Report on a toolkit for national and regional decision-makers

Supporting sustainability transitions under the European Green Deal with cohesion policy

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1. Introduction to sustainability transitions

Main messages

- Some environmental challenges, particularly those related to climate change, biodiversity and resource use, cannot be tackled by environmental policies alone;

- Systemic change in unsustainable systems of production and consumptions is needed. This requires a fundamental transformation of large socio-technical systems, including changes in technologies, infrastructure, legislation, markets, behaviours, etc. The European Green Deal sets ambitious climate, biodiversity and circular economy targets to guide this change and also encompasses a set of strategies aimed at transforming systems supplying energy, food and mobility to Europeans;

- Change will meet resistance from actors invested in retaining the status quo and at the same time requires support to new actors who can provide new solutions which enable sustainability transitions;

- The three main processes involved in a sustainability transition are Innovation (emergence), large-scale deployment of sustainable solutions (diffusion), and system reconfiguration (at the same time ensuring a just transition);

- Member States, regions and local communities will all need to contribute to the transition, but the impacts of the transition will be territorially differentiated;

- Cohesion policy has a strong role in sustainability transitions for a number of reasons. It contributes a significant amount of funding for regions and has a capacity building component, thus enabling territories both financially and in terms of implementing capacity. It is place-based and employs a multilevel governance approach, allowing for the implementation of transitions at the appropriate territorial scale. It has a strong focus on partnership, and it enables the implementation of integrated development strategies.

1.1. The European Green Deal: Europe's new policy agenda

The European Commission has proposed a European Green Deal as Europe's new growth strategy, making Europe and its social market economy fit for a healthy planet. The European Green Deal addresses environmental issues such as biodiversity, pollution and climate change, through the transformation of food systems, agriculture, energy, industry, buildings and mobility. The set of proposals which form part of the Green Deal action plan set out ambitious targets for climate change, biodiversity and set out strategies for transforming systems supplying energy, food and mobility to Europeans.

As Europe's new growth strategy, the European Green Deal and its initiatives are central to achieving a sustainable and rapid recovery and ultimately a just and fair transition, which leaves no person and no region behind. The EU has adopted a net zero emission target for 2050 for greenhouse gas emissions, and the Commission has proposed increasing the emission reduction target for 2030 from 40% to 55%. The Circular Economy Action Plan and its initiatives will strengthen our resilience and resource independence. The Biodiversity Strategy 2030 will protect our nature and ecosystems, the very foundation of our lives and economies. And because healthy ecosystems and clean

air are the basis for healthy and resilient societies, a Chemicals Strategy for Sustainability and a Zero Pollution Action Plan for air, water and soil are currently in preparation.

At the same time, the new Multi-annual Financial Framework (MFF) and Next Generation EU jointly encompass the most ambitious set of funding proposals the EU has ever made, making EUR 1,824.3 billion available over the period 2021-2027.1

These proposals made by the European Commission contain a set of measures to ensure that funding is not environmentally harmful and supports the transition to a low-carbon, green and circular economy, while making Europe resilient after the coronavirus pandemic. In addition, action needs to be taken by Member States, regions, cities and rural areas to ensure that the funding they oversee supports national, regional and local transition processes.

1.2. Systemic environmental challenges and sustainability transitions

Sustainable development is understood "as a process of navigating pathways between two sets of boundaries — the social foundation of basic needs and the environmental ceiling of planetary boundaries" (EEA & Eionet, 2016). The huge increases in economic output achieved during the 20th century enabled important gains in living standards but also caused major environmental pressures. In some cases environmental policies have successfully tackled these environmental issues. Much progress has been made for example in reducing emissions of gases that damage the ozone layer and investment in waste water treatment plants has contributed significantly to reducing levels of pollutants in effluent discharges into surface water bodies. However, some environmental issues, in particular climate change and biodiversity as well as challenges related to sustainable use of resources, have persisted or are becoming increasingly severe despite the implementation of policies aimed at mitigating them.

Table 1 State of the environment in the EU

Environmental issue	Selected indicators of the state of the environment in the EU
Climate change	23% reduction in GHG emissions since 1990 EU on track to meet 2020 renewable energy target EU partly on track to meet 2020 energy efficiency target EU largely not on track to meet 2030 climate and energy targets
Biodiversity and ecosystems	Predominantly unfavourable conservation status for 60 % of species and 77 % of habitats Decline in numbers of common farmland bird at 32 % over 25 years, while the common forest bird index decreased by 3 % in the EU Index of farmland butterflies declined by 39% over 27 years in countries with monitoring schemes Grassland butterfly populations declined by 39 % in 15 EU Member States since 1990 17 % of the bird species are still threatened and another 15 % are declining or depleted
Resources - Water	40 % of Europe's surface waterbodies achieve good ecological status, wetlands and 80-90 % of floodplains are widely degraded. Water abstraction is at 243 billion cubic metres per year but decreasing.

[1] The analysis throughout this toolkit is based on the Commission's proposals for a next MFF and for the Recovery Plan.

	In summer of 2015 19% of Europe's area experienced water stress.
Resources - Materials	High resource use and waste generation Low rate of circular material use Improving trends in prevention and recycling High rates of land take for grey infrastructure, urbanisation, industry

Source: EEA, 2019b

These **challenges have been difficult to address because they are systemic in nature, "tied in complex ways to prevailing economic, technological and social systems**" (EEA, 2017), and therefore "unsustainable systems of production and consumption require fundamental rethinking" (EEA, 2015a). Focusing on these systems of production and consumption that drive environmental degradation provides insights into the barriers to addressing environmental problems and how they can be overcome, while satisfying our needs for food, shelter, mobility, warmth, etc.

A systemic approach to addressing the persistent environmental issues of climate change, biodiversity loss and resource use involves the implementation of not only policies and interventions which are strictly environmental in nature, but rather the **implementation of a broader economic-social-technological transition**. Sustainability transitions have been described as "long-term, multi-dimensional and fundamental transformation of large socio-technical systems towards more sustainable modes of production and consumption" (Markard, Raven, & Truffer, 2012). The literature on transitions explains the stability and resilience of established systems and sees change as arising from interactions between micro-level innovation and macro-level disruption.

Three central concepts associated with transitions according to the 'Multi-Level Perspective', as described in the literature on sustainability transitions, are the concepts of landscape, regime and niche:

- The **landscape** level is the macro-level. It is defined a set of exogenous, high-level contextual structures consisting of e.g. culture, macro-economics and politics. Landscapes provide an overall structure within which regimes are embedded, but can also be a source of pressure which force regimes to change. They are beyond the direct influence of regime actors.
- Socio-economic **regimes** are the meso-level. They are "relatively stable configurations of institutions, techniques and artefacts, as well as rules, practices and networks that determine the 'normal' development and use of technologies". (A. Smith, Stirling, & Berkhout, 2005 referring to Rip & Kemp, 1998) The regime is self-reinforcing and stable, and innovation within the regime is incremental.
- **Niches** constitute the micro level. They are "protected spaces, i.e., specific markets or application domains, in which radical innovations can develop without being subject to the selection pressure of the prevailing regime" (Markard et al., 2012). These innovations are not initially competitive in terms of cost and performance at the regime level and are cannot seamlessly be integrated within the dominant regime.

An example of a socio-technical regime is the regime surrounding the private ownership of vehicles with internal combustion engines. The elements of the regime include *infrastructural* elements directly associated with these vehicles such as the system of roads, petrol stations and parking spaces, *technological* elements including the engine itself and the associated vehicle technology, *knowledge systems* focused on the technological design of internal combustion engines and personal vehicles, *socio-cultural* elements related to the feeling of freedom gained from driving these vehicles and social status related to owning one, *legislative* elements related to fuel and vehicle standards

and safety standards which are geared towards legislating the impacts of the use of these vehicles, etc. The regime also includes an entire upstream industry of oil extraction, refining and transport and the associated systems of power and geopolitics.

These elements together form a socio-technical regime, with actors, such as the automobile industry, having vested interests in maintaining the status quo. The regime is relatively stable, stabilised by the various elements listed above, e.g. petrol stations which cannot serve vehicles using alternative fuels, or vehicle ownership-conferred socio-economic status which cannot be gained by owning e.g. an electric bicycle or by using public transport. In addition to elements of the regime which passively maintain the current system, active resistance to change from actors with a vested interest in maintaining the status quo adds to the stability of the regime.

Several niche solutions exist which may provide alternative modes of satisfying the demand for mobility either locally or globally, such as the ownership of electric cars, hydrogen fuelled cars or electric bicycles, car-sharing schemes which differ not necessarily in terms of technology but in terms of business model, or car-free zones which make the choice of other mobility options necessary within a local context. These niche technologies, business models and practices may emerge from their niche status and become the dominant regime if there are pressures at the landscape level (e..g climate change), or internal pressures and inconsistencies within the regime (e.g. a widespread expectation to satisfy mobility demand in parallel to an equally widespread expectation to improve air quality). If these pressures make business as usual infeasible and if these niche solutions provide an adequate alternative to satisfying mobility needs, then niche solutions may emerge from their niche status. This requires support for innovative processes through shared expectations, learning processes and network building, and may require policies which level the playing field between existing and new solutions.

Without any pressure to replace the existing regime, the niche mobility solutions remain at the niche level, occupying cultural and market niches, kept alive by consumers with cultural norms, financial means, etc. which are different from the mainstream. Pressures, e.g. in the form of policy pressure to decarbonise transport systems, will result in a competition between different niche solutions and the dominant regime, with one or more solutions emerging as the new dominant regime. The emergence of a new regime which replaces an existing regime constitutes a transition.

The stages of a transition from an existing to a new regime could be the following based on an idealised description of a transition, from which departures are possible:

1. Initially the regime is stable, with small scale experimentation happening at the niche level without threatening the regime;
2. Ecological, economic, social, political or other conditions make the existing system untenable and the system becomes transformable (Walker, Holling, Carpenter, & Kinzig, 2004);
3. Niche and regime actors struggle to provide solutions to the initial pressure and many new ways of meeting needs emerge;
4. Novel solutions build up, "niches expand, attract more users, and become mainstream markets starting to compete with the incumbent regime" (Kivimaa et al., 2019);
5. Former niche solutions establish themselves as a new regime.

A sustainability transition viewed as resulting from the above process is not a single transition, but a multitude of transitions. The transition to a climate neutral economy requires new solutions to energy production, energy use in buildings, mobility, land use change, etc. The transition to a circular economy requires new solutions in a number of different industries, materials and consumer groups. The transition will therefore have to play out in a number of domains, e.g. energy, transport, food, housing, and include

changes in technologies, business models, cultures, etc., involving the entire process of resource extraction, production, consumption and (alternatives to) disposal.[2]

The process of niche emergence is shown in Figure 1.

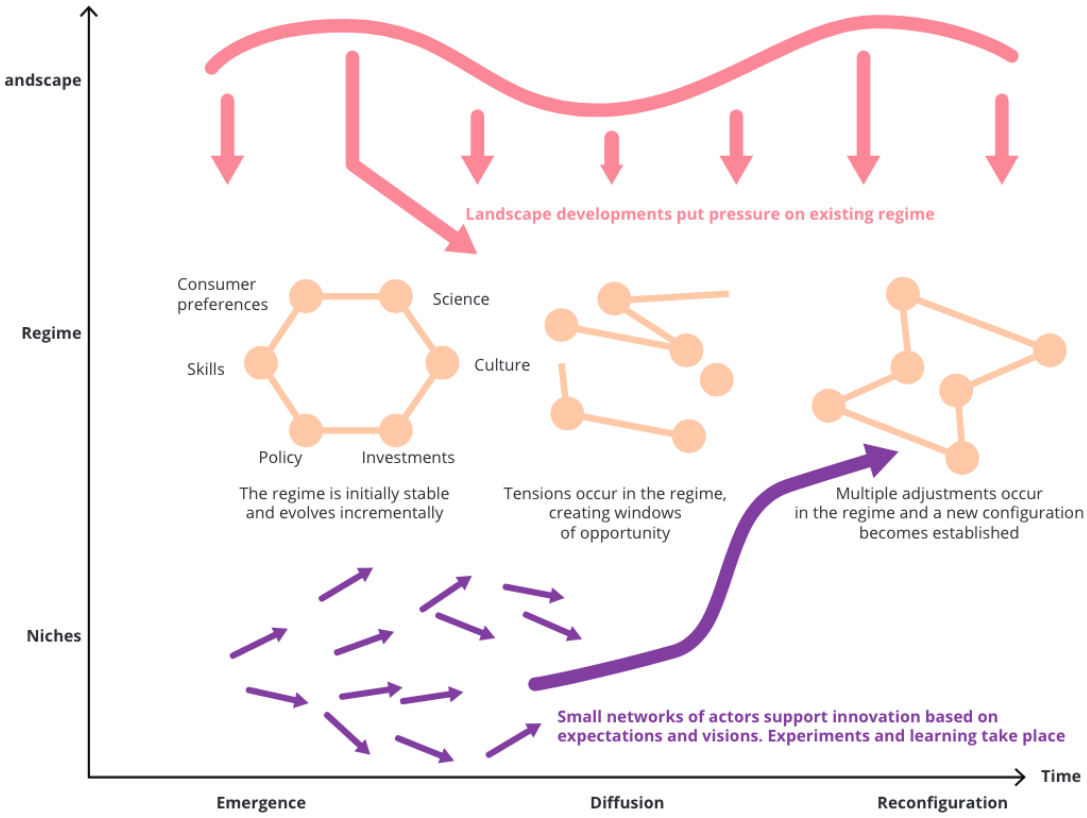


Figure 1 Sustainability transition according to the Multi-Level Perspective literature

Source: F. Geels et al., 2019

In order for a transition to take place whereby current unsustainable practices, technologies and solutions are replaced by new sustainable ones, the former need to be phased out. Therefore, in parallel to the emergence of niche technologies and practices as the new dominant regime, incumbent solutions need to be destabilised. If this does not happen, i.e. if regime actors identify solutions which maintains the existing regime in a largely unchanged form with a minor change in existing technologies, business models or practices, then a socio-economic transition does not take place. This parallel process of phasing out is depicted by the x-curve, shown in Figure 2.

[2] More information on sustainability transitions can be found in e.g. OECD, 2017, S. Smith, 2017 and Botta, 2018, EEA, 2017, EEA, 2016a, EEA, 2016b, EEA, 2015a and EEA & Eionet, 2016, Roorda et al., 2014, Jefferies & Duffy, 2011, Rauschmayer, Bauler, & Schäpke, 2013.

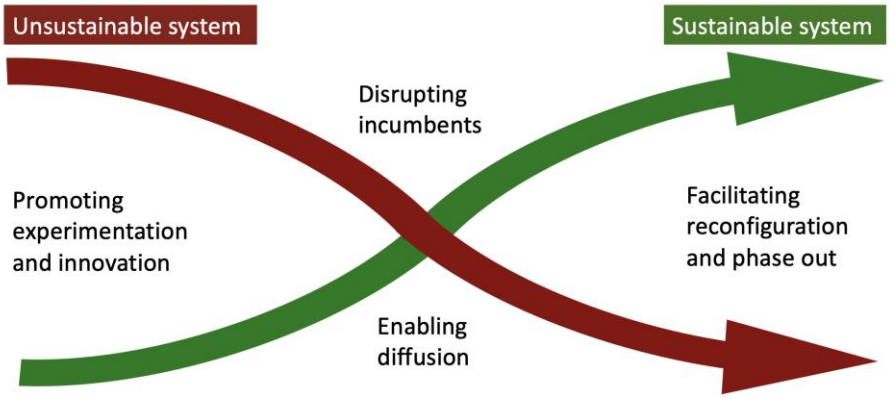


Figure 2 The x-curve of transitions: destabilisation of incumbents and establishment of new regime

Source: F. Geels et al., 2019

In order to reduce the complexity of discussion of transitions in this toolkit, the focus will be on three broad phases of the transition, also depicted on the x-axis in Figure 1, which also correspond to the stages of transition depicted in Figure 2, and which are further discussed in section 1.4 as well as in sections 4-7:

1. Innovation (emergence);
2. Large-scale deployment of sustainable solutions (diffusion) understood as both enabling diffusion of sustainable solutions, and in parallel, destabilising unsustainable ones;
3. System reconfiguration (in this toolkit the focus is on the just transition aspect).

All three stages need to be supported by government policies, including funding.

1.3. Sustainability transitions and other types of transitions

There has been a focus on different types of transitions in EU policy recently. These include, in addition to sustainability transitions, energy transitions (European Commission, 2015), industrial transitions (European Commission, 2020a) and just transitions (European Commission, 2019b). These are overlapping concepts.

Energy transitions, in their narrowest sense, focus on the topic of replacing one energy source with another. However, in reality, energy is so much tied up with our ways of producing, consuming and living that the energy transition also encompasses changes in production, consumption and behaviour.

The need to transform the energy system can be triggered by different types of landscape pressures, both economic and policy driven. For example, reduced demand and profitability for coal led to around 1000 mine closures in an industry that employed around half a million people in the UK during the period starting from the end of the Second World War to the mid-1990s. Currently energy transitions are often driven by the need to mitigate greenhouse gas emissions, but in many ways are similar to previous energy transitions in their socio-economic impact.

Sustainability transitions are broader than energy transitions and encompass a transformation towards a sustainable society in response to the types of persistent environmental issues described in section 1.2, including climate change as well as biodiversity and the circular economy. There are strong linkages between sustainability transitions and energy transitions, as recognised by the Energy Union (European Commission, 2015). Trade-offs are also present, e.g. between large scale use of biomass

to support a climate neutral economy and good ecological health, in line with a green economy.

Irrespective of what drives sustainability and energy transitions, they involve industrial transitions, as technological solutions produced by and applied in industry are important elements of the energy transition. They also involve broad changes in societal systems and individual behaviour.

Industrial transitions (OECD, 2019d) are transitions encompassing all industrial change which takes place in response to challenges and pressures on industry. These may include challenges related to systemic sustainability issues, as well as challenges such as globalisation and technological change. Industrial transitions are an essential part of sustainability (and energy) transitions. Industrial transitions, such as the Industrial Revolution, have in the past triggered broad changes in societal systems. The Industrial Revolution embodied not only the obvious change in technological systems, but resulted in a wide array of unforeseeable transformations in the socio-economic system as well, including changes in work hours, with more flexibility provided by coal than watermills, concentrated territorial patterns of development around coal mining areas, and a new concentration of wealth in the hands of the owners of capital. (Malm, 2016). Similarly, a broad transformation in all aspects of economies, societies and the lives of individuals may result from sustainability transitions.

Sustainability, energy and industrial transitions involve structural change, resulting in job gains and losses as well as economic gains and losses which are regionally and sectorally differentiated and may impact certain socio-economic groups more than others. The term **just transition** applies not to an additional type of transition but to the need for a transition that is fair and considerate of equity. This is not automatically the case, i.e. transitions may be environmentally sustainable but not socially just, therefore policies aimed at ensuring a just outcome are fundamental to transitions.

1.4. Sustainability transitions and cohesion policy

The European Commission has stated that an economic, social and industrial transition will need to take place to deliver long-term decarbonisation goals (European Commission, 2018a, European Commission, 2018b, European Commission, 2018c).

There are **three main processes involved in a sustainability transition** and regions need to be involved in all of these processes:

- **Innovation (emergence)**: Regions serve as the locations from which new technological and social solutions emerge;
- **Large-scale deployment of sustainable solutions (diffusion)**: Regions need to contribute to the achievement of European and national environmental, climate and energy targets by adopting, in ways suited to their local context, existing technological, economic, societal solutions. They also need to contribute to the phasing out of unsustainable solutions;
- **System reconfiguration (just transition):** The parallel processes of phasing in sustainable solutions and phasing out unsustainable results in a reconfiguration of socio-economic and technical systems. Within this toolkit the focus is on the just transition aspect of this reconfiguration - there is a need to ensure that scaling down and phasing out unsustainable technologies and practices does not negatively impact regional development, employment, and welfare.

Regions need to actively manage the transition towards a more sustainable social, technical, economic and environmental system. **Not all regions will participate in all**

processes equally – e.g. some regions have higher technological innovation potential than others and are more likely to contribute to certain types of high-tech innovation. Other regions may be socially innovative.

Transitions require a place-based approach because they happen in a territorially differentiated way. While there are commonalities across EU regions in terms of lifestyles, modes of production, technologies, etc., there are also important differences in factors relevant to how sustainability transitions can be implemented. **The types and severity of environmental impact, resources available to regional actors to deliver the transition, groups of actors, networks and institutions which can be involved in the transition process to drive or support the process and stakeholders who may oppose the process will be very different across regions. Capacity for technological innovation, the political strength of fossil fuel incumbents, potential for nature based solutions will also differ,** as will visions and priorities. Such factors will determine where the focus of the transition effort needs to be, e.g. on finding solutions which can win over losing segments of society, such as in coal regions, or on managing niches to ensure that innovative technological solutions are able to emerge, such as in high tech knowledge economy based urban areas. These territorial differences provide a strong rationale for regional and local governance of transitions, so that "regionally differentiated transformation trajectories" (Truffer & Coenen, 2012) which reflect regional needs and potentials, can be developed.

In addition, different transition processes will take place at different geographic scales and will require policy responses at the relevant level. For example, support schemes for renewable energy or changes in national educational curricula to reflect future challenges are national policies, other events and related policy challenges are regional or local in nature, such as the structural impacts and job losses related to phasing out coal power plants. The **concept of multilevel governance is therefore highly relevant to transitions**. The scale at which processes need to be governed depends both on the distribution of competencies and resources as well as on the geographic scale of drivers and impacts. Ideally, these two, the processes that need to be governed and the responsibilities, are aligned. Multi-level governance of sustainability transitions is therefore required.

A regional and local approach to transitions also allows for policy innovation and experimentation. Regions and cities are important for implementing innovative governance approaches and serving as sites of experimentation. While EU and national level governance systems are already largely set out by EU and national legislation and policy, there is significant scope for creative approaches. The regional and local level is also important for innovation, especially in the creation of protected niches necessary for transformational innovation. The regional and local level allows for experimentation through the creation of experimental conditions at a small scale local markets, such as local support schemes, networking of local actors, building on local innovation potential, local niche consumer segments, etc.

Given the level of ambition of EU goals related to a climate neutral, circular and green economy, all regions will need to participate in the large scale roll-out of sustainable technologies and solutions as well as in phasing out of unsustainable solutions (although some regions will need to focus less on phasing out unsustainable solutions if they currently do not rely on high carbon electricity generation and heavy industry). This **will require significant resource input and will have broad economic, societal and technological implications, including in relation to labour markets, consumers, producers, values and world views, attitudes and practices, culture, lifestyles, power relations between different stakeholders, financial systems, institutions and infrastructure**.

Both the pace and scale of transitions needs to be very high to enable the EU to meet its 2050 climate neutrality targets. Although transitions are already under way in some cities and regions of the EU, these efforts need to be scaled up and spread to regions currently not undertaking significant effort. The increase in scope and scale of transition efforts will also mean that the wider social and economic impacts of technological change will become profound and that in addition to managing technological change itself, these impacts will also need to be managed.

For a significant number of European Member States and regions the bulk of funding for public investment comes from cohesion policy. The share of cohesion policy funding in public investment is above 40% in Portugal, Croatia, Lithuania, Poland, Latvia, Hungary, Slovakia, Bulgaria, Romania, Estonia and Czech Republic, with the highest value in Portugal, where it is above 80% (European Commission, 2019d). The proposed budget for cohesion policy is EUR 330.6 bn[3] for the period 2021-2027 according to the Commission's proposal for a Common Provisions Regulation, which means that it will be making a very significant contribution towards public funding in this period.

The policy also **plays a significant role in building capacity** at the regional and local level. Not aligning cohesion policy with sustainable transitions would therefore constitute a lost opportunity, in particular because regional and local initiatives play such a crucial role in transitions.[4]

Cohesion policy is particularly suited to delivering sustainability transitions for a number of reasons:

- Cohesion policy implements investments which are relevant at **multiple scales**. It is **place-based**, therefore it is suited for delivering sustainability transitions which focus on co-creation within a local context. It also implements investments which are relevant on a national scale, which is required for large scale roll-out of new technologies and solutions.
- Transitions require a **multi-sectoral integrated approach**, in particular a link with innovation and the deployment of innovation, but also with other socio-economic system elements such as infrastructure, labour markets, skills and education. Cohesion policy has a strong focus on integrated approaches to development and therefore suited to delivering sustainability transitions. It also has a **strong focus on innovation**.
- Sustainability transitions are expected to have **significant investment needs** as well as **capacity building needs**. Both investment and capacity building can be delivered by cohesion policy.
- The **partnership approach** of cohesion policy can aligned with the co-creation approach of sustainability transitions.

[3] At 2018 prices

[4] Some authors (e.g. Coenen, Benneworth, & Truffer, 2011; Hansen & Coenen, 2013) have recently began to study the territorial aspects of sustainability transitions

1.5. Implications of coronavirus economic recovery for governing sustainability transitions

At the time of preparation of this toolkit the coronavirus pandemic is ongoing and economic impacts are being felt by all EU Member States and by other countries worldwide. The immediate economic impact has been severe. Unemployment has skyrocketed, people's livelihoods have become endangered. GDP has plunged and stock market losses have been higher than anything experienced since the Great Depression. Many companies may become unable to repay debts. The immediate response by governments has been to expand benefits to workers who have been made redundant by the crisis and by providing financial assistance to businesses.

The immediate task of governments in addressing the economic crisis caused by the coronavirus pandemic relates to rescue , i.e. "keeping businesses and people alive". Subsequently, the focus shifts to recovery, i.e. to "reinvigorating the economy" (Hepburn, O'Callaghan, Stern, Stiglitz, & Zenghelis, 2020) when further fiscal and monetary policy action by governments will be needed to help economies recover. Economic losses at the end of the crisis could be in the double digits. Restarting economies may not result in things going back to the way they were before – there will be impacts on income and wealth distribution, consumer spending may not bounce back after the crisis due to reduced consumer confidence (Pistaferri, 2016), impacts on sectors will be differentiated, with few winners and many losers, many of which will not be able to restart their economic activities.

Economic recovery is central to the new EU budget and will impact spending in Member States. On top of the 2021-2027 MFF, an ambitious financial package has been agreed on by EU Member States to address the impacts of the pandemic, totalling EUR 750 billion in grants and loans. This brings the total financial support to Member States to more than EUR 1,800 billion for the coming years. The Commission has also eased budget rules relating to budget deficits and public debt to GDP ratio, allowing Member States to put more money into economic recovery, and the European Central Bank adopted a Pandemic Emergency Purchase Programme, is purchasing commercial papers and expanding the eligible collateral in refinancing operations. National central banks have also taken measures to support economic recovery.

In this toolkit, some implications of sustainability transitions for spending are integrated into sections 5-7 which deal with support for the three phases of the transition, innovation, deployment and phasing out, and the just transition aspect of system reconfiguration.

One of the many things the Covid-19 crisis has underscored, is the need for a better understanding and incorporation of a systems approach (OECD, 2019e) into our policy and governance frameworks. Understanding the linkages between our production supply chains, biodiversity, climate, ecosystem degradation, pollution, health, agri-food systems, and the sustainability and resilience of our socio-economy model is an absolute prerequisite to elaborating a recovery plan that delivers both in the short and the long term.

There are also implications for overall governance of transitions, as the crisis and associated recovery presents a number of opportunities as well as challenges for transitions. The debate on these is ongoing and there is currently a lack of established conclusions and corresponding literature on the topic. Some of the main points that have been made to date are summarised below.

The economic crisis has resulted in significant damage to almost all economic sectors, including sectors which use technologies or produce products that will need to be phased

out or radically changed to achieve a sustainability transition. These include e.g. airlines, unconventional oil and gas producers and coal power plants. It is clear that public funding will be needed to help the economy to recover. Decision-makers have a choice to provide support for the recovery in a way that is undifferentiated, or to provide funding to sectors and technologies that promote sustainability transitions. This can be done in several ways, e.g. making support conditional on environmental performance, providing funding to unsustainable sectors and technologies only where sustainable alternatives are not available, or shifting support away from unsustainable technologies and sectors to ones which can deliver the same service sustainably (such as towards renewable energy or electric vehicles). In addition to EU funding, the suspension of EU budget rules also provides opportunities to fund a green recovery. However, there is pressure on governments to take a short-term view to solve immediate problems, which raises the possibility that funding for the recovery will be spent in part on actors, technologies and assets that will later become stranded.

Some positive environmental changes have taken place as an immediate impact of the economic crisis e.g. those related to air pollution and greenhouse gas emissions (CarbonBrief, 2020). These changes are temporary, linked to lower economic output and mobility caused by the crisis, and are likely to disappear without policy intervention as economies rebound. However, there is an opportunity for policy-makers to work on making some of these changes permanent.

Due to changed economic and social conditions and policy priorities, the crisis also presents policy-makers with an opportunity to review high-level policy frameworks, e.g. by implementing green fiscal reform. The role of taxation in fiscal consolidation is essential, as fiscal consolidation provides an opportunity to rationalise the tax systems by revenue-neutral reforms to enhance efficiency and remove distortions harmful to growth. This would imply shifting taxation toward growth enhancing tax bases (away from labour toward consumption, property and environment), broadening tax bases and improving tax governance and the quality of tax administration.). This can include shifting the tax burden to fossil fuels during while fossil fuel prices are low and away from labour (European Environment Bureau, 2020). It can also involve the phasing out of fossil fuel subsidies in a time when budgetary resources are scarce.

The shift from an economic system focused on optimisation to a system which is adaptive and resilient (see e.g. OECD, 2020 and Foroohar, 2020) is also timely, and very similar to the discussions on adaptation and resilience to climate change which have been ongoing for more than a decade. For example, in the short term, our economies' deep integration is a source of vulnerability in the face of wide-spread disruptions to supply chains. Knock-on effects may be large as companies often do not know all the details of who their suppliers are. In the longer term, the Covid-19 crisis will likely lead to greater scrutiny of supply chains, with greater focus on diversification and resilience.

Although the crisis may not seem like an appropriate time for taking decisions which are not closely related to health policy or economic rescue, it is a good time to institute changes in areas where resistance to change is low. For example, the temporary reduction in motorised urban transport demand presents an opportunity to reduce space for cars and increase space for non-motorised transport, e.g. by designating bicycle lanes (Transport & Environment, 2020).

