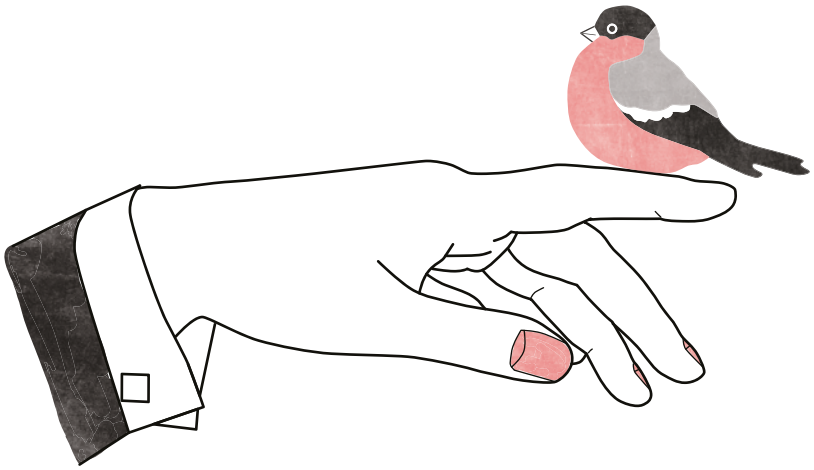

WHY

should public policy support transformative eco - innovation?

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WHY

should public policy support transformative eco-innovation?

Outlook 1

The Innovation Turn: Why transformative eco-innovation needs to be at the centre of any government's agenda today

By Michal Miedzinski, UCL ISR, Andrea M. Bassi, KnowlEdge, Will McDowall, UCL ISR, and René Kemp, UNU-MERIT

1 THE CHALLENGE OF SUSTAINABLE INNOVATION

The world today faces **multiple challenges** spanning environmental, economic and social dimensions. These challenges are global and closely interconnected. Major environmental crises, such as climate change, depletion of natural resources and harmful pollution, erosion and biodiversity loss, are driven by the economic system relying on the unsustainable levels of production and consumption. There is a growing realisation that solutions to the global environmental crises have to address their social and economic roots.

The nature and scale of sustainability challenges require systemic understanding and systemic solutions. While we have seen considerable improvements in environmental technologies tackling industrial pollution and more recently an impressive progress in renewable energy technologies, the overall progress towards greening the global economy has been modest. Worryingly, the state of the planet's ecosystems has continued to deteriorate in many areas. Technological innovation brought unquestionable benefits to businesses, societies and the environment. Alone, however, it cannot offer a systemic cure for the global challenges we face. The transition to sustainability cannot be reduced to a series of technological breakthroughsorisolated policies, and should directly embrace the societal processes of developing and diffusing new solutions, whether of technological or non-technological nature. We are yet to fully appreciate and embrace the systemic perspective on green economy transition in business, research and policy.

We need system innovations that transform the relations between economy, society and environment globally and locally to align them on the path towards sustainable development. Transformative innovations are to challenge dominant business models, redesign entire functional systems, change urban and rural landscapes, and advance new governance and policy frameworks (Steward 2008). Innovative technologies and products can become sustainable only when they are part of larger socio-economic shift towards sustainable future. The challenge of sustainable innovation, whether in a small town or in corporate headquarters, is to rethink and innovate systems.

2 ECO-INNOVATION FOR TRANSFORMATIVE CHANGE

Innovation has been and will be at the heart of all socio-technicaltransitions in the human history. Today we face an unprecedented challenge of imagining, designing and fostering **innovations with a purpose** to enable and accelerate the transition towards sustainable development. We need innovations that contribute to sustainability by striking a balance between environmental, social and economic needs. A reflection is needed about **what types and modes of innovation – or what combinations of innovations – are likely to become transformative and feasible** to implement in different economic, social and cultural contexts around the world.

Many types of innovation can contribute to sustainable development. Table 1 presents a classification of eco-innovation based on the selected classifications in the literature. Eco-innovation ranges from process improvements to systemic changes comprising many functionally connected innovations (e.g. new urban designs, new transportation systems, new production-consumption models based on services).

