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A Global Commons Framework for Systems Transformation toward the SDGs: Operationalizing pathways through coupling data infrastructures, integrated modelling, co-design, and sustainable financing

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Operationalizing pathways through coupling data infrastructures,
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Abstract

The world faces a convergence of interconnected crises (climate change, biodiversity loss, sovereign debt stress, food-energy-water insecurity, widening inequalities, wars and geopolitical instability) interacting through nonlinear feedbacks to produce cascading effects invisible to sector-by-sector analysis. Despite the comprehensive vision of the Sustainable Development Goals (SDGs), global implementation lags, constrained less by a lack of knowledge than by weak operational frameworks capable of translating systemic evidence into coordinated action. Influential sustainability transition frameworks such as the "Six Transformations" of 2019, and the "entry points and levers" of the 2023 Global Sustainable Development Report (GSDR) have organized what needs to change, but the categories they prescribe are imposed a priori on diverse country contexts and offer limited guidance on how to operationalize change. This Perspective argues that the persistent implementation gap is, at its core, an operational gap: entry points and levers should be the outcomes of measurement and modelling within a country-specific feasible set, not inputs assumed in advance. We propose a three-step operational framework: continuous monitoring and assessment, science-based co-designed transformation pathways bridging modelling and stakeholder engagement, and aligned financing and governance mechanisms, all delivered through an open-access digital Global Commons. Drawing on the architecture of the SDSN Global Climate Hub, we demonstrate how coupling data infrastructure, interdisciplinary modelling chains, digital twins, and stakeholder co-design processes can produce spatially explicit, policy-relevant, and implementable sustainability pathways at national to global scales. We further argue that embedding ecosystem services valuation into macroeconomic assessments and reforming the global financial architecture are essential complements to this approach. The framework is designed not as a universal prescription but as a replicable, adaptive methodology that can bridge the persistent gap between scientific assessment and policy delivery in the final push toward 2030 and beyond.

Keywords: Digital Global Commons; AE4RIA-SDSN Global Climate Hub; Systems Transformation; WEF Nexus; Beyond-GDP Computable General Equilibrium; Sustainable Finance; Participatory Co-Design; Accountability.

1. Introduction

The contemporary sustainability challenge is frequently characterized as a poly-crisis: A condition in which multiple systemic stresses (e.g., climatic, economic, social, ecological, and geopolitical) do not merely coexist but actively reinforce one another through cross-scale feedback loops (Lawrence et al., 2024). Climate shocks amplify food and energy insecurity; debt stress constrains adaptive capacity; institutional fragility undermines coordinated response; and technological disruption reshapes labour markets and trade patterns in ways that deepen existing inequalities. The result is a risk landscape that is fundamentally different from one in which challenges can be addressed independently: interventions that resolve one pressure may inadvertently worsen another, and apparent progress in one domain may mask deepening vulnerability elsewhere.

The 2030 Agenda for Sustainable Development and its 17 SDGs remain the most comprehensive normative framework for addressing these interlinked challenges. Yet implementation has been strikingly slow. At the global scale, 196 countries signed UN Agenda 2030, 193 submitted Voluntary National Reviews, but implementation progress stands below 20%, and many indicators are moving in the wrong direction (Sachs et al., 2023). The reasons are structural rather than epistemic: humanity possesses the scientific knowledge, the technological capability, and the aggregate financial resources (approximately $30 trillion in annual global savings) to achieve the SDGs. What is lacking is an operational infrastructure capable of aligning these assets across sectors, scales, and governance levels (Alamanos et al., 2025). The multilateral system itself is under strain, under continuous wars and instability, while accountability mechanisms to keep the globe on track for an equitable transition are too weak, and coordination structures are too fragmented to drive implementation at the pace and scale required.

Recent efforts to address this implementation gap have converged on the idea of organizing the SDGs around a small number of cross-cutting transformations. Sachs et al. (2019) proposed six SDG Transformations as modular building blocks of SDG achievement (covering education and inequality; health and well-being; energy decarbonization and sustainable industry; sustainable food, land, water and oceans; sustainable cities; and the digital revolution) each engaging a distinct subset of government, business, and civil society. The 2023 Global Sustainable Development Report (Independent Group of Scientists, 2023) extended this logic by identifying six entry points for transformation, largely overlapping with the Sachs et al. categorization, together with cross-cutting levers (governance; economy and finance; individual and collective action; science and technology; capacity building) through which transformations can be accelerated, and an S-curve dynamic that traces their emergence, acceleration and stabilization against the breakdown and phase-out of unsustainable systems. These contributions have shaped how international institutions, governments, and the scientific community articulate SDG implementation, and they remain essential reference points for any subsequent work on sustainable transitions.

