Organisation for Economic Co-operation and Development

Background note: Water investment planning and financing

January 2022

For the thematic workshop on 15 – 16th February 2022

This background note aims to inform and support discussions at a first thematic workshop, co-convened by the OECD and the European Commission's Directorate-General for Environment. The workshop is part of a series aimed to facilitate the implementation of the economics of the Water Framework Directive in European Member States. The background note builds on existing literature and experience of EU Member States. It may not reflect the opinion of the OECD, the European Commission or their Member States.

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1 Purpose of this note and suggested outcomes

This note provides background information for a thematic workshop co-convened by the European Commission, Directorate-General for Environment and the OECD. The workshop is part of a series aimed to facilitate the implementation of the economics of the Water Framework Directive in European Member States. This note aims to present options to improve the performance of investments for sustainable water resource management and flood protection.

Water-related investments often underperform or yield sub-optimal outcomes (with possible spill-over effects, such as undermining the achievement of other environmental objectives). Under certain circumstances, costly options are implemented because of conservative planning practices or financing models. In other contexts, investments keep building future liabilities, exacerbating financing needs now and in the future (for instance, when real estate developers build property in flood plains or coast lines).

Strategic investment planning can improve the performance of water investments, when taking account of all major positive and negative outcomes of an investment for all stakeholders and the broader system and when linked to a clear financing strategy. This paper discusses three sets of issues related to strategic investment planning and financing:

1. Investment planning in an uncertain context. Climate change, in particular, generates uncertainties about future water demand and availability, and exposure to water-related risks. This affects how infrastructures and assets can be designed, operated and financed and calls for resilience-based scenario planning.

2. The benefits of supplementing project level planning with a consideration for pathways of investments. Such a shift from individual project planning to the sequencing of projects can enhance the multiple values added by water-related investments, and contribute to innovative financing models. A pending issue is the lack of analytical tools to inform such a shift.

3. Facilitating access to a wider range of financing sources, most importantly commercial finance. Strategic ways to translate the value of water-related investments and to share and finance risks can help harness a range of private sources of funding, in combination with public ones.

Working along these lines at both national and sub-national levels, Member States can enhance the value created by investments in line with the Water Framework Directive at the least cost for communities and decreasing reliance on public finance.

2 Investment planning for uncertainty

Recent droughts and floods around Europe are timely signals that past weather patterns are no guide to the future, and that resilience to water risks is likely to be tested more harshly. For example, drought can happen in countries perceived as not water stressed. The frequency of drought events can test supply systems and challenge assumptions about their reliability. For example, in Northern and Western Europe, severe droughts in 2002-03, 2005-07 and 2011-12 all broke meteorological records in some way, and have led to a re-think about drought planning and supply resilience.

In the context of rising uncertainties, techniques using scenario planning and resilience modelling can help plan for secure supplies and a healthy environment. This chapter describes how Member States can (1) use resilience-based approaches and address uncertainty related to climate change. It then discusses (2) the use of scenarios and highlights practical examples in European Member States.

2.1 Resilience thinking to deal with uncertainty

In addition to droughts and floods, a range of threats exist, which can lead to a system's failure but which are not routinely considered in planning or operational thinking. Therefore, accounting for a variety of threats using an integrated system approach is vital.

A **water system** is the whole made from connected hydrologic, infrastructure, ecologic, and human processes that involve water and freshwater ecosystems. It includes bio-geophysical processes, such as the hydrologic cycle and ecosystem functioning, as well as human processes, including the construction, operation, and removal of infrastructure, and other human decisions and water uses (Brown et al., 2015[1]).

Stressors to water systems are shocks and uncertainties to which the water system must respond. They include incremental stresses from demand growth or from temperature and precipitation changes driven by climate change. Stressors also include disruptions – from 'routine' power failures, communications losses, and staff shortages due to extreme and unexpected events, such as flooding, droughts, earthquakes, fire, terrorism, and epidemics. Common stressors impacting water systems can be operational, socio-economic, climate and environmental stress or stress due to unexpected shocks (Brown and Boltz, forthcoming[2]). Figure 2.1 gives examples of different types of illustrative stressors, which would need to be adjusted according to the system in question and the operating environment of the user.