Box 1. The short history of eco-innovation

The concept of "eco-innovation" emerged from the debates in the 1980s that pointed to a possible alignment of technology, economy and the environment to tackle the emerging environmental challenges and to move towards sustainable development. The term "eco-innovation" entered the public debate in the second half of the 1990s on the wave of the sustainable development debates preceding and following the Rio Earth Summit in 1992.

In their book devoted to "eco-innovation", Claude Fussler and Peter James (1996) called for "super innovation" to address for sustainability challenges. Fussler and James built on the WBCSD's concept of eco-efficiency: "the delivery of competitively priced goods and services that satisfy human needs and bring quality of life while progressively reducing ecological impacts and resource intensity, through the life cycle, to a level at least in line with the earth's estimated carrier capacity." Eco-innovation and related terms have climbed the policy agenda over the last decade, notably in Europe and OECD. They were at the centre of green economy and green growth debates, and were explicitly recognised by the UN as key for meeting the Sustainable Development Goals (UN 2015).

Traditionally, the focus of eco-innovation was mainly on solutions minimising negative environmental impacts from production and consumption activities. These "end-of-pipe" or "downstream" solutions allow for limiting and cleaning up harmful emissions (e.g. pollution control technologies, catalytic converters in cars). Thanks to their social and environmental benefits, environmental technologies have become a tangible symbol of environmental modernisation. They will continue to play a crucial role in reaching Sustainable Development Goals (SDGs), notably by reducing negative impacts of human activity on health and climate. The "end-of-pipe" solutions, however, have not been designed to overhaul the current unsustainable production and consumption system.

(Next page) Figure 1. The many faces of eco-innovation

Process innovation

- Pollution control and pollution treatment technologies:
  - Pollution control technologies
  - Cleaning technologies that treat pollution released into the environment
  - Noise and vibration control
  - Environmental monitoring technologies (meters)
- Waste prevention and waste management:
  - Waste management processes and equipment
  - Integration of secondary materials in the production
- Resource efficient processes:
  - Material, energy and water efficient production processes
  - Renewable energy uses in manufacturing

Product and service innovation

- Innovative technologies, notably renewable energy technologies
- Innovative products
  - Novel competitive products with a reduced lifecycle-wide environmental impact (e.g. durability, reparability, re-usability, recyclability, biodegradability).
  - Novel eco-innovative materials with a reduced lifecycle-wide environmental impact and a capacity to substitute existing alternatives.
  - Frugal innovation with a reduced lifecycle-wide environmental impact due to a reduced complexity of products (re)designed or remanufactured to deliver core functions.
- Innovative services
  - B2B: Provision of services aimed at improving processes of clients (e.g. waste management, environmental consulting, eco-design).
  - B2C: Provision of services that are less resource intensive and reduce emissions (e.g. extended warranties and repair services).

Organizational innovation

- Environmental management and auditing systems (such as EMAS, ISO 14001).
- Introduction of Total Quality Management to the organization.
- Introduction of Extended Producer's Responsibility solutions (CSR).

Marketing innovation

- Informing customer choices (e.g. independently verified eco-labels).
- Science-based campaigns and awareness raising on sustainable consumption.

Business model innovation (single-actor models).

- Radical changes in value proposition and product-service systems of companies (e.g. circular economy business models, including product sharing and functional sales).

Social innovation

- New social arrangements that are environmentally advantageous (e.g. energy cooperatives, repair cafés, eco-villages)

Eco-system restoration

- Afforestation, soil remediation, re-introduction of mangroves for flood protection).\

System innovation (multi-actor models)

- Radical changes in value proposition and product-service systems engaging a group of functionally connected organizations:
  - Multi-actor product-service systems (e.g. product sharing platforms and infrastructure).
  - Industrial ecology.
  - Waste management systems (integrated approaches to collection, sorting, processing and disposal).
  - Green cities and urban ecology.
  - Integrated mobility systems with a reduced use of cars.