The pandemic has forced countries to implement changes in behaviours and habits (e.g. teleworking, online learning and e-health) on a large scale; an unplanned and unforeseen social experiment to combat the pandemic. Online solutions have had a significant role in enabling behavioural change. The experience gained allows for conclusions to be drawn on the efficiency of these new arrangements, and lessons learned may be used as a basis to promote sustainable behavioural change in future.

The crisis has had mixed outcomes in terms of social initiatives with some successful bottom-up initiatives having been implemented. However, at the same time the crisis has also shown how people rely on individual solutions when they do not trust that the state or society will provide for them. The crisis serves as an important opportunity for learning how to deal with a crisis situation at the societal level and how trust and resilience can be established.

The crisis has had mixed outcomes in terms of environmental awareness. On the one hand, it has raised awareness levels related to certain environmental issues, e.g. evidence of higher pollution levels being associated with worse outcomes for coronavirus patients has raised the profile of pollution related issues, and the zoonotic nature of the virus has raised awareness of the importance of healthy and undisturbed ecosystems. On the other hand, actors in sectors which rely on natural resource extraction and use or produce high-levels of waste and pollution have called for a relaxation of environmental regulations in order to reduce costs for companies. The net impact of these opposing forces depends in large part on how governments react to changes in preferences and demands from different constituents.

A key impact of the crisis has been that it has increased uncertainty. Broader landscape level consequences of the crisis (e.g. impacts on EU solidarity, destabilisation in some oil producing countries where marginal costs of oil production are higher than or close to the market price, destabilisation in low income countries with high debt payments, disagreements over buy-out of companies by foreign governments, etc.) are difficult to foresee. This uncertainty, combined with economic uncertainty, makes governments potentially less willing to implement transitions, as the uncertain outcome of transitions further increases uncertainty.

2. Aim and structure of the toolkit

Main messages

- The aim of the toolkit is to translate the sustainability transitions approach into concrete tools, methodologies and steps for Managing Authorities;

- While building closely on the sustainability transitions literature, it takes into account constraints imposed by the relevant regulations governing cohesion policy implementation;

- Cohesion policy can be used to leverage change required for transitions, but it relies on support from the surrounding institutional, legislative and policy framework. The toolkit therefore describes the broader governance framework as well as focusing on how to use EU funding to support transitions.

- Managing Authorities need to create an overall framework which is sufficiently flexible to accommodate local strategies, actions and conditions but at the same time orients implementation towards transitions.

- The toolkit is primarily aimed at programming and Managing Authorities, i.e. at the national and regional level. However, other bodies of national and regional governments, local authorities, local businesses and local civil society organisations will have a large part to play in implementation.

2.1. Aim of the toolkit

The aim of the toolkit is to assist Managing Authorities in operationalising the concept of sustainability transitions within the context of cohesion policy, and in prioritising available support to facilitate a transition to a climate neutral, green and circular economy. The toolkit attempts to translate the sustainability transitions approach into tools, methodologies and steps which can be implemented during planning and delivery of Partnership Agreements and Programmes and implementation. Rather than providing a general manual for supporting sustainability transitions, the toolkit focuses on how cohesion policy can support sustainability transitions.[5]

While building closely on the sustainability transitions literature, the toolkit takes into account constraints imposed by the relevant regulations governing cohesion policy implementation, fitting relevant elements of sustainability transitions into the planning and implementation of cohesion policy, where possible. The two processes do not fit seamlessly together; practical challenges (related to e.g. timing, involvement of stakeholders, ways of implememting adaptive governance) arise, and established theories and concepts related to regional development (e.g. New Economic Geography and endogenous regional potential) need to be reconciled with the theory and concepts of sustainability transitions.

In order for a sustainability transition to take place, a reconfiguration of the social, economic and technological system is needed. This involves changes in institutional,

[5] . Other toolkits are available on sustainability transitions in other contexts, such for urban transitions (see e.g. as Roorda et al., 2014) or for water systems (Jefferies & Duffy, 2011)

legislative and policy frameworks. Within the institutional, legislative and policy framework, **cohesion policy occupies a narrow space**. While it has strong links to the wider policy context of the EU and Member States, (including links to EU strategic goals as well as and to national policies through enabling conditions), it is a funding instrument that implements investments pursuing multiple policy objectives in a given territory. **Cohesion policy can therefore be used to leverage change, but it also relies on support from the surrounding institutional, legislative and policy frameworks in order to succeed**. This toolkit focuses on cohesion policy implementation, but also provides a brief overview in section 4 of policy instruments and institutions which can be used to flank cohesion policy to support sustainability transitions.

Sustainability transitions need to take place on multiple scales, including at the level of the EU, Member States, regions, cities and rural areas. The toolkit is primarily aimed at programming and Managing Authorities, i.e. at the national and regional level. However, ultimately local authorities, local businesses and local civil society organisations will have a large part to play in supporting transitions. They will be the ones who will use support from cohesion policy to plan and guide their own local sustainability transitions. The toolkit addresses how **Managing Authorities need to create an overall framework - through e.g. setting out policy objectives and project selection criteria – which is sufficiently flexible to accommodate local strategies, actions and conditions but at the same time orients cohesion policy implementation towards transition goals.** It does not, however, discuss cohesion policy implementation from the viewpoint of beneficiaries.

The toolkit needs to be applicable across EU regions. It therefore describes a generic process applicable to all types of Member States and regions; solutions will need to be tailored to their specific circumstances during implementation.

A further disclaimer needs to be made. As thinking on sustainability transitions are still evolving, and as we are still learning from practical examples of supporting sustainability transitions, the toolkit is not a final product but attempts to build on the current state of the art.

2.2. Structure of the toolkit

When supporting sustainability transitions, public authorities ideally need to address a variety of **questions related to strategic direction, policy design, implementation, and monitoring, evaluation and policy learning**. The toolkit is structured along this logic, as shown in Table 2. It describes an idealised process, where cohesion policy planning supports the elaboration of a broader development vision for national or regional development and is integrated into a comprehensive institutional and policy framework for sustainability transitions.

Table 2 Toolkit structure

Guiding questions	Stage of transition	Section of toolkit
1. What is a desirable environmental, social, economic and technological vision of the future? 2. What goals and targets can be set to operationalise this vision of the future? 3. What is the initial starting point, what are the initial economic, social, environmental and technological conditions? 4. What pathways can be followed to get from the present to the future, how would provisioning systems (e.g. food, mobility,	Strategic direction	3

energy) need to change? 5. Which actors are relevant to supporting or hindering sustainability transitions, what are their interests and how can they impact the transition process?		
6. How can different policies be used to influence the actions of these actors and what institutions need to be set up or what existing institutions can be used to enable them? 7. What are the specific governance challenges?	Policy design and implementation	4.3, 5.2, 6.2, 7.2
8. What is the role of funding instruments? 9. What role does cohesion policy play within this broader set of policy and funding instruments in supporting sustainability transitions?	Policy design and implementation	4.4, 5.3, 6.3, 7.3
10. What tools are available to increase the environmental performance of cohesion policy?	Policy design and implementation	9.1-9.3
11. How successful have transitions been? Are visions and goals still relevant? Are desired results being achieved? Is a change in approach needed?	Evaluation, monitoring, feedback of cohesion policy	9.4

The visioning exercise (questions 1-4 above) is addressed in section 3 of the toolkit. The governance of transitions, with a focus on relevant **actors, policies and institutions** (questions 5, 6 and 7), is addressed in section 4 as well as in sections 5.2, 6.2 and 7.2. The question of how cohesion policy can contribute to supporting transitions is addressed in sections 5-7. These sections describe the overall policy framework required for innovation, deployment of sustainable solutions and the just transition, respectively, as well as the role of cohesion policy within this overall policy framework. Section 8 focuses on territorial strategies for sustainability transitions. Section 9 addresses cohesion policy implementation to support transitions, with a focus on project selection and measures which can mitigate negative environmental impacts of funding, as well as the monitoring and evaluation of cohesion policy's contribution to sustainability transitions.

Ideally all of these steps need to be implemented to maximise cohesion policy's contribution to sustainability transitions. However, regions and Member States will be at different starting points when developing their Partnership Agreements and programmes. Some will have already implemented some of the steps, while for others, implementing all steps of the process will not be feasible before the finalisation of the Partnership Agreement and programmes. The toolkit can therefore also be approached in a modular way, focusing on a single step.

3. Developing a vision of a sustainable future

Main messages

- Systemic sustainability issues cannot be addressed through incremental change and require the transformation of socio-economic systems which drive environmental degradation (e.g. food systems, energy systems, mobility systems);

- Transformation of these systems needs to be driven by a strategy which is oriented towards ambitious long-term goals and targets;

- Strategy development is a hierarchical planning process, first setting out visions, then operationalising these visions as goals and targets, identifying pathways to achieve these, and translating these pathways into a consistent set of actions;

- What is achievable will be influenced by regional potential as well as external forces and megatrends. Regional potential can be influenced by decision-makers, while megatrends cannot;

- Before strategy development can take place, we need to understand the systems that need to be transformed. System mapping can help uncover how these systems drive environmental degradation, and how they may resist change;

- The EU has committed to implementing the United Nation's 2030 Agenda and the Sustainable Development Goals, and the European Green Deal and its initiatives will be an integral part of this Commission's strategy to implement the SDGs. This will help guide systemic change in EU economies and societies.

3.1. The relevance of strategic planning to sustainability transitions

The EU has the collective ability to transform its economy and society to put it on a more sustainable path, and the European Green Deal and its initiatives set out the current Commission's strategy towards transforming European economies. In the cohesion policy context, the Common Provisions Regulation sets out the overall framework for developing a Partnership Agreement and Programmes. This includes elements of strategic planning. The programmes set out the main development challenges, programme priorities, specific objectives and a strategy for the programme's contribution to the policy objectives. The analysis that serves as a basis for programming, which include an assessment of national and regional challenges, opportunities and potentials, can be further built on so that it can serve as a basis for supporting sustainability transitions.

The strategic level is the place for considering a wide range of development alternatives by setting out visions, goals and targets, and identifying pathways to reach these targets. This is also true of sustainability transitions. In a dominant analytical approach of managing sustainability transitions, these steps should follow a hierarchy, with long-term visions serving as the anchor point for goals and targets, while pathways set out the route to achieving the goals and targets, and serve as reference points for and short-term actions. The strategic level is important in order to set a Member State or region on a sustainable pathway. This section discusses how a sustainability transition can be planned.

In some cases some part of the visioning and pathway development exercise described below will have been completed already. Typically, strategies which set out targets may

already exist at the national level, e.g. national energy and climate plans and long-term strategies, biodiversity strategies, waste treatment strategies, circular economy strategies, etc., as shown in Table 3.

Table 3 EU environmental and climate targets

Environmental issue	EU targets	National documents containing national targets	Repository of national strategies
Climate change	The 2030 EU climate & energy framework sets out targets for 2030: • 32% renewable energy as a share of energy consumption, • 32.5% energy efficiency improvement, relative to the projections from the PRIMES Reference scenario 2007 • 40% reduction in greenhouse gas emissions compared with 1990 (43% in EU ETS sector and 30% in non-ETS sector compared with 2005) The amendment to the EU Climate Law proposes a 55% emission reduction compared with 1990 until 2030 Target for 2050: Net zero greenhouse gas emissions	National Energy and Climate Plan Long-term Strategy	https://ec.europa.eu/energy/en/topics/energy-strategy-and-energy-union/governance-energy-union/national-energy-climate-plans
Biodiversity loss	EU Biodiversity Strategy 2030 targets: • Legally protect a minimum of 30% of the EU's land area and 30% of the EU's sea area and integrate ecological corridors, as part of a true Trans-European Nature Network. • Strictly protect at least a third of the EU's protected areas, including all remaining EU primary and old-growth forests. • Effectively manage all protected areas, defining clear conservation objectives and measures, and monitoring them appropriately • Legally binding EU nature restoration targets to be proposed in 2021. By 2030, significant areas of degraded and carbon-rich ecosystems are restored; habitats and species show no deterioration in conservation trends and status; and at least 30% reach favourable conservation status or at least show a positive trend. • The decline in pollinators is reversed. • Three billion new trees are planted in the EU, in full respect of ecological principles. • Significant progress has been made in the remediation of contaminated soil sites. • At least 25,000 km of free-flowing rivers are restored. • There is a 50% reduction in the number of Red List species threatened by invasive alien species.	National Biodiversity Action Plan Management plans for areas of special conservation	https://www.cbd.int/nbsap/about/latest/

	• Cities with at least 20,000 inhabitants have an ambitious Urban Greening Plan. • No chemical pesticides are used in sensitive areas such as EU urban green areas. • The negative impacts on sensitive species and habitats are substantially reduced to achieve good environmental status. * Targets not mentioned here are related to the implementation of EU agricultural and maritime and fisheries policy and EU development aid		
Resources - Water	Water Framework Directive • Achieve good ecological status of all waterbodies • Good hydromorphological status • Good chemical status of all surface water and groundwater bodies • Good groundwater quantitative status Nitrates Directive • Reducing and further preventing water pollution by nitrates from agricultural sources Urban Waste Water Directive • To protect the environment from the adverse effects of urban wastewater, through collection & treatment of wastewater Bathing Water Directive • To preserve, protect and improve the quality of the environment and to protect human health Drinking Water Directive • To protect human health from adverse effects of contamination of water for human consumption	River Basin Management Plans Flood Risk Management Plans	https://ec.europa.eu/environment/water/participation/map_mc/map.htm
Resources - Materials	Revised legislative proposals on waste: • Recycling 65% of municipal waste by 2030; • Recycling 75% of packaging waste by 2030; • Reduce landfill to maximum of 10% of municipal waste by 2030; • Ban on landfilling of separately collected waste;	Waste Management Plan and Waste Prevention Programme	https://circulareconomy.europa.eu/platform/strategies

Although EU and national targets are often focused on the environmental issues (climate change, biodiversity loss, inefficient and wasteful use of resources), there has been a move away from this approach towards transforming systems in terms of provisioning systems, demonstrated by the Farm to Fork Strategy and Energy Union and Climate Action Governance. The strategic planning of transitions is ideally based on the transformation of provisioning systems (e.g. transport system, food production system, buildings) as environmental degradation, is driven by the way we meet our needs for mobility, food, warmth and shelter, and the development of corresponding strategies and actions plans. The links between the environmental issues and relevant provisioning systems are shown in Table 4.

Table 4 Drivers of environmental challenges in the EU

Environmental issue	Key drivers	Relevant socio-economic provisioning systems
Climate change	Energy use related to mobility, heat and consumption	Energy production Air, maritime and individual road transport Buildings Industry
	Decrease in carbon sinks due to land use change	Agriculture Forestry Land taken by industry, urban sprawl and grey infrastructure
	Other emissions from industrial processes, F-gases, methane from landfills, etc.	Various sectors
Biodiversity loss	Habitat loss, degradation and fragmentation	Intensive agriculture and forestry Urban sprawl Transport infrastructure
	Over-exploitation of natural resources	Fishing
	Accidental and deliberate introduction of invasive alien species	Various sectors
	Pollution pressures from nitrates, phosphates and pesticides	Agriculture
	Climate change	See above
Resources - Water	Hydromorphological pressures	River transport, drainage, urban development, ports, flood protection, water storage, hydropower and cooling water
	Diffuse pollution Point source pollution	Agriculture Industry Households Urban wastewater treatment
	Water abstraction	Agriculture (40%) Cooling water for energy production (28%) Industry and mining (18%) Households (14%)
Resources - Materials	Human needs: food, drink, dwellings, mobility, other consumption	Agriculture Buildings Transport Manufacturing and extraction industry

Source: EEA, 2019b

3.2. Understanding provisioning systems

Sustainability transitions require that production and consumption systems associated with meeting our needs be overhauled. "The level of detail of the systems analysis depends on how it will be used by the transition team. At one extreme, it could be solely aimed at preparing a presentation for an informed kick-off arena meeting. At the other, it could be an elaborate baseline study taking into account in-depth knowledge and a wide range of perspectives." (Roorda et al., 2014) Systems mapping serves several purposes:

- It **allows decision-makers to identify points of policy intervention** for sustainability transitions, such as at the level of drivers, through e.g. mixed use urban development to reduce travel demand, or incentivising home office, at the level of technologies and modes available to satisfy demand (including vehicle technologies, business models, etc.) and by changing regime structures (such as availability of parking infrastructure or policies) which
- It **allows for the identification of potential impacts** if changes are made to the system (e.g. in terms of employment)
- It allows for the **identification of structures and actors who may resist change**. Actor mapping can help understand the interests of various actors in maintaining the status quo or supporting change. This in turn can form the basis of policies aimed at mobilising actors, levelling the playing field between actors, or winning their support for the transitions (see section 4.2). Actor analysis also serves as a basis for involving actors external to the government in the process of co-creation. Structures (e.g. infrastructure, culture) which play a role in maintaining the status quo are also relevant.

Mapping a system involves the use of qualitative and quantitative data from studies, policy documents and statistical databases, interviews and various fora (e.g. transition arenas) through which experts and stakeholders bring diverse perspectives into the analysis. The steps of systems analysis should be the following:

- Delineate the system **boundaries** in terms of space, time and themes (e.g. CO_2 emissions from mobility in a city over the past few decades) (Roorda et al., 2014);
- Draw up the elements and **drivers** of the need that the system is satisfying (e.g. mobility required to visit shops, travel to work, leisure, etc.), as well as the elements influencing daily choices (e.g. cost, accessibility, comfort and time associated with mobility)
- Draw up the **technologies and modes** available to satisfy the needs, including regime solutions (e.g. private car with an internal combustion engine, electric vehicles, public bus transport, bicycle, etc.) and niche solutions (e.g. car sharing)
- Draw up the **regime elements** that influence available choices related to satisfying needs, especially cultural norms, behavioural practices, infrastructures, legislation and policy, market rules and conditions including prices, etc. (e.g. cars as status symbols, fuel taxation, low emission zones, road infrastructure, parking infrastructure, etc.), including existing structures and potential changes in these structures;
- Map **impacts** of regime and niche technologies and modes on the economy, society and environment (e.g. jobs, emissions to air and water, resource use);
- Map **actors** with a stake in the regime or niche solutions;
- Map the **wider landscape and megatrends** which serves as the backdrop (e.g. world fuel prices, geopolitics, global environmental agreements, artificial intelligence) to the regime and may impact the regime.

The **mapping of relevant actors** is necessary to understand the role that different actors can play to support or hinder transitions. It is helpful to view actors as having different interests, different types and levels of resources to advance these interests, different links with other actors, and different capabilities to influence the legislative and policy context, public discourse, technological development, and other conditions that frame transition processes.

Box 1 Tool to support assessment of relevant actors - Actor mapping

The steps of actor mapping are the following:
1. Identify the topic (e.g. transition to climate neutrality in the electricity sector, reduction of plastic waste, etc.) and the geographic boundaries of the system to be assessed (e.g. national level).
2. Identify actors who have a stake in the transition. This can be done by first looking at the systems that will need to change. The pathway analysis (section 3.4) identifies unsustainable elements of the system which need to be phased out, e.g. fossil fuel based electricity generation, single use plastics or sources of pollutants that have a negative impact on biodiversity. It also identifies alternative sustainable solutions. Relevant actors, e.g. power companies, manufacturers of single use plastics, etc. can then easily be identified.
Actors may include individuals as well as organisations, institutions, social movements, consumers of certain products, academia, federations, businesses etc. The identification of actors can happen at a generic level, or can involve identification of specific actors (e.g. specific organisations or individuals). For the purpose of national policy-making a generic actor map may be sufficient, whereas local sustainability transitions will rely on the mapping of specific actors.
3. Broaden the scope of identified, to include e.g. those linked to these systems which are affected financially (e.g. suppliers of the technology, business owners providing related services, workers employed in the sector, consumers of products produced by the sector, relevant policy-making bodies, etc.), as well as those impacted through material flows, those affected by positive or negative externalities of these systems, through knowledge systems, informal interactions and relationships, formal policy-making, advocacy, etc. Chart links between actors on an actor map.
4. Identify the following attributes of the actors:
    a. Territorial relevance (e.g. local, regional, national, EU-wide or global)
    b. Phase of the transition process by which the actor is impacted (e.g. innovation, deployment of new solutions, phasing out of unsustainable solutions)
    c. Influence of the actor on financing, political decision-making, public discourse, etc.
5. Identify whether the actor can help or hinder the transition, how they can achieve this (e.g. through influencing legislation or public discourse, etc.) and the extent of the impact the actor can have based on their level of resources and scope of influence.
6. Identify possible coalitions between actors.
The mapping of actors can be done through a participatory process involving people knowledgeable about the given sector/socio-economic subsystem.
A detailed description of how to conduct actor mapping can be found in e.g. Gopal & Clarke, 2017.

Identification of **external forces and pressures which impact provisioning systems** (e.g. megatrends and disruptive forces) is important as these landscape elements may influence future choice sets in different ways.

Box 2 Case study – Megatrends affecting European cities and regions

“European Strategy and Policy Analysis System […] assessed the long-term political and economic environment facing Europe over the next 20 years, and Europe's policy options for dealing with them. (ESPAS, 2012) They emphasised that Europe and the world are experiencing a period of accelerated change, in particular with respect to power, demographics, climate, urbanisation and technology.” (EEA SOER 2015) The OECD has identified megatrends fitting into three categories: technological change (especially automation, additive manufacturing (3D printing), artificial intelligence, autonomous vehicles, big data analytics, blockchain, civil technology and internet of things), demographic change (including rising life expectancy, and domestic and international migration), and environmental change (climate change, loss of biodiversity

and increasing pollution levels). (OECD, 2019a) Other megatrends include increasing urbanisation, changing disease burdens and risks of pandemics, challenges posed by barriers to continued economic growth, an increasingly multipolar world, intensified global competition for resources, diversifying approaches to governance (EEA, 2015b), changing globalisation patterns, shifting of the global centre of economic gravity, increasingly large gains for top performers and correspondingly heavy losses for those falling behind, and increasingly unequal and polarised societies characterised by increasing activism (McKinsey Global Institute, 2019).

3.3. Developing a vision

Sustainability transitions incur profound change, affecting many subsystems of social and economic systems simultaneously. It is important to deliver environmentally sustainable outcomes in a way that also has positive outcomes in terms of social and economic development. A vision is therefore needed which sets out not only environmental but also social and economic principles that guide the transition. Visions are not neutral, but value-loaded, and use terms such as healthy, just, equitable, resilient, liveable, sustainable, prosperous, safe, etc. They do not focus on numerical targets or the policies needed to achieve these, instead they formulate principles which address aspirations and are future oriented.

Visions are ideally created through a participatory process. The approaches for ensuring the involvement of relevant stakeholders is discussed in section 4.2.

The visions need to be developed for the relevant provisioning systems, e.g. the transport and agricultural system, for satisfying needs for mobility and food, in a way that links to higher level visions governments have adopted that relate to national development or sustainable development. For example, a vision for an urban mobility system may formulate aspirations such as fair distribution of costs, comfort and cleanliness, accessibility to all, sustainability, innovativeness, safety in terms of minimising accidents as well as crime, and giving space back to city residents for leisure and green spaces. These aspirations link to higher level visions of how society should develop. Some of these types of higher level visions are shown in Box 3.

Box 3 Case studies – visions for sustainable development

EU 7th Environment Action Programme
“In 2050, we live well, within the planet's ecological limits. Our prosperity and healthy environment stem from an innovative, circular economy where nothing is wasted and where natural resources are managed sustainably, and biodiversity is protected, valued and restored in ways that enhance our society's resilience. Our low-carbon growth has long been decoupled from resource use, setting the pace for a safe and sustainable global society.”
(European Commission, 2013b)
Denmark 2020
“We must be able to:
- work and make a living for the benefit of ourselves, our loved ones and our society.
- move upwards socially on the basis of education and work.
- seek peaceful communities.
- live our lives without threats and violence.
- breathe fresh air, drink clean water and have access to uncontaminated surroundings.
- benefit from our physical and academic skills as long as possible.
- be treated like independent citizens with full legal capacity irrespective of whether we are rich or poor, healthy or ill.
- obtain help when we are ill or in need of support.”

The principles formulated in visions do not just provide an overall direction for transitions but also need to be mainstreamed into implementation. For example, if equity is among the principles guiding the vision, then mainstreaming of equity considerations into all interventions is important. Examples include favouring community-based rather than large utility-scale renewable investments, favouring public modes of transport when investing in transport infrastructure e.g. by making road investment conditional on the creation of bus lanes, or considering equity when implementing energy taxation.

3.4. Identifying goals, targets and pathways

Goals are objectives which are operationalised by quantitative or qualitative targets relating to desirable outcomes, such as a greenhouse gas emission reduction target or energy network interconnectivity target under the broader principles of sustainability and energy security, respectively. Goals and targets serve to operationalise the vision, as the principles contained in the vision are open to different interpretations. Operationalisation is necessary to make the process more transparent and conducive to translating into actions and ultimately to monitoring and evaluation.

While policy-makers may set a single target for the future, pathways can show the development trajectories necessary to achieve these future targets. (EEA, 2017) A pathway links the current starting point with an end point determined by the targets, identifying one or several the trajectories of change, roadmaps, intermediate milestones and actions needed to achieve the target. As sustainability transitions are uncertain processes, the goals, targets as well as the pathways and actions need to be reviewed periodically.

These sustainability goals and targets, pathways to achieving them, and intermediate milestones and actions are often set out in official strategies, which may also contain information on principles and the vision. In such cases generally programming authorities will be guided by these existing targets, pathways and actions, which will serve as an overall framework, both guiding action and restricting possibilities. In other cases, sustainability goals and targets relating to specific provisioning systems will not exist in strategic documents and will need to be set as part of the strategic planning phase of programme development.

Even where strategies do exist, this does not mean that further goals, targets, pathways and actions will not have to be set during programming. The documents setting out environment, climate and energy goals and targets are often sectoral documents and are therefore limited in terms of the level of information contained with respect to social and economic dimensions. (National Energy and Climate Plans are an exception, as they contain an assessment, at national and, where applicable, regional level, of skills and social impact of the planned policies and measures or groups of measures in line with the Energy Union Governance Regulation.) It is important to complement these existing strategies with socio-economic aspirations (e.g. goals and targets related to innovation, education and skills, health, equity considerations, etc.) so that this can feed into an integrated approach at a later stage in programming of cohesion policy.

During the development of goals, targets and pathways for provisioning systems, analysists and decision-makers need to pay attention to a number of factors:

- **Promising niche developments and sustainable regime solutions**: The development of a pathway requires an assessment of the extent to which sustainable solutions can contribute to meeting targets, and when they are expected to become widely available. Sustainable solutions encompass not only technological solutions, but also changes in behaviours and practices, business, models, etc. For example, for transport one could identify e.g. electric vehicles,

hydrogen vehicles, non-motorised forms of transport, public transport, carsharing, home office, etc. as potential solutions which can contribute towards a sustainable outcome.

- **Resistance to change**: incumbent actors invested in the existing regime may actively resist change, and other system elements, such as infrastructure, policy and regulation, cultural norms and behaviours may be difficult to change, thereby passively contributing to preserving existing regimes. Policy-makers have some leverage to change existing structures, as described in section 4, but must also take into account limitations, such as the need to garner sufficient support for re-election, as well as constraints related to funding investment in new infrastructure, and resistance to change in cultural norms and behaviours.
- **Regional potential** will impact how and to what extent regions can contribute to sustainability transitions over the short and medium term. An assessment of factors influencing potential for development, including natural resources, human and social capital, institutions, and accessibility and infrastructure, needs to be made. Regional potential should not be taken as given. Instead, necessary changes in regional potential to deliver sustainability transitions (e.g. in terms of the quality of infrastructure, educational and research organisations, education level of the population, etc.) must be part of supporting transitions and should be a focus of cohesion funding as well as policies outside cohesion policy.
- **Megatrends:** Trends related to landscape factors may restrict the number of options available, e.g. negative demographic trends, but may also open up new possibilities, e.g. through technological change and advances in artificial intelligence.

Even within these constraints, **there are potentially several different pathways along which the same target can be reached.** For example, pathways can focus on implementing low-tech solutions (e.g. natural systems for waste water treatment) or high-tech solutions (e.g. smart buildings). Pathways can focus on different technology mixes, e.g. on renewables, nuclear[6] or carbon capture and storage for a climate neutral economy, or different combinations of these. They can depend in part or whole on non-technological solutions such as behavioural change and nature-based solutions. Some technological solutions can be applied within several different socio-economic contexts, e.g. renewable energy targets can be delivered by investing in large scale industry-owned or small scale community owned solar and wind. In some cases there will be clear trade-offs or synergies with technological solutions narrowing socio-economic possibilities. Societal choices, such as supporting emerging industries or the desire to limit costs to consumers will have a role to play in the choice of pathway.

[6] Investment in nuclear energy cannot be funded from the ERDF or Cohesion Fund, but is an option available to Member States when developing their National Energy and Climate Plans and Long-term Strategies

Box 4 Case study – Goals set by the city of Copenhagen

Goals were set by the city of Copenhagen for 2025 in relation to all three guiding principles: 'a living city', 'a city with edge' and 'a responsible city'.
The goals related to 'a responsible city' are the following:
- Copenhagen will be CO_2 neutral in 2025
- 75% of all trips in Copenhagen take place by bike or by public transport
- The number of homes affected by high noise has more than halved
- The majority of city residents make use of sharing, exchange or recycling schemes
- The risk of flooding has been reduced by 30% in Copenhagen and climate protection has helped 160,000 city residents
(Københavns Kommune Teknik- og Miljøforvaltningen, 2015)

Different approaches for developing foresight are available. These have different strengths and weaknesses, and the approaches can be combined. Some of the foresight tools available are presented in Box 5.

