, and society. The CASI-F framework was later validated through sectoral foresight studies such as The Future of Forest-based Bioeconomy Ar-

ea (Popper et al., 2020b), which demonstrated its capacity to map transformation pathways and policy foresight within bioeconomy value chains. Comparable analyses of global forest-sector transitions, including the evolving pulp industry in Uruguay, likewise show how sustainability paradigms and multinational dynamics reshape innovation capacity and collaborative governance (Tahvanainen et al., 2024). Together, these studies illustrate how evidence-based, participatory frameworks can inform strategic openings toward 2050 – linking innovation governance, sustainability assessment, and regional foresight within European and global bioeconomy contexts. In the Green Deal era, EU policy discourse further formalised the nexus between bioeconomy, climate neutrality, and competitiveness. Mission-style integration, programmatic stocktaking, and place-based orchestration emerged through initiatives such as Regional Innovation Valleys, while new regulatory instruments – including the Nature Restoration Regulation—anchored transition objectives in law and governance. Collectively, these evolutions reveal a maturing European ecosystem aligning sustainability, innovation, and governance. Our prior work shows how CASI agendas can be remapped to these Green Deal priorities, underscoring their transferability from empirical programme evidence to mission-oriented policy (European Commission, 2018, 2020, 2021a, 2021b, 2022, 2023; European Parliament, European Council, 2024; Popper et al., 2025a).

*Legitimacy, finance, and equity in the Green Deal era:* Transitions require legitimacy and finance alongside technology and policy. Global material use and environmental pressures intensify the urgency for systemic solutions and balanced trade-offs. Finance and governance trends in the bioeconomy illustrate how capital allocation, disclosure, and

risk norms co-evolve with policy mandates (UNEP, 2024; FGV, 2024; IACGB, 2024). Multi-level forest and genetic-resources governance studies further show how coordination and consensus-building unfold across ecosystem services and policy domains (Wiener et al., 2020; Hall et al., 2022; Lovrić et al., 2023; Winkel et al., 2022), while risk-informed decision frameworks demonstrate how uncertainty can be managed within sustainable land governance (Hurlbert et al., 2019). Recent analyses also reveal how digitalisation influences stakeholder coordination and learning in agroecological systems (Giagnocavo et al., 2025). Equity considerations – gender, rurality, and participation – remain pivotal for durable uptake and justice within transition pathways; empirical evidence on women-led social innovation in rural regions, for example, documents both enabling conditions and structural barriers (Sarkki et al., 2024), while collaborative innovation studies confirm the value of cross-sectoral partnerships in advancing the SDGs (Mariani et al., 2022). These strands reinforce the quadruple-helix orientation and the value of instruments that embed participation, accountability, and measurable impacts. This confluence of legitimacy, finance, and equity concerns underscores the continuing relevance of multi-actor foresight approaches and the need for operational tools capable of integrating social, economic, and environmental objectives within coherent innovation governance frameworks.

*Methodological lineage – From concepts to validated tools:* The conceptual bridge is the CASI Sustainable Innovation Conceptual Framework (Popper et al., 2016a), which synthesised definitional traditions (technological, systemic, social/institutional, transformative), reviewed FP5–H2020 trajectories, and identified the need for a flexible, multi-actor assessment and management tool, consistent with established foresight method-selection logic (Popper, 2008). CASI-F subsequently provided that tool through an inductive evidence base: from 548 nominations to 202 cases, from 1,852 goals to 1,700+ critical issues, and from 700+ actions to ten aspects and 150 meta-tasks, co-produced with innovators, experts, and citizen panels (Popper et al., 2016b; 2017a; 2017b; 2020a; Velasco et al., 2020). This corpus has since been connected to policy missions, aligning agendas with Green Deal priorities (Popper et al., 2025a) and extending the anticipatory dimension through wild cards and weak signals within a Sustainable Disruptive Growth perspective (Popper et al., 2025b). Together, these works establish internal consistency (concept-method–evidence) and external validity (programmatic and regional transferability) for a practitioner-facing instrument that informs development of the action-oriented Playbook introduced in the next subsection.

*From Evidence to Implementation – The Playbook Approach:* Given that EU and national instruments increasingly operate through designed ecosystems – such as interregional Regional Innovation Valley (RIV) initiatives (European Commission, 2023), cross-sectoral knowledge-transfer mechanisms (CEE2ACT, 2025), and national bioeconomy strategies that embed measurable sustainable innovation (SI) outcomes (Government of Finland, 2022; German Bioeconomy Council, 2018) – the field now requires a guided, repeatable operational instrument. The *Hundred and Fifty Shades of Green Playbook* translates the validated ten-aspect, 150-me-

ta-task corpus into sequenced, role-specific, and monitorable actions for government, business, academia, and civil society. It complements programme-level missions with an implementer’s logic – clarifying who acts, when, with which resources, and toward which indicators of impact. Drawing on the CASI-F and CASIPEDIA evidence base, as well as BOLERO’s regional learning, this study advances the Playbook as an integrative vehicle that operationalises the cumulative progression of sustainable innovation research – from conceptual frameworks to empirically grounded methodologies and actionable governance tools.

*Bridge to Methods:* Building on this cumulative body of scholarship and policy evolution, the next section shifts from conceptual synthesis to empirical grounding. We outline the inductive methodology and datasets – CASI-F, CASIPEDIA, and BOLERO – that underpin the ten aspects and 150 meta-tasks of sustainable innovation management. These datasets provide the evidence base through which principles of foresight, participation, and governance were translated into practice. The synthesis of this literature exposed a persistent gap between analytical frameworks and actionable implementation, motivating the development of the Action Roadmap (Table 4) and the Strategic Playbook for Sustainable Innovation Management (Table 5 and Annex A). Together, these instruments move the field from descriptive understanding to prescriptive guidance, enabling practitioners and policymakers to enact the systemic, foresight-driven logic articulated throughout this paper. The Playbook’s alignment with the SDGs and leading ESG frameworks is summarised in Annex B, illustrating its broader policy and reporting relevance.