Against this background, the purpose of this Perspective is twofold. First, we argue that, while these frameworks usefully organize what needs to transform and what levers can accelerate transformation, they leave a significant operational gap. Their entry points and levers are prescribed a priori, often before the actual ecosystem, sectoral interdependencies, and constraints of a given country have been measured. In practice, policymakers struggle to fit their specific situation into pre-defined categories, and the frameworks offer limited guidance on how to translate them into coordinated, country-specific action. We therefore argue that entry points and levers should emerge as outcomes of measurement and integrated modelling, within a feasible space defined by coupled biophysical, economic, and social systems. Second, we propose a practical framework for operationalizing this re-ordering: a three-step approach of continuous monitoring, science-based co-designed pathway development, and aligned financing, delivered through an open-access digital Global Commons. We draw on the architecture of the Global Climate Hub (GCH), an AE4RIA-United Nations Sustainable Development Solutions Network (SDSN) initiative, as an illustrative example (Alamanos, 2024). The framework developed here is also intended to inform the next iteration of this lineage, given that one of us (P.K.) is currently Co-Chair of the Independent Group of Scientists drafting the 2027 Global Sustainable Development Report, the final GSDR before the 2030 deadline.

2. The Systems imperative: Why sectoral and pre-categorized approaches fall short

Conventional policy design tends to address sustainability challenges within sectoral silos. For instance: energy ministries develop decarbonization plans; agricultural agencies set food security targets; water authorities manage basin allocations (Koundouri et al., 2025a). While each domain has generated valuable knowledge and policy instruments, this compartmentalized approach systematically underestimates the interactions between systems. A policy that accelerates renewable energy deployment, for example, may compete for land with agriculture, alter water demand through hydropower or biofuel production, and shift trade balances in ways that affect fiscal stability (Sovacool and Walter, 2019). Similarly, shipping decarbonization strategies that overlook domestic biofuel production potential may create new import dependencies (Koundouri et al., 2025c). These interdependencies are not peripheral complications; they are central features of the sustainability challenge that determine whether policy packages succeed or fail in practice.

The poly-crisis intensifies this problem. When multiple stresses interact simultaneously, the space for single-sector optimization narrows dramatically (Srikrishnan et al., 2022): E.g., a drought that would be manageable in isolation becomes a compounding crisis when it coincides with energy price volatility, sovereign debt pressure, and supply chain disruption due to wars. Under these conditions, policies designed within a single sector or without the acceptance and commitment of diverse stakeholders and funding mechanisms, can generate unintended cascading effects across others, creating a governance gap that no individual ministry or agency can bridge alone.

The frameworks introduced to overcome these silos have made important conceptual progress, but they leave a related gap unresolved. The Six Transformations (Sachs et al., 2019) and the entry points and levers of the Global Sustainable Development Report (Independent Group of Scientists, 2023) provide modular categories around which governments and stakeholders can organize SDG implementation. They make a strong case that transformation must be cross-sectoral and that levers such as governance, finance, science and technology, and individual and collective action must be mobilized in parallel (Figure 1).