Figure 2.1. Stressor categorisation and examples

	Internal	External
Chronic	• Insufficient rehabilitation • Resource depletion / degradation • Loss of collective skills and knowledge • Incremental innovation • Lack of investment	• Climate change • Urban creep • Population growth • Demographic change • Stringent regulation • Increasing affluence
Acute	• Insufficient maintenance • Accident • Human error • Strike action • Poor management	• Extreme weather • Natural disaster • Power outage • Sabotage • Riot/ war • Political pressures

Source: (Butler et al., 2016[3])

Design for resilience instead of risk-based approaches

Water infrastructure development and adaptation to stressors, such as extreme weather events, have historically been guided by **designs for robustness** - the ability of the infrastructure to tolerate anticipated extremes, minimizing disruptions through a risk-based approach emphasizing control, armouring, and strengthening as opposed to enhancing flexibility and adaptability (Markolf et al., 2018[4]).

Now, the robustness strategies' effectiveness is undermined by climate variability, unpredictability and increasing uncertainty about future conditions. Rather than designing for robustness, approaches to water infrastructure development and investment must be placed on increasing the ability of water systems to adapt and transform to varying internal and external conditions – to build their **resilience** to changing futures (Chester and Allenby, 2018[5]; Markolf et al., 2018[6]).

The **resilience** of a water system refers to its ability, by its design and operation, to sustain its function and expected services under stresses and shocks (Brown and Boltz, forthcoming[2]). Recognizing that our vital water systems are not suited to cope with the changing climate, in recent years, scientists and policy-makers have mounted a growing effort to develop and adopt a **resilience-based approach** to water system planning and investment (Rockström et al., 2014[7]).

Incorporating resilience into water-related investments strengthens a water system's robustness to predicted events and residual risks. It enables it to adapt to changing conditions and recover from extreme events. Building resilience reduces the risks of system failure during extreme events, thereby reducing the likelihood of disruptions to economies, losses of lives, and livelihood (Brown and Boltz, forthcoming[2]). Along with investment in risk reduction measures, resilience can reduce the costs of recovery when extreme events occur (OECD, 2022[8]). The massive financial outlays and long timespans of most water system investments combined with increasingly uncertain climate futures make a resilience-based approach to water system development and investment strategic, if not imperative.

Governments and regulators should challenge water service providers to consider resilience in their planning and operational activities. In England and Wales this has become routine, as the economic regulator Ofwat has been given a statutory responsibility to promote resilience among the companies it regulates. In the US, the EPA Water Infrastructure and Resiliency Finance Center provides technical advice and financial support and innovation to communities and stakeholders for resilient water infrastructure projects. The Center supports solutions to address systemic threats and cooperates with federal agencies, states and water industry leaders, for example in a National Drought Resiliency

Partnership (EPA, 2021[9]). The next section documents how climate change is factored in Member States' decisions in relation to the WFD

Addressing climate change in the implementation of the Water Framework Directive and the Floods Directive: An overview

Many of the stressors for sustainable water resource management are exacerbated by climate change. Impacts of climate change manifest through the water cycle and have significant effects on sustainable water resource management. Besides increasing frequency and intensity of extreme events, such as heavy precipitation or droughts, it also affects rainfall patterns more generally, snow melt, river discharge and water availability. Climate-induced sea level rise puts coastal areas at increased flood risk (IPCC, 2021[10]). Further, higher temperature resulting from global warming can stimulate the growth of harmful algae and bacteria, degrading water quality. Water-related hazards can cause additional water pollution, e.g. floods triggering disruption of treatment facilities, sea level rise leading to saline intrusion to groundwater reservoirs or heavy rainfalls causing pollutant loadings (Kerres et al., 2020[11]). Climate change will also affect water demand, such as increased irrigation water demand from agriculture or rising water demand for cooling in the energy sector, exacerbating competition for water and allocation challenges across sectors.

In a European context, these projections create additional pressures and significant challenges for the achievement of and the compliance with the objectives of the Water Framework Directive (WFD) and Floods Directive (FD) in the future. Also, there is significant uncertainty around how climate change effects will manifest on a regional and local level, as well as on the timing, magnitude and location of specific impacts (Kerres et al., 2020[11]). These uncertainties make planning and managing climate-related water risks a complex issue and renders resilience-based planning approaches even more vital.