Box 5 Tools – Foresight methods for developing pathways

Foresight tools can be categorised based on the extent to which they rely on expertise vs participatory approaches, and how they place along the spectrum between creativity and evidence. (Popper, 2008) There are various analytical evidence based approaches such as scenario modelling, while expert panels will involve experts but will not rely on consistent numerical analysis. Backcasting, scenario workshops and citizen panels are participatory approaches involving citizens without specific relevant expertise. Once different possible futures have been established using various foresight methods, the comparison of different futures may in some cases require a next step and can be done e.g. through multi-criteria decision analysis, cost-benefit analysis or participatory approaches.
Different approaches have different advantages and disadvantages in terms of their contribution to informing the governance of sustainability transitions. Analytical models allow for the assessment of cost-optimal technology pathways, and are currently the main tools used in impact assessments of policy proposals by the European Commission and Member States; their use is required for developing National Energy and Climate Plans. They are limited in their view of futures as their focus is mainly on technological options and their costs and economic impacts. Participatory methods allow for a broader view, they "complement quantitative modelling with a system thinking and long-term approach that is developed through qualitative and participatory methods involving all relevant stakeholders. They facilitate thinking out-of-the-box. The objective is to engage with different possible futures (e.g. providing alternative futures) and challenge present assumptions thereby broadening the policy horizon. It creates an experimental and safe space to discuss, explore and assess the consequences of disruptive events and potential sources of radical change. Such forward-looking processes will help identify targets and new ways for policy interventions in a more systemic manner. It contributes to connect research and science activities to societal challenges by strengthening the engagement of stakeholders and citizens in policymaking." (European Commission, 2017) In the absence of appropriate analytical tools participatory approaches may be the only way to assess system-wide impacts given the complex web of interrelated actors and domains and different timescales and geographic scales. These participatory processes may be provided the system assessment as input (see section 4.2.) for a better understanding of system-wide links and interdependencies.
For a summary of different tools for producing foresight, including analytical methods, expert approaches, participatory creative approaches and modelling approaches see the website of the European Foresight Platform (http://www.foresight-platform.eu/community/forlearn/what-is-foresight/)

Goals, targets, and pathways and actions are set as a result of political process. They take into account supporting analysis prepared by experts, or outcomes of participative processes, but do not rely exclusively on these. One of the reasons for this is that analyses may not be able to take account of all relevant factors, for example, techno-economic models are generally used to support energy planning, but which do not take into consideration social impacts. Another reason is that transitions have multiple impacts on different groups of actors, resulting in trade-offs in wealth, income and well-being between and within generations. Choices between outcomes that provide similar overall societal welfare but different welfare distributions are inherently political.

3.5. Developing strategies and action plans

The analytical and participative processes described in sections 3.1-3.4 ultimately feed into the development of strategies. Strategies and action plans may already exist, or there may be a need to develop these as part of the programming process.

As mentioned in section 3.1, strategies are important to transitions because the strategic level is the place for considering a wide range of development choices and setting relevant targets. Therefore, in order to avoid lock-in and re-entrenchment of current solutions and practices, strategies must set out ambitious targets, which then need to be implemented through a set of policies (including cohesion policy). The strategies need to address socio-economic aspects of the transition as well as environmental aspects and as such need to integrate e.g. innovation, finance, and just transition aspects. They should be focused on working towards restructuring entire economies to operate in a sustainable manner.

Case study – Convention Citoyenne pour le Climat, a participative approach to developing a climate action plan in France

The French Citizen's Convention for the Climate is a body consisting of 150 randomly selected members of society. They have been brought together to work together on identifying objectives and measures to ensure that France's greenhouse emissions are reduced by 40% by 2030 compared with 1990. The participative format of the convention has been a response to the negative societal reception of the fuel tax which was proposed in 2018 and triggered demonstrations of the so-called movement des gilets jaunes which lasted several months.

The group worked together over 8 months to come up with a set of proposals. They made 149 policy proposals centred around 43 objectives. The objectives and corresponding proposals are grouped along the most important provisioning systems (movement/transport, consumption, housing, production/work and food/nourishment) and presented in a report produced by the group.

(source: Convention Citoyenne pour le Climat, 2020)

In addition to setting out the main targets and milestones, strategies should also contain information on:

- coordination and organisational structures;
- involvement of stakeholders and citizens;
- overall budget and human resources needed for implementation and sources of funding;
- main policy instruments;
- implementation and monitoring process.

Action plans will also need to be developed and will operationalise strategies. They will contain information on the following:

- specific actions to realise the pathway and achieve targets, e.g. National Energy and Climate Plan, Sustainable Energy and Climate Action Plan, Biodiversity Action Plan, etc;
- list of specific actions including necessary investments and policies;
- responsible department, person or organisation;
- timing (start, end and major milestones);
- cost estimation (Investment and operating costs);
- estimated contribution to target and other relevant impacts;
- implementation and monitoring process.

Some relevant strategies will often already exist. However, often these strategies will be sectoral in nature and will focus on deploying new solutions (and perhaps on phasing out unsustainable ones). In addition, there is a need to complement these strategies with corresponding Research and Innovation Strategies for Smart Specialisation and territorial just transition plans (TJTPs), as a minimum. These need to take account of National Reform Programmes and Country Specific Recommendations. If these strategies are not already available, then the innovation and just transition aspects are ideally not added as an afterthought but form an integral part of strategy formation.

The strategies will feed into the selection of policy objective, and policy choices, coordination and complementarity in the Partnership Agreements as well as the programme strategy that details main development challenges and policy responses. The action plans serve as a basis for deciding on specific objectives, their financial allocations and interventions.

The entire process of developing visions, strategies, goals, targets, pathways and action plans is subject to the same concept of adaptive governance that is reflected in all of transitions thinking. The uncertainties with respect to what change can become feasible over time as technological, societal and other boundaries change, and the unplanned and possibly negative impacts that become apparent only after the transition process begins require constant reflection and reevaluation.

Good practice principles: steps of the implementation process

1. Map provisioning systems (e.g. food system, energy system, mobility system):
   a. Delineate the system boundaries in terms of space, time and themes (e.g. CO_2 emissions from mobility in a city over the past few decades);
   b. Draw up the elements and drivers of the need that the system is satisfying (e.g. mobility required to visit shops, travel to work, leisure, etc.) and the context which influences this need (e.g. urban sprawl)
   c. Draw up the technologies and modes available to satisfy the needs, including regime solutions (e.g. private car with an internal combustion engine, electric vehicles, public bus transport, bicycle, etc.) and niche solutions (e.g. car sharing)
   d. Draw up the regime elements that influence available choices related to satisfying needs, especially cultural norms, behavioural practices, infrastructures, legislation and policy, market rules, etc. (e.g. cars as status symbols, fuel taxation, low emission zones, road infrastructure, parking infrastructure, etc.), including existing structures and potential changes in these structures;
   e. Map impacts of regime and niche technologies and modes on the economy, society and environment (e.g. jobs, emissions to air and water, resource use);
   f. Map actors with a stake in the regime or niche solutions, including their interests, types and levels of resources for advancing these interests, links with other actors, and capabilities to influence the legislative and policy context, public discourse, technological development, and other conditions which frame transition processes;
   g. Map the wider landscape and megatrends which serves as the backdrop (e.g. world fuel prices, geopolitics, global environmental agreements, artificial intelligence) to the regime and may impact the regime;

h. Identify external forces and pressures which impact provisioning systems (e.g. megatrends and disruptive forces)

2. Develop a vision by implementing a participatory process to formulate aspirations (e.g. fair, accessible, sustainable, innovative, safe, healthy, just, equitable, resilient, prosperous) for relevant provisioning systems.

3. Translate visions into goals and targets and identify possible pathways using a combination of participatory processes, analytical methods (e.g. modelling) and political processes. Take into account:

a. available technical, behavioural and other solutions
b. regional potential
c. potential resistance to change
d. megatrends

4. Formulate a strategy and action plan through a participative and political process, taking into account analytical inputs. Include details on the following elements:

a. coordination and organisational structures;
b. overall budget and human resources needed for implementation and sources of funding;
c. main policy instruments to be used;
d. specific actions to be implemented including financial resources required, responsible department, person or organisation and timing
e. implement a monitoring and review process.

4. Governing transitions

Main messages

- Proactive governance is required to support and guide transitions, which directs change towards socially appealing and environmentally sustainable outcomes;

- Cohesion policy can have a supporting and catalysing role, but the governance of sustainability transitions requires a broad, additional set of institutions, stakeholders and policies.

  The involvement of other bodies of national and regional governments is especially relevant because Managing Authorities have a limited control over the most relevant policies and processes which lead to sustainability transitions, thus horizontal coordination is required. Sustainability transitions require a reconfiguration of the social, economic and technological system. Without supporting institutional, policy and strategic frameworks, cohesion policy and Managing Authorities alone can have limited leverage.

Governing sustainability transitions comes with a specific set of challenges:

- The impacts of systemic change are inherently difficult to predict and plan for due to our limited understanding of the internal dynamics of complex systems. The governance of transitions therefore needs to recognise uncertainty and build reflection into the governance process. Within the cohesion policy framework for review are provided by new programming every 7 years and the mid-term review;

- Due to the complexity of transitions and the need for innovative approaches, a number of initiatives are bound to fail. Therefore, it is important to provide scope for experimentation, e.g. through the European Urban Initiative;

- It is important to avoid lock-in, i.e. a development of technologies, behaviours, infrastructures, etc. which will prevent sustainability transitions, or significantly increase the cost of such a transition. It should be recognised that phasing-out unsustainable technologies, products, practices and norms is as important as investing in sustainable ones. Disruption is part of the transition process and needs to be managed to ensure a just transition. Focusing cohesion policy spending on transformative technologies and solutions and avoiding spending in unsustainable ones can support the processes of phasing out and phasing in.

- It may be necessary to address resistance to change as transitions necessarily result in losses to those groups invested in incumbent unsustainable technologies and practices. Cohesion policy funding can contribute to capacity building of transformative actors and can be used to support innovation and deployment of sustainable solutions;

- A just transition is needed to ensure that the transition does not pose a disproportionate burden to certain groups or territories. The Just Transition Mechanism and Just Transition Fund can support this objective.

Profound stakeholder involvement is key:

- The government cannot implement a transition without the broad involvement of stakeholders. There is also a need to work across levels of government, territorial scales, policy domains and sectoral boundaries;

- Cohesion policy needs to support actors who can support transitions, both through capacity building and by supporting relevant projects and initiatives;

- Instead of involving a representative set of stakeholders, the emphasis should be on the potential of actors to contribute positively to transitions. Various tools are available to involve relevant actors which are presented in the chapter.

The policy context within which cohesion policy operates can make or break transitions:

- The policy context that has to be considered is broader than the set of horizontal and thematic enabling conditions contained in the regulations;

- The relevant policy context consists of innovation policy instruments, environmental and sectoral policy instruments to support scale-up of new technologies and solutions and avoid lock-in, policy instruments for a just transition, including labour market, social and educational interventions, business development and redistributional policies, and communication instruments to increase support for the transition.

4.1. Specific challenges of governing sustainability transitions

Historically, a number of socio-economic transitions have taken place which encompassed parallel changes in social structures, cultures and traditions, technical solutions, and virtually all facets of human life. One example of such a transition is the Industrial Revolution, which took place in the late 18th and early 19th century. **The main difference between past transitions and sustainability transitions in terms of their governance is intentionality**. Change in the past was not oriented towards a pre-defined vision of society. In contrast, in order to support sustainability transitions, **proactive governance is required thatdirects change towards socially appealing and environmentally sustainable outcomes**. This section discusses how governance of sustainability transitions takes place through stakeholder involvement, institutions and policies.

The overall governance process of sustainability transitions departs from mainstream ideas of governance in several ways. The current section discusses those aspects of governance that are not generally discussed widely in the literature already familiar to regional policy-makers, but is specific to the governance of sustainability transitions. Principles such as accountability, fairness, coherence and consistency across levels of governance, etc. are therefore not subject to discussion here, although these remain relevant to regional development in general and to sustainability transitions. This section discusses governance issues in general, before sections 5-7 delve into the details of enabling and supporting transitions within the cohesion policy framework. Governing of sustainability transitions cannot be undertaken by Managing Authorities on their own, but require the involvement of a broad range of decision-makers. The aim of the section is to raise awareness among Managing Authorities that the governance of sustainability transitions requires a broad set of stakeholders and policies in addition to cohesion policy interventions, and that these are necessary to ensure the success of transitions. [7]

[7] For further reference, a number of publications focusing on the practical implementation of transitions are available, e.g. EEA, 2019a, Roorda et al., 2014, F. Geels et al., 2019, Roorda et al., 2014, Frantzeskaki et al., 2011, Fujiwara, 2016, Jefferies & Duffy, 2011, Terenzi, Alberto; Latinos, Vasileios; Peleikis, Julia; Porras, 2017, URBACT, n.d.-a and URBACT, n.d.-b.

The impacts of systemic change are inherently difficult to predict and plan for due to our limited understanding of the internal dynamics of complex systems. The **governance of transitions therefore needs to *recognise uncertainty and build reflection and the permission to fail into the governance process***. ***Adaptive governance* should be implemented.** This involves implementing feedback loops to ensure learning, and making adjustments as necessary once lessons from implementation are drawn. Within the cohesion policy framework, the opportunities provided by the need for new programming every 7 years enables Managing Authorities to draw lessons learned from implementation experience. The mid-term review also provides an opportunity for corrections.

Due to the complexity of economic-social-technological-environmental transitions and the need for innovative approaches, a number of initiatives are bound to fail. Therefore, it is important to **provide *scope for experimentation* to implement technologically and socially innovative actions without guarantee for success**. Within the scope of cohesion policy community-led local development and the European Urban Initiative provide opportunities to implement experimental activities. Community-led local development is supportive of networking and innovative features in the local context and the European Urban Initiative, which is aimed at supporting experimentation in the area of sustainable urban development focusing on innovation in governance, strengthening the integrated and participative approaches. In addition, for activities with a local and regional scope, implementing integrated territorial strategies provides more flexibility for implementing adaptive governance than mainstream programmes. This is discussed in section 8. Setting up a monitoring and evaluation system that is adaptive and provides scope for experimentation is discussed in more detail in section 9.4.

It is important to ***avoid lock-in***, which is technological path-dependency and arises due to various social, economic, cultural, network and infrastructure dependencies. It is important therefore to identify factors that cause lock-in and **work towards dismantling obstacles to the uptake of new sustainable solutions**. Lock-in can be avoided through a combination of measures, including **aligning actions with long-term goals** (see section 3)**, avoiding end of pipe solutions, exclusion from funding of activities with negative environmental impacts** (see section 9)**, and active dismantling of barriers to radical innovation** (discussed in section 5.2).

It should be recognised that *phase-out*, sometimes referred to as exnovation, **is as important as phase-in** (innovation and deployment) for sustainability transitions (see section 1.2 and Figure 2 The x-curve of transitions: destabilisation of incumbents and establishment of new regime). Disruption is part of the transition process; once alternatives to unsustainable technologies, products, practices and norms exist, it is important to phase out existing unsustainable ones in order to achieve sustainable outcomes. For the implementation of cohesion policy this means that not funding unsustainable technologies and investments is as important as providing funding for sustainable ones. In addition, it may be necessary to use flanking policies, i.e. policies outside the scope of cohesion policy which strengthen the impact of funding, which result in the destabilisation of existing regimes. These are discussed in section 4.3. Policy mixes which do not result in phasing out/exnovation are not sufficiently ambitious – whether exnovation is achieved can be used as a yardstick to judge whether planned policies and measures are supportive of the transition process.

It may be necessary to *address resistance to change*. Some policies and measure which pave the way towards a climate neutral, green and circular economy can be implemented on a large scale in a relatively uncontroversial way, such as providing financial support for insulating residential buildings. Others - especially those involving exnovation - result in losses to some groups, such as limiting parking spaces or increasing the cost of individualised transport modes, or require behavioural change, and can therefore be met with resistance. Typically, regime actors with vested interests in

maintaining the status quo will resist change. "System transitions necessarily disrupt and challenge established investments, jobs, behaviours, knowledge and values. While these changes create new jobs, business models and opportunities for green growth, structural change inevitably provokes resistance, constraining governments in their ability to impose regulations and pricing instruments that are consistent with long term environmental goals." (F. Geels et al., 2019) Just transition and funding for restructuring of economies is discussed in section 7.

Achieving a *just transition* is necessary for several reasons: to ensure a social licence for change, to manage resistance to change by ensuring political buy-in by those potentially negatively affected by change, and to avoid undesirable societal outcomes. It is important to avoid socialisation of costs and privatisation of benefits of the transition (i.e. costs borne by all and benefits accrued to few). Distributional and equity considerations need to be integrated into the design of the transition. Cohesion policy can support investment in SMEs and in innovation and finance territorial approaches in regions most affected by phase-out to implement territorial strategies (see section 8). Policies which can flank cohesion policy and are aimed at addressing resistance to transitions are discussed in section 7.2.

Profound stakeholder involvement in the management of transitions is necessary in order to ensure that the transition has societal support. It is important to recognise that actors other than government policy-makers also have a strong role in the transition process. These actors will influence events in different arenas: government, market, networks, opinion, etc. As is the general norm for solving systemic issues, there is a need to work across levels of government, territorial scales, policy domains and sectoral boundaries. Ultimately most of society needs to be brought on board to support the transition. However, as a departure from the usual understanding that the more involvement, the better the outcome, **transitions require that in the initial stages**, during the development of the main concepts and ideas driving the transition, the **involvement of stakeholders should be limited. It may be necessary to initially shield the process from regime actors** who may pose resistance to change. It is therefore important to conceptualise the transition by involving change agents rather than regime actors. This is described further in section 4.2.

4.2. Stakeholders

Within the context of the shared management of cohesion policy, the central actors are the Member States and the European Commission. The Member States are obliged to organise a partnership with other actors with the aim of involving those partners in the preparation of the Partnership Agreement and the preparation and implementation of the programmes. Actors to involve in the partnership include "regional and local authorities, urban and public authorities, economic and social partners, civil society and bodies promoting social inclusion, fundamental rights, gender equality, non-discrimination and rights of people with disabilities." (European Commission, 2019f)

The governance concept of the sustainability transition literature indicates **a move away from the view that governing is done by the central institutions of the state towards a view that diverse actors with diverse organisational forms, including private and voluntary organisations as well as public ones have a role in governing**. They are not just partners to the main decision-making body, but actively participate in shaping the world around themselves. Governance refers to "all processes of governing, whether undertaken by a government, market, or network […] and whether through laws, norms, power or language." (Bevir, 2012) "In contrast to top-down, state-led coordination, polycentric governance acknowledges that power, capabilities and resources are dispersed and that change often involves bottom-up and self-organising actions". (F.

Geels et al., 2019) Different stakeholders have different capacities to influence processes that are involved in social organisation and coordination. For example, the role of non-governmental organisations and social movements in influencing public discourse can be critical, while actors representing the private sector may also actively influence discourse, and will have a central role in processes involved in provisioning including through the profit-oriented activities of extraction, production and distribution, as well as in technological change, financing, etc.

“Governments retain a critical role in creating a framework for [society-wide] engagement and have a unique role in organising and regulating markets and correcting market failures” (EEA, 2017) In order to affect a transition, the coordinated activities of all actors are required, and “transition becomes coordinated at some point through the alignment of visions and activities of different groups”. (F. W. Geels & Schot, 2007) The role of government actors is then to influence actors with policies so that they become aligned towards implementing the future vision, itself developed through a participatory process as described in section 3.3.

A multitude of actors may become involved in different roles and capacities in enabling or hindering transitions:

- "Change agents, those that have resources such as knowledge, influence in networks and capacity to take transformative action […];
- Supporters of change, those that may not have resources or influence directly but can indirectly support change by mobilizing and activating their networks and peers to align with and support the actions [promoting transitions], and
- Connectors, those actors that can only benefit from [the transition] on the long term and can influence positively [transitions] by spreading the word, allowing new networks to be incorporated in the actions." (URBACT, n.d.-b)

However, at the same time, incumbent actors who have a stake in maintaining the status quo may work against transitions taking place.

Alignment towards implementing a vision requires that all actors relevant to the transition become mobilised in a coordinated way. If this is alignment of actors is unsuccessful, then instead of a full transition lock-in, the transition may result in a backlash (when disincentives for innovations reinforce traditional practices) or a system breakdown (when the innovations of the transition cannot selfsustain and leave no adequate substitute for the destabilised regime). (Grin, Rotmans, & Schot, 2010) In order to mobilise these actors, the following questions have to be answered:

- Who are the relevant actors, and how can they promote or hinder sustainability transitions?
- What tools does cohesion policy have to support actors who can promote transitions?
- What can be done within the broader policy framework to enable relevant actors?

The various steps needed to respond to these questions are discussed in the following sections 5.2, 6.2 and 7.2.

A significant difference between the governance of cohesion policy and sustainability transitions is the role of actor involvement and partnership. While the regulation on the European code of conduct on partnership in the framework of the European Structural and Investment Funds requires that partners should be “most representative of the relevant stakeholders”, **the emphasis in the transition literature when deciding on which stakeholders to involve at which phase of the transition is not on the degree of representativeness, but on the potential of actors to contribute positively to transitions**. For this reason, until vision formation and pathway analysis, the set of actors

involved is restricted to some extent, and the process is only opened up to wider stakeholder processes afterwards.

In a specific approach for the management of transitions, transition teams are formed as a first step to explore and oversee the transitions planning process.

Box 6 Tool for organising a governance process to oversee the transition – The transition team

The transition team is a small team of around 3-5 people. Transition team members are members of national, regional or local government organisations (or if the transition governance process is initiated by other stakeholders, then the transition team may instead involve these stakeholders). The team is tasked with exploring dynamics and working towards a system analysis and actor analysis (see section 3.2).
The transition team is also tasked with coordinating relevant responsibilities and areas of expertise, with the aim of making connections between transitions thinking and other parts of government. The transition team relates the transition process to on-going (policy) processes.
The team is responsible for logistics as well as providing content related input into transition arena meetings.
Transition teams may already exist in some Member States. Managing Authorities should try to identify them and explore to which extent their experience can be linked to the programmes.
(Source: Roorda et al., 2014)

At the second stage, a set of actors who can support change and engage in out of the box thinking are involved in the process through a transition arena. “Actors who are already adopting new or alternative ways of thinking and doing (change agents) should be found, as they can be influential in mediating and triggering transitions.” (Roorda et al., 2014) The focus is on individuals “willing to go beyond ‘business-as-usual’, who are intrinsically connected to the issue at hand and are open to other perspectives.” (Roorda et al., 2014) **There is a need to actively ensure a larger role for niche actors than incumbents to offset advantages the latter have in terms of resources and regime support.** Due to advantages that regime actors have, engagement and involvement does not guarantee a good outcome for those with less resources, so there is a need to set a framework which anticipates outcomes for different groups and takes interests and level of resources into account, protecting the vulnerable.

Box 7 Tool for the engagement of stakeholders: The transition arena

The transition arena is "a setting in which different perspectives, expectations and agendas are confronted and discussed, and synergies are identified" and in which actors can "engage in critical reflection and envisioning".
The format of the transition arena is a series of meetings between selected actors. The group of individuals participating in the meetings base their contribution on their own ideas and experiences, but can also draw on inputs from various analyses such as actor analysis, systems analysis and pathway analysis.
The transition arena has to provide a safe space and be sheltered from vested interests in order to be free to depart from solutions which are part of the current regime. The actors participating in the process are therefore participating in their individual capacity and not as representatives of their respective organisations.
Steps to selecting change agents to participate in the transition arena:

1) identify potential actors using snowball sampling, starting out from actor mapping
2) map backgrounds, competencies, and interests of actors,
3) select 10-15 change agents based on transparent criteria
    a) ensure different expertise and viewpoints are represented to ensure that

the group is diverse (but not necessarily representative).

b) change agents should be selected, who have innovative power (the power of new ideas), and transformative power (capacity to mobilize others for change) and who are willing to go beyond business as usual.

c) avoid selection of powerful actors if it is foreseen that these actors will hinder process, in which case this "could easily imperil the quality of the arena output by preventing it from overcoming business-as-usual."

Tasks of the transition arena:

1) structuring the transition challenge
2) drafting visionary images
3) developing transition pathways
4) developing a transition agenda.

(Source: Roorda et al., 2014)

After the transition arena “broadening events” should be organised to present outcomes to wider group of stakeholders and receive feedback.

Stakeholders can become directly involved as partners in cohesion policy planning and implementation through the institutionalised partnership process described in Articles 6 and 34 of the proposed Common Provisions Regulation and detailed in Commission Delegated Regulation (EU) No 240/2014 on the European code of conduct on partnership in the framework of the European Structural and Investment Funds. Partners are required to be involved in the preparation of Partnership Agreements and throughout the preparation and implementation of programmes through participation in monitoring committees. The involvement of partners in monitoring committees is not flexible, but the development of background studies and strategies identified in section 3 can be carried out through more flexible processes, taking into account the need to involve non-regime actors. In addition, involvement of local stakeholders through the implementation of community-led local development strategies also provides for a more flexible approach. Finally, Member States and regions can choose to go beyond legislative requirements with respect to partnership and **set up additional institutions and networks to involve partners or provide support to specific partners through capacity building**.

4.3. Policy context

The 2014-2020 programming period recognised the **very important role of the broader policy context within which cohesion policy operates to ensuring the success of funding** and introduced the concept of ex-ante conditionalities. The current policy proposals for 2021-27 refer to horizontal and thematic enabling conditions; these are policies, strategies and plans external to cohesion policy with which coherence must be ensured in order to increase the effectiveness of funding.

Relevant enabling conditions for the implementation of sustainability transitions include the existence of various strategies and requirements related to their content, such as national energy and climate plans, national long-term renovation strategy for buildings, national or regional disaster risk management plans, climate adaptation strategies, a national investment plan for water and waste water, and waste management plans. These are important because they set out the overall approach to certain environmental issues. Smart specialisation strategies are also required and relevant for transitions. At the EU level, the European Green Deal and related legislative and policy proposals as well as the existing climate, energy and environmental acquis provide an important part of the overall policy framework.

However, in addition to the enabling conditions specifically referenced by the regulatory proposals, further policy instruments may be required for the successful implementation of

sustainability transitions. This broader mix of policy instruments and tools are the means through which the behaviour and actions of stakeholders is aligned with visions and pathways for sustainability transitions.[8] The focus of this section is on providing advice to Managing Authorities on the areas they need to address together with policy-makers to provide an overall national policy framework which is conducive to sustainability transitions. The target audience is Managing Authorities. However, the section may also be useful to regional and local decision-makers.

Managing Authorities will have varying degrees of leverage over the implementation of different policies which are necessary to enabling a transition. If a Managing Authority is responsible for policy proposals within a specific domain, such as a ministry responsible for e.g. environment, transport or energy, then it will have direct control over making policy proposals within its domain of responsibility, which will make aligning policies with sustainability transitions easier. When policies are linked to enabling conditions, the Managing Authority will also have strong leverage on the fulfilment of these enabling conditions even in the absence of direct control. However, some policies will be entirely outside the remit of Managing Authorities but still necessary for the implementation of sustainability transitions and to ensure the effectiveness of cohesion policy funding for transitions. Therefore there is a need for policy coordination across different domains to set national policy mixes which enable transitions and – as transitions are implemented locally – for the coordination of local and regional policies and goals with national policies and goals. This requires involvement of relevant bodies such as ministries and agencies, as well as multi-level cooperation between government actors.

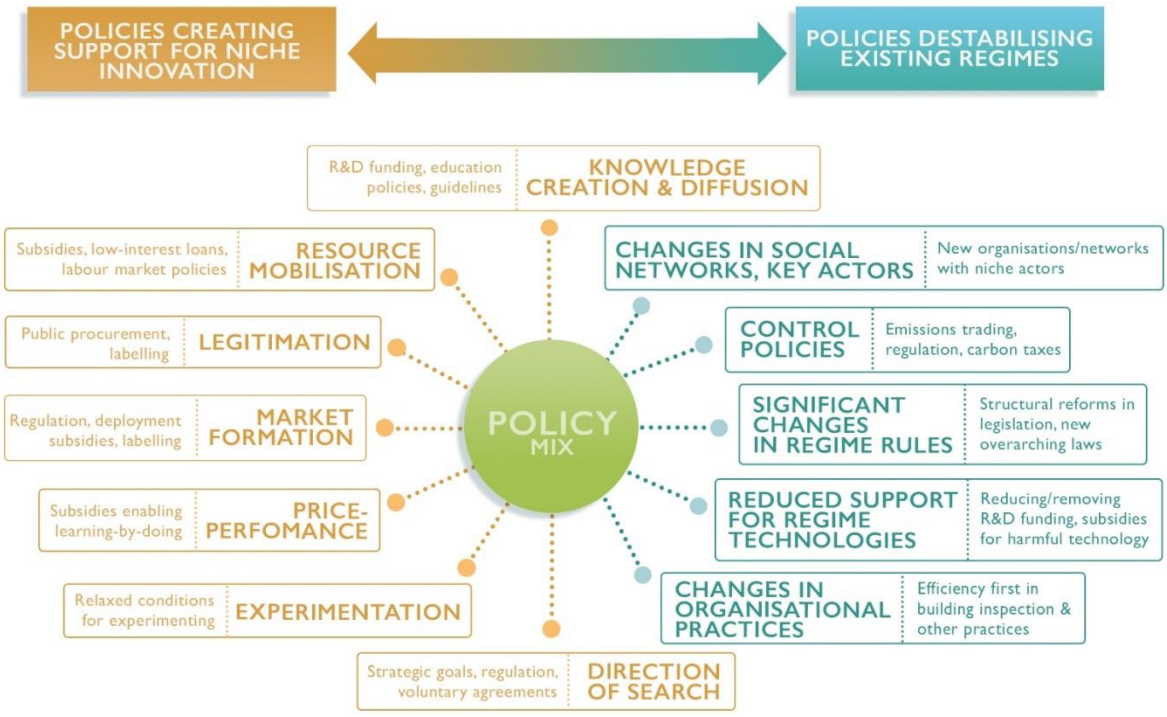


Figure 3 Policy mixes for destabilisation of incumbents and establishment of new regime

Source: Kivimaa, 2019

[8] In this toolkit we differentiate between strategic and policy instruments (see e.g. Edmondson, Kern, & Rogge, 2018); while the strategic level is discussed in section 3 which focuses on creating visions and translating them into goals and pathways, here the focus is on the mix of policy instruments available to deliver on the strategic goals, and the specific criteria that the sustainability transitions literature sets for establishing a policy mix.