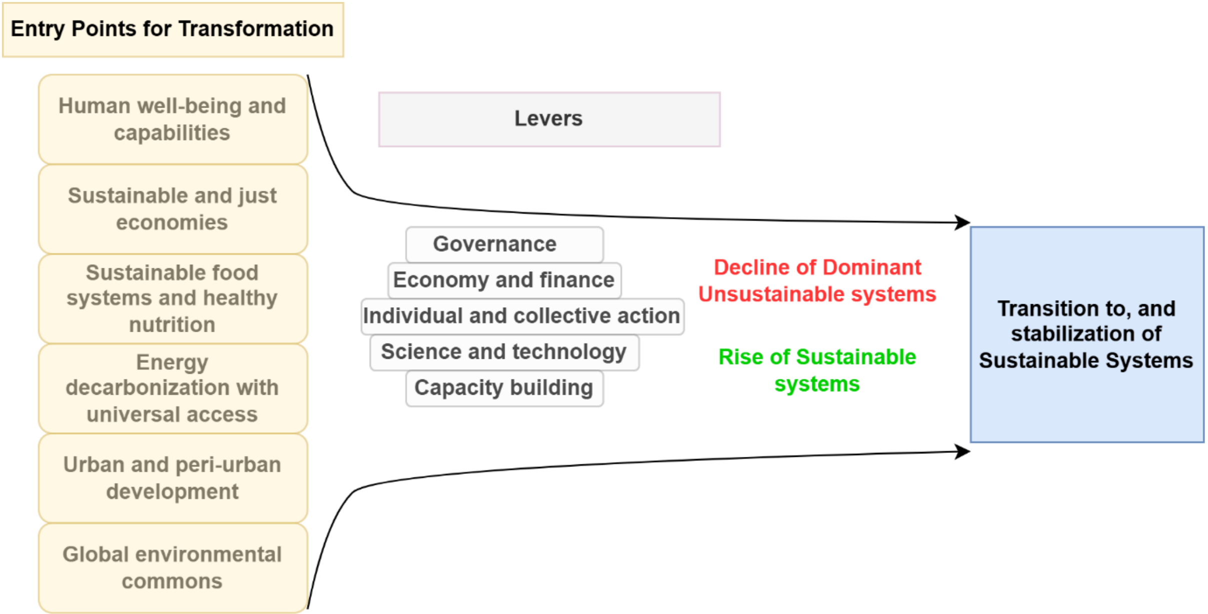

Figure 1: The conceptual framework as described in the GSDR 2023 report.

However, these categories are prescribed a priori. They are presented before any country-specific measurement of resource stocks, ecosystem condition, sectoral interdependencies, or institutional capacity has taken place. As a result, policymakers and practitioners are often asked to fit highly heterogeneous national situations into a fixed set of boxes whose boundaries do not always correspond to the actual structure of the system they are trying to govern. Where the institutional, ecological, or economic context differs substantially from the implicit reference case, the categories become abstract, and the link between the framework and concrete implementation becomes correspondingly weak.

This limitation can be expressed in more formal terms. Each pre-defined entry point (human well-being, sustainable economies, food systems, energy decarbonization, urban development, and the global environmental commons) can be understood as the maximization of a welfare or sustainability objective. Yet such an objective can only be meaningfully optimized once the feasible set has been defined: the constraints imposed by the underlying ecological, hydrological, energy, food, climate, and economic systems, together with their interactions and feedbacks. Without this constraint space, the optimization problem is incompletely specified. Frameworks that begin from the entry points themselves implicitly assume that the feasible space is either known, uniform across contexts, or unimportant; in practice, it is none of these. A country with binding water constraints, an export-oriented agricultural sector, and a fragile fiscal position faces a fundamentally different feasible set from one with abundant water, an industrial economy, and access to long-term concessional finance. Pre-categorized entry points obscure these differences rather than reveal them.

What is needed, therefore, is not simply better analysis within each sector or each pre-defined transformation, but a different ordering of the policy-design process. Sustainability challenges should be understood as coupled systems (climate, energy, land, water, food, transport and industry, health, and economic systems beyond GDP) (Huynh et al., 2022), whose interactions are first measured and modelled, and only then organized into entry points, levers, and pathways that reflect the specific constraint space of the context being analyzed. The categories of action should emerge from this analysis rather than be imposed on it. While the importance of integration is not itself a new idea, the contribution we develop in the following sections is the operational means to make it happen: a measurement-first, model-coupled, participatory architecture that produces tailored, implementable solutions rather than country-by-country adaptations of pre-existing categories. Data-driven modelling approaches contribute to this capability by translating alternative policies, investments, and social choices into quantified short-, medium-, and long-term outcomes. When combined with participatory processes, digital technologies, and capacity building, modelling becomes an operational instrument enabling decision-makers and communities to co-design, test, course-correct, and implement actionable pathways toward the 2030 Agenda and beyond.

3. Sectoral silos mirrored in the global financial architecture

The achievement of the 2030 Agenda is increasingly constrained not by a lack of global savings but by deep structural inefficiencies in the global financial architecture, which continues to misallocate capital away from high-return sustainable development investments, particularly in low- and middle-income countries. Financial flows remain concentrated in advanced economies, reflecting systemic biases in international markets, regulatory frameworks, and institutional governance structures (Sachs et al., 2023). This misallocation persists despite evidence that investments in human capital, infrastructure, and climate resilience in developing economies can yield significantly higher marginal returns than comparable investments in high-income countries (Khan et al., 2023).

Several structural barriers must be addressed. First, development processes require financing horizons of 20 to 40 years, yet most international capital flows are characterized by short maturities and high interest rates, exposing developing countries to refinancing risks (UN, 2023). The prevailing Debt Sustainability Framework has been criticized for prioritizing short-term debt indicators over long-term growth potential, thereby constraining productive investments (IMF and World Bank, 2025). Credit rating agencies may also underestimate the creditworthiness of developing economies, contributing to borrowing costs that are higher than warranted by fundamentals (UNDR, 2024). Second, multilateral development banks remain undercapitalized relative to the estimated SDG financing gap of $4 trillion per year, despite their demonstrated capacity for countercyclical lending and strong financial performance (OECD, 2023). Third, financing for global public goods such as climate mitigation, biodiversity conservation, and pandemic preparedness remains structurally underprovided, with official development assistance still below the 0.7% of Gross National Income (GNI) target (OECD, 2025).

