Circular Bioeconomy

An operational framework for developing place-based circular bioeconomy pathways

Shared Agendas

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SharedAgendas.org Bioeconomy framework

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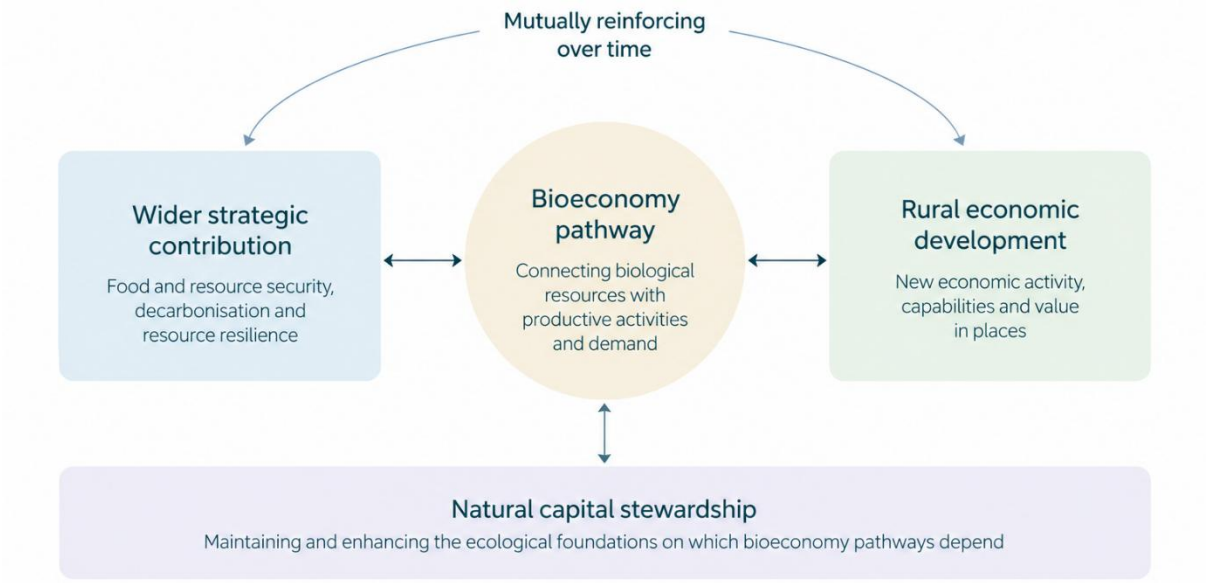
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1. Introduction

The circular bioeconomy is gaining strategic importance as pressure grows to strengthen food and resource security, reduce dependence on fossil-based inputs and advance decarbonisation. At the same time, it can create new opportunities for economic development in rural areas, where much of the natural capital on which bioeconomy pathways depend is located and stewarded. The opportunity is therefore to develop pathways that respond to these wider strategic needs while creating economic activity, capabilities and value in rural areas and strengthening the ecological foundations on which future development depends.

Developing these pathways requires several conditions to come together. Biological resources need to be available reliably, technologies and operating models need to work under real conditions, and infrastructure, demand, regulation and investment need to support productive activity. Many of the decisions involved are taken by different actors whose choices depend on one another. How these conditions interact influences not only whether productive activities become viable, but also where processing and specialised capabilities develop, who participates in decisions and value creation, how risks and returns are distributed, and whether part of the value generated is reinvested in the resource base and productive capacities. These relationships shape whether wider strategic contribution, rural economic development and natural capital stewardship reinforce one another over time. Figure 1 summarises this relationship.

Figure 1. Reinforcing relationships around a bioeconomy pathway



Source: SharedAgendas.org

The SharedAgendas.org Bioeconomy framework provides a common structure for understanding and working with these relationships. It focuses on bioeconomy pathways as the connections through which biological resources, productive activities, technologies, infrastructure, capabilities and demand come together to provide particular products, services or functions. Several pathways may develop in the same place, while similar pathways may take very different forms depending on the resources involved, local ecological and productive conditions, the capabilities that can be mobilised and the wider market, regulatory, technological and investment context. In place-based contexts, these pathways also interact with other productive activities, infrastructures, patterns of demand and areas of development, creating connections that extend beyond the analytical boundaries of the Bioeconomy framework.

Within a Shared Agenda, the framework supports collective interpretation around a place-based problematic situation and a shared future vision. It helps identify relevant pathways, examine the conditions shaping their development and understand how those conditions influence one another. This provides a basis for identifying where coordinated action is required and where progress depends on developments across organisations, sectors or governance levels. The framework can also inform public, business, investment and research decisions from different starting points, whether the initial focus is a biological resource, an existing productive capability or technology, or a strategic or market demand.

The document first defines the problematic situation and future vision and introduces the main families of bioeconomy pathways. It then presents the conditions shaping their development, brings their relationships together in a systems map and examines the reinforcing dynamics and broader configurations that emerge from these relationships. The framework is then applied to a pathway based on livestock effluents, agro-organic flows, biomethane and nutrients, illustrating how the general conditions and dynamics are expressed in practice and how they can inform collective action. The final section moves to place-based contexts, showing how the relationships relevant to a particular situation can extend across different domains and be brought together in place-based configurations. It also examines how these configurations can be connected with evidence from different sources and scales to support strategy development, implementation, monitoring and learning.

2. The challenge and the future vision

2.1 The problematic situation

The potential of the bioeconomy remains difficult to unlock because the resources, capabilities and initiatives needed to develop viable pathways are often highly fragmented. In rural areas, biological resources are distributed across many producers, firms and land managers, while processing capacity, infrastructure, knowledge and investment often develop through separate initiatives. At the same time, companies, investors and public authorities may be seeking reliable supplies, new bio-based products or opportunities to develop productive capacity. Individual projects may create valuable opportunities, but viable pathways require these dispersed resources, capabilities and forms of demand to connect through reliable supply, complementary capacities and value chains able to sustain productive activity.

Many of the technologies, investments, markets and specialised capabilities needed for pathway development are also located beyond the rural areas where much of the relevant natural capital is found and stewarded. These wider connections are essential, but the way they are organised matters. Pathways can connect rural resources and capabilities with wider demand while creating processing, ownership, specialised activities and economic opportunities in the places involved, or these functions and returns can accumulate elsewhere. The extent to which value is retained locally depends on how producers, firms and communities participate in processing, ownership, decision-making and value creation, with consequences for local capabilities, legitimacy and the capacity to reinvest in the ecological resource base.

The problematic situation therefore lies not only in fragmentation, but in the difficulty of connecting place-based resources and capabilities with the wider demand, investment and complementary capacities required for viable pathway development in ways that also strengthen rural economies and natural capital stewardship. When these connections remain weak, promising opportunities may fail to develop into sustained value chains; when they are uneven, wider strategic contribution may advance without comparable gains in place-based development. Unlocking the bioeconomy therefore requires stronger connections across these elements so that the development of productive capacity, rural value creation and stewardship can reinforce one another.

2.2 The future vision

The future vision is one in which bioeconomy pathways contribute to wider strategic needs while creating economic value and capabilities in rural areas and strengthening the natural capital on which they depend. Producers, local firms, cooperatives and communities participate not only as resource providers, but also in processing, specialised activities, ownership, decision-making and value creation, building capabilities that strengthen rural economic development.

These place-based resources and capabilities connect with demand, knowledge, technology, investment and other complementary capacities beyond the territory where necessary. These wider connections allow pathways to reach the scale and productive capacity required to contribute to food and resource security, decarbonisation and reduced dependence on fossil-based inputs. At the same time, natural capital stewardship remains part of pathway development: the ecological conditions that sustain biological resources are maintained and strengthened, and part of the value generated can be reinvested in the resource base and in the productive capacities on which future development depends.

These relationships can become mutually reinforcing. Stronger place-based capabilities and stewardship improve the conditions for reliable supply, productive viability and legitimacy, while wider demand and investment can support the infrastructure and productive capacity needed for pathways to develop. Value creation, participation and reinvestment can in turn strengthen the places and ecological foundations on which those pathways depend. The specific configuration will vary between places and pathways, but in each case the aim is for wider strategic contribution, rural economic development and natural capital stewardship to strengthen one another.

3. Bioeconomy pathways

Bioeconomy pathways connect biological resources with productive activities, technologies, processing, infrastructure, capabilities and demand to provide particular products, services or functions. Their form depends on the characteristics of the resources involved, the ecological and productive conditions of the place, the actors and capabilities that can be mobilised, and the markets and strategic needs with which they connect.

The framework can be applied to many different bioeconomy pathways. Some develop around the recovery of nutrients from manure, wastewater or organic side streams and their return to agricultural production. Others connect similar resource flows with the production of biogas or biomethane. Agricultural and forestry resources can support pathways for materials, chemicals, construction products, energy or biogenic carbon, while aquatic resources can contribute to food, feed, fertilisers, specialised compounds and other bio-based products. Changes in primary production can also connect regenerative practices with processing and markets.

In practice, these pathways frequently overlap. Nutrient recovery can be connected with biomethane production; forest resources can support materials, chemicals and energy at the same time; agricultural residues may enter several processing routes; and one productive activity may generate resources, energy or infrastructure that support another. Industrial symbiosis often emerges through these connections.

The sections below describe the main families of pathways covered by the framework. Their concrete configuration will vary considerably between places, and several may develop together as part of wider combinations of interconnected activities and value chains.

3.1 Nutrient recovery and biofertilisers

Nutrient recovery pathways develop around the recovery of nutrients from organic resource flows and their return to productive use, particularly in agriculture. Manure, food-processing side streams, wastewater and other organic materials can be treated and transformed into fertilising products through combinations of separation, biological or chemical treatment, concentration, extraction, composting or formulation.

These pathways can connect livestock and agricultural production with waste and wastewater management, processing activities and fertiliser use. They also frequently intersect with energy pathways, since anaerobic digestion can

generate both renewable gas and nutrient-rich outputs that can subsequently be processed and reused.

3.2 Renewable gases and bioenergy

Renewable gas and bioenergy pathways connect biological resources and organic side streams with the production of energy. Manure, agricultural residues, food-industry side streams, sewage sludge and other organic materials can be converted into biogas, biomethane or other energy products through different technological and organisational configurations.

Their development can involve collection and preprocessing of feedstocks, digestion or other conversion processes, upgrading and distribution of energy, together with the further use of residues generated during production. Because many of these resources also contain nutrients or other valuable components, renewable energy pathways often become part of broader configurations involving agriculture, nutrient recovery or industrial symbiosis.

3.3 Bio-based materials

Bio-based material pathways connect biological resources with the production of materials for uses such as packaging, construction, textiles, composites or industrial products. Agricultural and forestry resources, fibres, lignocellulosic materials and biological side streams can be transformed through mechanical, chemical, thermal or biotechnological processes according to the characteristics required from the final material.

These pathways can connect primary production with processors, material developers and manufacturers. They can also form part of wider configurations in which different fractions of the same resource are used for materials, chemicals, energy or other applications.

3.4 Regenerative food and agricultural pathways

Regenerative food and agricultural pathways develop through changes in the way biological resources are produced and managed and through the value chains built around those changes. They may involve soil regeneration, diversified rotations, agroforestry, nutrient cycling, water management or other approaches that strengthen ecological and productive functions, together with changes in processing, procurement and market relationships.

These pathways can also incorporate biofertilisers, biostimulants, biological pest control, fermentation, crop improvement or new ingredients. Their development can therefore connect changes in farming practices with other bioeconomy pathways operating around nutrients, food processing, materials or energy.

3.5 Forest-based pathways

Forest-based pathways develop around different uses of forest resources and forestry side streams. Timber, fibres, cellulose, lignin, bark and other components can support construction, materials, chemicals, energy and biogenic carbon applications.

A single forest resource can underpin several connected pathways, with different parts or qualities of the resource entering different uses. The way these uses are combined depends on forest characteristics, processing capacity and the productive structure around them.

3.6 Aquatic bioeconomy pathways

Aquatic bioeconomy pathways draw on marine and freshwater resources, including algae, microorganisms and side streams from fisheries and aquaculture. These resources can support food and feed production, fertilisers, materials, chemicals, energy and specialised compounds.

Cultivation, extraction, fermentation and other biotechnological processes can create additional uses, while existing fisheries and aquaculture activities can generate side streams for other forms of processing. Aquatic pathways can therefore connect established productive activities with emerging bio-based applications.

3.7 Bio-based chemicals and biogenic carbon

Bio-based chemical pathways use biological feedstocks to produce chemicals, polymers, solvents, additives and other industrial inputs. Depending on the resource and product, they may involve fermentation, enzymatic conversion, microbial production or combinations of biological, chemical and thermal processing.

Biogenic carbon can form part of related pathways in which biological carbon is incorporated into materials, industrial processes or forms of long-term storage. These developments often connect with forestry, agriculture, bio-based materials and energy because the same resource streams can support several forms of transformation and use.

3.8 Industrial symbiosis and interconnected pathways

Industrial symbiosis emerges when productive activities become connected through the use of biological resources, side streams, energy, water, infrastructure or processing capacity. A resource generated in one activity may become an input to another, and several pathways may share facilities, technologies or logistical arrangements.

Industrial symbiosis is therefore best understood as a way in which different bioeconomy pathways become interconnected. In many places, several of the pathway families described above will develop together, with resources, outputs and shared capacities linking different activities and value chains.