When implementing a policy mix to enable sustainability transitions, different types of policy instruments need to be used:

1. Policy instruments supporting **innovation**;
2. **Environmental and sectoral policy instruments** to support scale-up of new technologies and solutions and avoid lock-in;
3. **Policy instruments for a just transition**, including include labour market, social and educational interventions, business development and redistributional policies;
4. **Communication instruments** to increase support for the transition.

These policy instruments work together towards a single goal by (1) making available (through innovation and phase-in) alternatives to replace unsustainable technologies (2) providing advantages to sustainable solutions and removing support from or actively disadvantaging unsustainable solutions and (3) managing wider socio-economic system impacts by influencing public opinion and implementing measures to ensure broad acceptance of the transition. They are linked to the three potentially overlapping stages of transitions (emergence, diffusion and reconfiguration) as shown in Figure 4. The following sections discuss these sets of policy instruments.

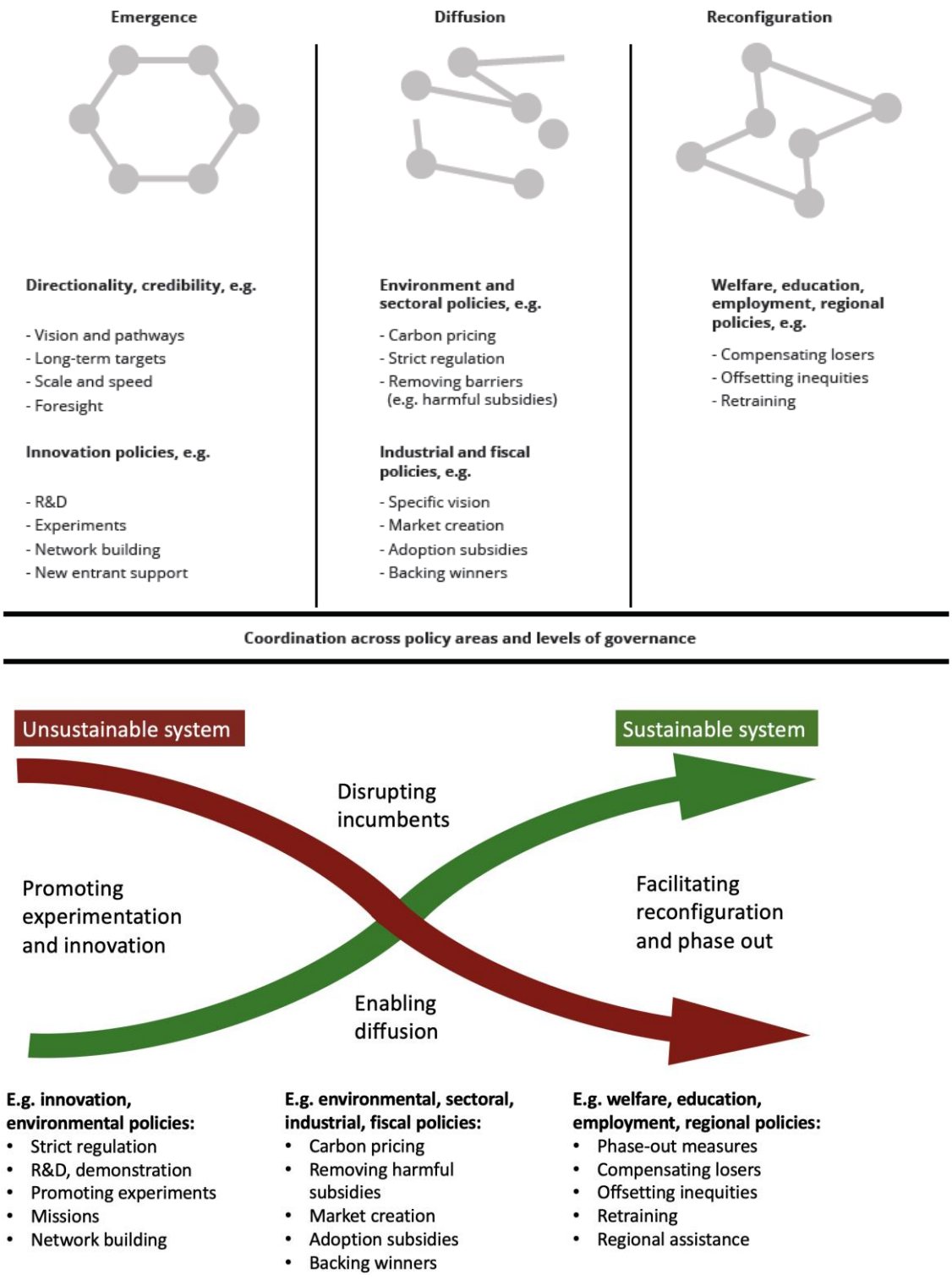


Figure 4 Examples of the policy mix contributing to sustainability transitions

Source: F. Geels et al., 2019

4.4. Investing in transitions

A series of questions need to be answered to determine if there is a role for cohesion policy in supporting sustainability transitions as envisioned (Section 3), how support should be implemented and what form it should take. Following a systematic approach can ensure that cohesion policy supports transitions efficiently and effectively, complementing other policy instruments. A series of questions needs to be asked to determine the role of cohesion policy in funding transitions:

1. What broad changes in social-economic-technological systems are needed to support sustainability transitions?
2. Which of these changes need to take place within the programming period?
3. Which actors are responsible for making these changes and how does their behaviour need to change?
4. What policies can be used to affect the behaviour of these actors?
5. Is public funding required to achieve the desired outcome?
6. If public funding is required, is support from cohesion policy required or are other funding instruments available and sufficient?
7. What form should support cohesion policy support take?
8. What environmental criteria should be satisfied?
9. What should be done at the national level and what should be done at regional or local level?

The three main phases of transitions (innovation/emergence, diffusion/deployment and system reconfiguration) broadly correspond to the funding of innovation (PO1), environment and climate investments (PO2), and integrated economic and social measures (PO4) as described in sections 5-7.

Article 8 of the proposed CPR requires that for each of the selected policy objectives complementarities between the Funds and other Union instruments, including LIFE strategic integrated projects and strategic nature projects. Therefore each of the following sections 5-7 deals with complementarities between different funding instruments available for funding operations related to the themes of innovation, deployment and just transition, respectively.

Good practice principles: steps of the implementation process

1. As a first step, the existing policy mix that supports or hinders sustainability transitions needs to be mapped. The assessment should cover all three main processes involved in a sustainability transitions (innovation, phase-in and phase-out and just transition) and their associated policy instruments (policy instruments supporting innovation, environmental and sectoral policy instruments to support scale-up of new technologies and solutions and avoid lock-in, and policy instruments for a just transition). These policy instruments are described in detail in sections 5-7.

The following questions need to be addressed:

   a. What broad changes in social-economic-technological systems are needed to support sustainability transitions?
   b. Which of these changes need to take place within the programming period?
   c. Which actors are responsible for making these changes and how does their behaviour need to change?
   d. What policies can be used to affect the behaviour of these actors?
   e. How can resistance to change be addressed?

2. As a second step, the existing policy mix needs to be assessed to determine how it needs to whether it poses barriers to sustainability transitions.

   a. What solutions need to be implemented according to strategies and action plans

for sustainability transitions?

b. Are new solutions available to replace existing unsustainable solutions, or is support for innovation needed?
c. Are sustainable solutions present at adequate scale or are policies required to scale up these solutions?
d. Are current technologies and solutions supported by harmful subsidies? Are social, economic, cultural, network and infrastructure dependencies creating lock-in by conferring advantages to existing solutions? What measures are needed to level the playing field between new sustainable solutions and existing unsustainable ones?
e. Are policies in place to address potential negative social impacts and ensure a just transition?

3. As a third step, the role of EU funding in the policy mix to implement sustainability transitions needs to be determined. A series of questions needs to be asked to determine what role cohesion policy and other EU funding instruments can play:

a. Is public funding required to achieve the desired outcome?
b. If public funding is required, is support from EU funding sources required or are other funding instruments available and sufficient?
c. What form should financial support take?
d. What environmental criteria should be satisfied
e. What should be done at the national level and what should be done at regional or local level?

4. As a final step, there is a need to implement procedures and institutions to promote adaptive governance and policy learning.

5. Supporting innovation

Main messages

- Innovation is central to transitions, as making sustainable alternatives available is what makes transitions feasible;
- Radical innovation, which results in a significant departure from current solutions and technologies, is required to successfully address systemic environmental challenges;
- Apart from technical innovation, social innovation, policy innovation and business innovation are also needed;
- Innovation a should be framed as a contributor to transformative change and should be goal oriented and driven by societal challenges, while building on regional potential and development needs;
- Policy-makers need to ensure protected niches are available to non-regime actors. These niches can shield innovation, protecting it from mainstream economic, infrastructural, consumer preference related and other selection pressures. They also allow for nurturing processes that support the development of the path-breaking innovation;
- Experimentation is key to innovation, as the success of the innovation process is uncertain, and all outcomes of radical innovations cannot be foreseen.

5.1. Innovation

The key features of innovation policy frameworks have evolved over time. **The current framing of innovation as a contributor to transformative change has replaced the previous focus on national systems of innovation**. This means that in transformative innovation policy, the emphasis is on the direction of innovation, rather than on market failures or system failures. (Bell et al., 2019) This is presented in Table 5. Innovation driven by transformative change implies that **innovation is goal oriented, driven by societal challenges**. Innovation for sustainability transitions is focused on transforming the systems (energy, mobility and food systems) that drive environmental degradation. For this reason, innovation must be oriented by long-term targets for sustainability, e.g. the prospect of a zero carbon, zero waste economy.

Table 5 Changing innovation policy framings

Overarching framing	Key features	Policy rationale	Policy approaches (examples)
Innovation for growth (1950s-)	Science and technology for growth, promoting production and consumption.	Responding to market failure: public good character of innovation necessitates state action	State financing of basic R&D, incentives for business R&D (e.g. tax breaks, subsidies).
National systems of innovation (1980s)	Importance of knowledge systems in development and uptake of innovations.	Responding to system failure: maintaining competitiveness, coordinating system actors.	Promoting science hubs; incentivising coordination; SMEs; education and training.
Transformative change (2010s-)	Alignment of social and environmental challenges with innovation objectives.	Promoting transformation: pathways, coordination domains, experimentation, learning.	Societal challenges (H2020), goal orientation (SDGs), mission-oriented innovation (FP9).

Source: EEA, 2019a

The change in the framing of innovation also has implications for funding of innovation. The objective of funding is no longer to fill the gap between private and societal benefits resulting from market failure, but to encourage initiatives which may contribute to future transitions. This is discussed further in section 5.3. The new framing of innovation as contributing to transitions also has implications for the preparation of Research and Innovation Strategies for Smart Specialisation (RIS3), as discussed in section 5.2.

The discussion on environmental innovation has long been centred around improving existing technological solutions in order to increase their environmental performance. These types of incremental innovations have been successful in addressing some types of environmental challenges, such as air and water pollution, where end of pipe solutions, e.g. industrial scrubbers or waste water treatment facilities achieve good results. However, incremental innovation, which "makes small improvements in existing products or production techniques, aimed at efficiency improvement, optimisation or cost reduction" (F. Geels et al., 2019) is insufficient to drive sustainability transitions as it does not lead to a significant departure from the status quo and therefore cannot adequately address systemic environmental challenges.

Radical innovation is required. "Radical innovations deviate significantly from established systems and incremental innovation trajectories in terms of the technology involved, user preferences and operational requirements (e.g. skills, infrastructure, regulations). Radical innovations therefore often face major barriers but also offer the potential to enable transformative change" (F. Geels et al., 2019). Radical innovations focus on solutions which embody radical departures from the current regime, i.e. solutions which differ from existing dominant technologies in at least one dimension as opposed to marginal change, which usually involves tweaking dominant technologies to achieve slight improvements in environmental or other performance. Disruptive innovation is "innovation that significantly challenges existing systems, business models or practices — with positive and negative consequences. Disruptive innovation can lead to radically new systems and industries, but can also imply structural change, with significant socio-economic consequences." (F. Geels et al., 2019)

This means that solutions which have the potential to make significant contributions to sustainability transitions need to be prioritised over solutions which only enable incremental change, both in the development of RIS3 and in the funding of innovation using cohesion policy resources.

Table 6 Incremental vs racial innovation

Incremental innovation	Radical innovation
Continuous (linear improvement of value)	Discontinuous (essential, non-linear improvement)
Based on existing technology, constitutes improvement of existing characteristics	Based on new technologies, introduces new set of performance features
Dominant design unchanged	Leads to new dominant design
Does not lead to paradigm shift	Can lead to paradigm shift
Low level of uncertainty	High level of uncertainty
Existing organisation and qualifications are sufficient	Requires new organisation and skills
Driven by market pull, result of response to demand or need	Driven by technology, result of chance

Source: based on Lokuge, 2015

Due to the radical nature of innovation, and the need to depart from currently known solutions, there is a **need to allow for failure** as part of the innovation process.

Innovation needs to focus not only on the technologies used in production and consumption systems, but on social and economic systems more broadly. Transition agendas need to be identified for each socio-economic system (Bell et al.,

2019) and synergies and overlaps need to be mapped and dealt with in a transparent manner. Recently, discussions have shifted towards innovation in **business models and social innovation**, as well as to the rediscovery and adaptation of low-tech or nature based solutions for addressing challenges related to climate change, resource use and biodiversity. The role of the government and the way that policy-making is done also needs to change, encompassed by an increased focus on **policy innovation**.

Changes in social practices can provide new and more sustainable answers to meeting societal needs. Social innovation can contribute to achieving sustainable outcomes faster and at lower cost than relying exclusively on technological innovation. Social innovations include "collective forms of living and work, local resilience initiatives (such as transition towns and urban gardens), commons-based forms of production (co-maker spaces and peer-production), practices of permaculture and slow food". (EEA, 2017) Innovative social initiatives are generally local in nature (e.g. Transitions Towns, Repair Café and Maker Faire), but some constitute broad social and cultural concepts rather than local initiatives, such as the concept of energy democracy (Szulecki, 2018, Burke & Stephens, 2017).

Table 7 Innovation for sustainability transitions

Domain	Focus	Examples
Technological innovation	Aimed at developing new products and processes and significant technological changes of products and processes.	• Mobility: battery electric vehicles, electric bikes, alternative fuels, autonomous vehicles • Food: permaculture, no-tillage farming, plant-based meat and dairy products, genetic modification • Energy: renewable electricity, heat pumps, passive houses, whole-house retrofitting, smart meters • Cross-cutting technological innovation includes e.g. artificial intelligence, big data and internet of things
Social innovation	Aimed at identifying new social practices that aim to meet social needs in a different way than the existing solutions.	• Mobility: car sharing, modal shift, teleconferencing, teleworking, internet retail • Food: alternative food networks, organic food, dietary change, urban farming, food councils • Energy: decentralised energy production ('prosumers'), community energy, energy cafes • Cross-cutting society-wide social innovations include energy democracy, the sharing economy, the repair economy, localism and crowdsourcing.
Business model innovation	Aimed at making changes to an organization's value proposition and to its underlying operating model through changing the rationale of how an organisation creates, delivers and captures value in economic, social, cultural or other contexts	• Mobility: mobility services, car sharing, remanufacturing vehicles, bike sharing • Food: alternative food networks, organic food • Energy: energy service companies, back-up capacity, vehicle-to-grid electricity provision • Cross-cutting innovation in finance includes various forms of crowdfunding such as peer to peer loans, donation based crowdfunding and community shares.
Policy innovation	Novel processes, tools and practices used for policy design, development and implementation that result in better problem solving of complex issues	• Systems thinking, strategic foresight, focus on behavioural insights, experimental design, digitally enabled approach, embracing complexity, focus on citizens and shaping new alliances, emphasis on impacts

Source: Axelrod Gerald Ford, Conte, & Hegselmann, 1997, EEA, 2019b, Brookfield Institute, 2019, Osterwalder, Pigneur, & Smith, 2010

The different domains of innovation (social, technological, etc.) cannot be treated as independent of each other; their interactions and interdependencies need to be

taken into account. A narrow focus on firm-centred technology-mediated change without considering necessary behavioural changes in established habits and lifestyles may be too restrictive to deal with contemporary societal challenges, and may not take into account that the different ways of using new technologies necessitate behavioural change. For example, intermittent renewables, such as solar and wind are not perfect substitutes for dispatchable power plants such as coal and gas-fired plants and require storage solutions as well as demand side management to be able to supply electricity when needed. The space for new markets and business models opens up, allowing consumers to become prosumers (both consumers and producers of energy), and allowing consumers to participate in balancing markets by scaling back their demand when supply is low and shifting demand to periods of high supply. Often the need for social and market innovations which need to accompany technological innovation are emergent – the requirement for energy storage and demand side response only becomes apparent when the share of intermittent renewables reaches a critical level in electricity generation.

Because radical innovation has the potential to change socio-economic systems, it also has the potential to change these systems in **unexpected and negative ways and exacerbate societal challenges**. In fact, many of the societal challenges confronting the world today are caused by the direct effects or indirect consequences of previous innovations. This has implications for experimentation and adaptive governance, concepts which were discussed in section 4.1.

5.2. Policy framework for innovation

Innovation is central to transitions, as making sustainable alternatives available – be these technological, social or organisational – **is what makes transitions feasible**. A number of policies outside cohesion policy can increase the effectiveness of innovation funding in delivering transitions. The focus of this section is on the overall innovation policy framework within which cohesion policy operates, while funding of innovation is discussed in section 5.3.

At the EU level several initiatives jointly set the overall direction for research and innovation in the EU, including the Smart Specialisation Communication, A renewed European Agenda for Research and Innovation, the New Industrial Policy Strategy, the Start-up and Scale-up initiative and the New Skills Agenda: Blueprint for Sectoral Cooperation on Skills. At the national and regional level, national innovation strategies and research and innovation strategies for smart specialisation set out the overall direction and framework. They will play a major part in finding innovative solutions to societal challenges linked to the green transition.

Research and Innovation Strategies for Smart Specialisation should continue to serve as the framework for funding innovation activities; innovation for sustainability transitions can be built into the process of planning and implementing RIS3. The RIS3 strategies are developed in the following steps[9]:

1) Analysing regional context and innovation potential;
2) Setting out the RIS3 process and governance,, ensuring participation and ownership;
3) Developing a shared vision for the future of the region;
4) Identifying priorities, and

[9] The main elements and steps to developing a research and innovation strategy for smart specialisation are contained in the existing literature (see e.g. Foray et al. (2012) or “European Commission Smart Specialisation Platform,” n.d..).

5) Defining a coherent policy mix, roadmap and action plan.

Innovation for sustainability transitions can be integrated into each step of the development of RIS3 strategies (Bell et al., 2019 and Arnold et al., 2019).

As part of the *first step, analysing regional context and innovation potential*, it is necessary to "identify and map the new knowledge, technologies and innovative solutions (technology-based public or societal) that are critical for unlocking or accelerating the transition of each key system, taking into account their level of maturity and […] positioning and assessing their potential impact" (Bell et al., 2019). Several factors may influence innovation potential, including research and education resources, access to broadband, access to markets, etc. There is a strong urban-rural divide with respect to several of these factors.

The *second step, setting out the RIS3 process and governance, ensuring participation and ownership*, involves **ensuring protected niches are available to non-regime actors such as new entrants, entrepreneurs and peripheral actors**. (Geels et al., 2019) Protected niches involve *shielding, nurturing and empowering* innovation. (A. Smith & Raven, 2012 and Raven, Kern, Verhees, & Smith, 2016)

Shielding innovation involves protecting it from mainstream economic, infrastructural, consumer preference related and other selection pressures. This can be achieved passively, e.g. in spaces which are geographically separated from market competition, e.g. off-grid sites, or spaces where consumer and cultural preferences (e.g. among consumers with strong environmental preferences) allow for the testing of new products even if their performance is technically inferior to existing technical solutions. Shielding can also be achieved through active innovation policy (Raven et al., 2016) "The role of cities and regions may be to provide protected "spaces" in which experiments may take place", with examples of such as transition towns and green cluster initiatives. (Truffer & Coenen, 2012)

Nurturing, the second element of protected niches, **is defined as involving "processes that support the development of the path-breaking innovation"** with the key nurturing processes being "assisting learning processes, articulating expectations, and helping networking processes". (A. Smith & Raven, 2012) Articulating expectations relates to providing direction to innovation (e.g. through pathways and targets). Assisting learning processes involves experimentation, which allows for testing of products and solutions among users, refining them, and testing them again.

Empowering, the third element of protected niches, can happen in several ways, but may involve "processes through which mainstream selection environments are changed in ways that make them more amenable for the niche innovation" which **involves reframing "the rules of the game, and reform institutions that influence prevailing performance criteria."** (Raven et al., 2016) Changing the rules of the game involves policy-makers who have sufficient power to open up the space for new entrants at the possible detriment of existing regime actors. Policy instruments for empowering are discussed in section 6 linked to deployment of innovative solutions.

The *third step of preparing RIS3, developing a shared vision for the future of the region*, involves creating a process that ensure that innovation contributes to sustainability (directionality), by setting collective priorities for transformative change, in line with visions and strategies developed according to section 3.

In the *fourth step, the identification of priorities*, there is a need to identify innovation priorities which are **in line with system level transition agenda** across all targets, by assessing the best options across the different transition agendas, taking into account all synergies and negative externalities, and optimising R&I priorities against the whole set of

targets and critical pathways of system-level transition agendas. This can be done through the following steps:

- Mapping and assessing cross-systemic impacts of R&I priorities (e.g. impacts on employment, health, well-being, equity, competitiveness, etc.);
- Identifying critical nexuses of knowledge, technologies, and innovations that enable the transformation of several systems;
- Ranking the identified critical nexuses based on their cross-system impact (e.g. against the targets of the different transition agendas).

As part of the *final step, defining a coherent policy mix, roadmap and action plan* there is a need to ensure that the innovation priorities identified under the previous step are supported through a coherent policy mix. The policy mix needs to take account of why businesses innovate, and to promote their capacity and willingness to be more innovative. Innovation activity is spurred by business opportunities and the desire on behalf of businesses to remain competitive, but it is also encouraged by a regulatory measures (e.g. environmental standards) and by economic instruments (e.g. taxation or funding).

The literature on sustainability transitions has a strong focus on **experimentation** as a means of promoting a diversity of options (T. Foxon & Pearson, 2008). Because radical innovation results in products, processes or societal solutions that differ with respect to the status quo along several dimensions. This means that they cannot readily replace existing solutions. Therefore, experimentation is important. This involves not just testing of technical performance, but also their markets, consumer preference and societal acceptance. T. Foxon & Pearson, 2008 advocate for promoting a diversity of options through experimentation as "it will be impossible to predict the winners ahead of time and there is a value in supporting the creation of options, which may later be further pursued or discontinued". "Organisations 'probe initial markets with early versions of the products, learn from the probes, and probe again. In effect, they run series of market experiments, introducing prototypes into a variety of market segments. (...) Probing and learning is an iterative process. The firms enter an initial market with an early version of the product, learn from the experience, modify the product and marketing approach based on what they learned, and then try again. Development of a discontinuous innovation becomes a process of successive approximation, probing and learning again and again." (F. Geels et al., 2019 referencing Lynn et al., 1996) Experimentation continues into the later stages of innovation, which involves testing different solutions in different circumstances to identify feasible options.

Box 8 Urban living labs as tools for experimentation

Urban living labs are "sites devised to design, test and learn from social and technical innovation in real time." They "can be considered both as an arena (geographically or institutionally bounded spaces), and as an approach for intentional collaborative experimentation of researchers, citizens, companies and local governments." Urban living labs can be strategic, led by government or large private actors, civic, led by urban actors such as universities, cities and urban developers, or grassroots, led by urban actors in civil society or non-profit actors.

Urban living labs have four types:

- Trial – serve to test products, technologies or processes under real world conditions;
- Enclave – serve as a niche for innovation under protected conditions
- Demonstration – a showcase for exhibiting what the urban could resemble
- Platform – creates an arena for concurrent interests, fosters emergence of new urban configurations

(GUST & Urban Europe, 2017)

The transition literature also focuses on **'open innovation'** which targets not only businesses, academia industry but also involves users, civil society, communities and other actors as active participants. In addition to RIS3 these considerations need to be taken on board.

5.3. Investing in innovation

Regions can contribute to new sustainable solutions both through supporting local stakeholders in developing innovative solutions, as well as through wide scale deployment of innovative sustainable technologies and social practices which enable cost savings and adaptation of solutions to different consumer markets and cultural expectations. Deployment is addressed in section 6. The boundary between innovation and deployment is not a clear one. New solutions which make alternative, more sustainable development pathways possible may be at different levels of maturity. While some sustainable technologies are mature and compete on the market with incumbent technologies and the main task is deployment, others may be at different technology readiness levels, as shown in Table 8. Although the distinction between the levels involving product demonstration and manufacturing seem clear cut, innovation continues after a product is ready for manufacturing, to further refine new solutions with the aim of increasing scope for applicability, bringing down costs, increasing performance, and enabling scalability by improving social acceptance and environmental impacts. This further refinement of new solutions typically takes place while the solutions are being scaled up.

Table 8 Technology readiness levels

Fundamental research	TRL 0	Idea. Unproven concept, no testing has been performed
Technological research	TRL 1	Basic research. Principles postulated and observed but no experimental proof available
	TRL 2	Technology formulation. Concept and application have been formulated
	TRL 3	Applied research. First laboratory test completed; proof of concept.
Product demonstration	TRL 4	Small scale prototype built in a laboratory environment ("ugly" prototype).
	TRL 5	Large scale prototype tested in intended environment.
	TRL 6	Prototype system tested in intended environment close to expected performance.
	TRL 7	Demonstration system operating in operational environment at pre-commercial scale.
	TRL 8	First of a kind commercial system. Manufacturing issues solved.
Manufacturing	TRL 9	Full commercial application, technology available for consumers.

A distinction between innovation and deployment is relevant from the aspect of funding. As described in section 5.2, new innovation policy frameworks no longer take a market failure view of innovation, whereby the rationale for innovation funding is that the market does not deliver sufficient levels of innovation on its own. This means that the logic behind innovation funding goes beyond correcting market failures, and is currently aimed at supporting desirable societal transformation. The previous focus on competitiveness and coordination of system actors has not been abandoned, but another layer has been added. In contrast, providing funding for deployment of new solutions is still seen as a market failure issue, as described in section 6.3.

Innovation requires significant funding, both for direct financial support for the development of innovative solutions, and for maintaining innovation infrastructure and networks. The Commission proposal for the 2021-2027 Multiannual Financial Framework sets an ambitious goal for innovation across all EU programmes. As a result of the coronavirus pandemic, private funding for innovation may become scarce due to lower availability of funding and a lower propensity to spend on high risk investment. This further highlights the need for public funding of innovation.

The **emphasis on technological innovation varies across the three systemic sustainability challenges of climate change, biodiversity and resource use**. For example, while ecosystems and biodiversity are not traditionally considered as areas where innovation has a strong role to play, and the focus is generally on nature based solutions or low-tech solutions inspired by traditional practices skills and knowledge, the climate neutral and circular economy are highly focused on technological innovation. Even in relation to biodiversity and ecosystems there is some role for technological innovation, e.g. remote surveillance and monitoring or genetic assessment of populations.

Social innovation, business model innovation and policy innovation are also relevant to sustainability transitions. In addition, in technological innovation related to new products and processes, focus should be not only on high-tech solutions, but also on low-tech solutions, which are applicable to certain sectors, such as buildings (Haselsteiner et al., 2017) as well as waste management and waste water management (Head, 2010). Low tech solutions are often nature based and reinvent traditional products and processes to address today's sustainability challenges.

A number of **policy instruments are available to support social innovation**. "Policymakers could offer more support for civil society innovations, for example by funding citizens' groups and projects; providing privileged access to public infrastructure (e.g. vacant land or offices); facilitating the circulation of knowledge about grassroots projects, stimulating experimental partnerships with public services (e.g. schools, hospitals); and more publicly displaying support for citizen-led sustainability projects and their positive contribution to public life locally." (F. Geels et al., 2019) Within cohesion policy innovative social practices can be funded within the context of the implementation of territorial strategies.

Experimentation needs to be supported by cohesion policy. The ERDF and Cohesion Fund proposal brings to life the European Urban Initiative (EUI), which will encompass the successors of the current Urban Innovative Actions (UIA) and the Urban Agenda for the EU. The UIA currently provides urban areas throughout Europe with resources to test new and unproven solutions to address urban challenges, in line with the experimentative approach of transition governance. The EUI will continue to support innovative solutions in the urban context by supporting capacity-building, innovative actions and knowledge, policy development and communication.

Different sources of funding from EU and national governments are available to invest in innovation for sustainability transitions. EU level instruments are presented in Annex 2.

Member States and regions need to make their own decisions on the areas they wish to focus on based on their own regional potential. The main focus areas for innovation funding in the EU for a climate neutral and circular economy are presented in Annex 1; these can serve as guidance on areas which need investment, but should not be seen as prescriptive at the level of Member States and regions.

Low generic levels of support will achieve deployment of technologies that are already close to market but will not affect those at lower levels of technology readiness, while higher levels of support for specific technologies at lower levels of technology readiness can contribute to advancing new solutions, but significant funding may be needed over a long time period to ensure that these reach commercialisation.

Good practice principles: steps of the implementation process

1) Development of Research and Innovation Strategies for Smart Specialisation in accordance with innovation needs for transformative change:
   a. Analysing regional context and innovation potential: identify solutions critical for unlocking or accelerating the transition of each key system which are in line with

regional innovation potentials;

b. Developing a shared vision for the future of the region by setting of collective priorities for transformative change, in line with visions and strategies;
c. Setting out the RIS3 process and governance, ensuring participation and ownership by ensuring protected niches are available:
   i. shielding innovation from mainstream economic, infrastructural, consumer preferences by creating protected spaces in cities and regions;
   ii. nurturing innovation by assisting learning processes, articulating expectations, and helping networking processes;
   iii. empowering innovation by reframing the rules of the game, and reform institutions that influence prevailing performance criteria
d. Identifying innovation priorities in line with system level transition agenda across all targets, by assessing the best options, mapping their impacts and ranking them accordingly;
e. Defining a coherent policy mix, roadmap and action plan.