The outcomes of the Fourth International Conference on Financing for Development (FfD4) in Sevilla (2025) reflect a growing consensus on the need for reform while illustrating the political constraints that hinder transformative change. Member States endorsed expanding MDB lending capacity, improving coordination between public and private actors, and exploring innovative instruments including blended finance and sustainability-linked debt. The conference also introduced “coalitions of the willing” as a governance mechanism to advance ambitious initiatives where universal consensus remains elusive (UN, 2025). These developments signal a gradual shift toward more pragmatic and adaptive global economic governance, though significant gaps remain between commitments and implementation, particularly in areas requiring structural transformation and redistribution of financial power.

Addressing these barriers requires an approach that treats financial misalignment not as a standalone problem but as part of the same systemic fragmentation diagnosed in Section 2, and therefore amenable to the same measurement-first, integrated response developed in the following sections.

4. A Global Commons for operational sustainability pathways

We argue that a practical way forward is to develop an open-access digital Global Commons: a shared infrastructure of data, models, and decision-support tools that allows governments, researchers, and stakeholders to develop operational and implementable sustainability

pathways at national to global scales. The concept draws on the tradition of knowledge commons (shared resources governed by collective rules) and extends it to the digital infrastructure required for evidence-based sustainability governance (Mazzucato, 2024).
The Global Climate Hub (GCH), anchored within the AE4RIA-SDSN network, offers one concrete example of this approach (Alamanos, 2024). The GCH is an interdisciplinary initiative that couples advanced AI-ready data infrastructure, interdisciplinary mathematical and statistical models, transdisciplinary stakeholder engagement, training, and co-design methods (Koundouri et al., 2024b). It brings together nine complementary units spanning digital infrastructure and AI, atmospheric physics, energy, transport, health, socio-economics, sustainable finance, innovation, and participatory co-design, to ensure the co-production of techno-economic analyses and societal needs. These processes are supported by an open e-platform that harmonizes data, hosts models and results, and creates interactive scenario explorers for users. Policymakers and practitioners can select scenarios, alter parameters (such as dietary patterns, renewable siting constraints, or carbon prices) and immediately see spatial maps, sectoral balances, welfare indicators, and exposed vulnerabilities, facilitating evidence-informed decisions and rapid policy prototyping. Following the principles of open science, all models, key datasets, and decision-support tools are made accessible through the platform, accompanied by training modules and curricula to upskill local teams. This open-access character is not incidental to the framework but constitutive of it: by making the analytical infrastructure itself a global public good, the e-platform addresses the classic market failure under which evidence, models, and decision-support capacity are systematically underprovided to the actors who need them most. It thereby converts what would otherwise be a fragmented set of proprietary or context-bound tools into shared, policy-ready capacity available across countries and institutions, ensuring reproducibility, transferability, and the long-term scaling of good practice across diverse institutional contexts. Capacity building is supported by AI-assisted training tools and open-access curricula developed within the GCH that lower the barriers to using the modelling chain in data- or expertise-constrained settings, and through partnerships with established global education platforms that extend the methods beyond expert users to broader implementation communities.
Compared with frameworks that begin from pre-defined entry points and levers (Sachs et al., 2019; Independent Group of Scientists, 2023), the architecture proposed here re-orders the policy-design process. Measurement comes first, defining the feasible space within which transformation is to be designed; sectoral and cross-sectoral interactions are then modelled with stakeholder co-design; and only after this is the question of where to intervene, with which levers, and through which financing instruments answered. Entry points and levers thus emerge as outputs of the analysis rather than as inputs to it. Our operational architecture can be summarized into three steps (Figure 2).