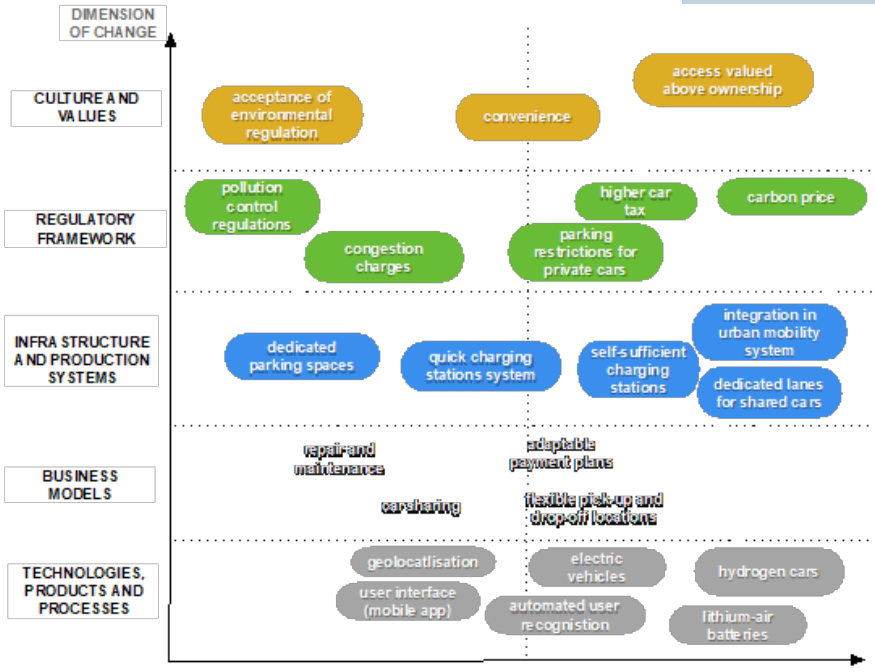
Source: Adapted from Miedzinski, McDowall, Bleischwitz (2017)

The need for the radical overhaul of the current production and consumption model calls for eco-innovations likely to bring about transformative impacts. Businesses and governments already pay increasing attention to such systemic solutions, and experiment with alternative business models (e.g. in the circular and sharing economy), integrated infrastructural systems (e.g. urban mobility), and governance and policy frameworks (e.g. carbon tax) that promise systemic impact.

One perspective on transformative innovation is the notion of **system innovation** (Geels 2005, OECD 2015). System innovations, as systemic eco-innovations, includes a range of functionally connected changes of both technological and non-technological nature (including policy framework) that, enacted together, deliver transformative impact on the level of functional systems (e.g. mobility, health, shelter). Such innovations can make some existing products or services redun dant, and prevent negative environmental impact. This perspective offers an integrated framework to foster synergies between innovation efforts pursued in various sectors and locations in an uncoordinated manner. This approach rests on the premise that design and process of system innovation can in fact be co-designed and collectively managed. This opens up questions on business models and modes of governance suitable for tackling complexity, uncertainty and risk inherent in innovation process.

Importantly, system innovation embraces changes of both incremental and radical nature seeking to exploit functional connections between them. The impact of system innovation depends on the strength of systemic synergies between its elements, and on its capacity to radically reconfigure or substitute existing systems. Industrial ecology or urban mobility models, for example, rely on the combination of product, organizational and process adaptations as well as infrastructural investments (see Figure 2). These individual changes may be incremental on their own, however, their combination may lead to disruptive impact in specific contexts. The system innovation cannot be captured from the perspective of its single components.This approach illustrates how system design can combine many innovations to gradually amount to a bigger change.

Figure 2. An electric car sharing model as a system innovation



The elements of electric care sharing model are highlighted in yellow. The model can be extended and gain further impact by covering other elements.

Source: Miedzinski (2017)

3 THE CASE FOR SUSTAINABLE INNOVATION

Challenges addressed by eco-innovation range from resolving specific technical problems to remodelling entire systems of production and consumption. We present benefits of eco-innovation (environmental, social and economic) implemented with a predominant focus on different problems.

We argue system eco-innovation can multiply positive impacts, and become a long-term strategy addressing complex sustainability challenges. Figure 3 illustrates the potential of eco-innovation to address Sustainable Development Goals (SDGs). Practically, there are eco-innovations that support reaching a single SDG, while possibly creating challenges for others (see Text Box 2 on the rebound effect as an example), and there are system eco-innovation that contribute to reaching several SDGs simultaneously. For instance, renewable energy supports clean energy (SDG7) and job creation (SDG8), if installed in remote areas it reduces inequalities (SDG10) and it represents climate action (SDG13). Further, if integrated in buildings it supports SDG 11, and indirectly it would reduce poverty (SDG1).