2) During implementation of RIS3, experimentation (testing of technical performance, markets, consumer preference and societal acceptance, probing and learning) needs to be ensured, together with 'open innovation' which targets not only businesses, academia industry but also involves users, civil society, communities and other actors as active participants.

6. Supporting deployment and phasing out

Main messages

- Deployment is required to make innovative solutions mainstream and to replace existing unsustainable solutions on a large scale;
- Different phases of the deployment process require different levels of government support, both through policy support and government funding;
- Cohesion policy operates within a broader context of environmental and sectoral policies, which can level the playing field by conferring advantages to sustainable solutions and by removing harmful subsidies and other forms of systemic advantages enjoyed by current technologies;
- Deployment of new solutions requires significant funding. There should be a significant contribution from private finance; government subsidies should only be made available to the extent of social return.
- Financial instruments should be used to the extent possible. For new technologies, the role of risk mitigation instruments is vital.
- Funding from EU sources (ERDF, Cohesion Fund, EIB, InvestEU, the Just Transition Fund, EAFRD and the Recovery and Resilience Facility) and national sources (including EU ETS allowance revenues) needs to be coordinated.

6.1. Deployment and phasing out

Deployment or 'scaling up' is the phase in which "innovations are applied in successively bigger projects at larger scales, leading to learning, performance improvement and cost reduction (economies of scale). In contrast, social innovations often diffuse in other ways, such as 'scaling deep' (influencing values, narratives and beliefs) and 'scaling out' (replicating and adapting practices in new settings)" (F. Geels et al., 2019).

The boundary between innovation and deployment is not possible to define exactly, as experimentation and improvement of new solutions is an ongoing effort even after products come to market or social and business innovations are scaled up or scaled deep. However, the distinction is important because **the role of public policies and funding changes as innovative solutions become more mature.**

Table 9 Role of public funding at different stages of maturity of new solutions

Phase of model	Costs vs expected return	Role of public vs private funding
Experimentation	Highly uncertain outcome	Very limited role for private investment, significant public subsidy required
Acceleration	Technology has niche market performance uncertain, costs high but decreasing quickly	Investment giving way to private sector (venture capital) but significant support required
Emergence	Technology economical with little subsidy	Banks and private finance, limited public subsidy and/or use of financial instruments,
Institutionalisation	Technology economical without subsidy but is not yet the default option as it does not fit seamlessly into the social-economic-technological regime	Private finance (accompanied by measures to break down remaining barriers)
Stability	Technology is the default option	Private finance

Source: Based on Schoenmaker & Schramade, 2019

For revenue generating or cost reducing technologies and solutions, as the maturity of the technology increases, the role of the public sector decreases, and the private sector takes over the role of funder, as depicted in Figure 5.

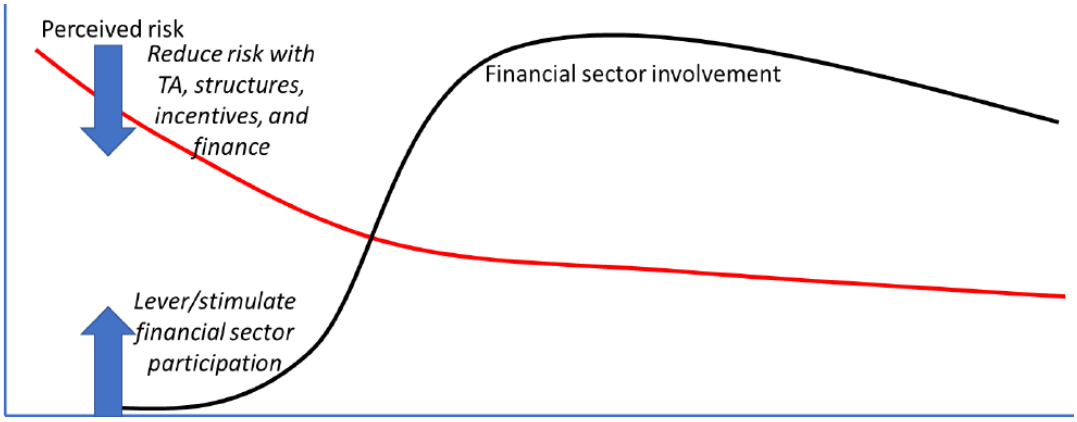


Figure 5 Role of public (red) and private (black) finance from start-up to mature business

Source: Schoenmaker & Schramade, 2019

Support to new sustainable technologies takes various forms, not only financial. This support is provided in order to ensure that, through experimentation and then for acceleration and institutionalisation, new solutions can replace the existing regime. The policies are concerned with levelling the playing field, in order to ensure that new technologies and solutions can progressively become competitive with existing technologies and solutions. This is discussed in section 6.2. The role of EU funding in supporting deployment is discussed in section 6.3.

6.2. Policy framework for sustainable solutions

Within the context of sustainability transitions, **the aim of sectoral and environmental policies is to confer advantages to sustainable solutions and level the playing field by removing harmful subsidies and other forms of systemic advantages enjoyed by current technologies**. This can play an important role in upscaling/deploying new sustainable solutions, which do not enjoy the advantages of low costs, returns to scale and consumer confidence possessed by established technologies. The set of available policy instruments for enabling sustainability transitions is no different to the set of policies used by policy-makers generally to advantage new technologies.

To allow for diffusion of new technologies, policy-makers need to:

- Support new, environmentally sustainable solutions using environmental policy instruments;
- Remove harmful subsidies;
- Remove other systemic obstacles which result in technological lock-in.

Full application of these policy instruments is desirable before resorting to EU funding in order to ensure that funding is efficient and effective. Since these policy instruments are not in the hands of Managing Authorities, cooperation between government institutions is required. Cohesion policy needs to complement other policy instruments and be used when other policy instruments are not available or sufficient to ensure desirable outcomes.

Environmental policy instruments play an important role in deployment, i.e. in enabling, motivating or obliging a large number of actors to adopt new sustainable solutions. An

often used categorisation of these instruments is along the mechanism through which they impact the behaviour of relevant actors. Policy instruments can be grouped into the following broad categories (based on EEA, 2018, Panayotou, 1994 and Rodríguez, Hašcic, Braathen, & Girouard, 2017):

- regulatory/legislative/command and control instruments: standards, bans, quotas, permits, emission limits, land use planning, zoning, etc.;
- economic instruments:
    - fiscal instruments: fuel taxes, emission taxes, differentiated taxes, tax concessions and rebates, etc.
    - charges and fees: effluent charges, user charges, access fees, abstraction charges
    - subsidies: feed-in tariffs, subsidised loans, grants, revolving funds, payment for ecosystem services
    - market creation: tradeable pollution permits, tradeable quotas;
    - bonds and deposit-refund systems:
    - property rights: land titles, water rights, mining rights, etc.
    - bonds and liability systems: non-compliance charges, liability for natural resource damage, etc.
- voluntary instruments: agreements on environmental targets, standards, etc.;
- instruments for information provision: eco-labels, information campaigns, environmental management systems, environmental audits, public participation, information disclosure, certification;
- public investment to mitigate environmental impacts;
- other instruments, e.g. green public procurement.

When choosing an appropriate policy mix to address a particular challenge, it is important to refer back to the need for focusing not only on phase-in of sustainable technologies, practices, rules, etc. but also on phase-out/exnovation of unsustainable ones. This translates into what Kivimaa & Kern (2016) refer to as **policy mixes for creative destabilisation**. This requires two foci within policy-making: providing support for innovation and phase-in of new solutions, and the creative destruction process involving destabilisation of the systems that support incumbents (regime actors) by withdrawing support. Policy change is important in destabilisation "because it shapes both the direct support for industries (e.g., subsidies) and economic frame conditions (taxes, import restrictions, regulations)." (Turnheim & Geels, 2012)

The phase-out of incumbent technologies involves removing environmentally harmful subsidies in first instance. Harmful subsidies are defined as "a result of a government action that confers an advantage on consumers or producers, in order to supplement their income or lower their costs, but in doing so, discriminates against sound environmental practices." (OECD, 1998) The OECD defines harmful subsidies broadly, to include not just subsidies which are paid from the government budget, but also off-budget subsidies such as market price support and preferential market access, and the types of indirect subsidies which do not result in additional revenue for companies but rather reduce costs compared with what would be socially optimal. The latter includes e.g. lack of user charging and according to some interpretations also uninternalised externalities.[10]

Getting prices right is important in enabling a transition. The economic system expresses itself in a language of prices and GDP. However, these prices do not fully reflect the true cost of, for example, pollution for society, these parameters every day inform and frame

[10] OECD (2006) and Valsecchi et al. (2009) contain checklists for identifying such subsidies which can serve as a starting point for the analysis that needs to be carried out.

most of our decisions, as policy-makers, as business managers, and as citizens/consumers.

However, phasing out of incumbent technologies requires much broader changes than just removing harmful subsidies – **an assessment of the social, economic, cultural, network, infrastructure and regulatory elements that contribute to advantaging incumbents and hindering the entry of new technologies is required.** Turnheim & Geels (2012) conceptualise the destabilisation process as "a multi-dimensional and enacted phenomenon involving technical, economic, political, and cultural processes". Kivimaa & Kern (2016) provide an example from Germany related to the phase-out of nuclear energy, where support for research and education for nuclear energy was withdrawn when the decision to phase out the technology from the energy mix was made.

Box 9 Case study – Barriers to intermittent renewable electricity

Radical technological change implies that there is a change in the functioning of technologies along not just one but several dimensions. Intermittent renewable electricity generation technologies (solar and wind) differ from traditional fossil fuel based electricity production along at least four dimensions: dispatchability, unit size and cost structure. These differences have in the past made it more difficult to invest in wind and solar than in conventional energy sources.

The shift from dispatchable generation towards non-dispatchable intermittent technologies requires a shift in technological solutions (e.g. storage technologies), changes in system balancing practices (shift to consumer demand response rather than only supply side flexibility) and changes in market operation rules (e.g. related to gate closure) compared with a system with dispatchable units only. These (and many more) changes have needed to be made to create an environment conducive to large shares of renewable electricity.

While a typical coal power plant unit is around 50-500 MW, wind turbines are typically around 1.5-3 MW and single solar panels are around 250 W. This presents the (technical) possibility of small scale investment by a large number of actors as opposed to large scale investments by a small number of actors, which in turn require a change in financing which allows for easy access to funding for small projects. This is particularly important because renewables have a different cost structure with higher investment cost but lower cost of operation, requiring more up front funding.

6.3. Investing in sustainable solutions

Deployment requires significant funding. The Commission proposal for the 2021-2027 Multiannual Financial Framework set an ambitious goal for climate mainstreaming across all EU programmes, with an overall target of 25% of EU expenditure contributing to climate objectives. In addition, operations under the ERDF are expected to contribute 30 % of the overall financial envelope of the ERDF to climate objectives, while operations under the Cohesion Fund are expected to contribute 37% of the overall financial envelope of the Cohesion Fund to climate objectives. This contribution will be tracked through a Rio markers methodology.

The Commission has estimated that achieving the current 2030 climate and energy targets[11] will require €260 billion of additional annual investment, equivalent to around 1.5% of 2018 GDP. (European Commission, 2019b) A total of 28 billion EUR investment is needed in meeting new targets related to municipal and packaging waste over the period 2021-2035, and EUR 5 billion is required for reuse and recycling potential for focus materials over the same period. (Eunomia & COWI, 2019) Additional investment is

[11] This does not take into account the more ambitious, revised, 2030 targets as proposed by the Commission.

required to halt the loss of biodiversity. The Commission's proposal for an EU Biodiversity Strategy 2030 states that in order "to meet the needs of this strategy, including investment priorities for Natura 2000 and green infrastructure, at least EUR 20 billion a year should be unlocked for spending on nature" (European Commission, 2020c).

Public funding for deployment has become even more relevant in light of the economic crisis triggered by the coronavirus pandemic, as it is likely that private finance will be less accessible. The Commission's green recovery package is aimed at ensuring that green investments drive the economic recovery, providing jobs and stimulating economic growth. Additional national funding can be made available as a result of the suspension of EU budgetary rules. In the energy sector the competitiveness of renewable energy and the profitability of energy efficiency measures is hindered by low fossil fuel prices resulting from the crisis, further highlighting the important role of public funding in incentivising these technologies.

Not all investments need to be made with public funding. Government should focus on complementing private finance with national and EU funding and should not be active where private finance is feasible without government support i.e. where the private rate of return is sufficient. In addition, as a minimum requirement, government funding should focus on areas where social return reaches a threshold value. The role for government funding in scaling up investment in a climate neutral, circular and green economy is shown in Figure 6. In addition, governments may also support investments which are only attractive on combined private and social return, but **subsidies should only be made available to the extent of social return and should be focused on correcting market failures.** This is very different from the funding logic of innovation, as in the latter case the emphasis is not on correcting market failures and maximising social welfare, but on transformative change, as was discussed in section 5.

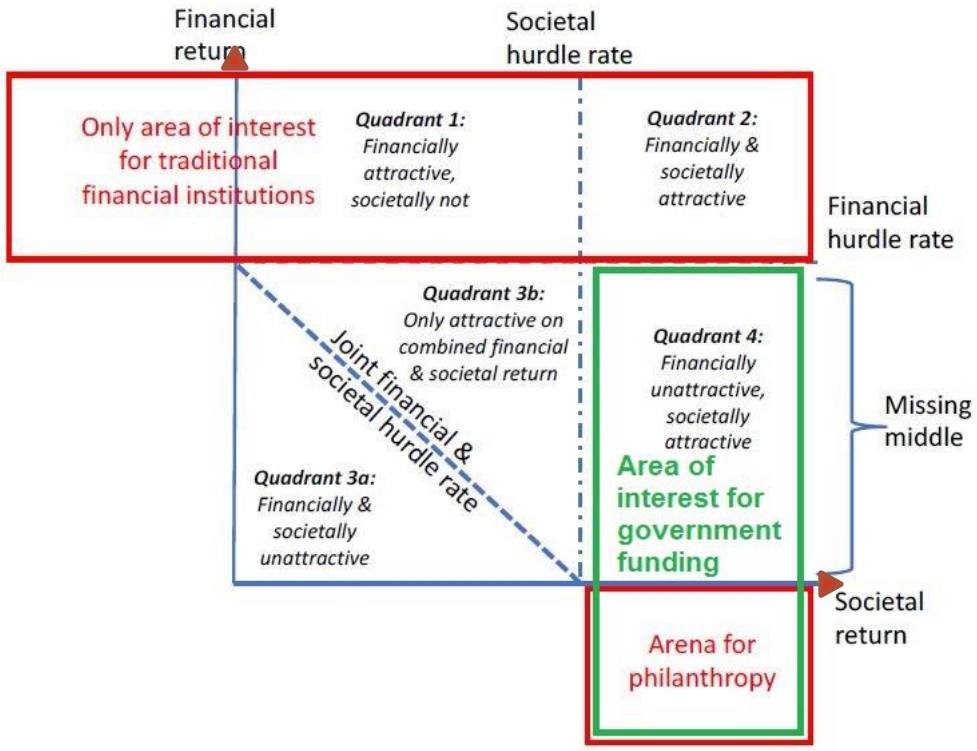


Figure 6 Role of private funding and cohesion policy/government funding

Source: Modified version of Schoenmaker & Schramade, 2019

National and regional governments should aim to provide structures, incentives and market rules to maximise private sector involvement in funding the transition. For projects which are attractive from a social perspective the degree to which the private sector can finance investments, and conversely, **the need for grants or financial instruments will depend on a number of factors**, including whether the project generates revenues in the foreseeable future, degree of risk and already existing policy framework (including existing support schemes):

- **Financial barriers**: The fact that investment is not happening is in itself not sufficient reason to assume that funding is needed. Financial support is warranted if the barrier to investment is financial in nature, i.e. if financing from market sources is not sufficiently available. Financing may be unavailable due to factors such as high risks to investors, unfamiliar asset class or a lower rate of return than expected by investors. High risk is often (but not exclusively) related to maturity of technology. For new technologies and solutions in the initial phases of experimentation risks to investors are high as there is a low probability that the solution can be scaled up in future. In such cases there may be need for public funding in the form of grants if further development of a particular technology is in the public interest (e.g. because it is environmentally sustainable or provides wider economic benefits to society as a whole). The risk to investors decreases as the product or technology moves from proof of concept through small-scale production, scale up to mass production and growth in mass production to steady state mass production as shown in Figure 5. (Schoenmaker & Schramade, 2019).
- Revenue generation or cost savings:
- **When revenues cannot be generated** by a project, such as in the case of non-market goods, the general view is that public grants are warranted if social benefits are sufficiently high, but private revenue streams do not exist or are insufficient to achieve an adequate return on investment.
- **If revenues or cost savings can be generated**, such as in the case of investment in energy supply and energy efficiency, loans and financial instruments can be used to overcome financial barriers such as the need for a large initial investment or higher investment risk. Grant elements should be used in cases where future revenue streams or cost savings cannot cover the initial investment, such as in the case of energy efficiency which results in higher than cost-optimal savings (when considering private costs and private benefits). There are **various types of financial instruments** which can potentially be used. The legislative proposals allow for loans or guarantees if financial instruments are managed by the Managing Authority, and for implementing financial instruments through the centrally managed InvestEU. These financial instruments can be implemented in different ways depending on the size of projects and other attributes; fewer large projects have higher transparency and lower transaction costs, but to tackle investment in small projects aggregator funds can be set up to bundle small projects. De-risking is especially relevant for upscaling of new technologies. The use of guarantee funds and other guarantee instruments to reduce risk need to be explored. Manuals on use of financial instruments in general (European Commission; European Investment Bank, 2014) and for the use of financial instruments for investment in a climate neutral economy (European Commission & European Investment Bank, 2014) are available. [These were drafted along the legislation for 2014-2020 and the reference will need to be updated if new manuals become available]
- The need for EU funding should be assessed **within the context of existing policies and support schemes and existing roles played by financial actors**. EU funding should be used if private funding and national funding is not available. The availability of these funding sources will differ by Member State and region and will depend in part on the ability of Member States or local authorities to raise funds. New sources of funding, including new local financing arrangements, e.g.

savings of city residents, crowdfunding, and new business models should be explored. National and regional strategies need to set out not only investment needs, but sources of funding and the role that cohesion policy plays in relation to other funding instruments and private funding.

Managing Authorities need to identify priorities for funding based on the actions needed to implement transition strategies, focusing on those actions that are relevant for a particular Member State or region, and where policy and funding gaps exist and where this prevents investment from taking place at sufficient scale. Some generic funding priorities are presented in Table 10; regions and Member States need to decide where to focus within these priorities.

Table 10 Possible funding priorities for investing in upscaling of sustainability transitions

Sustainability challenge	Priorities for funding
Climate change	1. Renewable and energy efficiency in buildings and district heating 2. Energy efficiency in SMEs and industry 3. Sustainable transport systems 4. Reducing methane emissions from waste and wastewater 5. Solutions for reducing industrial process emissions
Biodiversity and ecosystems	1. Green infrastructure a. ensuring connectivity of habitats and ecosystems by creating green corridors b. nature based solutions for climate adaptation and natural risks (e.g. expanding floodplains,) c. urban green infrastructure (parks, green roofs, community gardens, rain gardens) 2. Ecosystem restoration (e.g. wetland restoration, peatland restoration, forestation), rewilding and addressing invasive alien species 3. Biodiversity proofing measures (e.g. wildlife crossings) 4. Nature focused businesses (e.g. ecotourism, sustainable forest management (SFM)) 5. Biodiversity and ecosystems knowledge (e.g. ecosystem service mapping, biodiversity and ecosystem monitoring systems and assessments, networking and information sharing) 6. Nature based local development (e.g. enhancement of services for visitors in protected sites, sustainable branding of regions)
Circular economy	1. Circular design and production - Application of reduce/recycle strategies in design/production phases: a. Design for modularity, easy repair, disassembly and recycling, and longer product life b. Substituting virgin materials with secondary/recycled materials c. Reducing input of hazardous substances to facilitate reuse and recycling d. Development/deployment of innovative materials and process technology that increase circular resource efficiency 2. Circular use and life extension - Application of reuse/repair/repurpose/refurbish/remanufacture strategies in use phase a. Reuse, repair and remanufacturing of products and components up to generally accepted industry standards b. Repurposing and refurbishment of abandoned buildings and redundant assets up to generally accepted industry standards c. Decontamination and redevelopment of abandoned brownfield sites d. Extension of use/life of assets/products through product-as-service, sharing, leasing/subscription business models incorporating circular economy principles 3. Circular value recovery - Application of recycle/recover strategies in after-use phase a. Recovery of materials and chemicals from waste, residues and by-products b. Recovery of bioresources, chemicals and nutrients from bio-waste, bioresidues and wastewater sludge c. Reuse of treated wastewater 4. Circular support - Support and facilitation of all circular strategies in all lifecycle phases a. Development/deployment of key enabling ICT technologies and services supporting/facilitating circular business models and value chains 5. Other forms of waste management Forms of waste management which are low on the waste hierarchy, such as landfilling and waste incineration may be used when other options have been

	explored and are not feasible.

Source: Based on EIB, 2019 and own compilation

Several EU funding sources are available for upscaling investment in a climate neutral, green and circular economy, in addition to national sources. In some cases, e.g. investment in renewable energy in the electricity sector, national and private sources constitute the main sources of funding, and cohesion policy has a complementary role, if any. In other cases, EU funding may serve as the largest funding source, especially in countries and regions with high funding allocations. The EU funding sources available are presented in Annex 2.

Good practice principles: steps of the implementation process

1. Develop appropriate policy frameworks to address non-financial barriers to investment in sustainable solutions (e.g. information barriers, infrastructure barriers, harmful subsidies to incumbents, market access rules, etc.) for each provisioning system (e.g. food, transport, energy);
2. Develop appropriate national instruments to address financial barriers to investment in sustainable solutions (e.g. high investment costs, high risk, etc.) for relevant provisioning systems;
3. Identify gaps in funding required to reach low carbon, circular economy and biodiversity targets for each provisioning system;
4. Identify and develop appropriate modes of financing to fill gaps using cohesion policy funding, taking into consideration technological maturity and potential for revenue generation or cost reduction

7. Supporting a just transition

Main messages

- A just transition is the notion that the transition process to a greener economy has to be inclusive of all stakeholders, and that the unavoidable employment and social costs of the transition have to be shared by all;
- Policy instruments for a just transition can be categorised into three main types: industrial policy instruments which can include support for the development of new business models and support for diversification of activities, wide-reaching and creative labour adjustment programmes, e.g. reskilling, and robust social protection or 'safety nets'.
- The concept of a just transition needs to be integrated across all transition activities, including into innovation and upscaling of new solutions.
- Cohesion policy funding needs to be oriented by TJTPs;
- Funding needs to focus on regions negatively impacted by the transition, and needs to focus on the integrated development of these regions, including through funding of reskilling and labour market interventions, local investments in low-carbon growth sectors and technologies, research and innovation strategies, local economic diversification plans, targeted infrastructure investments, and recultivation of local environments.
- The crisis caused by the coronavirus pandemic will only exacerbate the challenges posed by a just transition and cohesion policy can therefore play a key role.

7.1. Just transition

The transition consists of parallel processes of deploying sustainable solutions and phasing out unsustainable ones, with the former having positive impacts in terms of new green jobs and economic growth of green businesses, and the latter impacting the economy negatively initially. The **territorial distribution of the positive and negative impacts may be highly differentiated**, with some regions clear winners and others, in particular regions reliant on coal and heavy industry, at risk of emerging as losers of the transition.

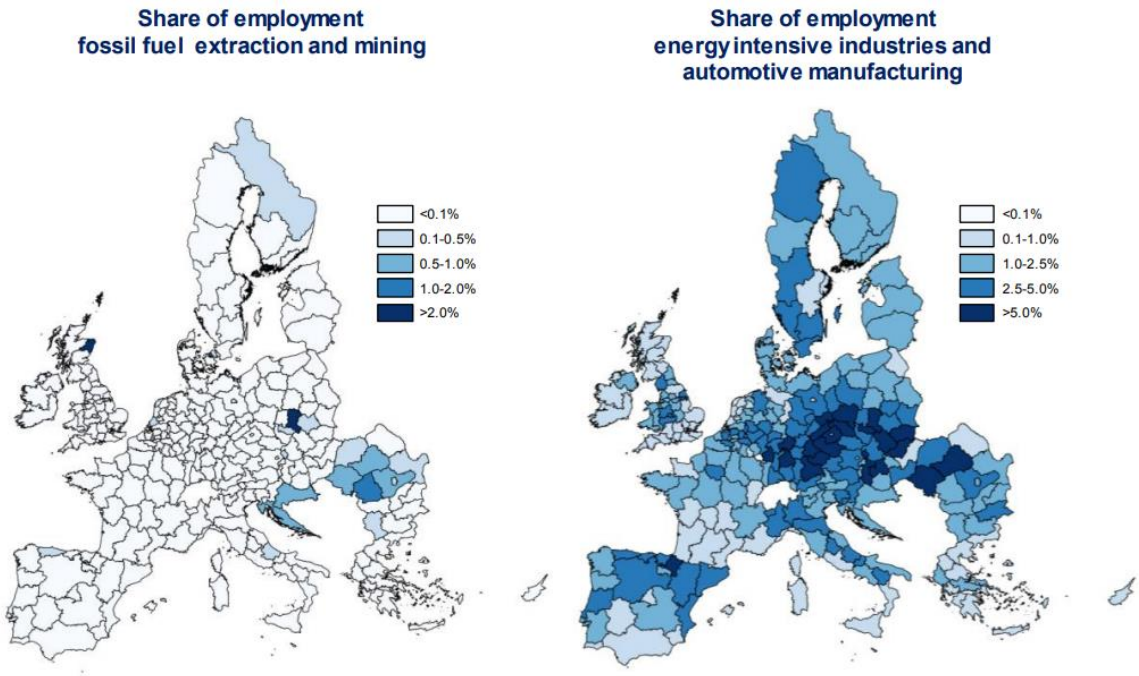


Figure 7 Regional exposure to sectors that will decline (left) and transform (right)

Source: European Commission, 2018

While some aspects of sustainability transition challenges have a clear territorial dimension (e.g. phasing out coal) others (e.g. increasing skills for installing heat pumps) do not. Even without differentiated impacts, there are adjustment costs related to the transition, which need to be addressed with appropriate policies.

The concept of just transition refers to "the notion that the transition process to a greener economy **has to be inclusive of all stakeholders, and that the unavoidable employment and social costs of the transition have to be shared by all**". (International Labour Organization, 2010) The concept strongly focuses on avoiding costs to vulnerable sections of society, but is also related to taking advantage of potential opportunities, such as reducing energy poverty through investing in energy efficiency in buildings, or using the transition to move towards a more equitable society, for example through creating an energy system with less concentrated ownership.

"Just transition incorporates a bundle of potential policies addressing the vulnerabilities of workers and communities, including bottom-up transition dialogues and democratic, participatory consultations in affected regions, local investments in low-carbon growth sectors and technologies, research and innovation strategies, reskilling and training, local economic diversification plans, targeted infrastructure investments, recultivation of local environments, and social protection measures" (Pilsner, de Pous, Reitzenstein, & Gaventa, 2018).

The crisis caused by the coronavirus pandemic will only exacerbate the challenges posed by a just transition and cohesion policy can therefore play a key role.

7.2. Policy framework for a just transition

Policy instruments need to be put in place, which address the socio-economic transition, in particular the potential negative impacts of the transition, and ensure that the transition is just. There is an interface between the social-economic system and environmental system – people have various roles as consumers of products, as workers

producing these products, as business owners, as individuals with certain cultural and behavioural norms and knowledge, etc., and it is through these roles they can be affected by the transition. Therefore, there is a need to ask a series of questions about who will be affected in what role, how, and whether the impacts will be concentrated in certain territories or within certain groups of stakeholders.

It is important to identify how it can be ensured that as many stakeholders as possible gain from the transition and to ensure that there are as few losers as possible; this is necessary to ensure sufficient support for the transition for political feasibility. **Increasing acceptance and reducing resistance may require a combination of policy instruments and principles related to how transitions are implemented**.

Policy instruments for a just transition can be categorised into three main types: industrial policy instruments which can include support for the development of new business models and support for diversification of activities, wide-reaching and creative **labour adjustment programmes**, e.g. reskilling, **lifelong learning and robust social protection or 'safety nets'**. (F. Geels et al., 2019) While the first two focus on implementing structural reorientation in a way that ensures that there are as few stakeholders as possible who lose out from the transition, the third instrument is aimed at compensation for those who are not able to adjust to new economic and social realities. Table 11 presents examples of the types of policies that can be implemented to ensure a just transition.

Table 11 Policies to address negative socio-economic consequences of transitions for workers, regions and firms

Targeted stakeholder group	Compensation – defensive, reactive	Structural reorientation – active
Workers	Compensation for losses, e.g. redundancy payments, early retirement benefits	Skill upgrading and retraining programmes, financial assistance to relocate, wage subsidies, assistance in finding jobs
Regions, communities	Compensation for losses, e.g. increased resource transfers to local policy-makers or regions, relocating public agencies to particular regions	Regional assistance for economic diversification, e.g. direct investments in public goods such as infrastructure, regional innovation policy, subsidies or tax incentives to new businesses in growth sectors, technical assistance
Firms	Compensation for lost asset value or continuation of existing privileges; state subsidies of company liabilities, e.g. pension or site remediation liabilities	Grant or in-kind assistance to upgrade existing technologies and practices, and to stimulate reorientation towards new technologies and markets

Source: EEA, 2019a

Structural reorientation measures are used to place regions and countries on new development paths. These development paths need to be oriented towards sustainable outcomes, at the same time taking into account regional realities and harnessing regional potential and taking steps to enhance these, and also taking into account global megatrends. A typology of new regional path developments is presented in Table 12.