## Methodology

### Developing CASI-F

The CASI project (2014–2017) adopted an action-research approach combining expert panels, citizen dialogues, and stakeholder workshops to analyse over 500 sustainable innovation (SI) cases and 40 pilot projects. This mixed-method design identified common success factors and classified innovations across product, service, social, and organisational categories. Using the RACER criteria – relevance, acceptance, credibility, ease, and robustness (European Commission, 2009) – CASI integrated multi-systemic indicators to assess SI impacts across economic, social, and environmental dimensions. The process revealed 1,700 critical issues (barriers, drivers, opportunities, threats) and more than 700 co-created actions from 43 pilots, clustered into ten management aspects and 150 meta-tasks forming an operational blueprint for governing sustainable innovation. These outputs were embedded in the CASIPEDIA web portal (<http://www.futuresdiamond.com/casi2020/casipedia/>), now hosting over 700 cases and functioning as a living repository refined through user contributions. Commissioned by the European Commission, CASI-F recognised that sustainability extends beyond technological innovation to include social, organisational, governance, and marketing dimensions. Following the project, the BOLERO initiative – a partnership between the University of Milano-Bicocca (Italy) and Futures Diamond (UK) – adapted CASI-F for national and

regional contexts, focusing on Lombardy’s SMEs and priorities such as mobility-as-a-service, manufacturing-as-a-service, and digital health.

The five-step CASI-F process (Figure 1) underpins both frameworks:

1. Scanning of innovations across diverse sectors;
2. Assessment 1.0 to evaluate 202 cases by practice, outcome, and stakeholder network;
3. Assessment 2.0 to map 1,721 critical issues and cluster them into 10 key aspects;
4. Management 1.0 to formulate 707 actions and derive 55 meta-actions; and
5. Management 2.0 to co-create 46 Action Roadmaps, culminating in 150 meta-tasks.

This inductive, evidence-based methodology enables structured learning and adaptation. CASI-F thus provides a robust foundation for cross-sectoral collaboration and foresight-driven management of sustainable innovation.

### Adapting CASI-F for BOLERO

The BOLERO project demonstrates how CASI-F can be localised to address the needs of SMEs and start-ups. While CASI-F offered a comprehensive, pan-European model, BOLERO refined it to match Italy’s policy landscape and regional sustainability goals. The adaptation preserved CASI-F’s pillars – multi-level stakeholder engagement, critical-issues analysis, and action roadmapping – but added stronger foresight and trend-scanning components. BOLERO’s platform enables mapping, evaluation, and management of local innovation portfolios. It guides SMEs in identifying barriers, aligning with national priorities, and co-creating roadmaps

for sustainable growth. The project has supported 28 case studies, most led by business, civil-society, and research actors, thereby linking local economic development with the broader Sustainable Development Goals (SDGs). Its foresight-driven design helps innovators anticipate emerging technologies, markets, and policy shifts.

Together, CASI-F and BOLERO exemplify a scalable approach in which global methodologies can be translated into regional action (see Table 2 above). As Nilsson et al. (2018) observe, the assessment of interactions is not purely technical but also socio-political – a perspective reflected in the frameworks’ participatory governance logic. By integrating analytical and social dimensions, both enable “joined-up” assessments of sustainability interactions and trade-offs across levels of governance.

### Insights from the BOLERO Platform: Sustainable Innovation Projects in Italy

The BOLERO platform provides a consolidated view of sustainable innovation activity in Italy. Its 28 registered projects span multiple regions and sectors, underscoring the country’s commitment to environmental and social sustainability. Approximately 60% originate in Lombardy, with others distributed across Lazio, Emilia-Romagna, and Campania, indicating national diffusion beyond major economic hubs.

Environmental priorities dominate: 18 projects address climate action, renewable energy, or sustainable mobility, aligning with SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action). Service and social innovations – about 10 and 8 projects respectively – tackle issues such as community engagement and equitable access. Nearly 46% incorporate digital technologies, and 79% are

Table 2. CASI-F vs. BOLERO

Aspect	CASI-F	BOLERO
Primary Focus	A comprehensive framework for SI across Europe and the world	Adapting CASI-F to suit national/regional needs, especially for SMEs
Geographical Scope	Pan-European	Primarily focused on Lombardy, Italy
Target Audience	Government, businesses, civil society, academia across Europe and the world	SMEs, start-ups, public administrations, civil society, universities in Lombardy and Italy
Sectoral Focus	Broad focus across multiple sectors (product, service, social, organisational, etc.)	Focus on local priorities: mobility as a service, manufacturing as a service, and digital health
Core Methodology	Multi-level engagement, action roadmapping, foresight-driven innovation management	Adapts CASI-F methodologies with greater emphasis on regional context, foresight, and stakeholder collaboration
Key Activities	Mapping, evaluation, action planning, meta-task development	Mapping, innovation assessment, boosting innovation with tailored roadmaps
Stakeholder Involvement	Broad multi-stakeholder involvement (government, business, civil society, academia)	Focus on enhancing participation of local SMEs and stakeholders from Lombardy
Output	46 action roadmaps for 43 pilot studies, 10 SI management aspects, 150 meta-tasks	28 case studies, innovation assessment reports
Strategic Tools	5-step process: scanning, assessment, critical issues mapping, action roadmaps, management	Foresight-driven strategies, action plans, and multi-stakeholder roadmaps tailored to regional goals
Post-Implementation	CASIPEDIA platform for ongoing refinement	Continuous support for SMEs and innovation projects through the BOLERO platform

Source: compiled by the authors.

initiated by public institutions, confirming strong governmental involvement. Every project links to at least one SDG, reflecting Italy's contribution to the 2030 Agenda.