Environmental benefits

Eco-innovation with the main focus on environmental challenges improves livelihoods of urban and rural communities around the world:

- Cleaner environment: preventing and minimising harmful emissions to air, water and soil, including GHGs and toxic substances, by applying environmental technologies, promoting renewable energy and waste management schemes.

- Improved resource and energy productivity: improving manufacturing processes and applying circular economy business models.

- System design with nature: contributing net benefits to ecosystems by investing in nature-based solutions, including green cities and green infrastructures.

Environmental benefits can be delivered by different types of technological innovation. The transformative solutions, however, can be advanced by system innovation engaging various stakeholders and aiming at longer-term benefits.

Business case

Eco-innovation focused on improving business performance and competitiveness offers multiple opportunities for firms:

- Cost savings: reducing operational cost by improving efficiency of the use of materials and energy.

- New markets:improving competitiveness and reaching new markets by developing eco-innovative technologies, goods and services.

- New business models: creating new markets by revisiting and redefining value proposition and customer channels.

Cost savings through material and energy efficiency are an example of low-hanging-fruit opportunities offered by eco-innovation. Efficiency improvements, however, are not without a risk for environmental sustainability (see Box 2).

The challenge of sustainability transition requires a more systemic reflection from innovative businesses. Business model innovation may spring from reconsidering the core service an organisation delivers to its customers and society. It may lead to pursuing models relying less on products and more on the services delivered.

Social opportunity and wellbeing

Eco-innovation may bring benefits for local communities and the society at large:

- Environmental health: improving health by controlling and reducing pollution and exposure to toxic substances.

- Green jobs: creating new jobs and improving quality of jobs.

- Wellbeing and social justice: contributing to wellbeing and social justice by implementing business models based on better access to affordable and healthy goods and services, including product sharing models.

Towards transformative system eco-innovation

While eco-innovations focused on specific problems will continue to provide benefits to communities around the world, the sustainability transition towards a green economy requires a broader focus on system solutions with benefits spanning environmental, economic and social dimensions. This is because side effects may emerge from the implementation of interventions and the adoption of technologies (see Text Box 2) that aim at maximising the performance of one indicator or one sector. The benefits these interventions generate may be offset by the additional challenges created for other sectors or indicators.

(Box 2)

System innovation is a strategy that aims to balance social and economic development with environmental sustainability. It supports the improvement of a system's performance rather than the optimisation of one of its parts in isolation. System innovation addresses all dimensions of development, including changes in behaviour and consumption practices.

(Box3)

Box 2. The risk of the rebound effect

Sustainable innovation is often referred to as a win-win solution. In order to become a win-win, however, new products and services need to be carefully scrutinised and assessed taking into account their likely system-wide impacts. This requires applying system thinking throughout the innovation process, from design to implementation.

In reality, the win-win solutions may be challenging to achieve, and some innovations with a sustainability ambition fail to achieve environmental or social benefits. Even products with improved energy and resource efficiency performance may inadvertently contribute to higher negative environmental impacts. This may occur when an improved product is used with a greater intensity and/or in greater numbers than its previous versions. In these cases, the overall aggregated negative impact of the use of the new product may offset the expected benefits based on the improvements of environmental performance on the product level.

Improvements in technological efficiency of products that lead to an absolute increase in consumption are often referred to as rebound effect. Font Vivanco et al (2016) give an example of the rebound effect related to fuel efficiency improvements in cars. As the fuel improvements make driving cheaper, users drive more and buy bigger cars (direct effect). They may also spend the remaining savings on other products (indirect effect). As a result, total fuel and energy savings, and the presumed wider environmental benefits, are reduced.

Box 3. Towards transformative eco-innovation (cases)

The banking sector has undergone a profound transformation in the way it provides services to its clients. Desk officers can be hardly found nowadays in Norwegian banks, with all services being cashless and managed by electronic kiosks. Africa has seen an even more dramatic change, with mobile phones being used as carrier for a transition to low cost banking services, or mobile banking. Reduced costs and ease of use have led to the creation of over 20 million M-PESA accounts in Kenya and Tanzania.