Table 12 Types of new regional path development

Type of path	Mechanisms
Upgrading	Major change of a regional industrial growth path based on new technologies or organisational innovations, or new business models
Diversification	Diversification into a new industry based on related or unrelated knowledge combinations
Emergence	Setting up of an established industry that is new to the region (e.g. through non-local firms or through radical new technologies and scientific discoveries) and unrelated to existing industries

Source: OECD, 2019d based on Grillitsch, M. and B. Asheim (2018)

Massive labour reallocation across sectors and occupations may be needed, requiring workers to learn new skills as their jobs are being 'greened' or as they move to new, emerging green jobs and occupations. **Firms and sectors will need to change their production models**, towards increasingly circular and local production and consumption modes. These types of impacts will be territorially concentrated, e.g. in regions with a high share of coal, heavy industry, unsustainable agricultural production methods, etc. Cohesion policy can fund measures under PO1 with the aim of boosting local economies as well as measures under PO4 with a strong focus on retraining and reskilling. Coordinating funding under different POs for supporting sustainability transitions requires an integrated and multi-sectoral approach. The combination of different measures needs to contribute towards a coherent development strategy.

Non-localised socio-economic impacts may also accompany transitions. Consumers may face rising energy and mobility costs and the cost of products may increase due to internalisation of externalities such as carbon emissions, air pollution and waste. Some measures, such as energy efficiency measures, which offset price increases, can be implemented with cohesion policy funding under PO2. Further, compensatory measures may be needed which will be funded from national sources.

Aside from the choice of policy instrument, the way in which these are implemented can also help increase acceptance and reduce resistance. Incrementalism (understood here as working towards ambitious targets through radical but small steps) and prudent timing of interventions can be important. Picking battles through the identification of a small number of large-impact priority areas (processes, sectors, segments of society) is also important.

Box 10 Case study – Removing street parking spaces in Amsterdam without resistance

In the city of Amsterdam 30-40% of public space is taken up by parking cars in the city centre and plans to remove 10,000 parking spaces are being implemented. Implementation has focused on increasing support of residents and reducing resistance through a combination of measures.

The change is implemented in an incremental fashion, starting on a smaller scale. It was initially piloted in the Frans Hals neighbourhood of Amsterdam, encompassing 12 blocks of buildings and their surrounding streets. Residents have been won over by the repurposing of parking spaces, which has resulted in increased space for benches, urban gardens and parks, bicycle storage, space on pavements, urban composting, etc. People living in the neighbourhood have a say in the final design of the repurposed space, thus ensuring ownership of the initiative. The change in the use of space is combined with environmental and climate adaptation measures such as rainproofing streets, decreasing the urban heat island effect, and increasing species diversity of songbirds, butterflies and bees.

At the same time, losses are not felt keenly by residents, as the parking permits of residents moving out of the city are revoked and new permits are not reissued instead.

(Source: "Amsterdam municipality website," 2019)

Much emphasis has been placed on the need to manage the negative impacts in terms of job losses and business closures of the reconfiguration phase of transitions. However, transitions also have positive impacts. Such **co-benefits allow the sustainability agenda to be translated into desirable development pathways** for many regions and enable decision-makers to secure ownership. For example, the benefits provided by ecosystems, and in turn the benefits which accrue to society from protecting ecosystems have been reviewed by Barker, Mortimer, & Perrings, 2010. An overview of the types of co-benefits/multiple benefits relevant to energy efficiency measures is provided by the International Energy Agency, 2014. Transitioning to a circular economy also has multiple benefits. (Ellen MacArthur Foundation, Deutsche Post Foundation, & McKinsey Center, 2015) The distribution of some co-benefits among members of society can be targeted at groups of stakeholders who incur losses from the transition to win their support for the transition.

The concept of a just transition needs to be integrated across all transition activities, including into innovation and deployment of new solutions. It is important to "to integrate the social dimension from the outset and not as an afterthought" (COM(2018) 773) For example, upscaling of investment in renewable energy can happen in several ways, including through investment in large scale wind and solar farms, or through small scale projects owned and operated by communities, households or farmers. This policy choice is made explicitly or implicitly when deciding on parameters of support schemes and will affect the distribution of benefits to different segments of society. The weighing of costs and benefits of different solutions need to be made based not only on direct costs and benefits but also broader benefits for regional development and the health of communities.

Box 11 Case study: Integrating just transition thinking into renewable energy investment – the example of community energy

Community energy generates benefits to the local community in the form of economic benefits, knowledge, participation, sustainable outcomes and environmental benefits, community building and innovation. (Brummer, 2018)

Community energy refers to a broad spectrum of energy-related initiatives, not a specific class of project.

- REScoops "may be either energy producers, suppliers, or both, and provide energy or revenue from sales to their members, who are not necessarily part of the same geographical community. (…) Some provide energy to members or local people directly (e.g., UK 59) but most sell electricity to the market and pay dividends to their members. (…) REScoops also may offer additional benefits, such as payments to citizens who provide assets like rooftops, royalties or rents to the municipality, or discounts on energy bills."
- Community development trusts or community benefit companies "are managed by a board of community representatives, returning income to the community as a whole, rather than just investors"
- Local Government Projects With Citizen Participation are "installations funded through citizen share offers. (…) They are crowdfunded initiatives which can be established in different ways, e.g. they can be initiated by municipalities, who initially own the capital and then open the project to local citizen participation. They can also be formed "as a contract between various actors (individuals, legal persons, business entities, research entities, and local municipalities), for the purpose of energy generation, balancing, trade or distribution."
- Public-Private Partnerships: In France, these companies "help finance municipal driven projects with citizen share offers. This serves to mitigate the financial risk to the municipalities that initiate the project."
- Private Companies can also be small and local, e.g. in the case of biogas installations owned and operated by local farmers, and may generate revenues to

the local community. Such installations may help farmers profit and diversify their income sources. It is important not to limit renewable support schemes to investments to a few large companies.

- Other Grassroots Initiatives also exist, e.g. eco-villages, occupied villages, transition towns, citizens' energy "platforms". These are diverse in terms of their organisational forms and ARE mainly oriented around the themes of sustainability and environmental issues, and energy democracy and fuel poverty.

(Hewitt et al., 2019)

Public discourse around transitions is also important to their feasibility, and can be actively shaped by policy-makers (and other stakeholders) in support of transitions. Turnheim & Geels (2012) state that "while many current efforts are focused on stimulating new green options, […] cultural criticisms and political contestations of existing systems are equally important." They describe how public outrage about environmental crises can erode the cultural legitimacy of polluting industries and their products. Although concerns about environmental issues are unlikely to have a destabilising effect on their own, they can "gain traction when they are expressed in conjunction with economic factors (e.g., alternative technologies, changing customer demands, accumulated dissatisfaction, shrinking markets)." However, "alarming climate scenarios may be less effective in generating public support than positive visions of low-carbon futures (which should include other features than low carbon emissions)." "Reform efforts, visions and renewable technologies should be linked to other attributes than climate mitigation. Examples could be improved service, quality of life issues, improved price/performance, energy independence, user freedom, etc." (Turnheim & Geels (2012).

Another important tool is that of **narratives and stories**. This tool can be used in several ways, including to change the dominant understanding of what is good and socially desirable, helping to develop visions of positive futures, or to help people understand what needs to happen to achieve change.

7.3. Investing in a just transition

The primary goal of cohesion policy is achieving socio-economic convergence of territories in different stages of development. The concept of a just transition, albeit not linked to sustainability transitions, is closely linked to the birth of cohesion policy, as the economic crisis at the time "raised social issues to the fore within EC debates and drew attention to the close link between declining industries and specific territorial areas." (Manzella & Mendez, 2009) The structural funds were aimed at bringing about structural conversion and adjustment in these declining industrial regions, enabling them to address their challenges and close socio-economic gaps in development. This is very similar to the current task of ensuring a just transition, which is closely linked to development of regions most negatively affected by phasing out of unsustainable sectors and technologies.

A new initiative, proposed by the Commission in January 2020, for a Just Transition Fund, means that funding is available for implementing a sustainability transition that is just. This funding needs to be complemented by funding from the ERDF and Cohesion Fund, as well as financial instruments available under the Just Transition Mechanism.

Box 12 The Just Transition Mechanism (JTM)

The JTM is focused on implementing the transition to a low-carbon economy in a just way. The just transition to a green economy is not within its scope.
It consists of 3 pillars:

(1) the Just Transition Fund (JTF) implemented under shared management to provide grants. The focus of the JTF is on the economic diversification of the territories most affected by the climate transition and the reskilling and active

inclusion of their workers and jobseekers. It is established within the framework of cohesion policy and is subject to its programming rules.

(2) a dedicated scheme under InvestEU to crowd in private investment. The scheme will cover projects for energy and transport infrastructure, including gas infrastructure and district heating, as well as decarbonisation projects.

(3) a public sector loan facility with the EIB Group to leverage public funding. It will enable public authorities to implement measures to facilitate the transition to climate neutrality and will fund e.g. projects in energy and transport infrastructure, district heating networks, and energy efficiency measures including renovation of buildings.

Member States need to prepare one or more TJTPs which are consistent with the National Energy and Climate Plans and the transition to a climate neutral economy by 2050. These plans will set out the social, economic and environmental challenges and give details on needs for economic diversification, reskilling and environmental rehabilitation, as appropriate. Funding from the JTF will focus on the most impacted NUTS 3 regions, while funding from the other two funding sources will be available also outside these territories.

Transfers of resources from the ERDF and the ESF+ should be made, and taken together should correspond to between 1.5 and 3 times the JTF allocation. Support from the JTF will programmed either in programmes supported also from the ERDF, the ESF+ or the Cohesion Fund or in a dedicated Just Transition Fund programme.

Technical assistance to territories benefitting from the JTF will be available through:

(1) a dedicated technical assistance facility to support the design of a tailored package of measures across the range of available support from the Commission, the EIB and other international organisations

(2) the InvestEU Advisory Hub, including Jaspers will provide support for the preparation of the project pipeline.

(3) the Commission will set up a Just Transition Platform to enable bilateral and multilateral exchanges of experience.

In order to mitigate negative impacts and to ensure that adjustment is as smooth as possible, a combination of structural reorientation and compensation measures will be required. The rationale for public funding is not related to market failure, as is the case for deploying new solutions, but to the need for structural change and the need for providing a safety net for those negatively impacted by change. **There are three distinct areas of funding that require attention, which have different funding rationales: structural adjustment, labour market adjustment and social protection**. Cohesion policy funding is mainly focused on the first two of these three areas, while it is generally left to national funding instruments to address the third priority.

Different sources of funding are available to implement a just transition. Some selected funding instruments and their scope are presented in Annex 2.

Good practice principles: steps of the implementation process

Preparation of a TJTP: a suitable tool for bringing together different elements of the overall policy framework into a consistent approach. The steps of developing a TJTP for a climate neutral economy are the following:

1.. Identify the territories most negatively affected by the transition process based on the National Energy and Climate Plan, long-term strategy or other relevant strategic documents related to e.g. biodiversity or the circular economy. These territories may be cities, regions, but also whole Member States for impacts which are not territorially differentiated. The focus of cohesion policy in this case is on regions;
2. Assess transition challenges based on the social, economic, and environmental impact of the transition to a climate neutral, green and circular economy. Identify the number of affected jobs and job losses as well as other social impacts, the development needs and objectives linked to the transformation which are driven by

e.g. closure of greenhouse gas-intensive activities in those territories;

3. Develop a transition strategy, ensuring consistency with other national, regional or territorial visions and strategies and plans, and taking into account regional potential and megatrends;
4. Identify the necessary policy tools to implement a just transition, including integration of just transition aspects into all relevant policies;
5. Identify funding needs, including support from the Just Transition Fund and Mechanism, ERDF, Cohesion Fund and national funding instruments as well as private sector funding, to address the social, economic and environmental impacts which cannot be addressed with other instruments;
6. Develop an action plan to implement the strategy, define tasks and deadlines;
7. Identify governance needs including monitoring and evaluation and responsible bodies.

8. Territorial approaches

Main messages

- Managing Authorities need to guide regional and local transitions, but at the same time ensure sufficient flexibility for taking into account local and regional circumstances. There also needs to be a clear allocation of responsibilities with respect to implementing national strategies between the national, regional and local levels. Responsibilities need to be aligned with resources;
- Integrated territorial strategies are particularly relevant to delivering sustainability transitions at the local level, as they have a strategic and participatory approach, deliver interventions in an integrated way and rely on local knowledge and capacities;
- The European Urban Initiative is an important tool for implementing sustainability transitions due to its focus on innovation and experimentation;
- Challenges and potentials for sustainability transitions differ across types of territories. The section reviews three types of territories in this context: cities, rural areas and coal regions.

8.1. Implementing territorial strategies for sustainability transitions

Preparation of Partnership Agreements and programmes and implementation of enabling conditions happens at the national level, or in some Member States with the involvement of the regions. However, the local and sub-regional levels are essential for supporting sustainability transitions, as described in section 1.4. Actions at the national or regional level need to ensure the overall framework is in place for local actors to be able to take advantage of the funds to finance local sustainability transitions. National-level action also needs to guide local action both in terms of the level of ambition and in terms of determining a clear division of tasks between the national, regional and local levels. At the same time, the programmes also need to provide sub-regional and local actors with sufficient flexibility to support transitions suited to their circumstances. Thus, **Managing Authorities at the national level have multiple tasks in setting out this overall framework to ensure that territorial actors can take appropriate actions**:

- **Guiding visions, strategies and plans**: National strategies and plans provide guidance to local and regional actors in terms of the overall vision, level of ambition and preferred actions. However, these targets and actions are not directly applicable at all territorial levels and need to be translated through local and regional strategies. Territorial actors can either access national or regional funds to fund individual projects, or through integrated territorial strategies. In the former case, Managing Authorities can guide local action by setting clear selection criteria, making funding conditional on the existence of relevant local strategies and action plans, setting appropriate shares for available funding for different types of interventions, and supporting local actors in the form of capacity building. When integrated territorial strategies are implemented, alignment of these territorial strategies at national level is required in accordance with the regulatory proposals of the Commission. Managing Authorities can guide the preparation of these strategies through selection criteria, where a competitive process is implemented, and through support for the preparation and design of territorial strategies.

- **Clear allocation of responsibilities at multiple levels**: National plans and strategies need to be clear about the way in which different actors can contribute to transitions within a framework of multi-level governance. All stages of the transition (innovation, phasing in and phasing out and just transition) need to be covered, as do all actors (regional and local governments, businesses, local citizen initiatives, NGOs, research and educational institutes, etc.) and all forums for coordinating the action of multiple actors (governments, markets, bottom-up participatory processes, etc.). Allocated responsibilities need to be aligned with resources and accompanied by technical assistance and capacity building, where required.
- **Scope for flexibility to accommodate local and regional circumstances**: At time when national programmes are developed, local territories may not yet have developed their strategies for sustainability transitions, or national decision-makers may be unaware of these. National programmes may allow for little flexibility to accommodate regional differences. Articles 22 to 28 of the proposed Common Provisions Regulation as well as Articles 8 to 11 of the proposed ERDF and Cohesion Fund Regulation are essential to **implementing territorial development strategies and therefore among the central regulatory provisions which enable delivery of sustainability transitions at the regional and local level.** This includes provisions for Community-led Local Development (CLLD) which apply not only the ERDF and ESF, but also the EAFRD and the EMFF, and are based on the positive experience of implementing the LEADER approach in rural areas. It needs to be ensured that funding for territorial strategies is sufficient, but in exchange strategies need to be aligned in their goals and priorities with national priorities and targets. The draft ERDF and Cohesion Fund Regulation also requires that 6% of ERDF resources be allocated to urban areas where integrated actions for sustainable urban development are to be implemented, providing a boost for sustainability transitions in urban areas.[12]

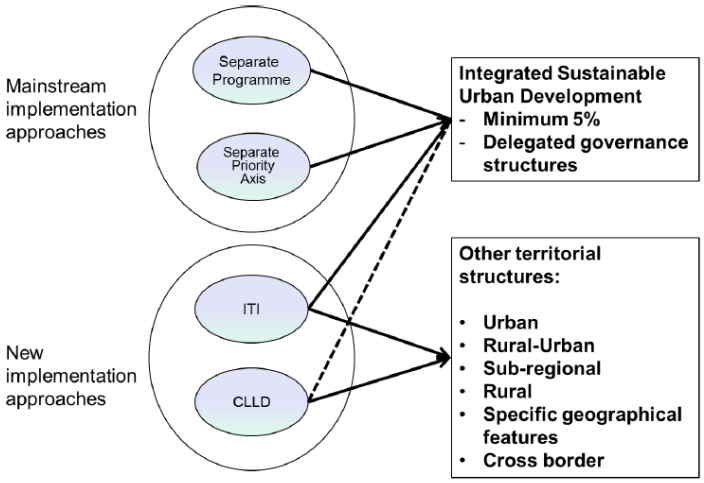
A number of features make integrated territorial strategies amenable to delivering sustainability transitions: they "rely on local knowledge, capital and control over resources, as well as a locally developed strategic framework in order to facilitate endogenous growth." (van der Zwet, Bachtler, Ferry, McMaster, & Miller, 2017) The **geographic scope, strategic approach, participatory approach, the integration of interventions as well as reliance on local knowledge and capacities** are very much in line with how sustainability transitions are ideally delivered.

Integrated territorial investments are more flexible than multi-thematic priority axes or OPs and "allowed changes to financial allocations and partnerships without having to change the OP" (van der Zwet et al., 2017). This is an advantage as it allows for flexibility and adapting programmes to territorial strategies rather than forcing these strategies to comply with a predetermined top-down vision. At the same time, national priorities can be translated to the local level through selection criteria.

For programming authorities and Managing Authorities, in order to allocate funding to integrated territorial strategies for sustainability transitions, two potential approaches can be followed: specifying the territories for which funding will be allocated, or using a competitive approach. A combination of the two is also feasible, and is recommended: where national policies (e.g. NECP) will necessitate change (e.g. coal regions) these can already be taken into account in programmes explicitly, and additional funding can be made available for territorial sustainability transitions where this is treated as an opportunity to be taken up by cities and regions which wish to do so. Territorial investments “can be implemented through so-called mainstream approaches (i.e. in a

[12] A political agreement between co-legislators at the time of writing increases this target to 8%.

similar way to how other ESI Funds are implemented) as either a separate Operational Programme (OP) or a separate mixed priority axis." (van der Zwet et al., 2017) However, this is an inflexible solution which does not allow for appropriate consideration of territorial specificities and is more difficult to review and adjust after the programmes have been adopted.



Source: Van der Zwet A, Miller S and Gross F (2014) *A First Stock Take: Integrated Territorial Approaches in Cohesion Policy 2014-20*. IQ-Net Thematic Paper 35(2), European Policies Research Centre, University of Strathclyde, Glasgow.

Figure 9 Mechanisms for implementing integrated place-based approaches in cohesion policy

The **European Urban Initiative** allows for implementing an integrated approach to development in line with the European Urban Agenda. It has a strong focus on innovation and allows for experimentation in an urban setting, serving as a good basis for implementing niches to support innovative actors through providing protected spaces and nurturing and empowering innovative actors.

8.2. Territorial challenges and potential for achieving transitions

Regions and territories differ in terms of their economic, social and environmental starting points. Regions also differ in terms of their challenges and potentials and will therefore be affected differently by transitions and will themselves need to implement support in different ways. Hansen & Coenen (2013) list six dimensions which are relevant to the influence of geographic context on sustainability transitions: urban and regional visions and policies, informal territorial institutions, local natural resource endowments, local technological and industrial specialisation, localised knowledge spillovers, and consumers and local market formation.

This section presents three types of territories: cities, rural areas and coal regions. These have been in the centre of the debate in the EU in terms of their contributions to sustainable development on the one hand, and the challenges they face related to sustainability transitions on the other hand. This section presents challenges and potentials specific to each of these types of territories - the first analytical step of transitions as recommended by this toolkit. However, the section provides information on typified regions, and it important to remember that large variations within these groups of territories exist.

8.2.1. Urban areas

There are 806 cities in the EU with an urban centre of at least 50000 inhabitants. In total, 39.3% of the EU population live in cities, with an additional 31.6% living in towns and suburbs. (EUROSTAT, 2020) They concentrate people and economic activity, resulting in a concentration of negative environmental impacts including congestion, pollution and high pressure on natural resources. (OECD, 2013) Globally, cities account for 53-87% of CO_2 emissions (Seto K.C. et al., 2014), they generate twice as much waste per capita as rural areas (World Bank, 2015) and are responsible for around 60% of global domestic material consumption (United Nations Environment Programme (UNEP) et al., 2018). A high level of pollutants and low environmental quality can undermine the competitiveness of cities. "Those living in cities were 2.3 times as likely as those living in rural areas to report that they were living in an area with problems related to pollution, grime or other environmental issues". (Brandmülle et al., 2016)

This concentration of negative environmental impacts provides strong rationale for sustainability transitions in cities. Cities have certain attributes that set them apart from other territories, and determine the framework conditions within which sustainability transitions can take place. These attributes set out opportunities, challenges and barriers to action:

- Cities are the centres of economic activity, producing around 80% of global GDP (United Nations Environment Programme (UNEP) et al., 2018). They are generally richer than rural areas; more resources are available to fund transitions.
- Cities generally have higher levels of innovativeness, an agglomeration of talent, a higher share of highly educated population (Brandmülle et al., 2016). They concentrate consumers, thereby enabling higher levels of product specialisation and the emergence of niche markets. These factors make cities more likely to serve as the locations for innovation in climate neutral, green and circular technologies, and should be built on by sustainable urban development strategies. However, not all cities are equally innovative. "During the period 2010 to 2014, 10% of cities accounted for 64% of patent applications to the European Patent Office" (OECD, 2019b)
- Cities generally have inhabitants with more progressive social attitudes which make them more conducive to change. As a result cities are often trendsetters. This makes cities more likely to be the locations of business, policy and social innovation; these types of innovation should also serve as the focus for sustainability transition strategies and can be supported by funding from cohesion policy.
- Cities offer solutions to environmental issues which are not available elsewhere. Compact cities are resource-efficient ways for people to live. (Brandmülle et al., 2016) In cities the proximity of different actors and infrastructure facilitate vertical integration and integrated solutions (e.g. use of waste heat generated by industry in households). Cities also enable the implementation of technical solutions which have increasing returns to scale due to high fixed costs, e.g. in public transport, which cannot be applied elsewhere.
- However, cities are also more inert to change due to the high concentration of incumbent assets and infrastructure which may result in inertia and a higher chance of lock-in when it comes to transforming cities. Special attention needs to be paid not only to supporting new solutions and technologies but also to dismantling existing solutions and structures.

When working on transitions in cities, it is important to consider global megatrends which will influence the ability of cities to respond to challenges. Cities are disproportionately the sites of the positive impacts of globalisation such as immigration of highly skilled workers, and the locations of international company headquarters, but they may also lose out if

they are not able to take advantage of global trends. The winners of the increasingly multipolar world are generally cities, but not all cities benefit. Cities which are not able to take advantage of globalisation can become sites of concentrated poverty and deprivation.

All cities are different; they are not a set of homogeneous territories as suggested by the generalised description above, diversity of situations. A number of attempts at city typologies have been made, either along common challenges, or common attributes which help address these challenges. (Aksoy et al., 2016, Gregor et al., 2018, Giffinger, Haindlmaier, & Strohmayer, 2014, KPMG, 2010, Nabielek, Hamers, & Evers, 2016, Rozenblat, 2007). Individual cities need to be able to identify their own challenges, but also their strengths, opportunities and potentials in order to successfully address sustainability issues.

A number of manuals and guidance documents are available for implementing urban sustainability transitions.[13]

Box 13 Case study – Bristol's 2030 climate neutrality target

The Council of the city of Bristol declared a climate emergency in 2018, calling on the Mayor to pledge to make the city climate neutral by 2030, taking into account emissions from production and consumption. The city had previously adopted a commitment in 2015 to reduce its emissions from production by 2020 compared with 2005 by 65%, a commitment which it achieved before the 2020 deadline, by achieving a 71% reduction by 2019.

The Mayor adopted the climate neutrality target in 2019, and set a process in motion to implement the target by creating new governance structures (the City Office Environmental Sustainability Board and an Advisory Committee on Climate Change to advise the city boards) and to kick off the process, invited all political parties to submit their ideas on how to achieve carbon neutrality. These ideas will feed into a participative process to develop a strategy together with stakeholders. The One City One Climate Strategy of the city is currently under development.

The actions undertaken to date have a strong technological focus, with the use of e.g. blockchain to incentivise actions that promote energy reduction, and by implementing the City Leap project which is aimed at harnessing low carbon technologies for a smarter, more connected energy system. The city is providing opportunities for SMEs to become involved, in particular in district heat networks and community renewable energy projects, and is also aiming to decarbonise its transport system through acceleration of the uptake of electric vehicles and developing a charging system that uses renewable energy.

Analysis prepared for the city has identified ten key areas of intervention which can enable Bristol to go beyond commitments made at the national level. These are implementing a programme of public and business engagement, securing new powers and additional funding, skills and capacity development, enforcing local planning policies and building standards, programmes for insulation and heat pump retrofit and district heating, smart electricity distribution network, transport modal shift and discouraging the use of private vehicles, electric vehicle charging stations and carsharing, reducing, reusing and recycling plastics and food waste, and involving businesses and households in smart energy initiatives.

Source: edie, 2019, Centre for Sustainable Energy, Ricardo, & Eunomia, 2019, Bristol City Council, 2019

[13] Roorda et al., 2014, Roorda et al., 2014, Frantzeskaki et al., 2011, Breil, 2016, Fujiwara, 2016, Terenzi, Alberto; Latinos, Vasileios; Peleikis, Julia; Porras, 2017, URBACT, n.d.-a and URBACT, n.d.-b.

8.2.2. Rural areas

Rural areas cover less than half of EU land and are home to around one fifth of the population. (European Commission, 2018e) In the EU these areas often face the multiple challenges of an ageing (and sometimes shrinking) population, lower economic performance, lower levels of human resources, lower access to services and higher poverty rates. The population growth rate is typically lower in rural than in urban areas, with many rural areas experiencing population decline and ageing as a result of low birth rates and outmigration of young people. GDP per capita is on average 40% lower than in urban areas. If adjustment is made for workplace (which is often in urban areas, with commuting rural workers) the difference in GDP per capita between urban and rural regions is even higher. (European Commission, 2018e) Rural areas are generally characterised by lower education and employment opportunities, hence populations in rural areas are at increased risk of poverty and higher shares of youth not in employment, education or training (NEET). (EUROSTAT, 2018) Rural areas are typically characterised by lower access to services and lower life quality than urban areas especially in the case in Member States joining after 2004. (Perpiñá et al., 2018) Rural areas are also characterised by lower digital access. (EUROSTAT, 2018) Underdeveloped social and institutional capital are often also characteristic of these regions. (EUROSTAT, 2013) These factors all hinder growth in rural areas. When analysing the challenges, there is a need to make a distinction between the different types of rural areas. The diversity is huge and depends on numerous circumstances; however, the remoteness from the city centres is a factor that influences strongly how pronounced the challenges are.

Innovation in rural areas faces multiple challenges, including longer distances to markets, the small size of local markets and lack of critical mass, limited access to market/product research and development (Halseth, Markey, Manson, Morris, & Ryser, 2019). These limit the potential for technological innovation. At the same time, it is important for rural areas to identify their own place-specific solutions to sustainability challenges which build on local strengths and traditions and addresses local manifestations of sustainability challenges. The potential for these areas to innovate needs to be acknowledged; “a broader definition of innovation for sustainable rural development is needed, which, in addition to traditional aspects linked to innovation (technology, applied sciences, ‘modern’ business organizations), considers innovation processes arising from local experiences and knowledge, which tend to be low technology and intensive in their use of natural resources.” (CELAC, 2017)

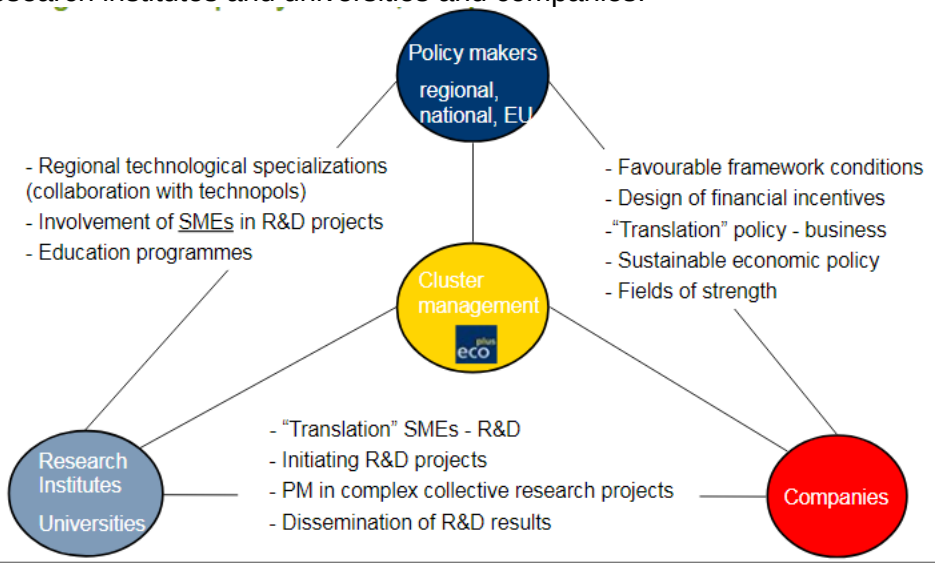
The outbreak of COVID-19 has significantly affected all aspects of life across Europe. The pandemic poses serious challenges to our socio-economic systems. In rural areas, farmers, businesses and communities are particularly affected but many initiatives primarily launched by rural communities have been blossoming across rural areas in Europe in coping with the COVID-19 emergency, supporting rural businesses and fostering solidarity with those more vulnerable in this exceptional situation.

Box 14 Case study - Innovation for sustainable development in rural areas – Buildings case study from Niederösterreich

Transforming provisioning systems (mobility, housing, food) in rural areas may require specific rural solutions which build on local knowledge and the availability of local materials and traditions. This does not necessarily imply low tech solutions, as traditional approaches can serve as the basis for innovative high tech solutions, or can be combined with them.

In the case of housing, although much of the rural architectural heritage has been lost, several European rural regions and Member States have specific building traditions, including materials, building methods and designs. (Council of Europe, 2008) The partners of the bau.energie.umwelt cluster of the Austrian region of Niederösterreich use

traditional building practices and materials to create buildings which meet challenges related to climate change. Traditional building practices are combined with high tech materials and smart building systems. Cluster partners have developed several passive house designs (with annual energy use below 15 kWh/m2) as well as active house designs (buildings which produce more energy than they consume).
The cluster brings together policy-makers (at the regional, national and EU level), research institutes and universities and companies.