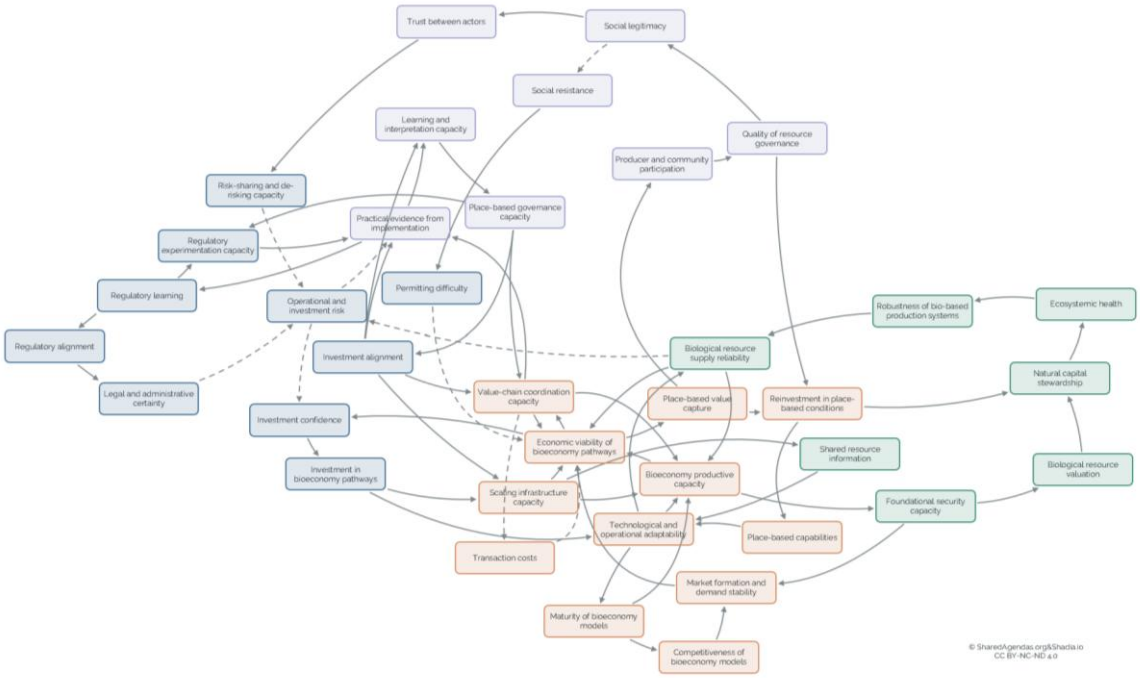
The next section examines the conditions that shape these pathways. Their relevance and influence vary according to the pathway, the place and the particular configuration in which they develop.

4. Conditions shaping progress towards the future vision

Bioeconomy pathways are shaped by multiple conditions whose relevance varies according to the pathway, the place and the actors involved. A condition that is decisive for a nutrient recovery pathway may play a different role in a forest-based materials pathway, and its influence may also vary between places. The framework identifies seventeen conditions organised into four connected areas: resource base, robustness and stewardship; productive and value-chain capacity; regulation, investment and risk; and governance, participation and learning. In the systems map, they are connected with additional variables that make the causal relationships and feedback dynamics explicit, resulting in 37 nodes.

In a Shared Agenda process, these conditions can be examined as facilitators or inhibitors in relation to the pathway and the future vision, helping identify what is already supporting progress, what requires attention and how changes in one area may affect others. Their significance lies not only in the individual conditions but also in the relationships between them. Figure 2 brings these relationships together in a systems map that provides the common structure for the framework.

Figure 2. Systems map of the SharedAgendas.org Bioeconomy Framework



Source: SharedAgendas.org and Shadia.io.

4.1 Resource base, robustness and stewardship

Bioeconomy pathways depend on the ecological and productive foundations that sustain biological resources. Four conditions are particularly important in this area: natural capital stewardship, biological resource supply reliability, robustness of bio-based production systems and foundational security capacity.

Natural capital stewardship

Bioeconomy pathways depend on the ecological systems that sustain the biological resources they use. Soils, forests, water systems, biodiversity, aquatic environments and productive landscapes are therefore not simply a source of inputs, but part of the conditions that make pathway development possible over time.

How these resources are managed matters directly for what can be mobilised and under which conditions. In forest-based pathways, for example, forest health, management practices and ecological functions shape both the availability of biomass and the capacity to use it productively over time. Natural capital stewardship links resource use with the maintenance and regeneration of these ecological foundations, making it an integral part of the productive base of the bioeconomy.

Biological resource supply reliability

Bioeconomy pathways depend on biological resources being available in sufficient quantity and quality, and with enough continuity to support the activities built around them. This depends not only on how much of a resource exists, but also on where it is located, how availability changes over time, what other uses compete for it, how well it can be traced and the practical arrangements needed to mobilise it.

These conditions look different from one pathway to another. Nutrient recovery may depend on the regular availability and composition of manure or food-processing side streams, while forest-based pathways may be shaped by harvesting cycles, accessibility and competing uses of particular resources. The more reliable these flows become, the easier it is to make decisions about operations, infrastructure, investment and productive scale.

Robustness of bio-based production systems

Agriculture, forestry, livestock production, fisheries and aquaculture need to remain viable under variable and changing conditions while continuing to sustain the biological resources on which bioeconomy pathways depend. This is what robustness refers to. Drought, changes in soil condition, forest disturbances or

pressures affecting aquatic ecosystems can alter both the quantity and quality of the resources available and, in turn, affect how pathways develop.

Robustness therefore helps sustain the continuity of the resource base, while adaptability allows practices and operating arrangements to change as ecological, climatic and market conditions evolve. Together, these capacities strengthen the resilience of the wider system.

Foundational security capacity

Bioeconomy pathways can strengthen some of the basic systems on which territories depend, from food and nutrient supply to renewable energy, materials, soil fertility, water and ecosystem functions. How they contribute will vary from one pathway to another: nutrient recovery can improve access to fertilising inputs and reduce dependence on externally sourced nutrients, renewable gas can strengthen energy supply, and forest-based materials can provide alternatives to fossil-based inputs. Pathway development is therefore not only about creating viable economic activity, but also about how that activity contributes to wider strategic needs.

4.2 Productive and value-chain capacity

Viable bioeconomy pathways require productive capacity to develop around biological resources, with the activities, organisations and infrastructure involved connected through functioning value chains. Five conditions are central here: place-based value capture, value-chain coordination capacity, scaling infrastructure capacity, technological and operational adaptability, and market formation and demand stability.

Place-based value capture

Where value is created and retained depends on how a pathway is configured. Processing, ownership, specialised knowledge, decision-making and economic returns may remain closely connected to the places where biological resources originate, or they may accumulate elsewhere.

This matters because many bioeconomy pathways draw on natural capital that is located and stewarded in rural areas. Their territorial contribution therefore depends not only on whether they respond to wider strategic needs, but also on the extent to which producers, local firms and communities participate in higher-value activities and build capabilities through pathway development. In a forest-based materials pathway, for example, the implications are very different when a place supplies raw biomass alone than when it also develops processing, specialised services, ownership and knowledge-intensive activities. When more value is retained locally, there is also greater scope to reinvest in firms, skills, infrastructure and stewardship of the resource base.

Value-chain coordination capacity

Bioeconomy pathways depend on decisions taken by actors across different parts of the value chain. Resource holders, processors, technology providers, logistics operators, regulators, buyers and users each influence different parts of the pathway, but their decisions are closely connected. Choices about supply, processing, product specifications, infrastructure or investment therefore rarely make sense in isolation.

This is especially visible in nutrient recovery pathways, where the characteristics of the recovered product depend on both the resource entering the process and the treatment applied, while agronomic testing, regulatory recognition, storage, distribution and farmer uptake all influence whether the pathway can move beyond experimentation. Coordination capacity is what allows these dependencies to be worked through together, connecting decisions that would otherwise remain fragmented across the value chain.

Scaling infrastructure capacity

Bioeconomy pathways need infrastructure to collect, store, test, pre-treat, process and distribute biological resources and products, but the type of infrastructure required and the scale at which it makes sense vary considerably between pathways and places.

Some functions can remain close to resource holders, while others depend on more specialised facilities shared across several actors or pathways. This is particularly relevant for producers, cooperatives and SMEs, which may need access to testing, processing or storage capacity that would be difficult to develop individually. The way infrastructure is organised therefore shapes not only productive scale, but also who can participate in the pathway and where productive activities and capabilities are located.

Technological and operational adaptability

Bioeconomy pathways rarely develop under standardised conditions. Biological resources vary in composition, quality and availability, while infrastructure, environmental conditions, skills and product requirements differ from one place to another. Technologies and operating models therefore need to be able to adjust to the conditions in which they are applied.

A solution demonstrated with a homogeneous industrial feedstock, for example, may require substantial adaptation when used with seasonal or heterogeneous agricultural side streams. Technological and operational adaptability is what allows these adjustments to be made so that technologies can operate reliably under real conditions.

Market formation and demand stability

Bioeconomy pathways need credible and sufficiently stable demand if productive capacity is to develop beyond isolated projects or demonstrations. Bio-based products and services have to find their way into regular purchasing, procurement and production decisions.

What this requires varies by pathway. A recovered fertiliser needs farmers or distributors willing to incorporate it into regular use, while a bio-based material depends on manufacturers or buyers integrating it into established production and procurement processes. As demand becomes more stable, producers and processors can make decisions about technology, infrastructure and productive capacity with greater confidence, making it easier for emerging activities to develop into sustained value chains.

4.3 Regulation, investment and risk

Bioeconomy pathways cut across regulatory domains and depend on investment decisions made under different rules, responsibilities and timeframes. Regulation shapes the routes through which pathways can develop, while investment decisions respond to the conditions and risks surrounding their development.

Four conditions are especially important in this area: regulatory alignment, regulatory experimentation capacity, investment alignment, and risk-sharing and de-risking capacity.

Regulatory alignment

Bioeconomy pathways often cut across several regulatory domains at once. How biological resources and side streams can be processed, transported, recognised and used depends on classifications, standards, permitting requirements and the responsibilities of different authorities.

This becomes particularly important when existing rules were not designed for emerging uses. In nutrient recovery, for example, materials with agronomic value may still be treated as waste or fall under product rules that restrict how they can be used. Better regulatory alignment can reduce these inconsistencies, clarify responsibilities and create clearer routes to implementation.

Regulatory experimentation capacity

Some emerging bio-based products and processes do not fit neatly within existing regulatory arrangements and need to be tested in practice before their conditions of use can be fully clarified. Regulatory experimentation creates a way to do this under agreed conditions, while generating evidence on performance, environmental effects, safety and implementation.

That evidence can help identify regulatory barriers, clarify how existing rules should apply and inform changes in procedures or requirements. This is particularly important when technical development and regulatory recognition need to progress together rather than one waiting for the other.

Investment alignment

Bioeconomy pathways require different forms of finance and funding as they develop. Investment in productive assets is only one part of this. Resource characterisation, experimentation, coordination, testing, shared infrastructure and market development may all require support before individual commercial opportunities are ready for investment.

The mix changes as development progresses. In a nutrient recovery pathway, for example, public or research funding may initially support resource characterisation and agronomic trials, while producer organisations help coordinate supply and use. Commercial finance may become more relevant as regulation becomes clearer, demand strengthens and implementation risks are better understood.

Investment alignment refers to how well these different forms of finance and funding correspond to the activities, capacities and conditions required at different stages of pathway development.

Risk-sharing and de-risking capacity

Bioeconomy pathways involve technical, regulatory, ecological, market and financial risks that are carried by different actors. Producers may need credible agreements before committing resources, investors may require clearer regulatory conditions before financing infrastructure, and buyers may look for evidence of product performance before making longer-term commitments.

How these risks are shared and reduced therefore matters for whether different actors are able to participate and invest while uncertainty remains. The mechanisms will vary depending on the type of risk and the pathway, and may include contractual arrangements, guarantees, public support, shared investment or other forms of risk allocation.

4.4 Governance, participation and learning

Bioeconomy pathways bring together actors with different responsibilities, interests and forms of knowledge, while many relevant decisions remain distributed across organisations and governance levels. Governance, participation and learning help actors work with these interdependencies as pathways develop.

The framework identifies four conditions in this area: place-based governance capacity, social legitimacy, producer and community participation, and learning and interpretation capacity.

Place-based governance capacity

Bioeconomy pathways often depend on decisions taken by different organisations, sectors and levels of governance. Resource management, infrastructure, regulation, investment and market development may all affect the same pathway, even though responsibility for them remains distributed across different actors.

Place-based governance capacity is the ability to connect these decisions around a shared direction while responsibilities remain distributed across different actors. It provides the spaces and arrangements through which interdependencies can be made visible, discussed and revisited as the pathway develops, helping actors coordinate action while continuing to work within their own mandates.

Social legitimacy

Bioeconomy pathways can affect how resources are used, where infrastructure is located, environmental conditions, ownership and the distribution of value. Social legitimacy depends on how these choices are perceived and experienced by the people and communities involved.

It is shaped by the relationship between the pathway and the place in which it develops. A decision about the scale or location of a processing facility, for example, may be received very differently depending on who has been involved in the decision, who bears the environmental or social effects and who benefits from the value created. These relationships influence whether participation and support can be sustained as implementation progresses.