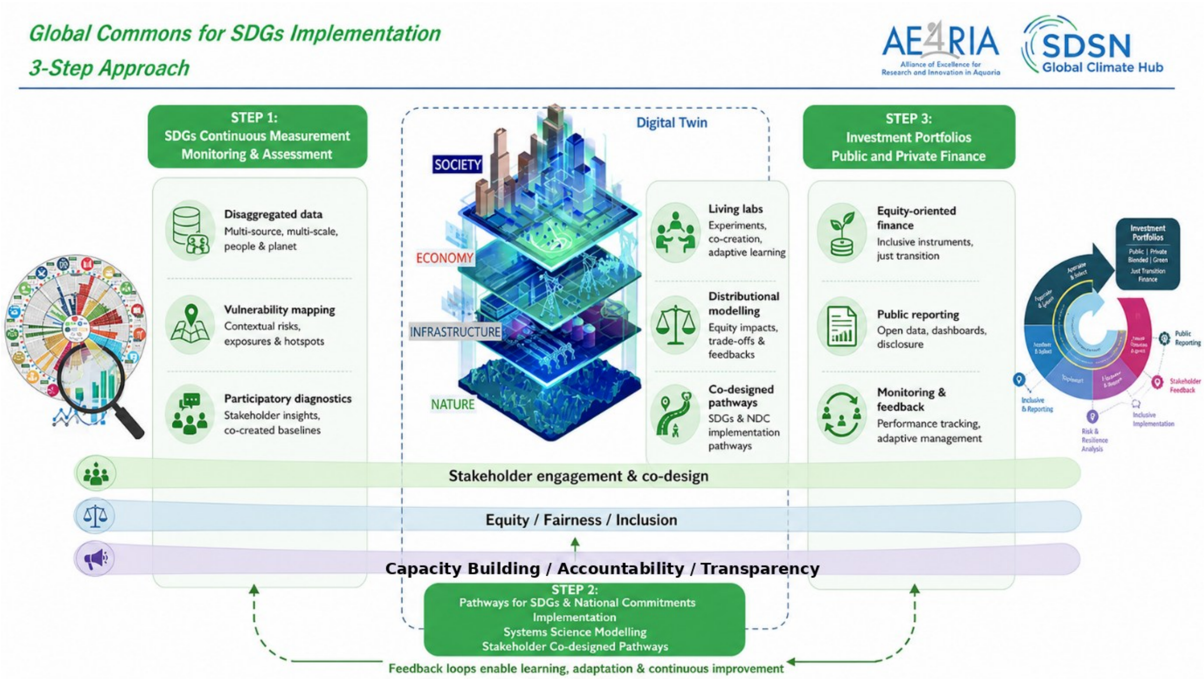

Figure 2: AE4RIA-SDSN Global Commons for Sustainability Transformations.

Step 1, Continuous Monitoring and Assessment:

The first step establishes a rigorous evidence base that is spatially explicit, temporally consistent, and policy-relevant. It combines observational and administrative data, remote sensing layers, socio-economic statistics, and infrastructure inventories; performs baseline diagnostics of resource stocks, vulnerabilities, and hotspots; develops digital twins and quality-assured data pipelines to feed the modelling system; and also assesses the gaps compared to existing national targets. The output is a policy-ready interactive baseline: dashboards, hotspot maps, and risk matrices that identify priority interventions, inform resource allocation, and help shortlist transformation systems and policy levers for immediate action. This step provides the foundation for both modelling in Step 2 and stakeholder engagement throughout the process. Whereas the Six Transformations and the GSDR levers begin by assuming the categories of intervention, Stage 1 begins by characterizing the system to be transformed: its resource stocks, its binding constraints, its vulnerabilities, and the interactions among them. This empirical foundation is what allows subsequent categories of action to fit the country in question, rather than the country being asked to fit the categories.

Step 2, Science-Based Transformation Pathways:

The second step combines modelling and stakeholder engagement in a two-way process of information exchange and co-design. It convenes stakeholders in living labs to define objectives, constraints, and plausible narratives (Alamanos et al., 2022; Guittard et al., 2024). In parallel, it runs coupled modelling chains, including spatial land-use, water-risk, marine-use, energy-system simulation and optimization, and economy-wide assessments that combine macroeconomic analysis with beyond-GDP inputs such as ecosystem service valuation. These models are used to evaluate synergies, trade-offs, and distributional outcomes across indicators including national commitments, the SDGs, and broader welfare metrics (Koundouri et al., 2024a). The aim is to connect sectoral expertise through a dynamic feedback loop that captures cross-system interactions more explicitly than conventional modelling approaches (Gambhir et al., 2019). For example, land use evolution pathways inform energy and macroeconomic projections; macroeconomic outcomes reshape land and energy demand and trade (in a uniquely complete manner, since they are adjusted to account for beyond-GDP considerations); water stress acts as a constraint that modifies productivity and feasible technical and financial pathways, and so on. Which are or will be these models can be a decision for the analysts, and our aim is to provide the connection logic rather than a strict plan.

Critically, models are not developed in isolation. Stakeholder engagement through transformative living labs and participatory workshops embeds user priorities and local knowledge into scenarios and assumptions, improving legitimacy, surfacing social feasibility constraints such as distributional impacts, and helping ensure pathways are implementable (Akinsete et al., 2025; Koundouri et al., 2026). Stakeholder engagement is operationalized through the AE4RIA Living Labs network and an asynchronous e-tool (the Living Lab Modeler) that enables distributed contributions across geographies and time zones, extending participation beyond what conventional in-person workshops can accommodate (Guittard et al., 2024).

The output is a portfolio of candidate transformation pathways across short-, medium-, and long-term horizons, together with quantified co-benefit and trade-off matrices, ranked policy packages, and investment roadmaps for decision-makers, ready to be matched to financing instruments in the third step.