In 2019, the Fitness Check of the WFD and FD highlighted that both "Directives are sufficiently flexible to address emerging societal challenges such as water scarcity, climate change, and pollutants of emerging concern such as (micro)plastics or pharmaceuticals" (European Commission, 2019[12]).

In the case of the WFD, European Member States (MS) are not explicitly required to include climate change in their River Basin Management Plans (RBMPs). The FD, on the other hand, does have an explicit requirement for MS to account for the impacts of climate change on the occurrence of floods[1] (European Commission, 2019[12]).

However, in the case of the WFD, Annex II to the WFD refers to the need to identify all 'significant pressures' affecting water bodies. This identification of pressures, together with the cyclical nature of the implementation, provides the framework for Member States to incorporate the expected impacts of climate change (both on water quantity and quality) and the updated scientific and technical knowledge into their planning process (European Commission, 2019[12]). This flexibility and cyclical nature of the WFD promotes adaptive management that allows for dealing with uncertainty, and thus has the potential to build resilience to climate change (Puharinen, 2021[13]).

The EU's long-term priority objective for 2050 is for its citizens to live well, within the planetary boundaries in a regenerative economy (European Commission, 2020[14]). Having this in mind, and given the long lifespan of water infrastructure, it is important that RBMPs in general, and water investment planning in particular, are resilient to a range of potential future climate scenarios and are designed with increasing climate risks built in. Thus, as acknowledged by the EU Member States, the design of measures with long design life and high costs need to integrate long term climate projections. It is also key that the assessment of pressures takes account of the changing climate (European Commission, 2019[12]).

[1] This requirement applies from the second PFRAs and FRMPs onwards (Article 14).

In this respect, the European Commission provided specific guidance to MS through the Common Implementation Strategy process on how to integrate adaptation within key steps of RBMPs (European Commission, 2009[15]). Notably, the WFD requires a 6-year planning cycle, and the programming has to be informed by long term forecasts on the human impacts on water bodies and on water supply and demand. These requirements seem to allow to adapt the water management planning to demand of long-term climate policy objectives.

However, there appear to be two challenges for such a flexible forward-looking approach: first, the inertia coming from the long lifetime of water facilities, and second, the current pressure of the 2027 deadline, dictating investments. Many River Basins need to take urgent action to achieve "good status" by 2027, as most of the exemptions foreseen in the WFD will then expire. There is a risk that this deadline for compliance leads to suboptimal investments choices from the long-term perspective.

The following section explores how climate change projections and uncertainties have been integrated in European RBMPs so far (up to the second planning cycle).

In practice: Integrating climate change in European RBMPs

The Integrated Assessment of the 2nd River Basin Management Plans (European Commission, DG Environment et al., 2019[16]) pointed out some weaknesses in the integration of climate change in European RBMPs, namely:

- Many management plans lack a comprehensive assessment of threats and stressors, including water scarcity and drought[2], desertification, climate change risk and the water resource consequences of land use trends. This was corroborated by the findings of the 5th Implementation Report (European Commission, 2019[17]): in only about half of the MS, droughts were considered as a relevant feature for water management and Drought Management Plans have not been adopted in all relevant River Basin Districts (RBD);
- The analyses deployed for the development of Programmes of Measures (PoMs) have given attention to *Pressures* (e.g. chemicals) on and the *State* of water systems, while paying limited attention to *Drivers* underlying the pressures (e.g. economic activities) and their *Impacts*. In the case of water abstraction – which is closely connected to climate change adaptation actions - the dynamic character of social and environmental systems and the related uncertainty in the planning process have not been addressed adequately in many MS. Additionally, it is often difficult to confirm how measures related to abstraction would work under future conditions, which may substantially differ from the prevailing ones. The lack of attention given to drivers limits the possibility to identify cost-effective measures that address threats at source, deliver long-term benefits and strengthen resilience. The priority given to further refining assessments of pressures and status could be challenged, and the development of more holistic assessments tools could be fostered.
- When looking at stressors which translate across sectors, the Fitness Check pointed to the existing trade-offs related to the strong pressures from nitrates and pesticides and from water abstraction, and to the possible synergies between, on the one hand, Community water policy and its implementation through the 2nd RBMPs, and, on the other hand, agricultural policy in the framework of the CAP (European Commission, 2019[12]). Neither historic trends nor transition pathways for the agricultural sector are analysed, as the RBMPs take the agricultural drivers as granted, reflecting policy implementation in silos, limiting the capacity of measures to foster water systems resilience (European Commission, DG Environment et al., 2019[16]). However, the European Green Deal has taken up this challenge to improve the cross-sectoral synergies in water management. For instance, the CAP does no longer provide financial support for the expansion of irrigation in