Private companies are increasingly using participatory approaches to create new ideas and increase their potential for innovation. Collaborative idea management allows managers to gain a more comprehensive understanding of the dynamics governing the system, and to identify solutions and new ideas based on a variety of different inputs and perspectives. IBM, for instance, has created the ThinkPlace programme, a platform where anyone from within the company can make suggestions, share problems and ask for advice. A second example is Procter & Gamble's open innovation programme, 'Connect + Develop'. This open approach to innovation provides the company with a variety of different options, from which the most valuable are chosen and developed in collaboration with the proposing partner (Zimmermann et al., 2013).
New approaches are coming to asset financing, with climate-resilient and socially inclusive investments being promoted to impact investing, 2 degree investing and Sustainable Asset Valuation techniques (e.g. IISD's SAVi approach). Having recognized the vulnerability of conventional infrastructure (e.g. roads and centralized power generation) several governments, multilateral development banks and project developers/landers are expanding the metrics for the evaluation of infrastructure projects to capture the social, economic and environmental benefits of green infrastructure, all of which contribute to reaching sustainable development goals more effectively.

Further information:
- https://thegiin.org/impact-investing/
- http://2degrees-investing.org/
- www.iisd.org

INNOVATION FOR SUSTAINABLE DEVELOPMENT

How can eco-innovation help reaching the SDGS?

1 NO POVERTY

- Simplified access to basic goods and services by promoting product sharing, repair and maintenance.

- Affordable, durable and safe products designed to be repaired and maintained.

- Local jobs by enabling eco-entrepreneurship and frugal innovation.

2 ZERO HUNGER

- Technological and non technological solutions for the local food production.

- Sustainable farming models.

- Business models minimasing food waste across the life circle.

3 GOOD HEALTH AND WELL-BEING

- Air, water and soil pollution control technologies.

- Prevention and management of toxic emissions.

- Innovative green city and infrastructure.

- Natur protection and conservation (including innovative community-based models of managing natural reserves and packs).

4 QUALITY EDUCATION

- Principles of circular economy, sustainable innovation and eco-enterpreneurship to be included into educational programmes at all levels.

- Schools to become a local demonstraitors of innovative sustainable systems (e.g. minimising waste).

5 GENDER EQUALITY

- Equal access to basic goods and services by promoting product sharing, repair and maintenance.

- Inclusive green public infrastructures.

- Gender inclusive design of environmentally friendly products and services.

-Enabling local entrepreneurship and frugal innovation.

6 CLEAN WATER AND SANITATION

- Innovative water sanitation products and technologies.

- Water management systems.

-Water efficient industrial and urban infrastructures and buildings (e.g. re-use of waste water, use of rain water).

- Social innovation supporting fair access to water.

7 AFFORDABLE AND CLEAN ENERGY

- Implements innovative renewable energy technologies.

-New business models supporting flexible pricing of electricity.

-New business models supporting efficient use of energy (e.g. ESCO, functional sales).

8 DECENT WORK AND ECONOMIC GROWTH

- Sales of eco-innovative technologies, products and services contribute to economic growth.

- Clean and resource-efficient manufacturing promotes jobs in safe and clean environment.

-Creates local jobs and support developoment by enabling local eco-entrepreneurship.

- Low carbon and material and energy efficient, production and consumption models (e.g. circular economy business models optimisingresource use across the life cycle).

- Innovative green infrastructure and sustainable buildings.

- Sustainable value chains.

- Social innovation based on business models promoting equal access to goods and services (sharing, repair and maintenance).

- Affordable, durable, safe and healthy productsdesigned to be repaired and maintained.

-Inclusive green public infrastructures.

- Green cities and sustainable urban design (including urban ecology).

-Green infrastructure and sustainable buildings.

- Sustainable urban movility systems (includingnew business models based on sharing and renting).

- Social urban innovation (including affordable energy efficient housing).

- Sustainable resource-efficient production and consumption models (e.g. social innovation, product sharing models).

- Sustainable supply chain management (e.g. responsible sourcing of materials).

- Business models engaging end-users and improving resource use across the life cycle (including extended producer's responsibility).

- Low-carbon resource efficient products and technologies (e.g. electric mobility).

-Affordable renewable energy technologies.

- Low-carbon resource efficient infrastructuresand buildings.

- Low-carbon resilient urban design.