Producer and community participation

Producers, resource stewards, local firms and communities hold knowledge and interests that directly affect pathway development. Their participation brings resource conditions, operational realities and place-based priorities into decisions about how pathways are configured.

Participation also shapes who has a role in decisions about resource use, ownership, infrastructure and value creation. In pathways built around agricultural or forestry resources, this can influence whether producers participate mainly through resource supply or also through processing, governance and value creation.

Learning and interpretation capacity

Bioeconomy pathways develop under changing conditions, and implementation continuously generates new information. Trials can reveal changes required in technology or product design, producers can identify logistical or seasonal constraints, buyers can refine specifications, and environmental observation can inform decisions about resource mobilisation or facility operation. Changes in regulation, markets or investment can modify the wider conditions at the same time.

Learning and interpretation capacity enables actors to bring these different forms of evidence together and use them to understand how the pathway is evolving. Collective interpretation can lead to changes in assumptions, priorities, actions or the configuration of the pathway itself. Learning therefore connects implementation with continued adaptation throughout the process.

5. Reinforcing dynamics shaping bioeconomy pathways

The conditions introduced in Section 4 are connected through a set of causal relationships. Changes in one condition can influence others and, through feedback, strengthen or weaken the development of a pathway.

The reinforcing dynamics presented below highlight some of the main relationships within this structure. The figures make the causal relationships visible, while the accompanying text explains what those relationships mean for pathway development and why they matter. Their specific expression depends on the pathway, the characteristics of the place, the actors involved and the wider regulatory, market, technological, investment and environmental context.

5.1 The central reinforcing dynamic: place-based development and wider strategic contribution

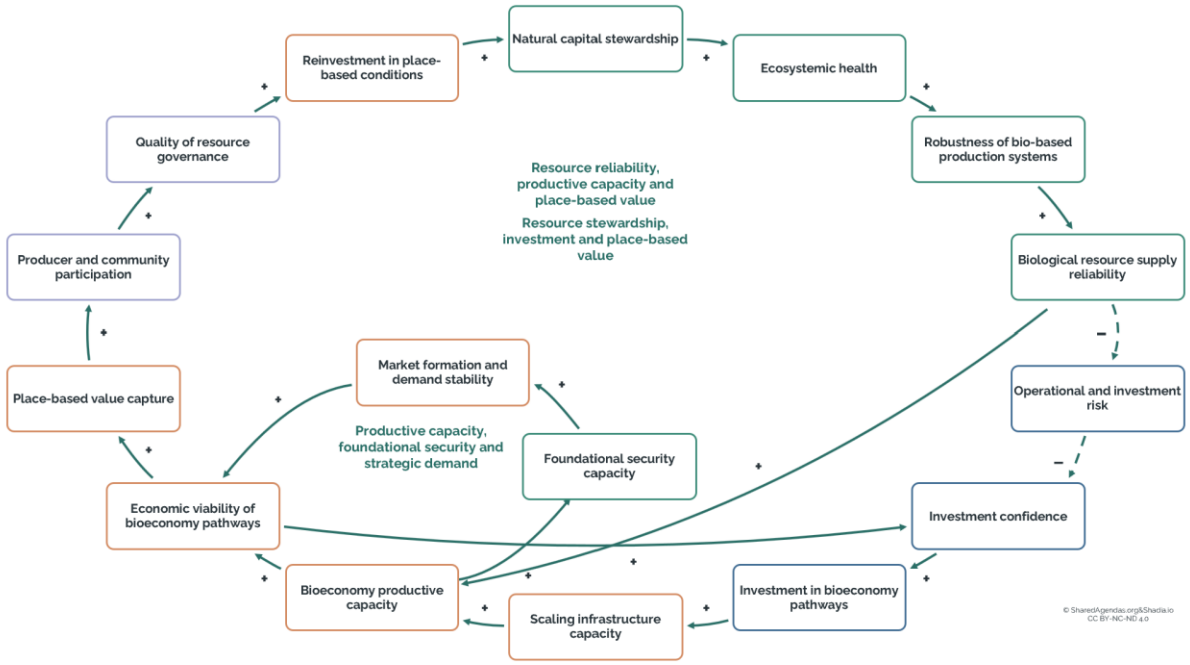
Figure 3 brings together the two reinforcing processes at the centre of the framework: one connecting pathway development with place-based value creation and stewardship, and another connecting productive capacity with wider strategic contribution.

On the place-based side, stewardship and robust bio-based production systems support more reliable resource supply, improving the conditions for productive activity and investment. As pathways become more viable, opportunities can emerge for processing, ownership, specialised activities and economic returns in the places involved. Participation, resource governance and reinvestment can

then strengthen the ecological and productive foundations on which further development depends.

These place-based dynamics are connected with the wider strategic contribution of the pathway. Greater productive capacity strengthens its ability to provide products, services or functions that respond to wider needs, which can in turn support more stable demand and further investment. The dynamic becomes reinforcing as wider demand and investment support the development of productive capacity, while place-based value creation, capabilities, participation and stewardship strengthen the conditions for further development.

Figure 3. Place-based development and wider strategic contribution



Source: SharedAgendas.org and Shadia.io.

5.2 Maturity, competitiveness, market formation and investment

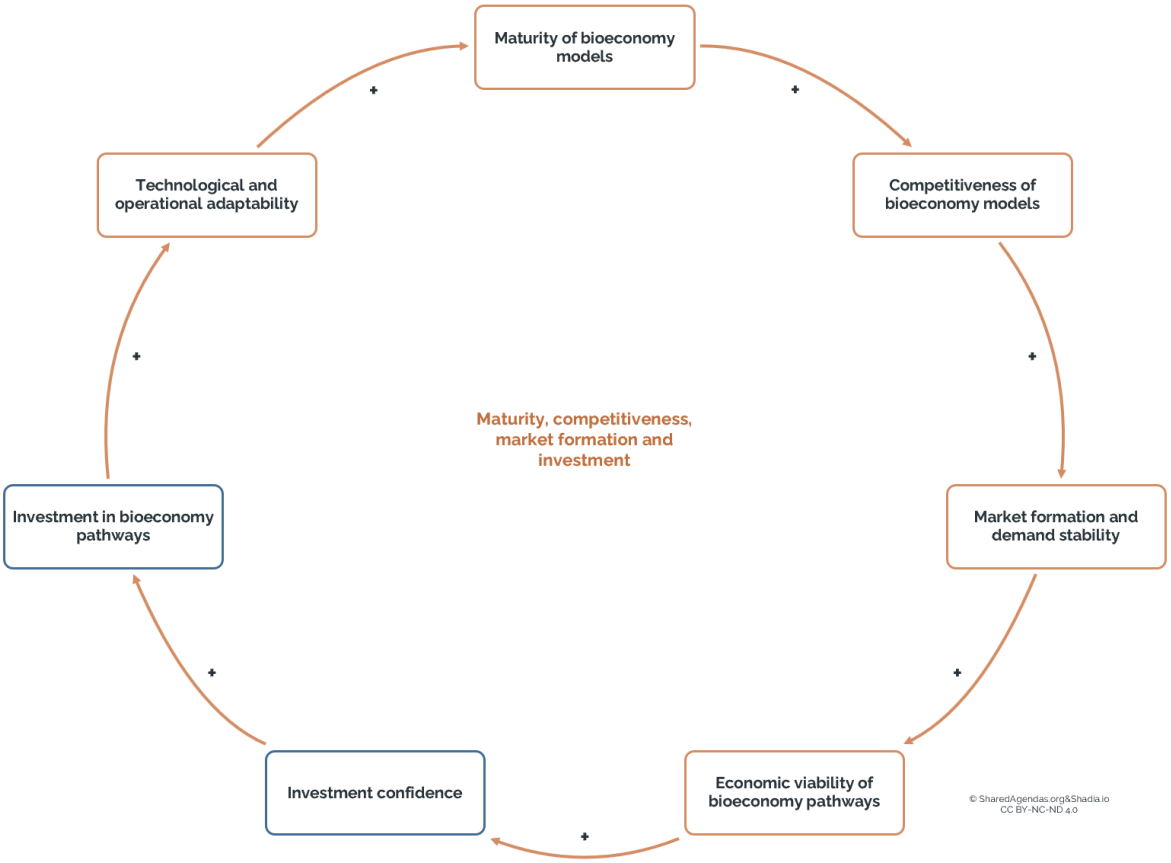
Figure 4 shows the reinforcing relationship between technological and operational maturity, competitiveness, demand and investment.

As technologies and operating models become more reliable under real conditions, the resulting products and services become more competitive and buyers are more likely to incorporate them into regular purchasing and production decisions. More stable demand can strengthen economic viability and investment confidence, while further investment can support the adaptation, demonstration and scaling needed to increase maturity. This helps explain why some promising pathways move towards sustained production while others remain in repeated pilots: technology may already be mature while demand

remains uncertain, or strong market interest may coexist with substantial technological or operational adaptation needs.

Competitiveness, however, depends on more than the performance of individual technologies or business models. It is also shaped by the robustness of the productive and ecological foundations on which pathways depend, the capacity of value chains and technologies to adapt, and the capabilities available to develop and renew productive activities over time. Bioeconomy pathways can therefore contribute to the competitiveness of the territories in which they develop not only by creating viable activities, but also by expanding productive options, capabilities and forms of specialisation while strengthening the conditions on which future development depends.

Figure 4. Maturity, competitiveness, market formation and investment



Source: SharedAgendas.org and Shadia.io.

5.3 Infrastructure, resource information, technological adaptability and supply reliability

Figure 5 shows how infrastructure contributes to pathway development not only by enabling productive activity, but also by generating information about the resources being mobilised and the conditions under which they can be used.

Collection, storage, testing and processing help clarify which biological resources are actually available, in what quantities and qualities, and with what degree of continuity. This information makes it possible to adapt technologies and operating arrangements more closely to real resource characteristics. As the fit between resources, technologies and operations improves, supply can become more reliable and operational and investment uncertainty can fall, creating better conditions for further infrastructure development.

This dynamic is especially important for pathways based on dispersed, heterogeneous or seasonal resources, where knowing that a resource exists is very different from knowing that it can be organised into a reliable productive flow.

Figure 5. Infrastructure, resource information, technological adaptability and supply reliability



Source: SharedAgendas.org and Shadia.io.

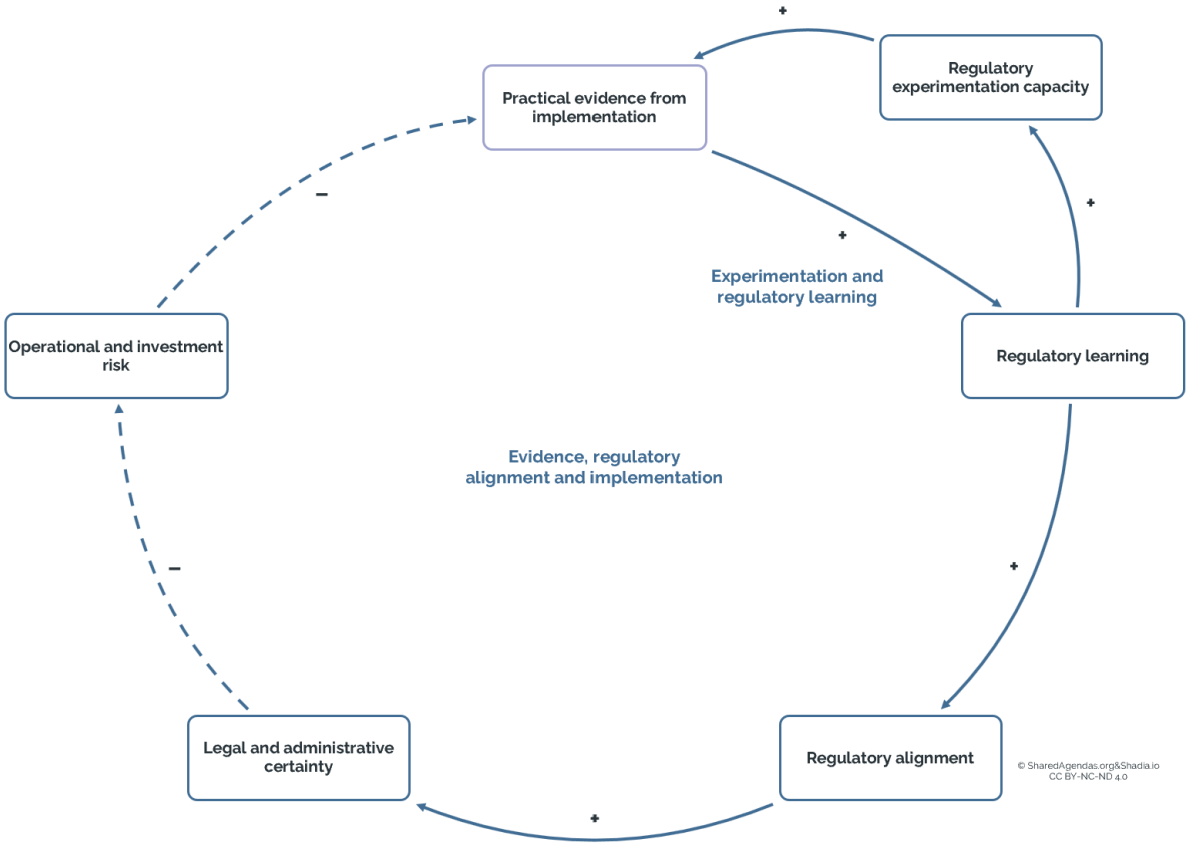
5.4 Regulatory experimentation, evidence and learning

Figure 6 shows how regulatory experimentation can connect implementation with evidence and regulatory learning.