[2] In this respect, it has to be noted that WFD Annex III on the mandatory economic analysis requires to "[take] account of long term forecasts of supply and demand for water in the river basin district."

areas where the water bodies are not in good status. Another important example concerns the ongoing development of an EU taxonomy for sustainable finance, including investments in sustainable water resource management (see Chapter 4).

- In all RBDs, except for some river basins in a few MS, a climate check of PoMs has been carried out. Most MS reported the use of the CIS Guidance Document No. 24. Specific sub-plans addressing the issue of climate change have been reported for a few MS.

Two years later, MS have made progress in the integration of climate change adaptation in RBMPs. Puharinen (2021[13]) notes that water managers have been able to evolve management plans in response to pressures and environmental effects that have not been explicitly addressed in the Directive itself, including climate change impacts such as droughts and periods of water scarcity. Such progress clearly emerges in the 6th Implementation Report of the European Commission (European Commission, 2021[18]) in particular related to **water abstraction and water efficiency**:

- Water efficiency was, and continues to be, a high priority for Member States – reflecting overall EU policy priorities, as shown in Box 2.1 below. Over half of them took measures in the previous cycle (2010-2015) and will continue to do so in the future. A further group of 10 countries took measures in the previous cycle but report no additional plans for measures in the future;
- Water abstraction and flow diversion are reported by MS as main pressures. Quantitative measures associated to reducing these pressures and their impacts, such as improvements in flow regime and/or establishment of minimum ecological flow (key type of measures - KTM 7) and technical measures to improve water efficiency (KTM 8) were reported by almost half the MS. Overall, significant progress can be seen on basic measures addressing water abstraction. Almost all MS reporting on abstraction have a permitting regime or register to control abstraction, and most MS have a concession, authorization and/or permitting regime in place.
- In anticipation of the new regulation on minimum requirements for water reuse, eleven Member States included reuse of water in the PoMs as a measure to manage water resources;

In contrast, when looking at specific measures on **adaptation to climate change** (KTM 24), it appears that more efforts would be needed. Although pressures on the availability of clean freshwater in sufficient quantity are expected to increase as a consequence of climate change, only six Member States reported actions for surface water, and four reported actions for groundwater. Most of the Member States reported diffuse pollution, abstraction or flow diversion, physical alteration and dams, barriers and locks as the main pressures (European Commission, 2021[18]).

Box 2.1. Water efficiency at the centre of the EU Policy Agenda

As part of the Green Deal, water efficiency is now a solid part of the EU policy agenda. The Circular Economy Action Plan highlighted the future role of the 2020 regulation on minimum requirements for water reuse. The latter will facilitate an alternative water supply for irrigation as part of integrated water management. The Circular Economy Action Plan also announced that the Commission will facilitate water efficiency in industrial processes (e.g. by revising the Industrial Emissions Directive). The 2021 EU Strategy on Adaptation to Climate Change calls for safeguarding freshwater access and more efficiency of water use in all sectors and announced that the Commission will help reduce water use by raising the water-saving requirements for products. Transition to water-saving technologies and practices needs to be supported with relevant economic instruments.

Overall, through the European Green Deal, a water resilience agenda has started to emerge, with attention to water efficiency in various legislative reviews and in horizontal strategies such as the Circular Economy Action Plan and EU Climate Adaptation Strategy. There is also progress on this issue at sectoral level, for instance in agriculture, energy and transport. It is vital that this integration is further strengthened.