- Pollution control technologies for shipping and fisheries.

-Closed-loop production systems and urban waste management preventing emissions to oceans and seas.

- Environmentally friendly alternatives to plastic products and packaging.

- Nature-based solutions and green infrastructures.

-Pollution control technologies.

-Closed - loop production systems and urban waste management preventing emissions to eco - systems.

-Novel models of sustainable resource management.

- Circular economy business models, resource and energy efficiency to reduce dependency on fossil fuels, minerals and bio - based materials from conflict areas.

- Green infrastructures and renewable energy technologies as an opportunity to rebuild post-conflict areas in a sustainable way.

- System innovation projects as a governance challenge and social laboratory of new governance models and new partnerships.

Source: The SDG icons were sourced from the UN on-line SDG communicationswebsite athttp://www.un.org/sustainabledevelopment/news/communications-material/

4 HURDLES AND TRAMPOLINES

Innovations enabling transformative changes towards sustainability have to overcome many hurdles, including an active opposition from incumbents who are at risk of not benefiting from the transition. **Market failure** is commonly seen as a key innovation barrier. A market failure manifests itself in an insufficient allocation of funding for risky and long-term projects despite the promise of societal benefits they may bring in the future. Eco-innovations suffer from a second market failure manifested by the failure of prices to reflect social and environmental costsof unsustainable products and services.In absence of mechanisms allowing to internalise these costs in prices, eco-innovators struggle to access funds for their projects and to attract customers. At the same time, society remains exposed to 'cheap and dirty' products contributing to major environmental problems, including climate change, toxic pollution and resource depletion, which pose direct threat to wellbeing and economic development.

To describe this specificity of market failure impeding eco-innovation,Klaus Rennings (2000) articulated the notion of **'double externality'.** Eco-innovations can produce knowledge spill-over effects similar to any R&D efforts and innovation activities. In addition, they bring positive external effects in the formof environmental benefits. 'Double externality' means that investments in eco-innovation are risky and potentially less profitable for companies, because, first, competitors can copy their ideas (knowledge spill-overs) and, second, because benefits and damages to the environment are not fully captured in the current prices (the negative externality).

Innovation system literature rooted in evolutionary economics brought us the notion of **system failures** (Smith 2010), which explains systemic barriers to innovation, including innovation for sustainability. The idea of system failure is based on innovation system approaches that consider innovation activities to be embedded in and determined by the system, in which innovators operate.

System failures may include shortcomings in:

- **Capacity of firms** – shortcomings in absorptive capacity, limited business creation and entrepreneurial capacity, managerial and organisational competences;

- **Knowledge base** – inadequacies in universities, research institutes, patent offices and so on. Rigid disciplinary orientation in universities and consequent inability to adapt to changes in environment and face societal challenges;

- **Collaboration and networks** – problems in the interaction among actors in the innovation system caused by institutional 'lock-ins';

- **Frameworks and institutions** – gaps and shortcomings of regulatory and policy frameworks, intellectual property rights (IPR), health and safety rules, etc., and other background conditions, such as the consumer demand, culture and social values.

Like market failure, systemic deficiencies can also inhibit realising benefits of eco-innovations. The symptoms of systemic problems in case of eco-innovation may include, for example, a limited capacity to improve material efficiency in companies or the low demand for eco-innovation from companies and consumers due to a limited environmental awareness.

The focus on barriers is only half of the story of innovation. It is crucial to understand what are **direct and indirect drivers stimulating companies, entrepreneurs and other stakeholders, including consumers, to engage in eco-innovation.** The relevance of specific drivers depends on the specific context of innovation. Evidence suggests, however, that eco-innovation is driven by existing or expected regulatory instruments, voluntary measures (e.g. standards) as well as by market demand (Kemp and Pontoglio, 2011).