Source: Geisslhofer, 2011, EcoPlus, 2019

The share of agriculture, forestry and fisheries in employment in rural regions is around 11.5% (compared with 4% on average in the EU), while the share of GVA of these sectors is 4.5% (compared with a 2% EU average) (Perpiñá et al., 2018). The importance of the primary sector has declined due to pressures such as globalisation and intensification of agricultural production (Perpiñá et al., 2018); this has led to the abandonment of marginal lands and outmigration. Diversification of rural economies has become increasingly important. (European Commission, 2018e) Due to the relatively high share of bio-based sectors, rural areas have an opportunity to invest in sustainable bioeconomy activities in agriculture, forestry, fisheries and aquaculture; as well as the production of food, feed, bio-based products, energy and services.

At same time, rural areas are also sites of activities which may have negative impacts on certain natural assets, e.g. agriculture, forestry, mining and industry. However, the Common Agricultural Policy (CAP) Rural Development (RD) provides support for environmentally oriented activities in agriculture and forestry already since the Agenda 2000 reform package. Changes in food systems and production methods will require changes in "rural land uses and land users, and also create complex dynamics of change that will impact on other major areas of social and policy concern, including food and water security, housing provision and rural employment and livelihoods." (Phillips, 2019) This in turn requires coordination between agricultural funding and policies and cohesion policy.

Rural areas are important sites for fossil fuel as well as distributed renewable energy production. They are therefore important sites of the energy transition, both in terms of jobs and GVA lost in the fossil industry as well as those gained in renewable energy production. Policies to ensure rural areas losing out will also gain from new economic opportunities need to be implemented at the national level, e.g. linking coal phase-out to new renewable installations by giving preference to coal regions for installing new renewable capacity. These sites already have good grid connections so such a policy is a win-win.

Although rural landscapes (often referred to as rural cultural landscapes, which are often main tourism attractions) are heavily influenced by agriculture and forestry and their value chains, a number of rural economies are largely not agricultural; the shares of the secondary sector (mining, manufacturing and construction) and of the tertiary sector on average far outweigh the share of the primary sector in rural regions in the EU. (European Commission, 2016b) This is partly due to the fact that mineral extraction and some types of industrial activities which are highly polluting and cannot be placed in densely populated areas have typically been sited in rural or intermediate areas. As discussed in section 8.2.3, the phase-out of coal has already begun in the EU, posing the first truly EU wide just transition challenge. Due to the fact that the weight of the secondary sector in rural regions is higher than in urban regions, the next wave of the transition to a climate neutral economy which will affect energy intensive industry; this will also disproportionately impact rural areas. Rural areas must therefore prepare to face these just transition challenges, and national policies and national and EU funding must create an enabling environment for regions which face multiple social and economic challenges. Rural areas generally have high degree of concentration within relatively few economic activities. (EUROSTAT, 2013) Diversification of local economies should therefore also be linked to the transition to a climate neutral, green and sustainable economy.

Rural areas have their own specificities in terms of their energy systems. In the residential sector they are characterised by detached housing, lower energy rating of homes, fewer homes connected to energy networks (e.g. gas) and higher fuel poverty (Phillips, 2019). Due to larger distances between energy users there is less scope for integrated energy solutions. There is more potential for agricultural waste biomass and biogas use, wind and hydro. There is a higher reliance on individual transport modes. These rural specificities need to be taken into account when designing support policies using EU funding, to ensure that rural areas can benefit from e.g. energy efficiency policies for buildings to the same extent as urban areas (these are in many cases oriented towards multi-storey buildings which ensure easier renovation of a large number of apartments than individual housing and therefore not favouring rural areas). In addition, renewable energy support schemes need to provide support for rural communities and farmers for small scale renewables, in order to contribute to the development of rural regions.

Rural areas, in particular those close to cities are also important sites of ecosystem service provisioning and central to the transition to a green economy. They provide opportunities for nature based solutions to sustainability challenges in sectors such as waste and waste water treatment. As rural areas sites of natural ecosystems and habitats, rural populations are also direct observers of environmental change and loss, providing an opportunity for involvement of the local population in protecting nature.

Rural areas are often seen as the hinterland to urban centres. In some respects, this is a valid view as the demand for the food, materials and energy produced in rural areas is primarily urban. The interaction of rural and urban areas needs therefore to be taken into account in transitions, as rural areas experience the negative externalities of urban demand which is outside their control. In order to achieve a circular economy, the rural-urban material cycle needs to be closed. Addressing the rural-urban interaction requires a national or cooperative approach. A complicating factor in this respect is the global interconnected economy – rural areas are hinterlands to urban areas in the sense that the supply of food, materials and energy is mostly rural while demand is mostly urban, but global markets for agricultural and mineral products and EU-wide energy networks mean that the connection is no longer local, i.e. between an urban centre and its surrounding rural area. In this respect it is important to make the distinction between the more remote rural areas, which suffer from the “distance penalty” and the rural areas which are close to the cities and which profit from the “economy of agglomeration”.

A mismatch between the relevant geographic scale of issues that need to be tackled and policy tools available at the local and regional level is a fundamental problem of rural development. (OECD, 2019c) This is also relevant for sustainability transitions, e.g. for natural sites and for material cycles.

In a context of local strategies and policies (e.g. at the level of towns or villages), the potential for community based approaches (including visioning and planning tools, e.g. participative approaches vs modelling as well as implementation) is higher in rural areas due to a higher share of personal connections. Since rural populations in general are less progressive and more traditional than their urban counterparts, with identities bound to local communities, traditions, and economic sectors (e.g. agriculture or mining), participative processes can also help ensure that transitions are not seen as forced on rural areas from the outside, but are built on local initiatives and place-based development concepts. “If the transition to clean energy is to gain broad-based social acceptance, strategies must be developed that anticipate and, where necessary mitigate its impact on rural populations.” (Agora Energiewende, 2019) Opportunities for implementing participative processes often need to be created from the outside due to lack of available resources locally; supportive top-down policies are required to enable bottom-up initiatives (OECD, 2019c)

In 2021, the European Commission will adopt a Communication on a Long-Term Vision for Rural Areas. This will be developed in consultation with rural people and stakeholders as well as with local and regional authorities. It will support rural areas in achieving their potential and will take into account challenges ranging from demographic change to connectivity and low income or limited access to services, and explore opportunities such as those offered by climate change mitigation, new technology as well as new developments arising from the current COVID-19 crisis, offering reflections to feed future policies.

8.2.3. Coal regions

Coal regions are on the frontline of the transition to a climate neutral economy in the EU as they are the regions where the potentially negative social and economic impacts of the transition will first be felt due to the phase-out of coal. Of the 20 EU MS where coal power plants are in operation, coal phase-out has been announced in 13 as of April 2020. (Europe Beyond Coal, 2019) In addition to planned phase-outs, a rising carbon price may force operators to close as production becomes increasingly economically unviable. Coal generation in the EU fell by 19% in the first half of 2019 following a rise in the price of EUAs which reached close to EUR 30/tonne of CO_2. (Sandbag, 2019)

There are currently 237,000 direct jobs in coal mining and power plants in the EU, and up to an additional 215,000 indirect jobs throughout the coal value chain. Assuming the average EU household size, this means that the livelihood of more than one million people could be affected over the coming decades by the coal phase-out. Potential job losses in coal related activities is spatially concentrated in Bulgaria, the Czech Republic, Germany, Greece, Poland and Romania. Further jobs and livelihoods could be affected in sectors such as in the steel sector which are reliant on coal mines that may close due to disappearing demand from coal power plants (Alves Dias et al., 2018), as well as in other downstream sectors (e.g. sectors using waste heat or ash produced in power plants), in the rail freight transport sector which relies on the transport of bulk goods such as coal for its revenues, and in the service sector where part of the demand comes from those employed by the coal sector.

The challenge of phasing out coal is therefore both a national challenge related to decarbonisation, energy security and energy prices, and a regional challenge related to employment, livelihoods and economic restructuring. The end to coal, whether in a planned way or as a result of rising carbon prices, is becoming the first large-scale test in the phase-out/exnovation aspect of sustainability transitions in Europe. The challenge of navigating different interests within the context of transitions in coal regions and bringing stakeholders on board to support change, or as a minimum not to oppose it, will serve as a reference point for future phase-outs as part of sustainability transitions.

Most coal regions have a lower GDP/capita than the national average which may make sustainability transitions more challenging. Unemployment rates are country-specific. (Alves Dias et al., 2018) Salaries in mining are often higher than average salaries in other sectors with corresponding levels of education, making alternative employment options which would be acceptable to coal miners difficult to find.

Alves Dias et al. (2018) list a number of post-coal mine closure strategies which have been successful. Tourism services are offered on lakes formed by flooding coal mines in Lusitania, Germany, while a ski slope has been built on the Kamieńsk Mountain, made of overburden from the lignite mine Bełchatow in Poland. Some regions have chosen to build museums to showcase their mining heritage, such as The Big Pit National Coal Museum in South Wales. The Frantisek mine in Horní Suchá in the Czech Republic has been converted into an industrial area. Several examples of the conversion of coal mines to sites for renewable energy generation also exist, including wind, solar and geothermal. In addition to converting former sites to new economic uses, the transition requires the creation of employment opportunities for those formerly employed in the coal sector as well as structural adjustment.

In terms of process, at the national and regional and local levels a number of steps are listed by Dudău et al. (2019) including:

- at the national level:

  - Processes: setting up a process involving representatives of the main stakeholders,
  - Plans and programmes: a restructuring plan, employment and requalification programmes, public programmes for job creation in other economic sectors, adapting (upper) secondary and higher education to new business, innovation and job opportunities;
  - Institutions: coal commission, employment agencies, creation of new research and innovative centres,
  - Funding: setting up restructuring funds, financing early retirement of coal miners, financing of environmental damage issues and perpetual mine management obligations, implementing support schemes which enable the shift to sustainable energy modes
- at the local and regional level:
  - Processes: processes involving representatives of regional and local stakeholders;
  - Plans and programmes: local and regional programmes for economic and social development, plans for diversification of economic activities, building on the heritage of the mining area, addressing brownfield sites left by mining, and creation of business-friendly economic environment;
  - Funding: local sustainable energy production capacities, investing in local education and infrastructure to increase regional competitiveness,

A large number of publications are available on the challenges faced by coal regions, lessons learned from previous transitions, and guidance on how to best implement a just transition in coal regions which leaves no one behind.[14] The European Union has also recognised the significance of the challenge and is supporting transitions through the Platform on Coal and Carbon-Intensive Regions (European Commission, 2019c) in 18 regions by building capacity, developing support materials and connecting stakeholders.

Box 15 Case study – Just transition of a coal region: Upper Nitra, Slovakia

The Upper Nitra region is a predominantly rural region, with Prievidza, its largest town, having a population of 46,000. (Platform for Coal Regions in Transition, 2019) There are three mines in the region which will be closed gradually, by 2027. 99% of the coal mined is for electricity production. A coal fired plant is located in Prievidza which produces around 5% of Slovakia's electricity generation and also supplies heat to 13,000 households. (CEE Bankwatch Network, 2019)

Challenges in the region relate to securing employment for workers made redundant by the transition, diversifying the local economy, solving issues related to environmental degradation and poor health of the population, and enhancing infrastructure and accessibility. The region has defined the following vision: "Upper Nitra will become an attractive and self-sustainable region where economy will be developed in symbiosis with clean environment and well interconnected with other economic centers". To achieve this, the four pillars of the action plan for the Upper Nitra region are

(i) mobility and interconnection: sustainable transport, local roads and motorways, rail and air travel and telecommunications networks;

(ii) economy, entrepreneurship and innovation: innovation, R&D, sustainable job creation, SMEs, agriculture and circular economy, tourism;

(iii) sustainable environment: elimination of environmental burdens caused by mining and other activities, sustainable energy, waste, water;

(iv) quality of life and social infrastructure: healthcare, medical spa, social services,

[14] See Alves Dias et al., 2018, Dudău et al., 2019, Gass & Echeverria, 2017, Green, 2018, Merrill & Kitson, 2017, Mertins-Kirkwood, 2018, Sartor, 2018, Schulz & Schwartzkopff, 2016, Schulz & Schwartzkopff, 2018, Strambo, Aung, & Atteridge, 2019, Szpor & Ziółkowska, 2018, Vaughan, 2017, Vriens, 2018, Wirth, Mali, & Fischer, 2012, World Bank & International Finance Corporation, 2013, Vallentin, Wehnert, Schüle, & Mölter, 2016, Muttitt & Kartha, 2020

quality of life, education, social care.

Around 4,000 people are currently employed in the mines in the region and the mining company estimates that a total of 11,000 jobs are dependent on the coal sector. (Furmanczuk, 2018) The region has relatively low unemployment levels. The population of the region has decreased over the past decade due to out migration and this trend is expected to continue. These demographic disadvantages can ease the transition, as due to low unemployment and outmigration the labour market can potentially absorb workers. The ageing population also means that 45% of miners are expected to be above 55 years old in 2023, which makes them eligible for early retirement. (Platform for Coal Regions in Transition, 2019) As part of the action plan, 215 projects have been identified with the potential to create 10,000 new jobs, at a cost of EUR 3bn of investment.

9. Mainstreaming sustainability considerations into programmes and projects

Main messages

- Climate change, resource use and biodiversity as well as social sustainability considerations need to be taken into account at all stages and levels of cohesion policy implementation in order to support sustainability transitions;
- The strategic level is important because on their own these tools, criteria and institutional approaches used at the programme and project implementation stage cannot achieve sustainability transitions,
- However, they can contribute to avoidance of negative environmental and social impacts;
- Important measures which enhance environmental and social performance of cohesion policy as included in the regulatory proposals are:
  - earmarking of funds and tracking of climate spending
  - selection and exclusion criteria
  - monitoring of environmental and social outputs and results
  - partnership and technical assistance
- Managing Authorities can go beyond regulatory requirements to further enhance the contribution of cohesion policy to sustainable development.

9.1. Introduction to mainstreaming of sustainability into investment

In order **to support sustainability transitions, climate change, resource use and biodiversity as well as social sustainability considerations need to be taken into account at all stages and levels of cohesion policy implementation**. The first stage, strategic planning, has been discussed in section 3 and the inputs to policy development and EU funding decisions were discussed in sections 5-7. This section discusses **tools, criteria and institutional approaches that can be used at the programme implementation stage**, such as during project selection and monitoring and evaluation, to increase the sustainability of cohesion policy.

These tools cannot fully compensate for any shortcomings in the design of the strategy for supporting sustainability transitions; they cannot replace tools and approaches relevant at the strategic level. They will not achieve a sustainability transition on their own. However, integrating environmental and social sustainability considerations into programme and project implementation **can help to avoid some undesirable impacts and can increase the environmental and social performance of funding**, especially if implemented with care. These tools are discussed in this section, first summarising regulatory requirements, and then discussing how Managing Authorities can go beyond these requirements.

9.2. Regulatory requirements for mainstreaming sustainability

There are a number of environmental provisions in the Common Provisions Regulation and the ERDF and Cohesion Fund Regulation to ensure that the ERDF and Cohesion Fund contribute to environmental goals. They are the following:

1) Provisions aimed at increasing funding for environment and climate:
   a) The ERDF and Cohesion Fund are available to fund the priority objective of a greener, low-carbon Europe by promoting clean and fair energy transition, green and blue investment, the circular economy, climate adaptation and risk prevention and management (CPR Article 4.1)
   b) Information has to be provided by Member States on the support for environment and climate objectives using a methodology based on types of intervention for each of the Funds. It is expected that operations under the Cohesion Fund will contribute 37% of the overall financial envelope to climate objectives. No specific regulatory targets have, however, been set. This contribution will be tracked through a Rio markers methodology. (CPR Article 4.3)
   c) Member States of group 1 shall allocate at least 85 % of their total ERDF resources under priorities other than for technical assistance to PO 1 and PO 2, and at least 60 % to PO 1. Other Member States need to allocate at least 30 % of their total ERDF resources under priorities other than for technical assistance to PO 2. (ERDF and CF Regulation, Article 3.4)
2) Provisions limiting negative environmental impacts of funding:
   a) In selecting operations, the Managing Authority has to ensure that operations which fall under the scope of the EIA Directive are subject to an environmental impact assessment or a screening procedure according to the requirements of the amended EIA Directive (CPR Article 67.3)
   b) Certain activities have been excluded from ERDF or Cohesion Fund support due to their negative environmental impacts. These include e.g. investment related to production, processing, distribution, storage or combustion of fossil fuels, with the exception of investment related to clean vehicles, and investments related to the treatment of residual waste (ERDF and CF Regulation, Article 6.1);
3) Provisions to ensure monitoring and evaluation of environmental and climate impact:
   a) Member States need to establish a performance framework, including relevant output and result indicators. Core indicators include a number of indicators relevant to monitoring the environmental and climate impact of interventions under PO 2. (CPR Article 12.1 and ERDF and CF Regulation, Article 7)
4) Provisions to ensure involvement of environmental partners in planning and implementation, capacity building of partners:
   a) Member States have to organise a partnership with the competent regional and local authorities, and have to include relevant bodies representing civil society and environmental partners. These partners have to be involved in the preparation of Partnership Agreements and throughout the preparation and implementation of programmes, including through participation in monitoring committees. (CPR Article 6)
   b) Technical assistance may be provided to reinforce the capacity of Member State authorities, beneficiaries and relevant partners (CPR Article 31)

The following sections provide a brief overview of tools and approaches which ensure best practice implementation of the relevant regulatory provisions aimed at increasing the environmental performance of cohesion policy, and some examples of how Managing Authorities can go beyond these obligatory requirements to maximise the contribution of programmes to sustainability transitions and minimise negative environmental and social impacts.

9.3. Increasing funding for environment and climate

The **thematic concentration** requirements are minimum requirements, which can be exceeded. In addition, the contribution towards climate change, tracked through the **Rio markers** methodology, can also be increased by Member States and regions during programming.

Green public procurement can be both a flanking measure which can be used to mitigate the impact of cohesion policy funding, or it can contribute to transitions. A large share, around 14% of EU GDP is spent by public authorities through public procurement (European Commission, 2014a). Therefore the effect of public procurement on shaping demand, and thereby generating supply of more sustainable solutions, is potentially significant.

The role green public procurement plays depends on how it is used. As transformational technologies and solutions differ along several dimensions compared with regime solutions, defining a single environmental performance indicator may not result in procurement of truly transformational products and technologies unless allowances are made for differences along other dimensions as well. If this is allowed then GPP can be a powerful tool to assist sustainability solutions. Using green public procurement in this way may not always be possible, as it generally requires that technologies are deployable and not still in a testing phase.

If used in a less ambitious way, to ensure that more environmentally friendly products and technologies are purchased, where these technologies and products are already mainstream (e.g. recycled paper), green public procurement can still limit negative environmental impacts and growing the market for more sustainable products and technologies.

In the context of a circular economy, circular procurement can be an effective way of promoting circular materials and practices. Circular procurement is when “public authorities purchase works, goods or services that seek to contribute to closed energy and material loops within supply chains whilst minimising – and in the best case – avoiding negative environmental impacts and waste creations across their whole lifecycle.” (EIT Climate-KIC, 2019)

Green public procurement criteria and good practice examples for a number of products and technologies have been published by the European Commission and are available in European Commission, 2020b.

Box 16 Use of green public procurement to stimulate innovation

Green public procurement is generally used to procure environmentally friendly products which are already tested and commercially available, but possibly more expensive than their less environmentally friendly substitutes. In Pre-commercial public procurement (European Commission, 2007) is less common, but can be used to successfully promote research and innovation (European Commission, 2019e) to satisfy public sector needs and to provide a first customer reference to enable companies to market their products.

Pre-commercial green public procurement has been used in the Valle D’Aosta region in Italy for the full scale development and testing of prototypes, installed on end user premises using the “Living Labs” methodology to meet needs in smart energy and intelligent mobility:

- Energy storage systems;
- Systems for monitoring, controlling and managing consumption and energy production of users characterised by complex (multi-) energy systems, including remote systems;.
- Smart management systems for service networks;
- Monitoring of the road networks by means of sensors with the capacity to detect the environmental conditions of road surfaces and accidents;
- Innovative parking payment systems integrated with local public transport information systems;
- Vehicle sharing management systems.

Source: European Commission, 2010

Instead of GPP, Sustainable Public Procurement criteria may also be used. SPP is "a process by which public authorities seek to achieve the appropriate balance between the three pillars of sustainable development - economic, social and environmental - when procuring goods, services or works at all stages of the project". (European Commission DG Environment, 2020)

9.4. Limiting negative environmental impacts of funding

Limiting negative environmental impacts of funding is relevant for the types of projects and programmes which are likely to cause negative impacts in terms of biodiversity, climate change or resource use, such as in the field of infrastructure investment or transport. There are a number of tools available to limit negative impacts:

- strategic environmental assessment (SEA);
- environmental impact assessment (EIA);
- respecting environmental hierarchies;
- applying proofing measures;
- limiting or avoiding spending on environmentally harmful alternatives;
- compensating for negative impacts;
- integrating environmental considerations in project selection criteria.

Strategic Environmental Assessment (SEA) is not mentioned in the regulatory proposals, but is obligatory for all plans and programmes, which are likely to have significant effects on the environment in accordance with Directive 2001/42/EC. Guidance prepared by the Commission on the interpretation of the directive is available. (European Commission, 2001). **Environmental Impact Assessment** (EIA), which is applicable at the level of projects, needs to be carried out for all projects which fall under the scope of Directive 2011/92/EU, and is a precondition for project selection according to Article 67 of the Common Provision Regulation.

In addition to SEA and EIA, a number of assessment tools and methodologies are available to limit negative impacts of interventions. These are not required by legislation but can increase the knowledge of environmental impacts of programmes or projects. They include life cycle analysis and materials flow analysis. Since a large part of the production of goods for the European market happens outside the EU, a lifecycle approach can help avoid exporting pollution, CO_2 emissions, poor working conditions and deforestation to territories outside the EU.

Tools with a broader scope, covering environmental as well as social and economic impacts include cost-benefit analysis (European Commission, 2014b), multi-criteria decision analysis (European Commission, 2016a), SWOT analysis (EFP, 2017) and sustainability impact assessment (OECD, 2010). Carrying out assessments beyond the obligatory SEA and EIA is only warranted if the risk of environmental impact is high and impacts not sufficiently accounted for by these two procedures need to be assessed.

Rather than increasing the number of assessments, it is important that all tools for environmental assessment are linked to the decision-making process. The outcome of these assessments needs to be taken into account when making decisions regarding the conditions under which the project or programme can be implemented, and when deciding whether further protection and avoidance measures need to be taken to limit environmental impacts. In light of the need for a transition to a climate neutral, green and circular economy, decision-makers need to be ambitious in setting benchmarks above which projects are selected and implementation can proceed. For more contentious projects, mandatory external verification of the assessment of project impacts can be required.

It is also important to respect procedures for involving the public through participation early in the planning and assessment process. Finally, it is important to increase capacity for carrying out assessments through e.g. provision of guidance to facilitate environmentally friendly project design, or through advisory institutional structures and technical support to MAs and project developers.

Box 17 Case study – Institutional support for EIA in Finland

In Finland the EIA liaison authority serves as an institutional solution to improving the quality of EIA and increasing capacity to carry out EIA.
The liaison authority "coordinates the EIA process" but is not an authority in the sense that it "does not issue permit decisions related to the project being assessed". "The authority coordinates the EIA process from the very beginning and thus developers are well informed throughout the process about the requirements and principles of EIA.37 Furthermore, the liaison authority plays a central role in ensuring meaningful public participation in EIA". "It enables a single regional authority to specialise in EIA issues and gain extensive expertise on the legal requirements, guidelines and good practices related to projects being assessed". "The liaison authority as the primary controller of the quality of EIA." "Quality assurance works through the statements issued by the liaison authority in the scoping phase and at the end of the process, after the submission of the [environmental impact statement]".
Source: Pölönen, Hokkanen, & Jalava, 2011

Transitions are not only creative, but also destructive processes whereby the former social-economic-technological system is replaced by a new system. This requires shifting of resources, including financial resources, away from incumbent stakeholders and technologies, which in turn requires **limiting or avoiding spending on environmentally harmful technologies and solutions**. The question of what not to fund is as important as the question of where to allocate funding. Art 6 of the ERDF and Cohesion Fund Regulation identifies a number of areas that cannot be supported with the funds. These include some which are relevant to sustainability transitions, such as the decommissioning or the construction of nuclear power stations, investment to achieve the reduction of greenhouse gas emissions from activities listed in the EU ETS Directive, investment in airport infrastructure except for outermost regions, investment in disposal of waste in landfill, investment in facilities for the treatment of residual waste and investment related to production, processing, distribution, storage or combustion of fossil fuels, with the exception of investment related to clean vehicles. This approach of avoiding spending on environmentally harmful solutions is also in line with the 'do no harm' principle of the European Green Deal.

Managing Authorities may go beyond this list and add other types of projects which are ineligible for funding. An ambitious approach, where only the most sustainable projects are allowed to be funded, can contribute to transitions, whereas a less ambitious approach, where only the most environmentally harmful projects are excluded from funding, can be considered a classical mainstreaming tool which can limit the negative environmental impacts of spending, but will not contribute significantly to achieving a sustainability transition.

Article 67 of the common provisions regulation states that a transparent set of criteria, which take into account the principle of sustainable development and of the Union policy on the environment, need to be used by Managing Authorities for **project selection**. Managing Authorities need to ensure that selected operations are consistent with the corresponding strategies and planning documents established for the fulfilment of enabling conditions according to Article 67 of the Common Provisions Regulation.

Selection criteria can be applied in several additional ways. Based on GSIA (2019) and modified for the context of cohesion policy, selection criteria can be applied in the following ways:

1. Negative/exclusionary criteria can be used which result in the exclusion from funding of certain sectors, technologies or practices based on environmental criteria;
2. Positive/best-in-class screening: investment in sectors, technologies, practices or projects selected for positive environmental performance;
3. Norms-based screening: screening of investments against minimum standards;
4. Integration of environmental factors into financial analysis of the project, e.g. through a carbon price;
5. Orienting as much funding as possible towards sustainability themed investment (for example low carbon energy);
6. Orienting as much funding as possible towards impact/community investing where funding is specifically directed to traditionally underserved individuals or communities.

Criteria related to these requirements can be formulated in different ways: as obligatory requirements in the calls for projects or as selection criteria giving preference to projects which fulfil these requirements. The former is highly recommended. Good practice examples related to project selection, as well as advice for the use of specific selection criteria in different sectors is contained in COWI & Milieu, 2020.

Ensuring that funded actions are in line with various **policy priorities and hierarchies** can provide an additional check. Relevant additional criteria include:

- Respecting the water hierarchy - water demand management should come first, and alternative supply options should only be considered once the potential for water savings and efficiency has been exhausted;
- Respecting the waste hierarchy - prevention, reuse, recycling should come before options for recovery and disposal are considered;
- Alignment with the energy efficiency first principle - the best energy is energy not produced, therefore energy production should be considered only when reasonable options for energy saving have been exhausted;
- Preference for nature based solutions when feasible, preference for green instead of grey infrastructure.

Of the above, the waste hierarchy has been operationalised in the ERDF and Cohesion Fund Regulation to some extent, as investment in disposal of waste in landfill and investment in facilities for the treatment of residual waste are on the list of activities which cannot be funded. Managing Authorities may require that additional criteria for funding be

met in line with the above principles. There are several ways that these hierarchies can be integrated into cohesion policy – not allowing funding of projects which are low on the hierarchy, maximising funding available for certain types of projects at the level of programmes, or giving preference to projects which are high on the hierarchy through project selection criteria.

Environmental proofing, used in the context of e.g. biodiversity proofing or climate proofing, refer to a combination of tools (some of them discussed earlier in this section) and a hierarchical view of how to apply these tools in order to mainstream biodiversity or climate mitigation and adaptation into projects, but also programmes. Proofing requires, as a first step, avoiding harm, and if this is not possible, then reducing harm to the extent possible and compensating for losses. An illustration of how this can be done to avoid adverse impacts on biodiversity is contained in Table 13.

Table 13 Biodiversity proofing measures

Source of potential pressures	Direct mortality	Direct habitat loss (footprints)	Habitat fragmentation	Disturbance	Indirect habitat degradation	Secondary impacts
Transport infrastructure						
Avoidance measures	Avoid areas with sensitive species or known movement corridors	Avoid areas with sensitive species or threatened habitats	Avoid areas with sensitive species or where habitat patches may become too small to support viable populations and ecosystem functions	Avoid areas with sensitive species	Avoid transport modes that lead to pollution levels that cannot be reduced to acceptable levels	Avoid sensitive areas and/or include regulations to avoid secondary development
Reduction measures	Fencing, reflectors, removal of tall vegetation close to roads / railways etc.	Reduction of carriageways and associated infrastructure, use of viaducts or tunnels to avoid especially sensitive areas	Maintain some habitat linkages, or if not possible then use wildlife tunnels and green bridges etc. – at known key crossing points where ecological benefits are reliable and cost-effective Sound and light barriers (e.g. fences, trees) use of low-noise road surfaces, limited use of lighting or screened lighting	Technologies to reduce or capture emissions, barriers to pollution (e.g. trees), pollution traps in ditches and balancing ponds.	Monitoring and if necessary actions to address alien species risks	Limiting access points to adjacent habitats, especially in sensitive areas, e.g. by absence of joining secondary roads
Compensation measures	Reduction of other sources of mortality e.g. from alien predators	Habitat restoration or creation, if this is feasible	Strategically placed habitat restoration / creation to link up or increase the area of fragmented habitat patches	Reduction in other sources of disturbance, or habitat restoration or creation, if this is feasible	Habitat restoration or creation, if this is feasible	Habitat restoration or creation, if this is feasible
Energy infrastructure						
Avoidance measures	Avoid areas with sensitive species or known movement corridors	Avoid areas with sensitive species or threatened habitats	Avoid areas with sensitive species	Avoid construction in areas with sensitive species or times of year when they are present	Use construction techniques that avoids pollution	-
Reduction	Add reflectors / markers to	Use designs and construction	Avoid working at the most sensitive times of day; use sound and light	Technologies to reduce or capture emissions,	-	

measures	overhead lines	techniques that minimise footprint	barriers (e.g. fences) use of low-noise machinery, reduce lighting at night	e.g. pollution traps.		
Compensation measures	Reduction of other sources of mortality e.g. from alien predators Habitat restoration or creation, if this is feasible	Strategically placed habitat restoration / creation to link up or increase the area of fragmented habitat patches	Reduction in other sources of disturbance, or habitat restoration or creation, if this is feasible	Habitat restoration or creation, if this is feasible	-	

Source: Skinner, Medarova-Bergstrom, Rayment, & Tucker, 2014

The Commission is developing guidance on sustainability proofing, which will operationalise the InvestEU Regulation and the InvestEU Fund, and shall address market failures or sub-optimal investment situations under its four policy windows (sustainable infrastructure; research, innovation and digitisation; SMEs; and social investment and skills). In addition, the Commission has developed a substantive body of guidance for the climate proofing of infrastructure projects (both mitigation and adaptation) for the period 2021-2027. Both these guidance documents can be referred to by beneficiaries as well as Managing Authorities, e.g. when developing project selection criteria.