Testing products and processes under agreed conditions generates practical evidence on performance, environmental effects, safety and operating requirements. This can help clarify classifications, interpretations, procedures or other regulatory requirements and reduce uncertainty around implementation. Greater clarity can then make further implementation easier, generating additional evidence and allowing technical development and regulatory recognition to progress together.

The same dynamic can also work in the opposite direction. Where implementation remains limited, less evidence is generated and regulatory clarification may progress more slowly, making it harder for technically available solutions to move into wider deployment.

Figure 6. Regulatory experimentation, evidence and learning



Source: SharedAgendas.org and Shadia.io.

5.5 Value-chain coordination, transaction costs and economic viability

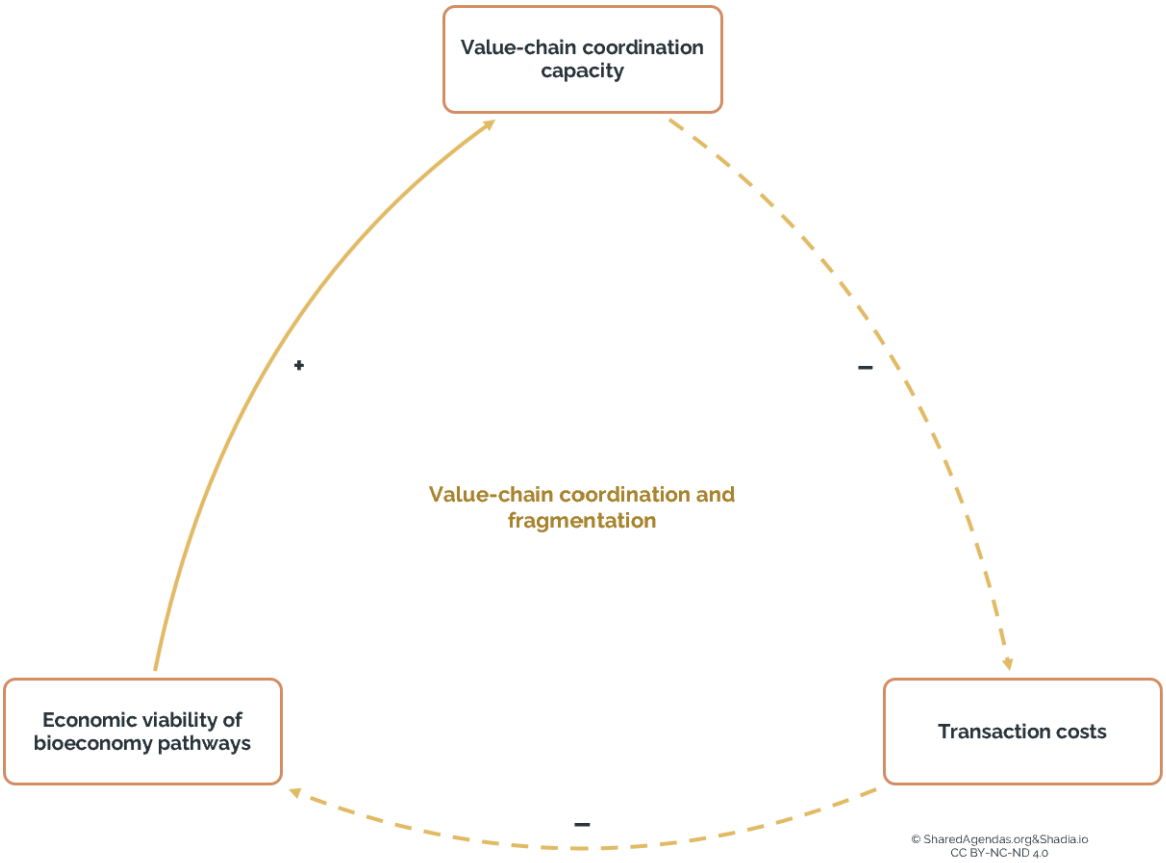
Figure 7 shows how coordination across the value chain can influence transaction costs and economic viability.

Bioeconomy pathways depend on agreements and decisions across resource mobilisation, processing, logistics, standards, compliance, finance and demand.

When these elements are better coordinated, less time and fewer resources are required to manage the relationships between them, reducing transaction costs and improving economic viability.

Greater viability can in turn make it easier for actors to maintain relationships, invest in coordination and establish longer-term arrangements. When coordination remains weak, the opposite can happen: high transaction costs make it harder to connect the different parts of the pathway, leaving technically promising activities isolated rather than allowing them to develop into sustained value chains.

Figure 7. Value-chain coordination, transaction costs and economic viability



Source: SharedAgendas.org and Shadia.io.

5.6 Place-based value capture, participation and legitimacy

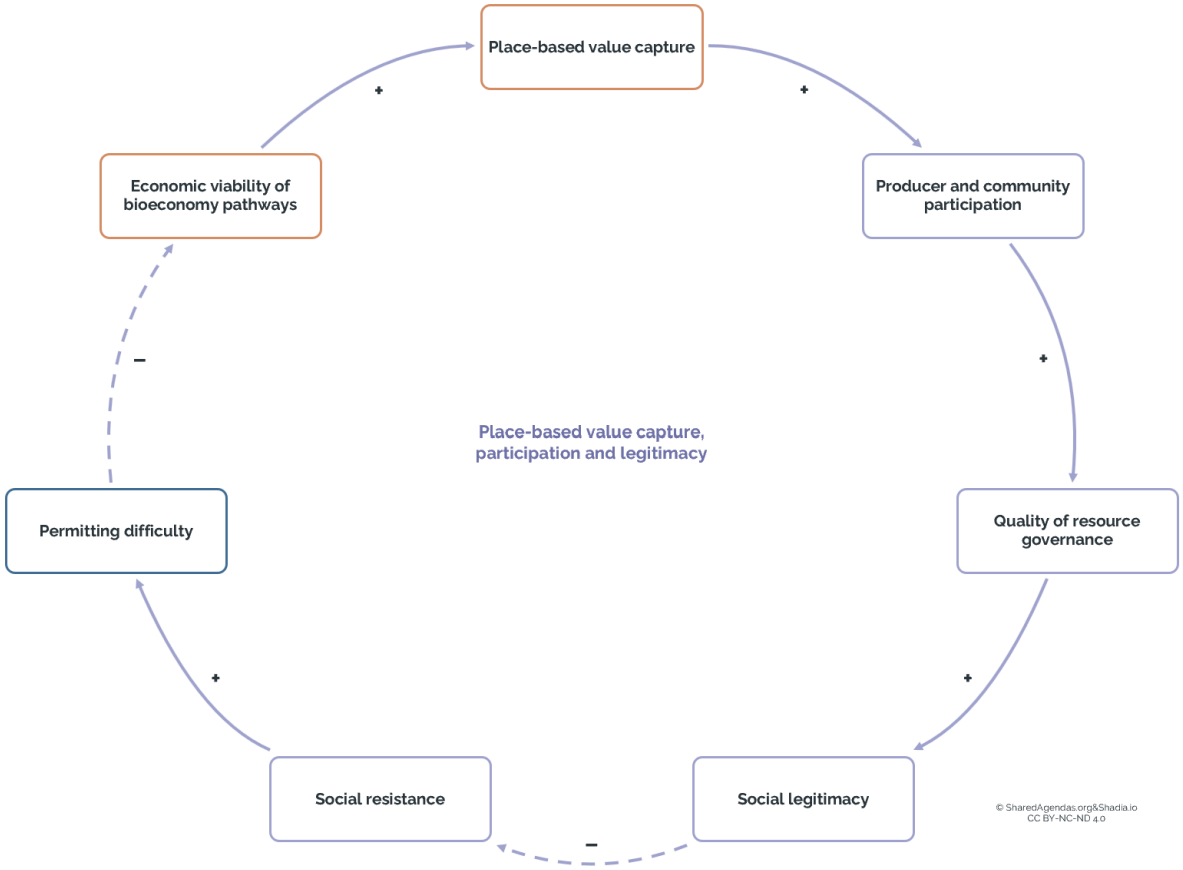
Figure 8 shows how the distribution of value generated through pathway development can influence participation, resource governance and legitimacy.

When processing, ownership, specialised activities and economic returns are retained in the places involved, producers, resource stewards, local firms and

communities have more opportunities to participate in pathway development and decision-making. This can bring resource governance more closely into line with the interests and knowledge of those directly involved in or affected by the pathway.

The same dynamic can work in the opposite direction. When little value is retained locally, participation and influence may weaken, reducing legitimacy and making implementation more difficult over time.

Figure 8. Place-based value capture, participation and legitimacy



Source: SharedAgendas.org and Shadia.io.

5.7 Stewardship, robustness and supply reliability

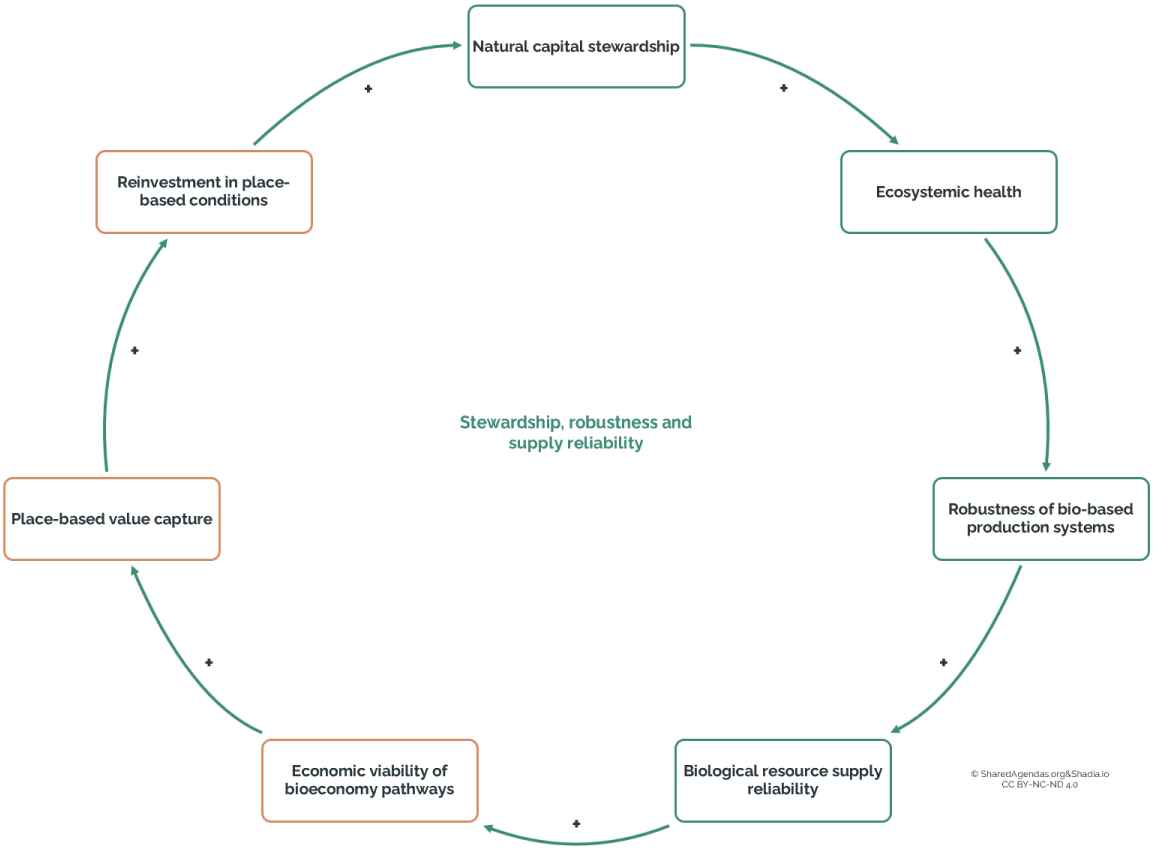
Figure 9 shows how bioeconomy pathways depend on the ecological and productive conditions that sustain their biological resource base, and how pathway development can in turn contribute to strengthening those conditions.

Natural capital stewardship helps maintain soils, forests, water systems and other ecological foundations, while robust bio-based production systems are better able to continue providing biological resources under variable and changing conditions. Together, these conditions support a more reliable resource supply,

making it easier for bioeconomy pathways to sustain productive activity over time.

As pathways become more viable and generate value in the places where these resources are produced and managed, part of that value can be reinvested in the ecological and productive base. This can strengthen stewardship and production conditions, further improving resource reliability. The reinforcing dynamic therefore depends on whether pathway development helps maintain and renew the resource base on which future productive activity depends.

Figure 9. Stewardship, robustness and supply reliability



Source: SharedAgendas.org and Shadia.io.

5.8 Investment alignment, shared capacities and risk

Figure 10 shows how investment interacts with the capacities, infrastructure, evidence and risk conditions that shape bioeconomy pathway development.