This diversity illustrates BOLERO's capacity to integrate technological and societal innovation, connect regional initiatives with national sustainability strategies, and provide data for evidence-based policymaking.

### ***Showcasing MOBBI: An Exemplar of CASI-F and BOLERO's Combined Efficacy***

Among the BOLERO cases, MOBBI – a city-wide power-bank rental service – illustrates how the CASI-F framework can be transferred from EU-level design to a regional ecosystem. The service enables users to rent mobile power banks via app-connected stations, reducing disposable-battery waste and advancing SDG 11 (Sustainable Cities) and SDG 12 (Responsible Consumption).

MOBBI was integrated into teaching at the University of Milano-Bicocca's MSc programme, where students applied the BOLERO framework to evaluate sustainability, stakeholder engagement, and governance. The resulting feedback improved the company's operations and alignment with sustainability principles. This collaboration validates the transferability and practical relevance of CASI-F and BOLERO: even as MOBBI operates in a specific urban setting, the methodology's logic – foresight, stakeholder mobilisation, and action roadmapping – remains universally applicable.

This case therefore serves as a validation example for the framework's adaptability to diverse regional and institutional contexts, and it anchors the Action Roadmap presented later as a guide for operationalising the 150 meta-tasks across government, business, academia, and civil society.

## **Findings**

The CASI project analysed 500+ cases and 43 pilot projects, engaging the quadruple helix (government, industry, academia, civil society) to co-create 46 action roadmaps and 558 tasks. The evidence was clustered through expert panels and focus groups into 353 themes, which were then synthesised into 15 meta-tasks for each of the 10 key aspects of sustainable innovation (SI) management – yielding 150 universal meta-tasks (Figure 3). The complete set appears in Annex A.

These findings translate into practical managerial lessons that organisations can apply when integrating sustainability into strategy and operations. Their usefulness has been further validated through BOLERO, which adapts CASI-F to regional and SME contexts, demonstrating transferability across sectors and governance levels. Collectively, the results position CASI-F as a flexible, scalable tool for SI governance, supporting long-term change through stakeholder engagement and capacity building.

To aid navigation, the ten aspects are briefly profiled in table 3; Annex A provides the full inventory of 150 meta-tasks, and below we present an Action Roadmap that operationalises them across helix actors.

## **Discussion**

Both the CASI-F framework and its regional adaptation through BOLERO make substantive contributions to the governance and management of sustainable innovation (SI). One of CASI's most practical outcomes is the identification of 150 meta-tasks, synthesised from more than 550 actions and 350 themes, and structured under ten key aspects of SI management. These meta-tasks represent a coherent corpus of evidence-based managerial guidance for organisations seeking to embed sustainability within innovation processes.

What distinguishes CASI-F and BOLERO from other approaches is their adaptive, multi-stakeholder design. Built around the quadruple helix – government, business, academia, and civil society – the frameworks provide a participatory and continuously evolving platform for co-creating, co-assessing, and co-managing innovation. Unlike narrowly technical or sector-specific models, CASI-F and BOLERO embrace social, economic, and governance dimensions, ensuring that sustainability transitions are both viable and scalable.

BOLERO's application in the Lombardy region demonstrates how global frameworks can be translated to regional ecosystems without losing methodological coherence. The case of MOBBI, discussed below, illustrates how CASI-F principles can guide a start-up service innovation while validating the framework's transferability across contexts.

### ***Case Study: MOBBI as an Exemplar of Framework Transferability***

MOBBI is a Milan-based service innovation offering a city-wide network of mobile power-bank rental stations. The initiative addresses urban sustainability challenges – reducing e-waste and encouraging shared resource use – thus contributing to SDG 11 (Sustainable Cities and Communities) and SDG 12 (Responsible Consumption and Production). Its model integrates digital convenience with circular-economy principles, exemplifying how entrepreneurial innovation can simultaneously deliver environmental and social value.

Within the BOLERO framework, MOBBI served as a live learning laboratory. Students from the University of Milano-Bicocca applied the CASI-F methodology to analyse MOBBI's stakeholder ecosystem, governance model, and sustainability metrics. The co-evaluation process provided actionable recommendations that improved MOBBI's operational efficiency and strengthened its engagement with public and private partners.

MOBBI's relevance extends beyond its sectoral niche: it illustrates how CASI-F enables regional adaptation of EU-level priorities to local innovation ecosystems. By aligning citizen-centred services with sustainable-mobility agendas, MOBBI demonstrates the framework's transferability across “world-of-learning” regions – those capable of absorbing and contextualising European sustainability instruments. This reinforces the argument that CASI-F and BOLERO can remain relevant even if specific projects or platforms evolve, since the underlying logic of foresight, stakeholder mobilisation, and action roadmapping is universally applicable.