Compensating for negative environmental impacts may be necessary where negative impacts cannot be completely avoided. The principle of 'no net loss of ecosystems and their services' requires avoiding or preventing negative impacts, but where this is impossible, it allows for some damage. This damage needs to be either remedied through restoration, or as a last resort, compensation or offsetting can be applied.

Compensating negative impacts requires some kind of tracking mechanism to quantify total impacts and achieve, as a minimum, no net loss, no increase in emissions or no increase in environmentally harmful impacts. For assessing net greenhouse gas emission impact, tools such as CO2MPARE (European Commission, 2013a) and NECATER (Baltzar, Varbova, & Zhechkov, 2009) are available. Both these tools can be used at the programme level, and enable Managing Authorities to ensure that the net contribution of cohesion policy to increasing emissions is zero. However, although ensuring carbon-neutrality of programmes can guarantee that Cohesion Policy does not contribute to an increase in emissions, it does not ensure a contribution to the overall effort to reduce emissions, and allows for investment in technologies and solutions which increase emissions and may therefore need to be phased out over the medium to long term.

Adhering to a "no net loss" or "do no harm" principle is therefore in itself insufficient to promote sustainability transitions, which require an improvement in environmental performance over time, not just a neutral environmental impact.

9.5. Monitoring of environmental and social impacts and programme contribution to sustainability transitions

Article 12 of the Common Provisions Regulations requires that Member States establish a **performance framework for monitoring, reporting on and evaluating programme performance**. The performance framework consists of output and result indicators linked to specific objectives, milestones to be achieved by the end of the year 2024 for output indicators, and targets to be achieved by the end of the year 2029 for output and result indicators.

The ERDF and Cohesion Fund Regulation sets out common output and result indicators in Annex I of the regulation. These indicators are suited to tracking the intended positive outputs of projects under certain policy objectives. They can be complemented by additional programme-specific indicators.

In order to meaningfully monitor and evaluate the environmental impact of programmes, it is necessary to **assess the negative environmental impacts of programmes**, in particular for investments under PO1 and PO3, in addition to assessing the positive environmental impacts of interventions under PO2. This is needed to form a view on the net contribution of cohesion policy to environmental targets, in particular to targets related to greenhouse gas emissions and biodiversity.

Box 18 Tools – GHG monitoring tools for tracking programme impact on emissions

Many tools exist which model the impact of different interventions on greenhouse gas emissions. However, these are complex tools that are not targeted at Managing Authorities, where the impacts of various drivers of emissions (e.g. population growth, technology mix, behavioural change, etc.) and policy mixes (e.g. carbon tax or support to renewables) are translated into emissions trajectories. Tools which specifically translate investment portfolios into net impact on emissions are few. A tool developed for the Commission, the CO2MPARE tool, and NECATER, formerly used to calculate the net impact of programmes on CO_2 emissions, are two such tools.

The CO2MPARE tool estimates the emission impact per euro spent for a given type of activity and multiplying this by the amount spent on the activity. This makes it possible to estimate the net emissions of programmes on emissions. It can be used at the EU, national or regional level, and is expected to provide fairly accurate results at the programme level, although it is not accurate at the level of interventions. It provides information on both direct emissions (i.e. emissions directly attributable to investment projects) as well as indirect emissions (e.g. emissions resulting from secondary effects, induced by production and consumption generated by the investment).

The tool has not been calibrated for all countries, and in any case, data updates are required to reflect changing specific emissions per euro invested over time. However, it is free to download and does provide default values for the impact of spending in different investment categories which can be used if national or regional data is unavailable.

Source: European Commission, 2013a

The monitoring and evaluation of the contribution of programmes to sustainability transitions is more complex than the monitoring of environmental impact of the programmes. Monitoring and evaluation of transitions is particularly challenging as there is little experience with monitoring system-wide change. Due to the complexity of systemic change, consequences cannot always be foreseen and trade-offs are emergent. This can cause **difficulty in identifying all relevant indicators and targets ex ante**.

Preparing for such unintended results is possible if one adopts a system view, by seeking to understand and describe the whole system, including components and connections, focusing on the nature of relationships and interdependencies within the system. (Preskill, Gopal, Mack, & Cook, 2014) Methods which are suitable for ex ante identification of unintended consequences include (Better Evaluation, 2014,):

- Key informant interviews: asking experienced people to identify in advance possible unintended outcomes, based on their experience with similar programmes;
- Risk assessment: identifying the potential negative impacts, their likelihood of occurring and how they might be avoided;
- Six Hats Thinking about unintended results: promoting holistic and lateral thinking in decision-making and evaluation;
- Unusual events reporting: making sure that unforeseen events, incidents or outcomes are recorded.

After implementation, not yet identified unexpected results can be identified through e.g. case studies, observational techniques, focus groups, causal effect models, ripple effect mapping or reflexive monitoring (European Commission, 2013c, Preskill et al., 2014, CompetentieCentrum Transities, n.d.).

Evaluation of systemic change is made more difficult by the fact that impacts on transitions are often not observable over the short term, therefore over the shorter term often only early signals of system change can be observed.

Evaluation plans need to be designed to be flexible and iterative as trade-offs emerge, failures become apparent and information from experimentation becomes available. Evaluation has to be iterative, in light of lessons learned. The evaluation exercise needs to remain open to unintended and unanticipated results, which can be ensured by e.g. including open-ended questions in interviews.

In addition, due to the experimental nature of some of the activities, where the focus is on learning rather than on guaranteed results, **learning experience should be evaluated positively even in the absence of positive outcomes**, and lessons about successes and failures need to be extracted. This means that a focus on generating knowledge in all activities, especially in relation how to successfully implement transformative innovation (technological and social) and just transition is important.

Monitoring of sustainability transitions is still very much an evolving field, and it is expected that significant developments will take place during the programming period 2021-2027.

In order to monitor the transformative impact of funding, a set of questions related to system-wide change need to be asked. In formulating these questions there is a need to refer back to visions and broad socio-economic goals and targets, but the following questions provide some guidance:

- How have actors working for sustainability transitions been strengthened and enabled? (profits, market shares, capacities, etc.)
- How has distribution of income and capital and access to natural resources changed?
- What is the extent of knowledge gained (policy learning, technological learning) by decision-makers, supporters of the transition, the general public?
- Has a structural shift towards more sustainable subsectors taken place?
- How have attitudes, practices and behaviours changed?
- Is there broad acceptance of the need for a transition and the way it is implemented?

Examples of relevant input, output and outcome indicators are presented in Table 14. These should be seen in combination with the list of output and result indicators included in the final version of the CPR.

Table 14 Examples of output and result indicators related to different transition goals and targets

Transition phase	Goal	Indicators
Innovation	Creating enabling circumstances for transformative innovation, including protected spaces	Output indicators • Number of protected niches supported • Number of experimental sites supported Result indicators • Number of patent applications in radically new technologies
Scaling up, phasing out	Structural change	Output indicators • Number of clean technology SMEs receiving support Result indicators • Change in shares of relevant subsectors

		• Change in GVA of relevant subsectors • Employment in clean technology sectors • Transfer of results to other regions, territories
Technological innovation and scaling up	Enabling and strengthening actors working to support sustainability transitions	Output indicators • Number of clean technology SMEs receiving support • Number of actors benefitting from capacity building in civil society sector • Number of clean technology investment projects supported Result indicators • Increased market share of renewable energy/circular solutions • Increased influence of civil society actors on public perception measured by proposals of civil society adopted by policy-makers
(Social) innovation and scaling up	Changes in attitude, practices and behaviours	Output indicators • Number of innovative social initiatives supported • Number of campaigns supported for behavioural change Result indicators • Consumption of goods produced locally vs imports • Consumption of products from less to more sustainable • Number of initiatives working towards sustainable outcomes
Just transition	Equitable transition	Output indicators • Price increase of goods/energy carriers, etc. attributed to policies supporting the transition • Number of vulnerable consumers receiving payments • Number of unemployed enrolled in training/reskilling • Number of SMEs supported in transition regions • Number of ITIs supported in transition regions • Share of small projects Result indicators • Number of workers in clean technology sector in transition regions • Unemployment levels in transition regions • GVA in transition regions
Just transition	Social acceptance	Output indicators • Number of projects supported related to sustainable attitudes and behaviour • Number of people reached through processes aimed at ensuring public participation

		Result indicators • Trust, commitment and support for transitions
Across all phases	Knowledge generated	Output indicators • Number of reports available on the successes/lessons learned • Number of meetings/conferences organised focusing on lessons learned Result indicators • Transfer of positive examples to other regions, territories

Source: own compilation and examples based on Luederitz et al., 2017

Transparency and accountability of transitions is important, and this applies also to evaluation, especially as transitions can be politically contentious and as evaluation impacts future policy-making through feedback loops. Therefore the methods applied and evaluation results need to be public, as well as data on which it is based.

List of potential measures for mainstreaming environment into the programmes

Increasing funding for environment and climate
- meeting and exceeding thematic concentration targets
- meeting and exceeding earmarking targets for PO2
- use of green public procurement

Limiting negative environmental impacts of funding
- strategic environmental assessment of programmes
- environmental impact assessment of all projects with potentially negative impacts
- respecting environmental hierarchies in programming and calls for projects
- applying climate and biodiversity proofing measures to projects through selection criteria
- limiting or avoiding spending on environmentally harmful options when alternatives are available, applying negative lists for investments which are excluded from funding;
- applying tools to assess net impact of programmes (e.g. NECATER or CO2MPARE) and compensating for negative impacts;
- integrating environmental considerations in project selection criteria

Partnerships and institutions:
- involving environmental partners as well as change agents, supporters of change and connectors in programme preparation and implementation;
- providing technical assistance to environmental and social partners
- creating dedicated institutions to assist environmentally sound programme implementation and project development (e.g. for implementing EIA, SEA, developing project selection criteria, etc.)

Monitoring of environmental impacts and programme contribution to sustainability transitions
- assessing positive environmental impacts of interventions in the field of environment and climate (PO2)
- assessing negative environmental impacts of interventions (in particular for PO3)
- assessing programme contribution to sustainability transitions through relevant indicators
- applying flexible and iterative evaluation plans, ensuring feedback into decision-making and applying adaptive governance

Glossary

Adaptive governance is „governance that aims to deal with the uncertainties and surprises inherent in transforming complex social and ecological systems. Adaptive governance relies particularly on iterative cycles of policymaking and planning, implementing, evaluating and learning." (F. Geels et al., 2019)

Governance refers to "all processes of governing, whether undertaken by a government, market, or network […] and whether through laws, norms, power or language." (Bevir, 2012) "In contrast to top-down, state-led coordination, polycentric governance acknowledges that power, capabilities and resources are dispersed and that change often involves bottom-up and self-organising actions"

Just transition is "the notion that the transition process to a greener economy has to be inclusive of all stakeholders, and that the unavoidable employment and social costs of the transition have to be shared by all". (International Labour Organization, 2010) It "incorporates a bundle of potential policies addressing the vulnerabilities of workers and communities, including bottom-up transition dialogues and democratic, participatory consultations in affected regions, local investments in low-carbon growth sectors and technologies, research and innovation strategies, reskilling and training, local economic diversification plans, targeted infrastructure investments, recultivation of local environments, and social protection measures." (Pilsner et al., 2018)

Lock-in is primarily thought of as being a technological concept, but technological path-dependency arises due to various social, economic, cultural, network and infrastructure dependencies. (T. J. Foxon, 2002) These include financial dependence on the maintenance of the status quo, for example reliance of workers for jobs on today's industries, or the reliance of companies on the continued production of their (unsustainable) products or use of (unsustainable) production methods. This kind of financial reliance on maintaining the current system as-is is referred to as vested interests; changes in the existing system result in losses to these actors and redistribution of wealth to new actors. Cultures, norms and beliefs, behaviours, practices and lifestyles can also result in lock-in. Networks of actors, both informal and formal (e.g. supply chains), infrastructures supporting and linking existing technological solutions, technical knowledge and education and regulatory-policy frameworks which are geared towards/built around existing solutions can also cause a system to become resistant to change. In some cases this involves active resistance from actors opposed to change, in other cases (e.g. in the case of infrastructure) even without intentionality the system confers advantages to supporters of the status quo. This means that innovation and dissemination of innovative solutions faces an uphill battle which is exacerbated by the higher cost and higher uncertainty surrounding new technologies which have to compete against a mature technologies.

Niche is a protected space, i.e., "specific markets or application domains, in which radical innovations can develop without being subject to the selection pressure of the prevailing regime" (Markard et al., 2012)

Regime is a relatively stable configurations of institutions, techniques and artefacts, as well as rules, practices and networks that determine the 'normal' development and use of technologies". (A. Smith et al., 2005 referring to Rip & Kemp, 1998)

Sustainable development is "a process of navigating pathways between two sets of boundaries — the social foundation of basic needs and the environmental ceiling of planetary boundaries" (EEA & Eionet, 2016)

Sustainability transition is a long-term, multi-dimensional & fundamental transformation of large socio-technical systems (regimes) towards more sustainable modes of production & consumption (Markard et al., 2012)

Systemic environmental challenges are environmental challenges which are "tied in complex ways to prevailing economic, technological and social systems." (EEA, 2017), and therefore "unsustainable systems of production and consumption require fundamental rethinking" (EEA, 2015a)

Stranded assets are economic assets which are retired before the end of their economic lifetime, and are therefore not economically viable as they do not achieve a positive return on their initial investment cost.

Systems analysis "is an integrative mapping of (the environment of) the selected issue. This enables a systemic understanding of the current situation, provides insight into long-term change dynamics and into the interactions between multiple domains." (DRIFT)

Transition pathways "describe possible routes from now to the envisioned future. Each pathway revolves around a subtheme. It describes intermediate goals, barriers to overcome, important actors, and essential actions. The transition pathways are neither fixed plans nor detailed scenarios; they are inspiring storylines that include goals and interventions on the short, mid and long term. They provide insight into what is needed to reach the envisioned future and give direction to the subsequent development of the transition agenda." (DRIFT)

Foresight methods are structured techniques for exploring potential future developments and consequences in technology, society and other relevant topics. It includes a wide range of approaches that in varying degrees emphasise evidence, creativity and social interaction. (F. Geels et al., 2019)

Pathways are alternative ways of achieving a transition, which vary in terms of actors, innovations, institutions and multilevel interactions. (F. Geels et al., 2019)

Annex 1. Innovation focus for a climate neutral circular economy

Funding focus	Broad policy framework to increase effectiveness of funding
Climate neutral economy – Energy	
Technologies for 'zero-carbon molecules' to market readiness, such as biofuels with CCS, hydrogen, and other synthetic fuels. Energy storage and conversion technologies at all time scales: batteries, heat storage, Power-to-X. Intelligent networks and infrastructure for electricity, heat and gases to include spatial issues and benefits of pooling.	Market designs that facilitate RES integration, enable prosumer participation and incentivise demand flexibility to achieve fast power sector decarbonisation; Making policies robust against negative interactions with other policies on EU, national and regional levels, e.g. the weakening of the ETS price signal due to national decarbonisation policies; Deeper understanding of dynamic transition processes, innovation dynamics and energy market developments (instead of static analyses); A wide array of tools, from large-scale quantitative models incorporating sophisticated market mechanisms and consumer behaviour to empirical case studies, to step-by-step implementation recipes for policy-makers, regulators and administrations.
Climate neutral economy – Mobility	
Electrification of common land-based transportation systems, industrial vehicles, trucks and the electrification of ports & short distance water-based transport (e.g. ferries). New battery chemistries as well as the re-use and recycling of batteries. Identify efficient hydrogen carriers (e.g. liquid hydrogen organic compounds) in rail, road freight, emergency vehicles and shipping. R&I on new ships and airplanes is needed to Further reduce the specific fuel consumption per transport unit for ships and planes, including designs and new materials Sustainable production of biofuels and synthetic fuels as equivalent substitutes for fuel oil and jet fuel, in particular lignocellulosic feedstock. International and transcontinental transport infrastructure requirements and new	Policy framework includes urban planning, congestion taxing, public transport provision and other policies that transform urban spaces and urban transport. Internalisation of all transport-related externalities. Measures to reduce air travel and shipping demand (carbon accounting policies, carbon emission quotas for airlines, campaigns to promote alternative transport modes): Policies encouraging model shift from aviation and sea-born transport to (high-speed) rail where feasible, and modal shift of freight transport from road to waterways. Policy landscape with a technology neutral approach, correcting counterproductive existing policies (e.g. fuel subsidies, incentives for commuting; 'flat tax' for highway use instead of 'pay per demand') and avoiding discrimination between particular powertrains and energy carriers. Re-configuration of the taxation scheme and fiscal and capital market implications as the

technologies to substitute short-distance EU air traffic with high-speed rail as well as to shift long-distance freight transport based on road or ship to rail freight transport. Design of electricity retail markets, electricity grid enforcements, and digitally supported smart integration of EVs in the power grid. Sustainable hydrogen supply, comprising production, storage and transport, including new materials such as MOFs as catalysts, and the realisation of sector coupling projects along with H2 and CH4 network design and operation. New transport service business models and new production chains for transport equipment production. Development of modular battery storage packages, suitable both for EV and for stationary storage.	transport sector shifts from an energy-intensive towards a capital-intensive market when deep decarbonisation is pursued.
Circular economy - Novel plastics in existing chemical industry from alternative feedstock	
Set up and facilitate investment mechanisms that pool public and private money to consolidate and accelerate the transition towards a circular economy for plastics; Financial incentives to redesign plastic products to facilitate reuse, collection, sorting and recycling; Funding for research to develop alternative materials based on the same mechanisms as natural polymers; Funding to develop infrastructures and technologies that maximise plastics value retention.	Extended producer responsibility schemes Set up a plastics oversight board for strategic planning and long-term investment; Information and business guidance on applying systems thinking in the context of the plastics value chain; Develop and implement a plastics product information system across the value chain
Circular economy - New materials and technologies (compostable plastic, new processes such as use of microbes to produce plastic, etc.) to replace traditional plastics	
Financial incentives and support systems to ensure continuity for implementing industrially attractive R&I projects on alternative processes and/or materials; Funding to develop educational programmes and to stimulate multidisciplinary	Business guidance to incorporate behavioural sciences, digital, marketing and commercial expertise in R&I projects;

exchanges; Funding for investments in strategic infrastructure for the production at scale of novel nature-based plastics	
Circular economy - Novel processing and handling technologies for plastics	
Financial incentives to selective industries in the plastics value chain to convert to a circular economy based on recycled plastics or biological feedstock; Financial incentives to safely recycle or replace thermoset and cross-linked plastics; funding for research into alternative plastics manufacturing and processing technologies that enable value retention	Develop and implement digital techniques to register and follow which actor added what substance to a product throughout the supply chain; Set up and maintain a collaboration platform and open marketplace for science and technology exchange related to plastics;
Circular economy - Biological feedstock	
Financial and regulatory incentives to support the scale-up of biobased plastics and chemicals to move towards a low-carbon economy; Financial incentives and investments to ensure continuity for implementing industrially attractive R&I projects on bio-based materials	Develop strategic planning for scaling biorefineries related to plastics and chemicals production; Information for business on the differences and similarities in performance of biobased polymers and chemicals compared to fossil-based counterparts; Set up an oversight organisation to track existing and expected inventories of non-fossil-based feedstock.

Source: European Commission, 2019a, European Commission, 2018d

Annex 2. Coordination of funding instruments

FUNDING AREA	AVAILABLE FUNDING INSTRUMENTS AND THEIR SCOPE
INNOVATION	
Research and innovation into low-carbon, green and circular technologies	**ERDF** can support innovation by enhancing research and innovation capacities and the uptake of advanced technologies, reaping the benefits of digitisation for citizens, companies and governments, enhancing growth and competitiveness of SMEs and developing skills for smart specialisation, industrial transition and entrepreneurship. **ESF+** can provide support for skills for smart specialisation, skills for key enabling technologies, industrial transition, networking activities and partnerships between higher education institutions, vocational and educational training (VET) institutions, research and technological centres and enterprises and clusters; **JTF** is available for funding investments in the creation of new firms, including through business incubators and consulting services; (c) investments in research and innovation activities and fostering the transfer of advanced technologies; **Horizon Europe** supports researchers through fellowships and exchanges as well as funding to projects, it directly supports research relating to societal challenges, and market-creating innovation. **Digital Europe Programme** supports digital transformation of public services and businesses. **EU ETS allowance revenues** can be used to finance research and development in energy efficiency and clean technologies under the Directive, develop technologies that contribute to the transition to a safe and sustainable low-carbon economy, and the environmentally safe capture and geological storage of CO_2. **InvestEU** provides support for research and innovation, digital networks, scaling up larger innovative companies and artificial intelligence. **EIB** supports investment in the digital economy, SMEs and research and innovation **Innovation Fund** can support the demonstration of low carbon technologies (low-carbon technologies and processes, carbon capture and utilisation (CCU), carbon capture and storage (CCS), innovative renewable energy generation, energy storage) **Recovery and Resilience Facility** focuses on public investment and reforms in the field of research and innovation.
SCALING UP	
Funding area	**Available funding instruments and their scope**
Physical investment in the climate neutral economy	**ERDF and Cohesion Fund** can support climate mitigation by promoting energy efficiency measures, promoting renewable energy, developing smart energy systems, grids and storage at local level, investing in sustainable national, regional, local and urban mobility. **JTF** can support the deployment of technology and infrastructures for affordable clean energy, in greenhouse gas emission reduction, energy efficiency and renewable energy, **EAFRD** can contribute to climate change mitigation and adaptation, as well as sustainable energy, and improving biodiversity while providing climate friendly feedstock

	to the climate neutral economy. **EU ETS allowance revenues** can be used to develop renewable energies and to increase energy efficiency, for measures intended to improve energy efficiency, district heating systems and insulation, as well as to encourage a shift to low-emission and public forms of transport. The **Modernisation Fund** can support investment to modernise energy systems and improve energy efficiency, in Member States with a GDP per capita at market prices below 60 % of the Union average **InvestEU** supports investment in sustainable energy. **EIB** can support investment in energy efficiency, renewables, power grid and energy innovation, near zero emissions public transport, energy efficient buildings, smart cities **LIFE** can support revenue-generating or cost-saving pilot projects promoting the preservation of natural capital, including climate change adaptation projects, through the Natural Capital Financing Facility (NCFF) **Recovery and Resilience Facility** is focused on public investment and reform for a green transition. **Modernisation Fund** supports 10 lower-income EU Member States in their transition to climate neutrality by helping to modernise their energy systems and improve energy efficiency through investment in renewable energy, energy efficiency, energy storage and energy networks.
Physical investment in the green economy	**ERDF and Cohesion Fund** can support investment in the green economy by promoting climate change adaptation, risk prevention and disaster resilience, enhancing biodiversity, green infrastructure in the urban environment, and reducing pollution. **JTF** can support investments in regeneration and decontamination of sites, land restoration and repurposing projects. **EAFRD** can contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes. **EU ETS allowance revenues** can be used to support forestry sequestration **EIB** can support investment in forestry, agriculture, urban environment, urban regeneration **Recovery and Resilience Facility** is focused on public investment and reform for a green transition.
Physical investment in the circular resource-efficient economy	**ERD**F and Cohesion Fund can support investment in the circular resource-efficient economy by promoting sustainable water management and the transition to a circular economy. **JTF** can support investments in enhancing the circular economy, including through waste prevention, reduction, resource efficiency, reuse, repair and recycling. **EAFRD** can foster the sustainable development and efficient management of natural resources such as water, soil and air. **InvestEU** is available to fund investment in the circular economy, water, waste and other environment infrastructure **EIB** supports investment in circular cities, solid waste management and water and sewerage **Recovery and Resilience Facility** is focused on public investment and reform for a

	green transition.
Implementation of EU environmental and climate legislation	**LIFE** is available for investment in nature and biodiversity, the circular economy, climate mitigation and adaptation and clean energy.
JUST TRANSITION	
Funding area	**Available funding instruments and their scope**
Employment, education and skills	**ESF+** can provide support for improving access to employment of jobseekers, modernising labour market institutions and services, adaptation of workers to change, improving the quality, effectiveness and labour market relevance of education and training systems, and promoting education and training as well as flexible upskilling and reskilling. It can also provide skills for industrial transition, and support a greener, climate neutral Europe through the improvement of education and training systems necessary for the adaptation of skills and qualifications, the upskilling of all, including the labour force, the creation of new jobs in sectors related to the environment, climate and energy, and the bioeconomy. **ERDF** can support the enhancing the effectiveness of labour markets and access to quality employment through developing social innovation and infrastructure, improving access to inclusive and quality services in education, training and life-long learning through developing infrastructure, and increasing the socioeconomic integration of marginalised communities, migrants and disadvantaged groups, through integrated measures including housing and social services. **JTF** provides support for upskilling and reskilling of workers, job-search assistance to jobseekers and active inclusion of jobseekers. **EAFRD** can promote employment, growth, social inclusion and local development in rural areas, including bio-economy and sustainable forest management. **EGAF** provides financial support to dismissed workers, for job search, careers advice, education, training and re-training, mentoring and coaching and entrepreneurship and business creation. Responds to events, can be used where over 500 workers are made redundant by a single company (including suppliers and downstream producers), or if a large number of workers are laid off in a particular sector in one or more neighbouring regions. **EU ETS allowance revenues** can be used to promote skill formation and reallocation of labour in order to contribute to a just transition to a climate neutral economy, in particular in regions most affected by the transition of jobs. **InvestEU** is available to fund investment in skills, education, training, schools and universities. **EIB** supports investment in education and training, **Recovery and Resilience Facility** focuses on public investment and reforms in the field of health, education and skills, and jobs.
Compensatory payments	**ESF+** can provide support for addressing material deprivation through food and/or basic material assistance to the most deprived, including accompanying measures. **EU ETS allowance revenues** can be used to provide financial support in order to address social aspects in lower- and middle-income households; **National, regional and local funding instruments** can be used for unemployment benefits, early retirement, financial support during reskilling, protection of vulnerable consumers from high energy prices, etc.

Enterprise support, SMEs	**ERDF** can support enhancing growth and competitiveness of SMEs and developing skills for smart specialisation, industrial transition and entrepreneurship. **ESF+** can provide support for adaptation of enterprises and entrepreneurs to change and support to micro, small and medium sized enterprises and the social economy. **JTF** provides support for productive investments in SMEs, the creation of new firms, in research and innovation activities **EAFRD** can facilitate business development in rural areas and can promote growth in rural areas. **InvestEU** provides support for SMEs and small mid-cap companies. **EIB** supports SMEs including innovative companies **Recovery and Resilience Facility** focuses on public investment and reforms in the field of competitiveness, resilience, productivity
Physical infrastructure investment (transport, energy, broadband)	**ERDF and Cohesion Fund** can support developing TEN-T, developing national, regional and local mobility and promoting urban mobility. **ERDF** can support investment in enhancing digital connectivity. **EAFRD:** Can support investments in digital infrastructure (broadband roll-out) in rural areas **JTF** provides support for investments in the deployment of technology and infrastructures for affordable clean energy, in greenhouse gas emission reduction, energy efficiency and renewable energy; investments in digitalisation and digital connectivity; **CEF** is available for funding investment in TEN-T, TEN-E and high capacity and backbone digital networks. **EU ETS allowance revenues** can be used to encourage a shift to low-emission and public forms of transport. **InvestEU** is available to fund investment in sustainable infrastructure, including sustainable energy, digital connectivity, transport. **EIB** supports transport infrastructure, transport innovation, near zero emission public transport and investment in power grids, **Recovery and Resilience Facility** is focused on public investment and reform for a digital transition.
Social infrastructure investment	**ERDF** can support equal access to health care through developing infrastructure, including primary care. **ESF+** can provide support for modernising social protection systems, including social protection, healthcare and long-term care services. **EAFRD** can support investments for basic services in rural areas **EIB** can provide support for education and training, health infrastructure, medical research and e-services (e-health, e-learning) **InvestEU** can fund hospitals, healthcare, long-term care and accessibility, social innovation, social enterprise and social housing. **Recovery and Resilience Facility** focuses on public investment and reforms in the

	field of health, education and skills.
Integrated development of regions and communities	**ERDF** can support fostering the integrated social, economic and environmental development, cultural heritage and security in urban areas and for rural and coastal areas also through community-led local development. **ESF+** can foster active inclusion and promoting equal opportunities, promote socio-economic integration of marginalised communities, and promote social integration of people at risk of poverty or social exclusion. **EAFRD** can promote social inclusion and local development in rural areas, including bio-economy and sustainable forest management. **EIB** supports regional development (SMEs, R&I, clean environment, energy efficiency and tackling climate change, strategic infrastructure, including improving access to digital technology, urban environment and TENs) **Recovery and Resilience Facility** focuses on public investment and reforms in the field of economic, social and territorial cohesion, and smart, sustainable and inclusive growth. **Modernisation Fund** supports 10 lower-income EU Member States in their transition to climate neutrality by supporting the just transition in carbon dependent regions.

Source: own compilation based on respective EU regulations and regulatory proposals and legislative factsheets

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