Investment can strengthen shared capacities for learning, interpretation and place-based governance, helping actors understand where constraints remain and how investment priorities may need to evolve. It can also support infrastructure, coordination and implementation, allowing activities to be tested and developed under real operating conditions. The evidence generated through

this process can improve understanding of technical, economic and organisational conditions and inform subsequent investment decisions.

These relationships also affect risk and investment confidence. As infrastructure and economic viability improve, greater place-based value capture and participation can strengthen resource governance, legitimacy and trust, while better risk-sharing conditions can make further investment possible. Investment alignment therefore goes beyond financing individual productive assets: it also depends on the capacities, evidence, coordination and legitimacy needed to direct financial resources towards the activities and investments required for pathway development.

Figure 10. Investment alignment, shared capacities and risk



Source: SharedAgendas.org and Shadia.io.

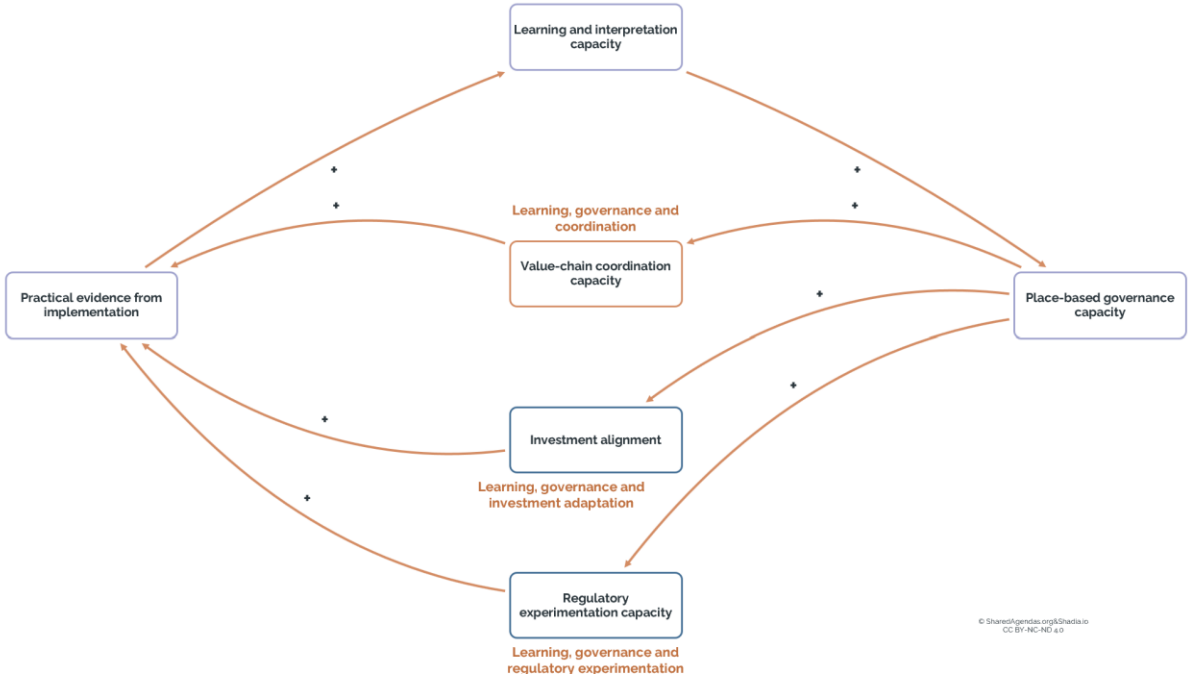
5.9 Learning, governance and adaptation

Figure 11 shows how bioeconomy pathways can develop through a continuing cycle of implementation, learning and adaptation.

Implementation generates evidence on resource flows, technical performance, logistics, costs, environmental effects, regulation and market response. Bringing this evidence together allows actors to revise their understanding of the conditions shaping the pathway, identify changing dependencies and reconsider priorities or assumptions as new information emerges.

Governance arrangements provide the spaces in which this learning can inform coordination, investment, experimentation and other forms of action. Those adjustments then generate further experience and evidence, creating a reinforcing dynamic in which implementation changes what actors know and that learning, in turn, shapes how the pathway develops.

Figure 11. Learning, governance and adaptation



Source: SharedAgendas.org and Shadia.io.

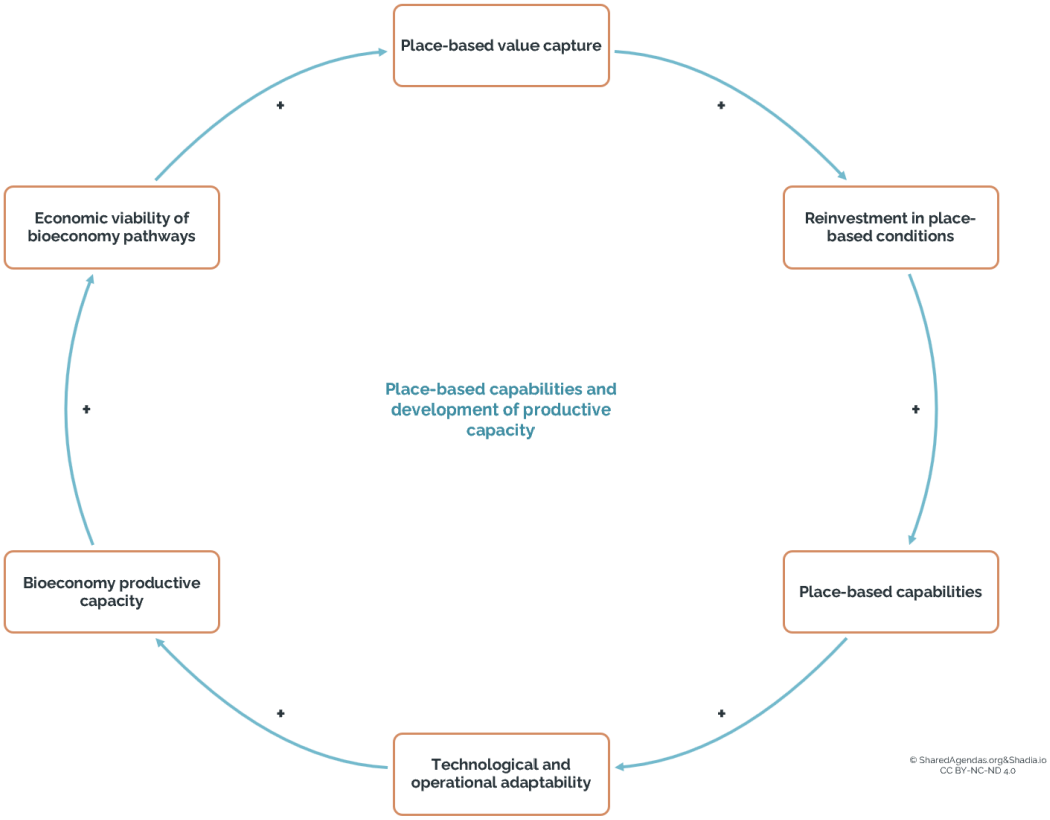
5.10 Place-based value capture, reinvestment and capability development

Figure 12 shows how the value generated through bioeconomy pathways can contribute to building the capabilities needed for their further development.

When part of that value is retained and reinvested in the places involved, it can strengthen knowledge, skills, organisations, technical competencies and productive capacities. These capabilities make it easier to adapt technologies and operating models to local resources, ecological conditions, infrastructure and markets, improving the conditions for productive activity.

As these capabilities grow, they can strengthen adaptability, productive capacity and economic viability, creating further opportunities for value creation and reinvestment. The reinforcing dynamic therefore depends on whether the pathway helps build and renew the place-based capabilities needed to sustain and adapt it over time.

Figure 12. Place-based value capture, reinvestment and capability development



Source: SharedAgendas.org and Shadia.io.

6. Broader configurations of bioeconomy pathway development

As bioeconomy pathways develop, the reinforcing dynamics described in Section 5 can combine in different ways. The three configurations presented in this section show different ways in which place-based development and wider strategic contribution can relate to one another. In some pathways, these two dimensions strengthen one another; in others, one develops more strongly than the other, creating imbalances that shape the opportunities, vulnerabilities and priorities for further action.

The configurations help interpret how a pathway is developing and identify where relationships may need strengthening. Depending on the configuration, this may involve strengthening place-based value creation and participation, improving connections with demand, investment or infrastructure, or sustaining the conditions that allow both dimensions to reinforce one another.

6.1 Mutually reinforcing development

Figure 13 represents a configuration in which the development of a bioeconomy pathway strengthens both its wider strategic contribution and the places and resource base on which it depends.

As productive capacity grows, the pathway is better able to respond to wider demand and strategic needs. This can strengthen market opportunities, economic viability and investment confidence, supporting further investment in infrastructure and productive capacity. At the same time, when producers, local firms and communities participate in processing, ownership, specialised activities and decision-making, a greater share of the value and capabilities generated through the pathway can remain in the places involved.

This place-based value creation can strengthen local capabilities and create more scope for reinvestment in the resource base, while participation supports better resource governance and greater legitimacy. Stronger stewardship and more robust production systems help maintain ecosystem health and improve the reliability of biological resource supply, creating better conditions for continued productive activity. Legitimacy and trust can also improve the conditions for sharing risk and making further investment possible.

These relationships become mutually reinforcing as wider demand and investment support the development of productive capacity, while participation, value capture, governance and reinvestment strengthen the social, ecological and productive foundations on which it depends. The result is a pathway in which the development of productive capacity does not become detached from the

territory, but helps build the conditions that allow both place-based development and wider strategic contribution to continue over time.

Figure 13. Mutually reinforcing development



Source: SharedAgendas.org and Shadia.io.

6.2 Imbalance towards wider strategic contribution

Figure 14 represents a configuration in which a bioeconomy pathway develops strongly in productive and market terms, but the benefits and decision-making associated with that development remain weakly connected to the places where the resources originate.

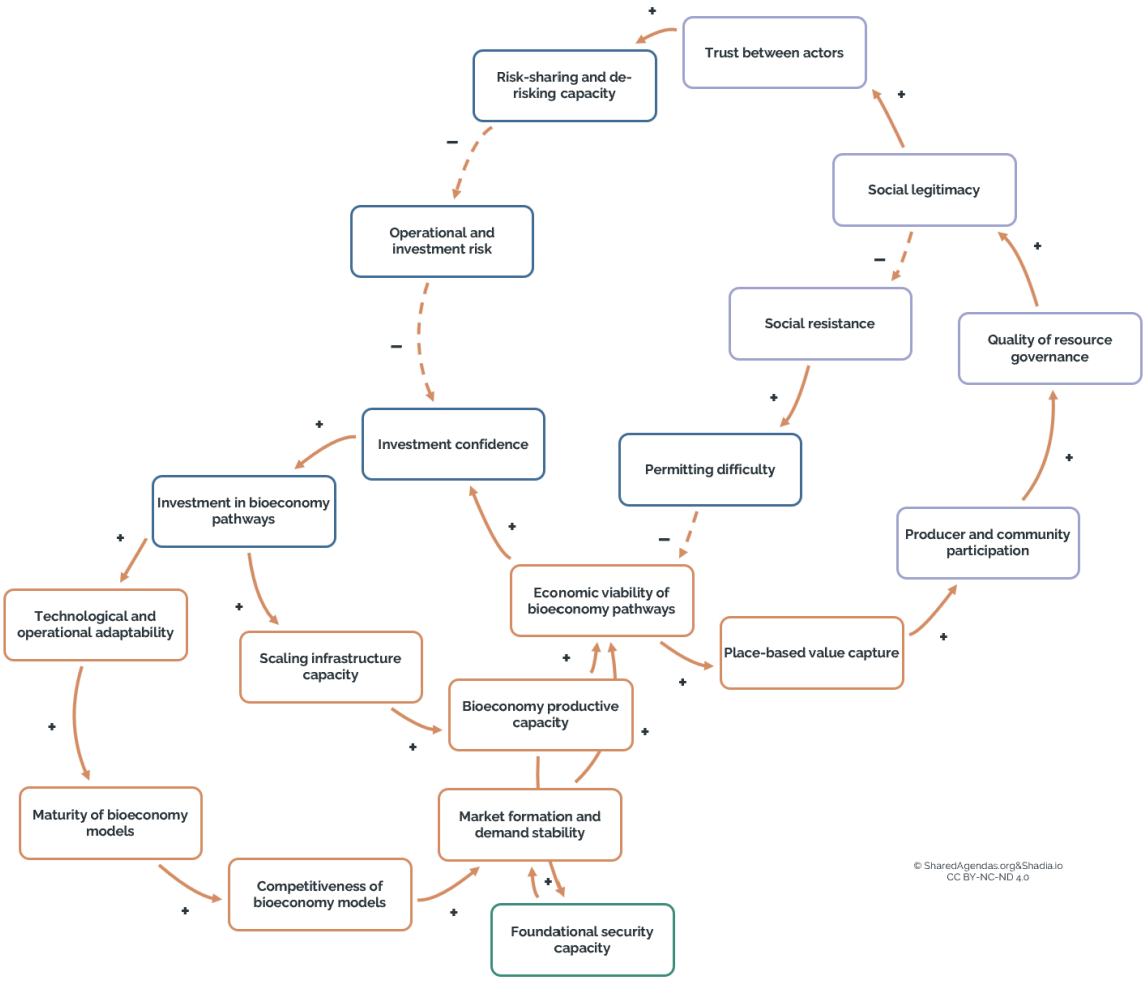
Demand, investment and productive capacity may continue to grow, allowing the pathway to respond to wider strategic needs and become economically viable. However, processing, ownership, specialised capabilities and a large share of the economic returns may accumulate elsewhere. Producers and communities in resource-supplying places can then remain mainly in the role of resource providers, with limited participation in higher-value activities or in decisions about how the pathway develops.