Step 3, Financing Pathways and Investment Portfolios:

This step directly addresses the structural financial barriers diagnosed in Section 3. Effective transformation requires aligned fiscal instruments, blended finance, and policy coherence, linking funding sources to priority measures and using compact key performance indicators to track progress. Where Section 3 identified the misalignment between short-term capital flows and the 20- to 40-year horizons that development processes require, this step responds by connecting co-designed pathways to financing strategies that are explicitly structured around long-term investment logic, risk-sharing mechanisms, and performance-linked instruments capable of attracting both public and private capital on appropriate terms.

In practice, this means translating the modelled transformation pathways from Step 2 into NDC gap assessments, budget stress-testing frameworks, and adaptation investment plans that can engage multilateral development banks, sovereign wealth funds, and blended-finance facilities. The Pathways2Resilience Catalogue for Adaptation Finance, developed by AE4RIA, supports this translation by offering a comprehensive overview of 55 funding sources, 61 financial instruments, and 169 implementation case studies, helping regions identify which mechanisms match their fiscal constraints, overcome financing barriers, and develop bankable investment plans (Pathways2Resilience, 2025). In this way, the third step operationalizes the reform agenda emerging from processes such as FfD4 in Sevilla (expanding MDB leverage, deploying sustainability-linked debt instruments, and building coalitions of the willing) by grounding these instruments in the evidence base and co-designed pathways produced in Steps 1 and 2.

The financing layer should also represent resilience and transition investments over time and compare financing options (from grants and concessional debt to guarantees, blended finance, private participation, and contingent finance) according to their affordability, fiscal implications, distributional consequences, and overall economic performance. Ecosystem-service valuation can help translate environmental and resilience benefits into economic signals that inform revenue models, public support mechanisms, and blended-financing structures.

A further bridge between system-wide transition pathways and real-economy transformation lies at the micro-economic level of finance. Even where governments adopt credible sustainability strategies, implementation depends on how firms, investors, and financial intermediaries allocate capital, manage risk, structure supply chains, and disclose sustainability performance. Aligning corporate emissions accounting, double-materiality assessment, ESG indicators, and SDG-relevant metrics can translate broader sustainability goals into decision-relevant signals for markets and regulators. Firm-level sustainable finance is therefore not separate from the wider transformation agenda; it is one of the mechanisms through which pathways become operational, investable, and accountable. It also raises important equity concerns, since smaller firms may struggle to meet expanding reporting and data requirements unless new standards are accompanied by technical support, proportionate compliance arrangements, and open-access enabling infrastructure — precisely the kind of capacity that the open-access Global Commons is designed to provide.

Across the three-step architecture, stakeholder engagement is embedded as a cross-cutting implementation mechanism rather than a separate consultation exercise. In Step 1, participatory diagnostics and disaggregated evidence reveal whose vulnerabilities, capabilities, and constraints define the feasible space; in Step 2, living labs and modelling translate these inputs into pathways whose distributional impacts and social feasibility are tested; and in Step 3, accountability arrangements link financing, public reporting, and corrective action to stakeholder review. Equity, capacity building, and accountability therefore operate throughout the cycle, helping ensure that pathways are technically sound, socially legitimate, and revisable over time.

5. Integrating Ecosystem Services and beyond-GDP valuation into multi-model transformation pathways

Within the three-step architecture described above, beyond-GDP valuation is not an add-on but a structural component of the modelling chain at Step 2. Ecosystem service values, externalities, and natural capital accounts enter the macroeconomic layer of the coupled model chain (typically through a Computable General Equilibrium – CGE framework) as welfare-relevant variables, allowing the framework to estimate the costs of inaction across sectors and regions and to compare them with mitigation and adaptation pathways. The model outputs are then translated into policy and finance tools, including National Commitment gap assessments, budget stress-testing frameworks, financing pathways, and a web-based Decision Support Navigator hosted on the open-access e-platform that allows users to test customized scenarios in line with the Global Commons Vision (Figure 3).

A core pillar of the socio-economic architecture is a beyond-GDP valuation framework that monetizes non-market benefits and damages associated with water quantity and quality, flood regulation, pollination, marine and freshwater ecosystem health, biodiversity, air quality, urban cooling, public health, and other ecosystem-dependent services. It also includes the values of out-of-market human and cultural capital. This broadens pathway appraisal from narrow GDP accounting toward incorporating natural, human, and cultural capital into assessments of welfare, resilience, and sustainable development performance (Koundouri et al., 2023a, 2023b, 2024c; Halkos et al., 2024; Remoundou and Koundouri, 2009). This is supported by an AE4RIA Digital Public Good and Externalities Valuation infrastructure based on meta-analytic value-transfer methods and biophysical–economic modelling that allow context-specific estimation of non-market values, including in data-scarce regions.