**Table 3. Key Dimensions of Sustainable Innovation Governance, Their Functions and Examples of Implementation**

Aspect	Function	Example
Momentum	Build mandate, direction, and visibility for SI.	Secure executive sponsorship and define 3–5 outcome KPIs; benchmark communication channels (cf. mission-oriented ecosystems)
Foresight	Anticipate trends, weak signals, and policy shifts; align action with futures evidence	Run a periodic horizon scan and convert insights into time-bound roadmap items.
Resources	Mobilise finance, data, infrastructure, and skills	Align public–private funding options to a staged SI portfolio; prioritise two high-impact capability investments
Mobilisation	Engage stakeholders and expand coalitions	Create cross-sector task forces and co-design a pilot showcase; strengthen transparency and participation
Aptitude	Develop competencies for SI management	Deliver targeted training (foresight, critical-issues mapping, roadmapping) and establish a peer-learning loop
Attitude	Shape culture and behaviours that sustain SI	Appoint SI ambassadors, recognise early wins, and link incentives to sustainability outcomes
Catalysts	Enable experimentation and early scaling	Conduct ex-ante evaluation and rapid pilots with end-users; communicate enablers and barriers widely
Fosterers	Support implementation and diffusion	Institutionalise feedback mechanisms with users and publish concise impact briefs to aid replication.
Transformation	Embed systemic change and transferability	Align pilots with regional missions and document socio-economic/ environmental stories for policy audiences
Sustainability	Ensure continuity, accountability, and learning	Adopt standard SI indicators and run annual multi-actor reviews to recalibrate priorities and reinvest savings

Source: authors, based on (Popper et al., 2020a; Köhler et al., 2019; Georghiou, 2018; Georghiou et al., 2008; Velasco et al., 2020; Martini et al., 2020).

### Action Roadmap for Implementing the “Hundred and Fifty Shades of Green”

*Purpose and context:* While Annex A enumerates 150 detailed meta-tasks for Sustainable Innovation (SI) management, practical implementation requires sequencing and prioritisation across the quadruple helix of actors – government, business, academia, and civil society. The following Action Roadmap distils this complexity into twenty integrative actions (two per aspect) designed to guide collective operationalisation of the CASI-F/BOLERO principles. Each action derives from the empirical evidence of more than 500 cases and 43 pilots, reflecting the shared logic of iterative learning, foresight-based planning, and participatory governance embedded in the original frameworks. The roadmap is therefore not prescriptive but configurational, adaptable to context-specific missions, institutions, and policy agendas.

This roadmap translates the conceptual architecture of the CASI-F and BOLERO frameworks into an operational

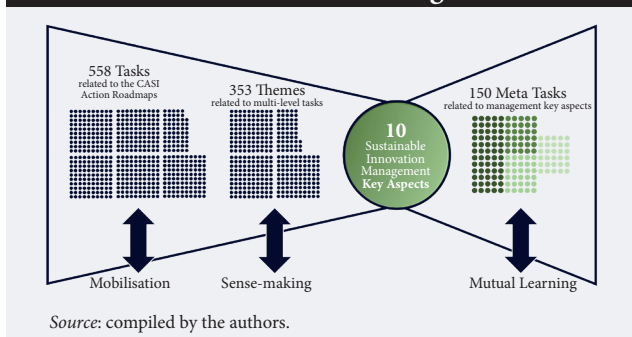
schema for coordinated action. Each aspect functions as a lever: Momentum provides leadership and direction; Foresight aligns vision with anticipatory intelligence; Resources and Mobilisation ensure capability and inclusion; Aptitude and Attitude cultivate human and cultural capital; Catalysts and Fosterers create adaptive feedback and diffusion mechanisms; Transformation and Sustainability embed systemic resilience.

In practice, these actions can serve as a diagnostic and planning matrix for policymakers, enterprises, and research institutions. By cross-referencing the roadmap with the 150 meta-tasks in the Annex A, organisations can identify maturity gaps, sequence priorities, and design collaborative interventions. Iterative use of the roadmap strengthens collective learning and accountability, ensuring that Sustainable Innovation Management evolves as a living system rather than a fixed framework.

Ultimately, this roadmap operationalises the evidence distilled from CASI-F and BOLERO into a replicable governance tool that fosters systemic collaboration and measurable progress toward sustainable, foresight-driven innovation ecosystems.

By embedding each aspect within an iterative cycle of analysis, planning, and review, the roadmap ensures that sustainable innovation initiatives remain responsive to emerging challenges and adaptable across geographies. For scholars, it provides a comparative lens to assess implementation maturity; for practitioners, a blueprint translating policy intent into operational reality. Together with the empirical base of CASIPEDIA and the regional learning from BOLERO, the roadmap completes the methodological arc from evidence to framework to action, reinforcing the paper’s dual contribution to theory and practice in sustainable innovation governance.

**Figure 3. The Journey from Multi-Actor Mobilisation and Sense-making to Mutual Learning**



Source: compiled by the authors.