The effects of this imbalance extend beyond the local distribution of economic benefits. Limited participation and weak place-based value capture can reduce the quality of resource governance and weaken the legitimacy of decisions around resource use, infrastructure or the location of facilities. If local actors

perceive that they bear part of the environmental or social impacts without having a meaningful role in decisions or sharing sufficiently in the value created, social resistance can increase. This can make permitting and implementation more difficult, weaken trust between actors and increase operational and investment risk.

These effects can eventually feed back into the productive side of the pathway. Greater uncertainty and conflict can reduce investment confidence, complicate coordination and make further development more difficult, even where demand and technological conditions remain strong. The imbalance therefore does not simply mean that place-based development is weaker than strategic contribution. It means that a pathway that appears successful in productive terms may undermine some of the social, governance and territorial conditions on which its continued development depends.

Figure 14. Imbalance towards wider strategic contribution



Source: SharedAgendas.org and Shadia.io.

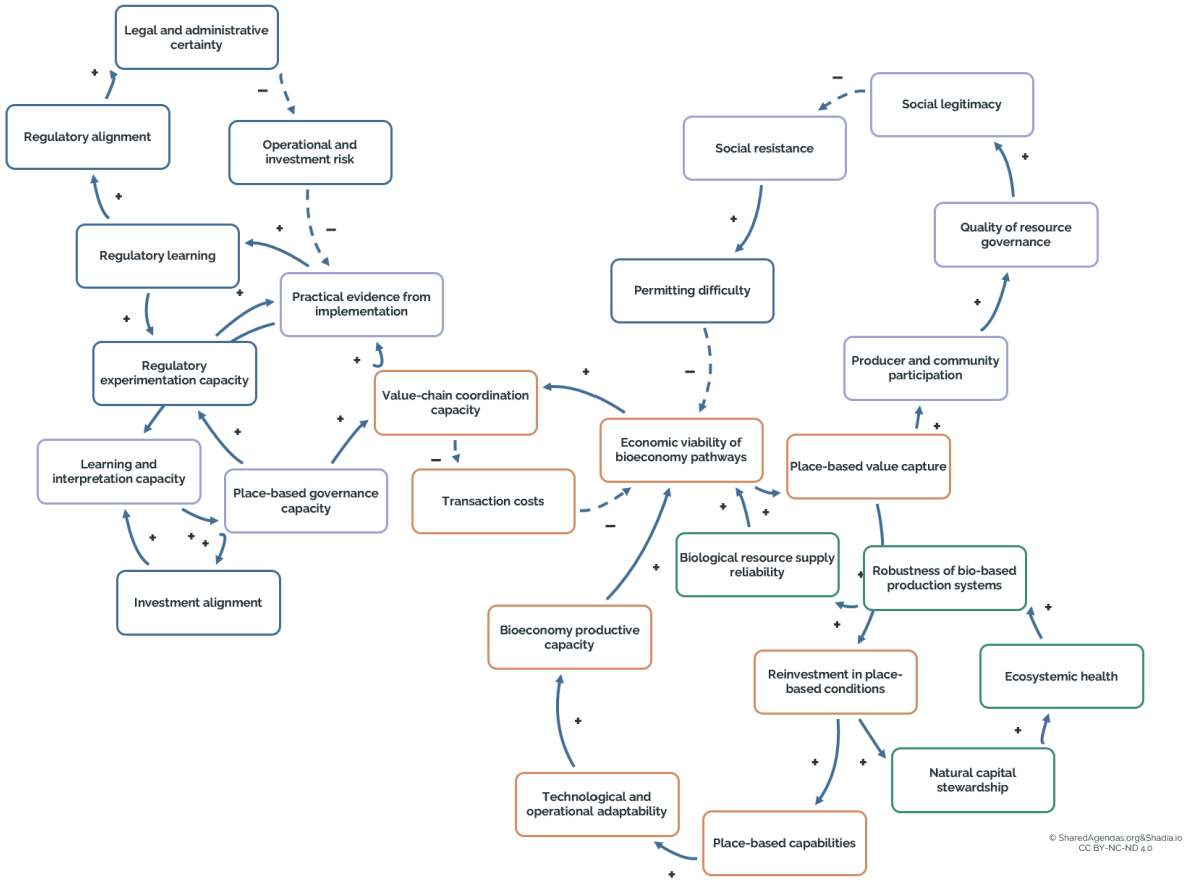
6.3 Imbalance towards place-based development

Figure 15 represents a configuration in which a bioeconomy pathway has developed strong local capabilities, relationships and governance, but still lacks some of the wider market, investment and infrastructure conditions needed to consolidate. Producers, local firms, public authorities and other actors may be well organised around the resource base, with strong participation, knowledge of local conditions and capacity to experiment and learn. Resources can be better understood and governed, technologies and operating models tested and adapted, and practical evidence used to clarify regulatory requirements. In this way, trust, legitimacy and place-based capabilities can grow even before sustained productive activity is established.

The imbalance emerges when these advances are not matched by sufficiently stable demand, investment, infrastructure or other conditions needed to move beyond experimentation. Technologies may work in practice and actors may be ready to cooperate, but activity can remain fragmented or small-scale if buyers are uncertain, infrastructure is missing, investment confidence remains weak or regulatory routes are still incomplete. Knowledge and local capacity may therefore continue to grow without yet translating into viable value chains or a significant contribution to wider strategic needs.

The challenge is to connect these place-based strengths with the conditions needed for the pathway to develop at a larger and more sustained scale. The knowledge, relationships, legitimacy and governance already in place can provide a strong basis for attracting investment, organising infrastructure and building demand, while preserving participation, local value creation and stewardship.

Figure 15. Imbalance towards place-based development



Source: SharedAgendas.org and Shadia.io.

7. Applying the framework to the bioeconomy pathway of livestock effluents, agro-organics, biomethane and nutrients

This section applies the SharedAgendas.org Bioeconomy Framework to livestock effluents, agro-organics, biomethane and nutrients, showing how the relationships identified in the framework take shape in a specific context.

The example focuses on territories with a high concentration of livestock production, where significant quantities of manure and slurry are generated across farms together with other compatible agro-organic flows. These resources can be used for anaerobic digestion and biomethane production, with heat or electricity produced where relevant, while digestate can be further treated and nutrients recovered for agricultural use. How this pathway develops depends on the connections between agricultural production, resource management, infrastructure, technology, demand, regulation, investment and place-based value creation.

These connections will take different forms from one territory to another. Resource characteristics, farming structures, ecological conditions, existing infrastructure, relationships between actors and wider market, regulatory and investment conditions all influence how the pathway can develop.

7.1 Problematic situation and future vision

In areas with a high concentration of livestock production, manure and slurry are generated across many farms and need to be managed continuously. Their volume, nutrient content, storage and application are closely linked to land availability, soils, water conditions, farming practices and logistics. These relationships become particularly important where nutrient loads are high or water systems are vulnerable. At the same time, manure and slurry can provide the resource base for anaerobic digestion and biomethane production, often together with other compatible agro-organic residues. Digestion also produces digestate, which needs to be integrated into nutrient-management systems and can provide further opportunities for nutrient recovery.

The difficulty lies in connecting these dispersed resource flows with the actors, technologies, infrastructure, demand, regulation and investment needed to make the pathway viable. Farmers control manure and farming practices; operators and technology providers organise processing; logistics connect dispersed flows; energy users and network operators shape demand and infrastructure; nutrient users influence the options for digestate and recovered nutrients; public authorities shape permitting and regulation; and investment decisions depend

on how these elements come together. Resource agreements may remain fragile, collection and storage may be poorly organised, digestate uses may be insufficiently developed, grid access or demand may constrain productive activity, farmers may have little influence over decisions and value creation, or regulatory and investment conditions may delay activities that are technically feasible.

The future vision is one in which these elements are connected in ways that combine wider strategic contribution with place-based development and natural capital stewardship. Biomethane and other energy services can contribute to renewable energy supply, fossil substitution and industrial decarbonisation, while nutrient recovery and appropriate use of digestate can improve nutrient management and reduce dependence on externally sourced or fossil-based inputs. Farmers, cooperatives and other actors in the places where these resources originate can participate not only in resource supply, but also in processing, service provision, ownership, governance and value creation.

When these elements reinforce one another, part of the value generated through the pathway can strengthen local productive capabilities and be reinvested in the ecological and productive conditions on which agricultural activity depends. Better nutrient management can support soils and water systems, stronger farmer participation can improve resource governance and legitimacy, and more reliable resource organisation can strengthen the conditions for continued productive activity. The aim is for energy production, manure and nutrient management, farmer participation, value creation and stewardship to reinforce one another over time.

7.2 Conditions shaping this pathway

The seventeen conditions introduced in Section 4 provide a common reference for examining how this pathway develops in a particular territory. Their importance depends on the characteristics of the place and on the relationships between resources, infrastructure, demand, regulation, investment and the actors involved.

The resource base is a first critical element. Manure, slurry and compatible agro-organic residues need to be available in sufficiently stable flows, but estimated volumes alone do not determine what can actually be mobilised. Farm participation, ownership and control, existing uses, seasonal variation, storage, transport distances, co-substrate availability and contractual arrangements all influence resource supply. These flows are also closely connected with natural capital stewardship and the robustness of agricultural production. Manure management affects nutrient cycles, methane emissions, soils and water, while the treatment and destination of digestate determine how energy production connects with nutrient management and agricultural needs.

Infrastructure and technology need to fit these resource and territorial conditions. Collection, storage, transport, digestion, upgrading, gas connection, digestate treatment and nutrient recovery may require different forms and scales of infrastructure depending on the spatial distribution of farms and resources. Technologies and operating arrangements also need to accommodate differences in composition, methane potential, nutrient content, contamination and handling requirements.

The productive viability of the pathway also depends on what happens beyond the resource base. Biomethane needs reliable buyers or market routes, while heat, electricity, digestate and recovered nutrients each depend on suitable forms of demand. Farmers, cooperatives, operators, technology providers, logistics companies, nutrient and energy users, network operators, public authorities and financial actors all influence different parts of the value chain. Agreements on resources, logistics, processing, outputs, responsibilities and risk determine how effectively these parts can work together.

Regulation and investment are closely connected to these decisions. Feedstock classifications, animal by-product rules, permitting, gas-quality requirements and the legal status and use of digestate and recovered nutrients can all affect what is possible. Where new treatment routes or uses do not fit existing arrangements, regulatory experimentation can generate evidence and help clarify possible routes forward. Investment in infrastructure, meanwhile, may depend on secure resource agreements, grid access, credible uses for digestate and recovered nutrients, regulatory clarity and sufficiently stable demand. Different actors also carry different feedstock, technological, regulatory, market and operational risks, so the way these risks are distributed influences who is willing to participate, invest or make longer-term commitments.

The pathway also has a strong place-based dimension. Farmers may participate only as suppliers of manure and slurry, or they may also take part in processing, service provision, ownership and governance. Municipalities and communities can be affected by facilities, traffic, odour, infrastructure and land-use decisions, making the distribution of roles, value, risks and influence important for both legitimacy and implementation.

As implementation progresses, it generates evidence on resource flows, operating performance, methane yields, digestate quality, nutrient balances, water conditions, logistics, costs, demand and local responses. Bringing this evidence together allows actors to refine their understanding of what works, where constraints remain and what needs to change. What matters, therefore, is not treating the conditions as a checklist, but understanding how they interact: resource reliability may depend on farmer participation and infrastructure,

investment confidence on credible output routes and regulatory clarity, and regulatory development on evidence generated through implementation.

7.3 How the broader configurations take shape in this pathway

The three configurations introduced in Section 6 can take very different forms in this pathway. Their expression depends on concrete relationships between manure and nutrient management, farmer participation, processing and infrastructure, biomethane and nutrient demand, regulation, investment and the ecological conditions of agricultural production.