Systemic perspective on drivers and barriers of eco-innovation

The drivers and barriers to eco-innovation should not be reduced to market failures. Eco-innovation determinants can be analysed following the STEEPV classification spanning:

- Social: Human capital, Collaboration capacity

- Technological: Technical and R&D infrastructure

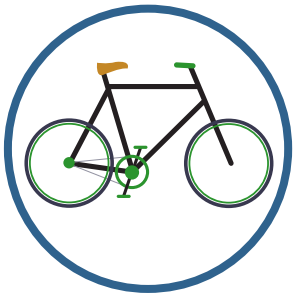
- Economic: Access to R&D and innovation funding (including international donors), Eco-entrepreneurship and business creation, Local and international markets and demand, Internationalisation and competitiveness of eco-innovators

- Ecological: Access to natural resources (e.g. the lack or limited access to natural resources may be driver to innovate)

- Political determinants: Policy failure, Political support for eco-innovation; Policy instruments supporting eco-innovation

- Value system: Consumption patterns and eco-innovation acceptance.

The barriers to system innovation are multiple and interlocking. The case of integrated mobility helps to understand this. The absence of safe infrastructure for cycling creates a big disincentive for using a bicycle. Bus use suffers from several problems: rigid schemes, low-frequency and cultural views about buses as a form of transport for poor people. The combination of different modes of transport offers a system vision for reducing car mobility but this requires seamless interchanges, a better infrastructure for cycles, integrated ticketing, smart cards for mobility and high-frequency public transport. Even in the Netherlands, a country with a good infrastructure for cycling and well-developed public transport, major organisational barriers exist, such as the fragmented systems of mobility providers and public transport concessions, and limited political support (Parkhurst et al, 2012).



5 TOWARDS SUSTAINABLE RESEARCH AND INNOVATION POLICY

Overcoming market and system failures which impedetransformative eco-innovations requires research and innovation policy fit for purpose ofinstigating systemic change. Policy makers should strive for a comprehensive, consistent and coherent 'policy mix'comprising mutually supporting instruments and new ways of designing, implementing and evaluating policies (Rogge and Reichardt, 2016). Public policy supporting transformative innovation needs to contribute to a particular direction of transition with milestones and long-term stable targets as a whole mix.This requires political commitment and specific competencesfrom policy makers.

The challenge of transformativeeco-innovation is as much a policy and governance challenge as it is the concern for innovative businesses and technology developers. Innovating policy and governance deserves to be in the spotlight just as the new technologies and business models are. The scale of sustainability challenges influences the scope and nature of the policy mix applied to address them. The perception of the problem limited to the market failure can be associated mainly with the market-based and economic instruments. See Figure 4 for selected policy instruments and their potential roles in policy mixes supportingeco-innovation.

(Next page) Figure 4. Policy measures with a potential to foster transformative innovation

Public policy has a role to co-design and set up **a governance system for transition** to assure that risks and benefits of the transition are borne in a fair way (Altenburg and Pegels, 2012; Weber and Rohracher, 2012). Public policy at all levels has a role to play in creating protected innovation spaces (or social transition laboratories), where experimentation and demonstration can be initiated and scaled, and social participation encouraged. The focus on the systemic change can create an implicit or explicit tension between advocates of change and the incumbents. It, therefore, requires strategic leadership and competences from policy makers businesses and other leaders of the transition to anticipate and manage potential conflicts. Policies pursuing transformative change need to be able to both challenge and disrupt existing regimes as well asprovide incentives for incumbent companies and networks to stop unsustainable practices and join in the transition process towards a green economy.

The challenge of transformative innovation calls for a collaboration between many stakeholders who co-design and jointly implement innovations and, at the same time, actively create an enabling environment for these innovations to take off. System innovation is not about creating a fully controllable mechanistic intervention, but rather about collectively managing a transition process by actors with shared incentives and a direction of change (Kemp et al, 2007). System innovation is a governance challenge prompting new processes and mechanisms of social deliberationand collaboration. This challenge concerns all dimensions of innovation governance, including leadership, participation, responsibility and accountability, policy design, implementation, monitoring and evaluation. The short-term challenge is to make an optimal use of existing capacities and competences by stimulating collective action on the ground. Transformative innovation for sustainable development also calls for experimentation and alternative governance models, organisations and policy instruments which will complement, and in some cases gradually replace, established practices and bodies.