**Table 4. Action Roadmap for Operationalising the “Hundred and Fifty Shades of Green” Playbook**

<b>Governance dimension</b>	<b>Proposed actions</b>
Momentum	1) Establish a Sustainable Innovation Mandate within each participating organisation, defining strategic goals and key performance indicators (environmental, social, economic). 2) Benchmark communication and coordination mechanisms among helix partners, and launch a collective awareness campaign to strengthen commitment.
Foresight	3) Conduct a participatory Critical Issues & Horizon Scanning exercise to anticipate sustainability trends, policy shifts, and technological opportunities. 4) Translate foresight insights into Action Roadmaps with explicit time horizons, responsible actors, and monitoring indicators.
Resources	5) Map and align financial, infrastructural, and human resources across organisations to identify synergies and funding gaps. 6) Develop a Resource Mobilisation Plan integrating public grants, private investments, and citizen contributions (e.g. crowdfunding).
Mobilisation	7) Build cross-sectoral task forces for Sustainable Innovation focusing on shared missions (e.g. circularity, decarbonisation, social inclusion). 8) Implement multi-channel stakeholder engagement (workshops, online platforms, media) to co-create and validate key actions.
Aptitude	9) Establish joint training programmes on foresight, innovation management, and sustainability assessment methods. 10) Encourage peer learning by creating a Community of Practice across regions and organisations implementing the framework.
Attitude	11) Promote a culture of responsible optimism and shared ownership through ambassador networks and incentive systems. 12) Showcase tangible sustainability impacts to reinforce pro-innovation behaviour and legitimacy among employees, users, and citizens.
Catalysts	13) Pilot rapid experimental projects (“learning-by-doing”) to test new governance or technological approaches in controlled settings. 14) Strengthen cross-media communication of pilot outcomes, highlighting enablers, barriers, and lessons learned.
Fosterers	15) Institutionalise feedback mechanisms to integrate user and stakeholder insights into policy or managerial adjustments. 16) Create recognition schemes (awards, certifications) to sustain motivation and visibility of successful innovations.
Transformation	17) Facilitate cross-sectoral transferability of effective practices, promoting knowledge spillovers between industries and territories. 18) Embed sustainability objectives within organisational strategies and regional development agendas, supported by data-driven evaluation.
Sustainability	19) Adopt standardised sustainability indicators and dashboards to monitor systemic progress and ensure accountability. 20) Institutionalise annual multi-actor reviews to recalibrate actions, reinvest benefits, and sustain long-term innovation ecosystems.

Source: compiled by the authors.

**Table 5. Strategic Playbook for Sustainable Innovation Management**

<b>Aspect</b>	<b>Strategic Objective</b>	<b>Key Actions (illustrative)</b>	<b>Intended Outcome</b>
Momentum	Create and sustain institutional drive	Establish cross-sector steering groups; set clear KPIs for SI impact; align communication strategies	Shared direction and leadership commitment
Foresight	Anticipate drivers, weak signals, and wild cards	Conduct annual horizon-scans; integrate scenario results into policy and investment planning	Future-proofed innovation agendas
Resources	Secure and optimise financial, human, and infrastructural assets	Blend public-private funding; develop open data infrastructures; encourage community financing	Resilient, diversified resource base
Mobilisation	Activate stakeholder participation	Launch multi-actor pilots; organise citizen co-creation labs; publicise success stories	Inclusive engagement and legitimacy
Aptitude	Build skills and organisational learning	Implement foresight and leadership training; establish inter-university SI modules	Enhanced innovation competence
Attitude	Foster responsible and ethical culture	Introduce sustainability incentives; promote ambassadors and role-model narratives	Values-based organisational behaviour
Catalysts	Enable experimentation and early validation	Pilot rapid prototypes; perform ex-ante impact assessments	Evidence-driven iteration
Fosterers	Consolidate diffusion and feedback	Create continuous evaluation loops; issue open impact reports	Transparent improvement cycles
Transformation	Scale systemic change across helix actors	Coordinate cross-sector missions; document transferable lessons	Policy and social-system alignment
Sustainability	Institutionalise learning and longevity	Integrate SI indicators into budgets; establish annual multi-stakeholder reviews	Enduring, self-reinforcing ecosystems

Source: compiled by the authors.

## ***Integrating the Roadmap into the Playbook***

The roadmap reinforces the inductive, evidence-based logic of CASI-F and BOLERO by offering an actionable synthesis that can be reused independently of any single case. It operationalises the *Hundred and Fifty Shades of Green Playbook*, translating the 150 meta-tasks into a living management tool for scholars and policymakers alike. By embedding each aspect within an iterative cycle of analysis, planning, and review, the roadmap ensures that SI initiatives remain responsive to emerging challenges and adaptable across geographies.

For academic readers, it provides a structured lens to compare implementation trajectories and evaluate the maturity of innovation ecosystems; for practitioners, it offers a blueprint to translate policy intent into operational reality. Together with the empirical base of CASIPEDIA and the regional learning from BOLERO, the Playbook and its roadmap complete the methodological arc from evidence → Playbook → action, strengthening the paper's contribution to both the theory and practice of sustainable innovation governance.

## **Conclusions**

The CASI-F and BOLERO frameworks have demonstrated substantial potential as adaptable instruments for assessing and managing sustainable innovation (SI) across governance levels, sectors, and regions. By combining stakeholder-led methodologies, foresight-based planning, and multi-systemic impact criteria, they provide structured yet flexible pathways for aligning sustainability objectives with real-world applications. Through the quadruple helix model – engaging government, business, academia, and civil society – they foster collaboration, mutual learning, and shared responsibility, thereby enhancing the likelihood of achieving long-term sustainability goals. The synthesis of 150 meta-tasks across ten key aspects of SI management offers an evidence-based management blueprint to guide, evaluate, and refine innovation processes in alignment with economic, social, and environmental priorities.

The Action Roadmap for Implementing the “*Hundred and Fifty Shades of Green*” Playbook provides a tangible mechanism to operationalise these findings. By linking strategic foresight with stakeholder mobilisation and sustainability assessment, it extends CASI-F and BOLERO into a practical governance instrument. This enhances usability across organisations and strengthens their value as transferable models for sustainable innovation management across regional, national, and global contexts. Significantly, it ensures continuity and alignment with global sustainability frameworks, including the United Nations Sustainable Development Goals (SDGs) and Environmental, Social and Governance (ESG) disclosure standards (see Annex B).

## ***Future Research Directions and Way Forward***

Future research should deepen comparative analysis and scalability. While CASI-F and BOLERO have proven versatile, further studies are required to explore their performance across diverse socio-economic and cultural contexts,

including regions beyond Europe. Implementing these frameworks in contrasting governance settings will help clarify their global applicability and reveal how participatory innovation systems adapt to local institutional realities.