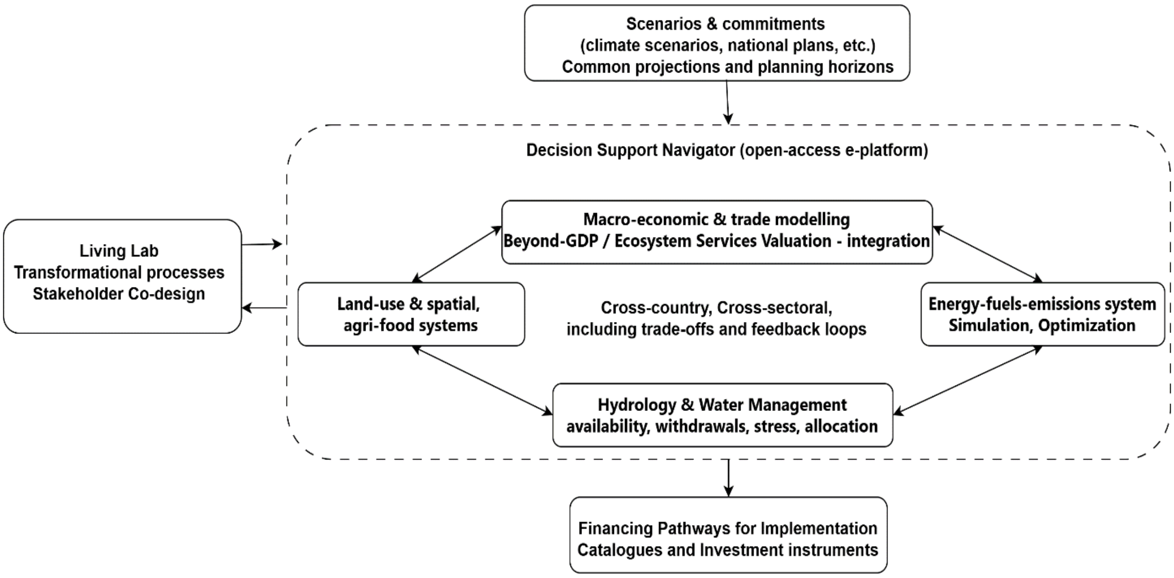

Figure 3: The architecture of the GCH's approach. The dashed container represents the open-access e-platform (Decision Support Navigator) hosting the entire modelling ecosystem. Inside, four generic sectoral 'expert' models are shown with indicative linkages (land-use, energy, water, economy) showing the hard-coupled feedback loops. The Living Lab process sits outside the platform as a parallel participatory process, with two arrows showing the two-way flow: stakeholder priorities and constraints going in, model results and trade-offs coming back for co-design iteration. At the bottom, Financing Pathways (with P2R) receives the outputs from the platform, closing the loop from analysis to delivery. Thus, we also show how the steps of Figure 1 can be connected.

This positioning is a substantive departure from frameworks that treat economy and finance as one of several generic levers (Independent Group of Scientists, 2023): in our architecture, the welfare space within which pathways are evaluated is itself constructed through beyond-GDP integration into the macroeconomic core, rather than corrected after the fact by external instruments. Operationally, this draws on established environmental and resource economics methods. Meta-analytic value-transfer functions and biophysical–economic modelling generate context-specific welfare estimates for ecosystem services, including in data-scarce environments (Guignet et al., 2022), drawing on harmonized repositories such as the Environmental Valuation Reference Inventory and the Ecosystem Services Valuation Database to produce shadow prices for externalities and natural-capital change (Koundouri et al., 2013, 2024c). These valuation outputs are linked to a dynamic CGE macroeconomic core (e.g., a GTAP-type multi-region, multi-sector structure extended with natural-capital, land-use, water, and ecosystem-service accounts), where ecosystem-service flows enter as productive inputs, resource constraints, welfare shifters, or damage modifiers. This allows water shocks, ecosystem degradation, conservation policies, restoration investments, and externality-pricing instruments to propagate through production, consumption, trade, fiscal outcomes, employment, welfare, and distribution. Pathways can then be compared not only on aggregate efficiency, but also on distributional impacts, intergenerational equity, and the long-run costs of inaction, with appropriate weight given to future ecosystem services and climate benefits through declining discount rates in long-run policy evaluation (Buła and Foltyn-Zarychta, 2023).

When these welfare-adjusted outputs are incorporated into fiscal instruments, investment frameworks, or blended-finance schemes, they lay the groundwork for bankable projects that reward conservation, restoration, and sustainable resource use. At the firm level, ESG–SDG toolkits enable companies to quantify ecosystem benefits and externalities, translating impacts into financially relevant metrics that facilitate the development of green bonds, sustainability-linked loans, and other instruments mobilizing private capital toward sustainable development (Koundouri and Landis, 2026).