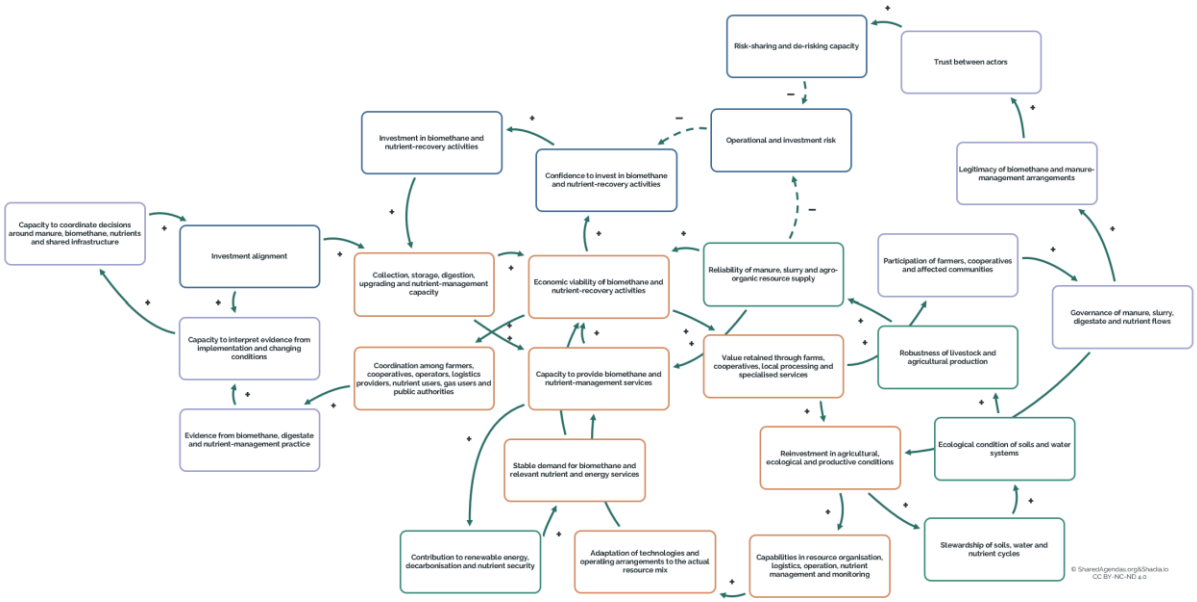
Figures 16–18 illustrate these different possibilities: a configuration in which the productive capacity and place-based development reinforce one another; one in which productive capacity and wider strategic contribution advance more strongly than local participation and value creation; and one in which strong local capabilities and coordination are not yet matched by the market, infrastructure and investment conditions required for productive consolidation.

Mutually reinforcing development

Figure 16 shows how mutually reinforcing development can take shape in this pathway. Reliable manure and agro-organic flows, suitable infrastructure and adapted operating arrangements support biomethane production and nutrient management, strengthening the contribution to renewable energy, decarbonisation and nutrient recovery.

At the same time, when farmers and other local actors participate in processing, services, governance and value creation, part of the value generated can be reinvested in local capabilities, manure and nutrient governance and the ecological conditions on which agricultural production depends. Place-based development and wider strategic contribution can therefore reinforce one another.

Figure 16. Mutually reinforcing development in the pathway of livestock effluents, agro-organics, biomethane and nutrients



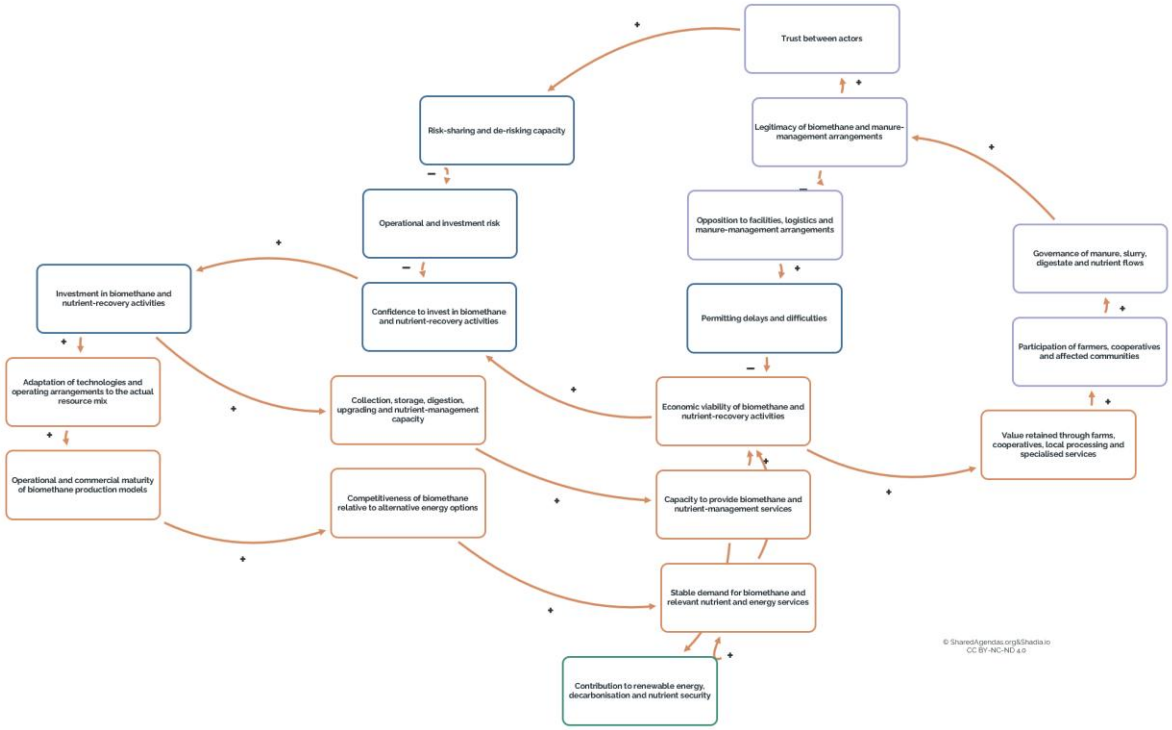
Source: SharedAgendas.org and Shadia.io.

Imbalance towards wider strategic contribution

Figure 17 shows how an imbalance towards wider strategic contribution can emerge when biomethane demand, productive capacity and investment grow more quickly than farmer participation, place-based value creation and stewardship. Investment in digestion, upgrading, grid connection and related infrastructure can increase renewable-gas production and strengthen the contribution to decarbonisation and energy objectives.

The imbalance appears when farmers remain mainly suppliers of manure or slurry while processing, ownership, specialised capabilities and financial returns accumulate elsewhere. This can weaken the connection between pathway development and farming needs, nutrient management, soils and water conditions, while limiting local influence over decisions and value creation. Productive and strategic contribution may therefore advance while place-based benefits remain weaker and challenges around legitimacy and implementation increase.

Figure 17. Imbalance towards wider strategic contribution in the pathway of livestock effluents, agro-organics, biomethane and nutrients



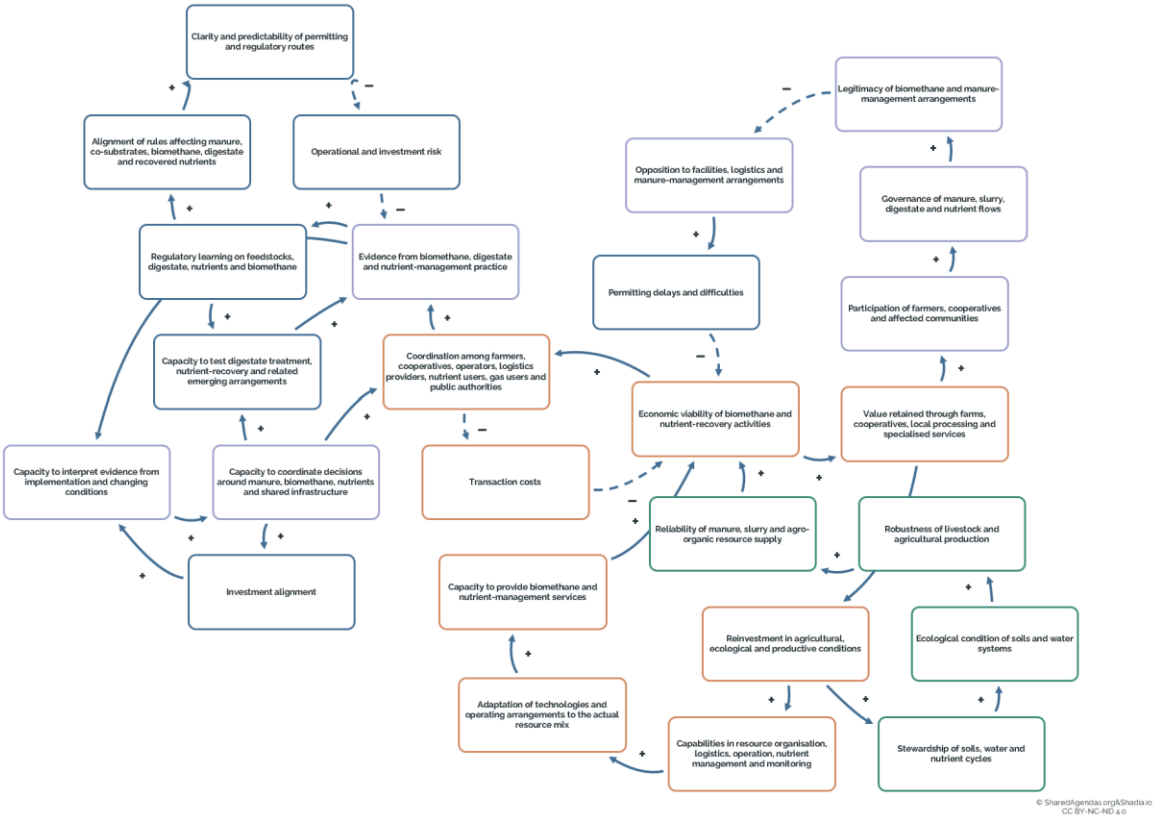
Source: SharedAgendas.org and Shadia.io.

Imbalance towards place-based development

Figure 18 shows the opposite imbalance. Farmers, cooperatives and other local actors may become increasingly organised around manure management, nutrient recovery and stewardship, building knowledge, testing technologies and strengthening governance around soils, water and nutrient flows.

These place-based capabilities can become substantial while biomethane demand, processing and grid infrastructure, investment or regulatory certainty remain too weak for sustained productive activity. The pathway may therefore be well developed locally but still struggle to move beyond experimentation or small-scale implementation because the wider conditions needed for productive consolidation and strategic contribution are not yet in place.

Figure 18. Imbalance towards place-based development in the pathway of livestock effluents, agro-organics, biomethane and nutrients



Source: SharedAgendas.org and Shadia.io.

7.4 From pathway interpretation to collective action

Applying the framework to a specific pathway helps identify where collective action is needed and which relationships require attention. The priorities will vary from one context to another. In a territory where substantial manure and slurry flows are generated across many farms, the main challenge may be to organise resource supply through agreements with farmers, collection and storage arrangements and reliable information on the flows that can be mobilised. Elsewhere, resource supply may already be sufficiently organised while digestate treatment, nutrient recovery or agricultural use requires further development. In other cases, technical and resource conditions may be strong while grid access, stable demand or finance remain the main constraints.

These issues are interdependent. Investment in digestion or upgrading capacity may depend on secure resource agreements and credible routes for digestate use; farmer participation may depend on value-sharing and risk arrangements; regulatory clarification may require evidence from trials or operating facilities; and stable demand may depend on the reliability provided by infrastructure and

value-chain coordination. Making these dependencies visible helps identify where different actions need to be connected rather than developed separately.

Within a Shared Agenda, these interdependent actions can be organised through systemic portfolios according to the roles they play, their dependencies and the conditions they are intended to influence. Depending on the context, this may involve resource agreements, cooperative arrangements, shared collection or processing infrastructure, digestate and nutrient trials, offtake arrangements, regulatory experimentation, risk-sharing mechanisms or new forms of participation and governance. In this way, collective action remains connected to the pathway and to the causal relationships identified through the framework.

At the same time, Shared Agendas develop within a wider place-based context in which bioeconomy pathways interact with other productive activities, infrastructures, investment dynamics, patterns of demand and other areas of development. Understanding these connections can therefore require moving beyond the relationships represented in a single framework. The next section shows how place-based configurations can bring these wider relationships into a coherent understanding of the situation being addressed.

8. Applying the framework in place-based contexts

The previous section showed how the Bioeconomy Framework can be adapted to a specific bioeconomy pathway. In place-based contexts, however, the questions being addressed often extend beyond the boundaries of a single pathway or field. Biological resources, food production, industry, energy, water, land use, infrastructure, investment, cities and social practices are part of the same interconnected reality, and developments in one area can change the conditions and possibilities in others.

SharedAgendas.org frameworks provide analytical structures for understanding different parts of this reality. In place-based work, these analytically separated domains come together around concrete situations and a direction of change. The relevant geography therefore emerges from the relationships shaping the situation rather than being defined in advance by administrative or sectoral boundaries. A place-based configuration may include relationships extending beyond the territory when demand, infrastructure, knowledge, investment, regulation or other capabilities located elsewhere influence what can develop in the place.

Place-based configurations bring the relationships that matter for these questions into a coherent picture. Depending on the situation, they may draw on relationships developed through several SharedAgendas.org frameworks and connect them with the specific resources, capabilities, initiatives and conditions of the place. The purpose is not to represent every possible relationship, but to make visible those that help explain the situation and how change could take place.

8.1 Building place-based configurations

Building a place-based configuration starts from the situation being addressed and the direction of change being pursued. The configuration identifies the relationships that are most relevant for understanding how that change could take place. These may involve resources, productive activities, demand, infrastructure, investment, governance or other conditions addressed through different SharedAgendas.org frameworks.

These relationships are brought together around the story that needs to be understood and connected with the specific characteristics of the place. The resulting configuration can show how existing resources and capabilities relate to emerging opportunities, which conditions enable or constrain their development, and where changes in one area may affect possibilities elsewhere. The three cases below illustrate how this works in practice.