Integrating these frameworks into major policy agendas – such as the European Green Deal – presents an opportunity to test their effectiveness in large-scale sustainability transitions (Csedó et al., 2025; Chatterjee et al., 2023). Research should also investigate how digital transformation and AI-driven analytics can augment foresight and monitoring capacities, improving responsiveness and coordination across governance levels. Moreover, embedding foresight as a diagnostic dimension within innovation-system analysis can help identify and mitigate potential system failures – including directionality, coordination, and capability gaps – that often hinder sustainability transitions (Kim, Flanagan, 2024; Woothius et al., 2005; Lee, 2018). In this way, foresight-oriented management becomes a preventive mechanism, transforming vulnerabilities into opportunities for adaptive learning and resilience.

Finally, future inquiry should address soft institutional barriers – such as cultural inertia, informal networks, and risk aversion – that constrain innovation uptake. Overcoming these socio-cultural impediments requires fostering trust, openness, and experimentation across the quadruple helix. Building such an enabling environment will allow sustainability-oriented innovation to flourish not only through technological or financial resources but also through renewed social capital and institutional learning. At the same time, researchers and practitioners must remain alert to the risk of path dependency when playbooks are adopted wholesale; the iterative, participatory review cycle embedded in this approach is designed precisely to ensure flexibility, contextual adaptation, and continuous learning.

In conclusion, the integration of policy foresight, participatory governance, and evidence-based management, as embodied in the CASI-F and BOLERO frameworks, provides a robust foundation for advancing sustainable innovation governance. The *Hundred and Fifty Shades of Green Playbook* builds upon this foundation – together with the Action Roadmap – to translate empirical findings into strategic implementation. By linking conceptual insight with operational guidance, these instruments ensure that innovation ecosystems remain adaptive, resilient, and aligned with global sustainability goals. Collectively, they fulfil the paper's dual ambition: to strengthen the theory of sustainable innovation management and to deliver a practical, foresight-driven tool for shaping future-ready, sustainability-oriented ecosystems.

## ***From Framework to Playbook: A Decade of Learning***

This article represents the latest stage in a decade-long programme of research on sustainable-innovation governance and foresight-based management. It consolidates and extends a coherent body of work that has progressively defined, validated, and operationalised the CASI-F methodology and its derivative frameworks, culminating in the development of the *Hundred and Fifty Shades of Green Playbook*.

The conceptual foundations were established in *CASI-F: Common Framework for the Assessment and Management of Sustainable Innovation* (Popper et al., 2017a), which introduced the original structure for evaluating sustainability across environmental, social, and economic dimensions. Subsequent studies (Popper et al., 2017b; Velasco et al., 2020) empirically validated this model through multi-actor case analyses, producing the evidence base for the ten management aspects and 150 meta-tasks.

The framework's theoretical consolidation appeared in *Sustainable Innovation Assessment and Management Framework: Principles, Methodology and Practice* (Popper et al., 2020a), which formally situated the inductive, quadruple-helix approach within contemporary innovation-management scholarship. Parallel advances in foresight and anticipatory governance – including the integration of wild-card and weak-signal analysis (Popper et al., 2025a) – provided

the forward-looking dimension now embedded within the Playbook's logic. The most recent policy synthesis (Popper et al., 2025b) demonstrated its alignment with the European Green Deal and broader sustainability-transition agendas.

Collectively, these contributions establish a coherent research corpus that underpins the present study both conceptually and methodologically. The *Hundred and Fifty Shades of Green Playbook* thus emerges not as an isolated tool but as the operational embodiment of this validated lineage – a practitioner-ready extension of the CASI-F and BOLERO frameworks that translates evidence into action. This cumulative progression ensures conceptual coherence, empirical credibility, and a demonstrable trajectory from theory → framework → practice, reinforcing the robustness and transferability of the current contribution to sustainable-innovation governance.

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## Annex A. 150 meta-tasks for SI development, distributed across 10 management aspects