6. Discussion

The central argument of this Perspective is that the persistent gap between sustainability ambition and implementation is not primarily a knowledge deficit but a structural one. Sections 2 and 3 diagnosed two faces of the same fragmentation: sectoral policy silos that fail to account for cross-system interactions, and a global financial architecture that mirrors those silos by misallocating capital through short-term, sector-bound, and geographically biased instruments. These are not separate problems requiring separate solutions; they are reinforcing dimensions of a governance model designed for a simpler world than the one we now inhabit. Even the most influential efforts to overcome this fragmentation (Sachs et al., 2019; Independent Group of Scientists, 2023) have made important conceptual progress while leaving the operational layer largely unaddressed. Their categories tell governments *what* to transform and *what* levers to pull, but not *how* to design coordinated, country-specific action when the constraint space differs from one nation to the next. The framework proposed in Sections 4 and 5 responds to this operational gap, not by displacing those contributions, but by providing the measurement-first analytical and financial infrastructure through which their ambitions can become tractable in practice.

Four features distinguish this approach from earlier integrated assessment work. First, and most fundamentally, it re-orders the policy-design process: measurement comes before categorization, so that entry points, levers, and pathways emerge as outputs of analysis rather than inputs assumed in advance, reflecting the actual ecosystem, sectoral interdependencies, and institutional realities of the country being analyzed. Second, the hard-coupled multi-model architecture treats cross-sectoral interactions as endogenous feedback loops that are formally modelled and quantified, with beyond-GDP integration changing the welfare calculus that drives pathway ranking, investment prioritization, and distributional analysis. Third, participatory co-design is embedded as a structural input to the modelling process rather than as external consultation, improving both technical quality and political feasibility. Fourth, the framework closes the loop between analysis and delivery by connecting co-designed pathways directly to financing instruments — through NDC gap assessments, budget stress-testing, adaptation investment plans, and catalogues such as Pathways2Resilience — addressing a recurring weakness of integrated assessment: the production of sophisticated analyses that do not translate into implementation.

The framework is designed to be applied in multiple contexts, which is why we do not prescribe a fixed set of models. Instead, we present a modular structure that can be adapted to local data availability, institutional capacity, and policy priorities. It has already been demonstrated through place-based applications that provide evidence of its transferability and reproducibility. National-level assessments have exposed critical interdependencies that remain invisible in single-sector plans, such as competition between renewable land-use expansion and agriculture, or cascading effects of shipping decarbonization on domestic fuel demand (Koundouri et al., 2025a). Regional assessments across European national climate plans have revealed the need for coordinated cross-border electricity and hydrogen trade, alignment between energy and agricultural policy frameworks, and equity-oriented finance for lower-income Member States (Koundouri et al., 2025b). International assessments in developing countries have identified pathways that generate multi-country co-benefits while avoiding policy conflicts (Englezos et al., 2023). These are not theoretical illustrations; they are decision-support tools already informing policy processes, and they constitute the practical foundation on which the philosophy advanced here has been built.

We do not claim that this framework resolves every dimension of the poly-crisis. Geopolitical instability, armed conflict, and deep structural inequalities in global power relations remain beyond the reach of any modelling exercise. Peace and institutional stability are therefore preconditions for SDG implementation: without them, the security, trust, fiscal space, and cooperation required for long-term investment and stakeholder participation erode. What the framework can do is help governments act more strategically within the space available to them: making trade-offs explicit, identifying co-benefits that justify political coalition-building, and connecting scientific evidence to financial instruments capable of mobilizing action at the required scale. In a world where the temptation is either paralysis in the face of complexity or retreat into the false comfort of sectoral silos, providing a measurement-first, participatory, and finance-connected operational infrastructure is, we believe, a meaningful and overdue advance.

Looking beyond 2030, the priority must shift from target dates to system resilience, institutional learning, and equity-first implementation, with pathways treated as flexible, adaptive portfolios that monitoring, stakeholder feedback, and evidence-based corrective action can revise as risks and opportunities evolve. The SDG agenda is not fundamentally flawed; it lacks the operational infrastructure required to deliver on its own ambition. The Global Commons Vision proposed here is one possible model for that infrastructure: an adaptive, open-access platform that tracks outcomes at high granularity, shares best practices across borders, and supports targeted technical and financial assistance where it is most needed. Its value lies not in providing a universal blueprint but in offering a replicable way to connect evidence, participation, and finance in support of durable transformation. After years of working alongside governments, communities, scientists, and financial institutions, we are convinced that the missing piece is not another conceptual map of where the world should go, but the practical means by which it can get there — and that the cost of failing to build that infrastructure, in human, ecological, and economic terms, is one no generation should be asked to bear.

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The authors declare no conflicts of interest.

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