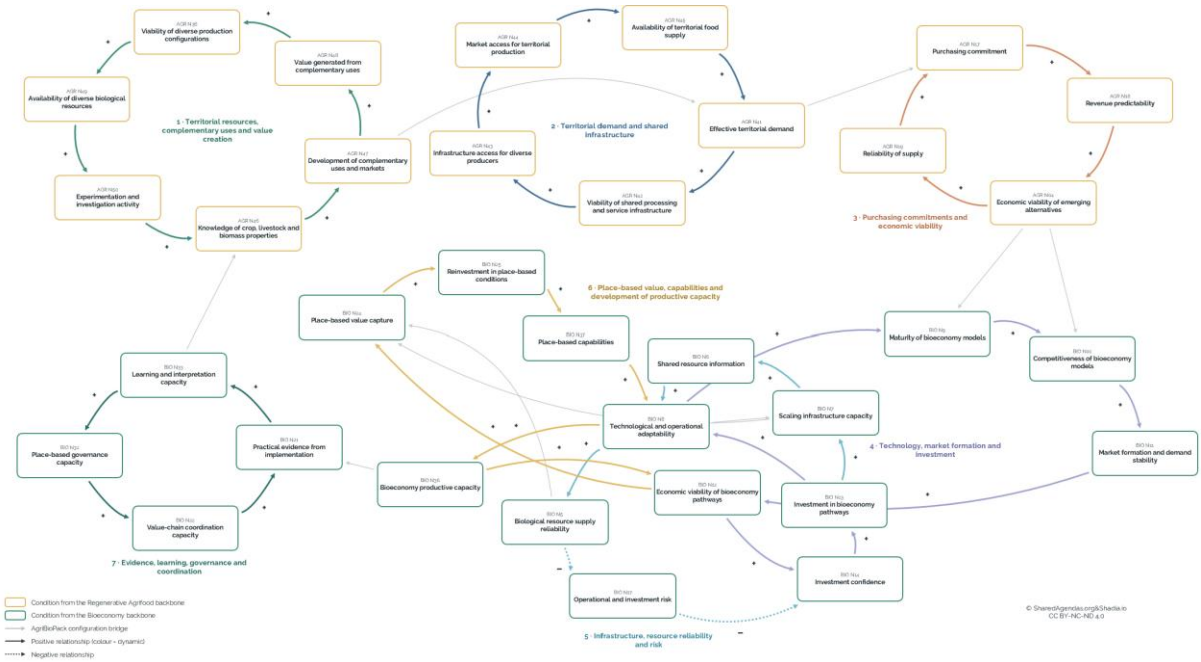
European AgriBioPack project: building bioeconomy pathways from agrifood resources

The European AgriBioPack project explores how biological resources and productive activities present in a place can support the development of new bioeconomy corridors. Understanding this process brings together relationships addressed through the Agrifood and Bioeconomy frameworks.

Knowledge of biological resources and their properties helps identify possible complementary uses and markets. Developing these uses depends on demand, shared infrastructure and credible purchasing commitments, which influence the viability of emerging alternatives and the possibilities for technology development and investment. Infrastructure and reliable resource supply then affect the capacity to develop productive activities at greater scale, while place-based value creation, capabilities, governance and learning influence how this development can be sustained.

Bringing these relationships together shifts the focus from identifying resources or individual business opportunities to understanding what needs to come together for a bioeconomy corridor to develop.

FIGURE 19. Configuring place-based bioeconomy pathways



Source: SharedAgendas.org and Shadia.io.

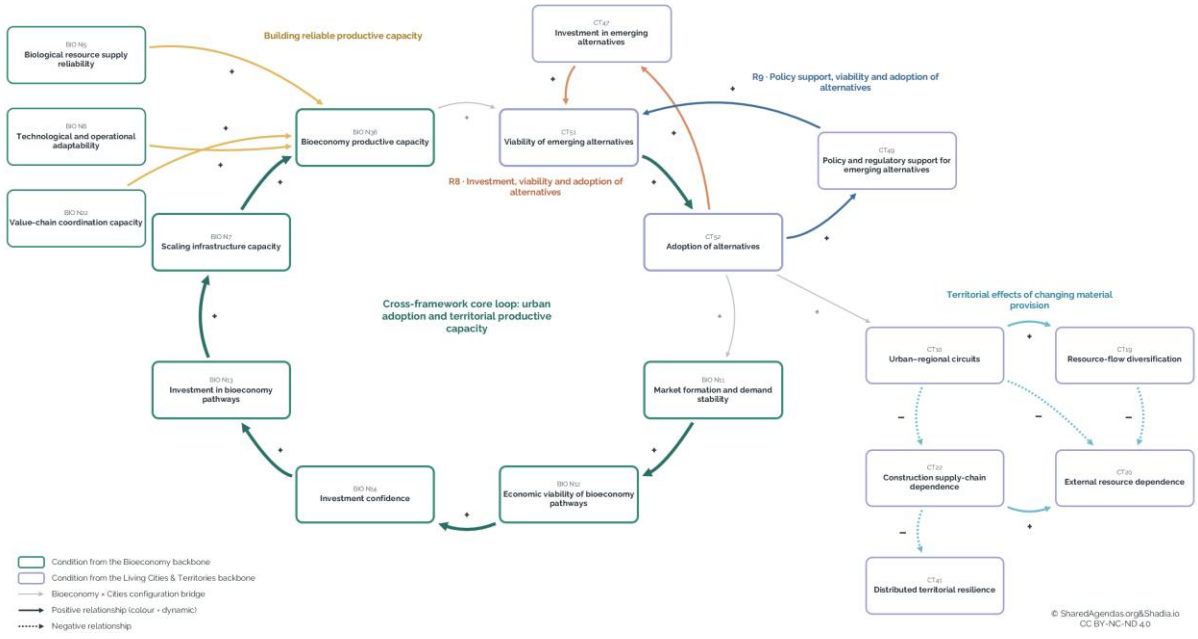
Bioeconomy and Living Cities & Territories: connecting productive capacity with demand

A different question concerns how demand for bio-based alternatives can support the development of bioeconomy pathways. Cities concentrate demand for food, materials, construction, energy and services and can therefore influence whether emerging alternatives become viable and are adopted.

The configuration connects bioeconomy productive capacity with the viability and adoption of alternatives in urban contexts. Greater adoption can contribute to more stable demand, strengthening economic viability, investment and the infrastructure needed to expand productive capacity. When these alternatives are supplied through place-based bio-based value chains, their adoption can also strengthen urban–regional circuits and diversify resource flows.

These relationships show how productive opportunities and demand can develop together. Productive capacity makes new alternatives possible, while their adoption can create the more stable demand and investment conditions required for further development.

Figure 20. Connecting bioeconomy productive capacity with demand in cities



Source: SharedAgendas.org and Shadia.io.

The Terres de Lleida, Pirineu i Aran Shared Agenda: connecting bioeconomy productive capacity with systemic investment

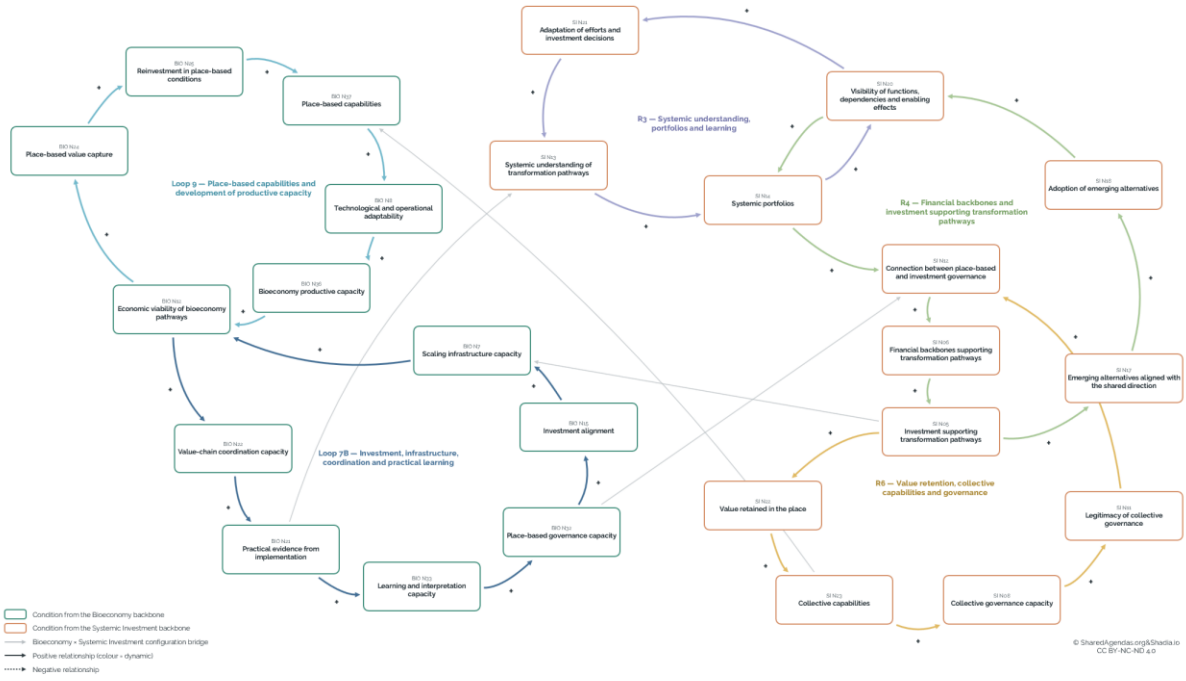
The Terres de Lleida, Pirineu i Aran Shared Agenda starts from a situation in which years of place-based work have progressively built relationships,

capabilities, governance, experimentation and practical evidence around bioeconomy opportunities. The question is how these accumulated conditions can support the next stage of development, including the investment required for infrastructure, productive capacity and emerging value chains to reach greater scale.

Investment is therefore connected with a process that is already underway. Practical evidence can strengthen the understanding of the pathways being developed and inform systemic portfolios and investment decisions. Connections between place-based and investment governance can help organise finance around interdependent needs, while investment can strengthen infrastructure and productive capacity.

Further implementation generates new experience, evidence and learning. At the same time, value retained in the place can reinforce collective capabilities and create better conditions for further productive development. Investment can therefore build on capabilities, relationships and evidence already developed through the Shared Agenda while contributing to their further development.

Figure 21. Connecting bioeconomy productive capacity with systemic investment



Source: SharedAgendas.org and Shadia.io.

The three cases address different questions, but follow the same logic. The relevant relationships are defined by the situation and the direction being pursued rather than by sectoral or framework boundaries. As the configuration becomes more specific, these relationships can be connected with what is

actually present in the place: biological resources, productive activities, firms and cooperatives, research capabilities, infrastructure, institutions, practical knowledge, existing initiatives and investment opportunities.

This provides a basis for moving from interpretation to strategy and action. Different initiatives can be related to the conditions they influence and to their dependencies on one another, while portfolios can bring together complementary actions around a shared direction. The configuration can therefore help identify not only what is already happening, but also what may need to be connected, strengthened or developed for new possibilities to emerge.

8.2 Connecting evidence and collective sensemaking

Once a place-based configuration has been developed, it provides a structure for connecting this understanding with evidence about what is happening in the place and in the wider context. Local and regional data can provide information on biological resources, productive activities, infrastructure, environmental conditions, firms, projects and investment. Initiatives and experimentation generate practical evidence, while developments in regulation, technology, markets, investment and strategic priorities at national, European or global level can change the opportunities and constraints surrounding the configuration.

Bringing these sources together makes it possible to interpret developments in relation to the strategy rather than in isolation. A change in regulation may open possibilities for a particular pathway. New demand may increase the relevance of resources or productive capabilities already present. Implementation evidence may reveal a missing connection between infrastructure, technology, supply or demand. The same development can also have different implications in different places because the conditions around it are different.

The configuration provides a common structure for relating this evidence to the relationships that matter. New information can progressively enrich the understanding of the situation, reveal connections that were previously unclear and open new questions about what could be developed. Quantitative data, documents, implementation evidence and knowledge generated through practice can therefore contribute to the same evolving picture.

Shadia.io is being developed as an infrastructure for working with this relational knowledge computationally. It formalises the relationships represented in frameworks and systems maps into structured backbones that can be connected across domains and linked with different sources of evidence and data. This allows place-based configurations to be built and explored around particular questions while retaining the relationships from which they are derived.

From this structure, different entry points can be explored. A process may start from the resources and capabilities present in a place and examine what pathways could be developed from them. It may start from an emerging market or strategic demand and explore which existing resources and capabilities could respond to it. It may also start from an initiative, technology, investment opportunity or policy development and examine what other conditions would need to come together for it to contribute to a wider strategy.

Connecting these possibilities with evidence creates a hybrid form of sensemaking. Computational capabilities can help work across frameworks and large volumes of heterogeneous information, identify relevant connections and incorporate new developments into existing configurations. Place-based knowledge, collective processes and human judgement provide the contextual understanding required to assess what these connections mean, which possibilities are relevant and how they could be pursued.

The same infrastructure can support this work as strategies develop. New projects, evidence, investment, policy changes or wider developments can be connected back to the configuration, making it possible to examine how the conditions surrounding a strategy are changing and whether new opportunities or constraints are emerging. Monitoring and learning therefore become part of the same process used to build and interpret the strategy, rather than a separate layer added afterwards.

In this way, place-based configurations can evolve while retaining a coherent understanding of the relationships on which they are based. They provide a way to connect what a place already has with what it could build, relate local possibilities to developments at other scales, and continuously refine the strategies and portfolios through which those possibilities are pursued.