MOMENTUM: Actions that help to move the SI forward.				
Analyse the competition	Analyse existing training programmes	Analyse top-level & strategic management structures	Benchmark communication channels by target group	Create guidelines for industries
Gain senior management team buy-in	Identify & study best practices and state of art of the field	Identify critical issues and challenges	Identify high-level objectives for project impact	Identify new partnerships, networks, and investors
Identify relevant people and regulations in politics	Identify relevant structures and frameworks	Improve business practices (standards, certificates, tools)	Organise site visits	Strengthen marketing channels (brand image)
FORESIGHT: Actions that help to deal with future-oriented strategic drivers of the SI.				
Conduct inventory of strategic targets and projects	Create an internal and external communication strategy	Differentiate “buzzes” from trends	Develop staff expertise and knowledge on future trends	Engage into existing dialogue on topic with leading experts
Engage the public in decision-making processes	Explore tools for collaboration & communication	Identify emerging business models, trends & innovations	Identify mutual objectives with other actors	Identify new target groups, potential investors & alliances
Monitor events, news, articles and conferences	Organise brainstorming sessions to identify new ideas	Scan the horizon for trends, practices and opportunities	Set strategic objectives and activities	Set up umbrella organisations to deal with market changes
RESOURCES: Actions that provide the means needed for the SI conception				
Apply for local/(inter)national funding with the right partners	Attract business partners, investors and collaborators	Choose a spokesperson and lobby for resources	Conduct an inventory of infrastructure needs	Develop infrastructures for monitoring and marketing
Engage local citizens and local businesses as partners	Evaluate and improve education material	Expand geographical coverage with economics of scale	Explore crowdfunding opportunities for innovation	Facilitate internal knowledge exchange
Gain access to data on best European and global practices	Generate information on relevant reference cases	Identify and monitor existing relevant databases	Include funding opportunities into concept development	Map and manage resources (e.g. limiting target groups)
MOBILISATION: Actions that boost the SI capacity to reach and involve key stakeholders.				
Conduct pilots encouraging sustainable values	Create multimedia content and social media campaigns	Develop real-time communication channels	Engage in knowledge exchange with similar projects	Engage regional and local stakeholders
Find advocates by launching competitions	Gain internal support from management	Identify existing expansion strategies	Identify new stakeholders and strengthen existing networks	Identify training needs and develop new training methods
Improve the relationship with policymakers and investors	Increase the transparency in the decision-making process	Organise workshops and roadshows to boost awareness	Promote public participation and citizen engagement	Seek endorsements, references and success stories
APTITUDE: Actions that help to build or boost the actual skillset or competences of people involved in the SI.				
Accumulate knowledge with stakeholders and partners	Adapt to different contexts, e.g. language, environment	Attract strategic partners and use public participation	Create educational and training material (for trainers)	Develop key skills (foresight, leadership, negotiation)
Educate public on the impact of the innovation	Enable internal knowledge sharing (e.g. away days)	Enable external knowledge exchange (e.g. study visits)	Encourage mutual motivation among team members	Engage managers in critical issues mapping
Engage stakeholders in innovation and idea generation	Foster creativity, research skills and networking	Identify correct contact points for stakeholders	Implement systematic evaluation system	Matching correct people with correct task
ATTITUDE: Actions that help to deal with the behaviour of people involved in the SI.				
Create an innovation culture with social responsibility	Disseminate facts on positive impacts of the innovation	Encourage enthusiasm and commitment to learn	Engage high-profile people as ambassadors and mentors	Foster interpersonal and communication skill
Foster optimism, engagement and collaboration	Increase understanding of customer needs and end-users	Involve staff in PR activities to clarify the company vision	Involve top managers in attitude-changing campaigns	Implement incentives for personnel engagement
Nurture dialogue between employees & local community	Promote cost savings & quality improvement spirit	Recruit people passionate about the cause	Train ambassadors for the cause internally & externally	Use several methods/tools to measure satisfaction
CATALYSTS: Actions that help to deal with critical factors enabling the SI design and development phases.				
Apply for multiple sources of funding	Collaborate with local and national media	Conduct ex ante evaluation of the innovation process	Conduct pilots and testing with specific target groups	Identify scalability challenges and react accordingly
Initiate cooperation to reach larger audience	Introduce learning-by-doing methods to deepen knowledge	Involve employees and stakeholders in testing	Involve key business partners in research activities	Involve new actors at different stages of the process
Launch educational material on the innovation's impacts	Launch targeted PR and communication campaigns	Organise crowdfunding campaigns	Segment shareholders into groups	Use bottom-up processes in the development phase
FOSTERERS: Actions that help to deal with critical factors supporting the SI implementation and diffusion phases.				
Apply for funding opportunities and programmes	Attend and organise networking activities	Build collaboration practice with employees and partners	Create good practices, FAQ and guidelines for employees	Create incentives for ambassadors and citizens
Develop innovation by engaging in research	Engage experts in creating the teaching materials	Engage into social research or political discussions	Ensure continuous dialogue with end-users	Exploit the best existing bottom-up processes
Highlight the environmental, social and economic impact	Implement systematic management of critical issues	Improve communication and dissemination plans	Promote ex post evaluation of impact and excellence	Re-invest the savings gained for continuous improvement
TRANSFORMATION: Actions that help to deal with positive changes in the quadruple helix of SI and knowledge transfer.				
Consolidate emerging players and promote spinoffs	Create knowledge-based products and services	Create targeted campaigns on the impact	Engage multi-actors in visioning & paradigm shifting	Foster sustainability in targeted geographical areas
Foster transferability between different sectors	Gather success socio-economic & environmental stories	Increase community sense and young people engagement	Promote entrepreneurship and innovations skills	Promote positive cultural and behavioural change
Provide user-friendly information to stakeholders	Refocus goals and priorities based on impact assessment	Support the development of competences and skills	Use innovative marketing to promote sustainable lifestyles	Use job creation as measurement of impact
SUSTAINABILITY: Actions that help to bring positive changes in the socio-technical system in which the SI operates.				
Allocate resources to support sustainable innovations	Create self-sustainable sustainability campaigns	Develop green & social solutions in rural/urban areas	Develop transparent public engagement strategies	Emphasise the environmental economic & social impacts
Expand networks & collaborate with local actors	Identify key markets in need for sustainable innovations	Identify new ways to encourage cost/energy savings	Implement new regulations & incentives for sustainability	Share knowledge on green firms, products and services
Use of clear sustainability indicators and targets	Refocus priorities and goals based on impact assessment	Seek sustainability assessment and management advice	Share sustainability best practices and infrastructures	Support the deployment of sustainable services

Source: compiled by the authors.

## Annex B. Linking the “Hundred and Fifty Shades of Green” Playbook to SDGs and ESG

Annex B shows how the Playbook’s ten aspects operationalise priority Sustainable Development Goals (SDGs) and align with leading Environmental, Social and Governance (ESG) reporting frameworks—such as the Global Reporting Initiative (GRI), Corporate Sustainability Reporting Directive (CSRD), Sustainability Accounting Standards Board (SASB), and Task Force on Climate-related Financial Disclosures (TCFD). It supports scholars and practitioners to:

- map actions to internationally recognised outcomes,
- select decision-grade indicators, and
- report consistently across projects and regions.