	Policy instruments	How they can offer support to eco-innovation
	Environmental protection regulations.	Provides incentives to innovate to comply with environmental performance targets. Provides disincentives for free riders by introducing penalties.
	Product and industrial process standardisation.	Provides incentives to innovate to comply with environmental and social performance standards for products and processes.
	Extended Producer's Responsibility.	Provides incentives for producers to significantly improve environmental performance of their products and services.
	Labels and certification.	Promotes eco-innovative products and processes by providing information to customers.
	Intellectual property rights.	Encourages companies to engage in eco-innovation activity, opens access to knowledge important for diffusion of eco-innovation.
	Trade policy (e.g. tariffs).	Removes barriers to trade in eco-innovative goods and services; opens access to knowledge important for eco-innovation diffusion; also imposes barriers on environmentally harmful goods and services.
	R&D funding.	Provides direct support for R&D underpinning disruptive eco-innovation.
	Innovation funding for companies.	Provides direct support for eco-innovation activity.
	Equity support to venture and seed capital.	Provides equity dedicated to eco-innovation; de-risks eco-innovation investments.
	Feed-in-tariffs and similar subsidy schemes .	Provides financial incentives to adopt and diffuse eco-innovative technologies.
	Tradable permit systems (including emissions trading).	Allocates or sells emission rights to polluters which can be traded. The price for emission rights and prospect of reduction of emission rights creates incentives for eco-innovation.
	Removal of subsidies for environmentally harmful activities.	Removes distortion from markets and brings level playing field for eco-innovators.
	Green public procurement.	Creates local markets for eco-innovative goods and services.
	Pre-commercial (R&D and innovation) procurement.	Creates markets for transformative eco-innovative goods and services.
	Support to private demand.	Provides incentives for customers to purchase eco-innovative goods and services (vouchers, tax cuts).
	Tax incentives for R&D for companies.	Tax reduction (CIT) for companies undertaking R&D underpinning eco-innovation.
	Tax incentives for technology adopters.	Tax reduction (CIT) for companies adopting eco-innovation with environmental and social benefits.
	Environmental taxation.	Tax reduction (CIT) for companies undertaking R&D underpinning eco-innovation.
	Removal of tax reliefs for environmentally-harmful sectors.	Removes distortion from markets and brings level playing field for eco-innovators.
	Clusters, industrial zones, and science and technology parks.	Encourages specialisation in eco-innovation in regions with high potential and/or need for goods and services with environmental and social benefits.
	Technology platforms and networks.	Promotes information and knowledge sharing on eco-innovation.
	Roadmaps and foresight.	Creates shared vision, commitments and roadmaps for experimentation, investment and development of eco-innovation.
	Business advisory services for SMEs.	Promotes skills and knowledge relevant for eco-innovation.
	Local entrepreneurship and business incubation support.	Promotes local entrepreneurship focused on eco-innovation.
	Technology transfer and matching.	Promotes transfer of eco-innovative technologies.
	Market intelligence services.	Promotes information and knowledge sharing on eco-innovation (reduces information asymmetry).

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ABOUT

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The Inno4SD Policy Outlooks series focuses on the horizontal policy issues or transversal topics relevant for public policy supporting innovation for sustainable development. The selected topics are based on questions and issues raised by policy makers and stakeholders active in the Innovation for Sustainable Development (Inno4SD) network.

- **1. Why should public policy support transformative eco-innovation?**

2. How can policies supporting innovation deliver on the sustainable development goals (SDGs)?

3. How to support eco-innovation in trade policy and international trade regimes?

4. Can environmental process standards enable eco-innovation?

5. Can eco-innovation respond to NEXUS challenges?

6. Can public procurement in cities support circular economy?

7. How to measure eco-innovation and assess its impacts?

8. How to build effective policy mixes for eco-innovation?

9. How to ensure the level playing field for eco-innovation, taking into account adverse effects of existing policy measures?

10. How to design and implement science, technology and innovation (STI) roadmaps to foster eco-innovation for sustainable development?

11. How to account for macro-economic framework conditions in designing eco-innovation policy?

12. Can environmental product standards enable eco-innovation?

The content of each document has been peer- reviewed by experts and by the editorial team of the inno4sd network. The views expressed in each Outlook are those of the authors and not necessarily reflect the views of inno4sd or its strategic partners.

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The Innovation for Sustainable Development Network (inno4sd.net®) brings together networks dedicated to innovation for sustainable development with the aim of reducing fragmentation and supporting collaboration, whilst engaging policy-makers, research & development, and businesses to achieve the sustainable development goals.

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