### How to read this annex

- Primary SDGs are direct linkages; adjacent SDGs indicate frequent co-benefits.
- ESG pillars show where value is created or risk is mitigated.
- Illustrative indicators are examples—select those most material to the innovation and context (double-materiality logic).

### B1. SDG–ESG Mapping by Playbook Aspect

Playbook Key Aspect	Primary SDG linkages (adjacent)	ESG pillar(s)	Illustrative contribution/ outcome	Example indicators (GRI/CSRD/TCFD-friendly)
Momentum	SDG 9 (SDG 8, 17)	G	Clear SI mandate, targets, governance	Board-approved SI policy; % leadership incentives tied to SI KPIs; existence of SI risk register
Foresight	SDG 13 (SDG 7, 12)	G	Anticipatory planning, climate & transition alignment	Scenario coverage (including 1.5–2°C scenarios); frequency of horizon scans; % capex aligned with foresight priorities
Resources	SDG 12 (SDG 9, 7)	E, S, G	Efficient capital, infrastructure, skills	Share of budget to SI; energy/material intensity trends; % of staff trained in SI
Mobilisation	SDG 17 (SDG 11, 16)	S, G	Multi-actor coalitions & transparency	# co-creation events; diversity of stakeholders; public reporting cadence
Aptitude	SDG 4 (SDG 8, 10)	S	Workforce & partner capabilities	Training hours/FTE (full-time equivalent) on SI/foresight; competency assessments; inclusion metrics in capacity-building
Attitude	SDG 12 (SDG 3, 5)	S, G	Culture of responsibility & ethics	Code-of-conduct coverage; whistleblowing uptake; employee engagement on SI
Catalysts	SDG 9 (SDG 11, 13)	E, G	Prototyping, pilots, early validation	# pilots; time-to-pilot; % pilots adopting ex-ante impact appraisal
Fosterers	SDG 11 (SDG 1, 10)	S, E	Diffusion, inclusion, continuous improvement	Adoption rate beyond pilot; access/affordability metrics; ex-post impact evaluations
Transformation	SDG 16 (SDG 17, 8)	G, S	Policy alignment, norms, market rules	Policy changes supported; standards adopted; inter-agency Memoranda of Understanding (MOUs)
Sustainability	SDG 13 & SDG 12 (SDG 6, 14, 15)	E, S, G	Long-term integration and accountability	Science-based targets status; lifecycle impact metrics; annual multi-actor review completed

### B2. Indicator menu (pick-and-use)

- **Environmental (E):** Greenhouse gas (GHG) emissions (Scopes 1–3), energy mix, water use, waste and circularity rate, lifecycle impacts of products/services, and climate-risk exposure (TCFD alignment).
- **Social (S):** Access and affordability of SI outcomes, stakeholder participation breadth, job quality and reskilling, gender and inclusion metrics, and community-impact evidence.
- **Governance (G):** SI strategy and oversight, internal controls for claims, transparent evaluation (ex-ante/ex-post), grievance and ethics channels, and supply-chain due diligence.

Evidence sources: CASIPEDIA case entries, BOLERO assessments, Action Roadmaps, citizen-panel outputs, policy briefs, financial plans, and external audits.

### B3. SDG target cues (illustrative, select as relevant)

- Examples include SDG 7.2–7.3 (renewable energy, efficiency), SDG 9.4 (industry upgrading), SDG 11.2–11.6 (urban mobility, pollution), SDG 12.2–12.7 (resource efficiency, waste reduction, sustainable procurement), SDG 13.2 (climate integration), SDG 16.6–16.7 (effective, inclusive institutions), and SDG 17.16–17.17 (partnerships).

### B4. ESG disclosure alignment (quick guide)

- **GRI and CSRD:** Use a materiality assessment to select indicators for each Playbook aspect, and document policies, actions, and outcomes following a Policy–Action–Result logic.
- **SASB:** Add sector-specific metrics – e.g., material efficiency for manufacturing or data privacy for digital sustainable innovations.
- **TCFD:** Position foresight outputs (scenarios, risk analyses, resilience strategies) under the Governance, Strategy, and Risk Management pillars, and link the Catalysts and Fosterers aspects to Metrics and Targets.

### B5. Implementation checklist

- Select 3–5 material SDGs per project; map Playbook actions to ESG indicators; set time-bound targets; define data owners and methods; schedule annual multi-actor reviews; and publish a concise SI impact note.

### B6. Risks and safeguards

- **Path dependency:** Avoid rigid templates by applying the Playbook’s iterative review cycle (learn–adapt–scale).
- **Impact washing:** Require ex-ante and ex-post evaluations with documented assumptions and independent verification where feasible.
- **Equity gaps:** Track inclusion metrics and ensure benefits are equitably distributed across communities (Aptitude and Fosterers aspects).

### B7. Worked micro-example

- **Mobilisation** → SDG 17 / S, G: Co-creation labs with small and medium-sized enterprises (SMEs) and municipalities; indicator: number of joint roadmaps adopted; evidence: signed Memoranda of Understanding (MOUs) and published actions; disclosure: GRI 2-29 (stakeholder engagement), CSRD ESRS S1–S3.

**Value added:** This annex demonstrates that the Playbook is not merely procedural—it is externally legible against SDGs and ESG frameworks, audit-ready for reporting, and adaptable across regional and organisational contexts. It thus enhances the Playbook’s legitimacy, comparability, and measurable impact within sustainability-oriented innovation governance.

Source: compiled by the authors.