Source: (European Commission, 2021[18])

In practice: Integrating climate change in European Flood Risk Management Plans

Among the present and future impacts of climate change, the risk of flooding, inundations and flash floods, due to the rise of sea level and flash rains ranks among the major policy challenges in this policy domain . With the Floods Directive, the EU has a legal framework that is fit for purpose, but its potential can only be reached in the future, to start with Member States' second of Preliminary Flood Risk Assessments (PFRAs) and the Flood Risk Management Plans (FRMPs). Reducing flood risk where and when it matters most is a matter of consistent implementation that requires attention over a long period and cooperation across borders. The dramatic events of summer 2021 in Europe show that much remains to be done to reduce flood risk effectively. As mentioned earlier, Article 14 of the FD requires reviews and updates of each of the three flood risk management steps. It specifically requests that the impact of climate change on the occurrence of floods is taken into account as part of the review process of the PFRAs and the FRMPs (European Commission, 2021[19]).

The **6th Implementation Report** (European Commission, 2021[19]) found that:

- Fourteen MS presented strong evidence of the impact of climate change, whilst eleven presented some evidence and one MS did not report any evidence;
- Four MS explicitly mentioned their national adaptation strategy. Seven MS mentioned the IPCC scenarios, although in almost all cases it is not clear from the information provided whether the findings have been used as the basis for future work;
- Five MS explicitly stated that they have used modelling studies to assess the impact of climate change on flood risk.

In the second cycle, Member States have given more consideration to the impact of climate change on floods than in the first cycle, with most countries having carried out assessments. However, in many cases it is not clear how the results of the studies have been incorporated into the PFRA and/or been taken into consideration in the selection of Areas of Potential significant Flood Risk (APSFRs) (European Commission, 2021[19]).

The lack of reference to the national adaptation strategies in many Member States is a finding that requires follow up, given concerns that climate change will affect flooding patterns in many Member States. Notably, the European Climate Law – adopted in June 2021 - requires Member States to “develop and implement adaptation strategies to strengthen resilience and reduce vulnerability to the effects of climate change.” Surely, the findings of FRMPs would constitute a major input to the national adaptation strategy–.

Current issues experienced by MS with integrating climate change into flood risk management – and, in particular, in the context of the second cycle of the Floods Directive – have been discussed in the Working Group on Floods (WGF3) of the Common Implementation Strategy (CIS). In 2019, the WGF3 concluded that, in this respect, MS could (HR Wallingford & Wood, 2021[20]):

- Address uncertainties related to climate change and floods through enhanced research on climate scenarios and the impacts of climate change on future floods;
- Derive pertinent measures making appropriate use of EU modelling tools, such as those available through the Copernicus Climate Change Service;
- Coordinate the FRMPs with national climate change strategies and their adaptation measures.

In 2020, MS contributed to a survey on how to improve the planning and implementation of flood risk management in the EU, with respect to the impact of climate change on floods. This allowed for the identification of the main challenges that Member States face when factoring the impact of climate change into flood risk management, namely (HR Wallingford & Wood, 2021[20]):

- Uncertainty related to future flood risk and addressing the local scale;
- Better identification of tools and measures and corresponding guidance, aimed at a robust adaptation to future flood risk;
- Coordination of input from various working groups/platforms;
- Lack of the so-called ‘climate change factors’, for different regions of a country and emission scenarios, which serve as key input to adjust hydrological variables in long-term flood risk scenarios (e.g. flood flows & intense rainfall);
- Substantial differences between various projections of flood hazard and risk over the country reported by different researchers.

The survey results also identified potential solutions to move forward, namely (HR Wallingford & Wood, 2021[20]):

- Addressing the issue of the “stationarity assumption” in flood frequency estimates (i.e. the estimates are based on the assumption that the mean and variance of the flood event probability are constant over time, since the available time series tend to be too short to separate a secular trend from the natural climate variability cycles spanning decades);
- Improving the process of integrating climate change science into flood risk management practice;
- Using a risk-based approach;
- Using online tools to provide a portal for flood and rainfall information under climate change.

Recently published technical guidance on the climate-proofing of infrastructure projects for the period 2021-2027 , further supports Member States in mainstreaming climate considerations in future investment and development of infrastructure projects, including floods related infrastructure. The next CIS work programme for the period 2022-2024 provides an opportunity to further intensify the work on climate change and flood risk management (European Commission, 2021[19]).

Focus on economic appraisal in WFD and FD implementation in the context of climate change

Economic appraisal tools applied in the production of European RBMPs can provide useful indications on how climate change considerations are actually incorporated in river basin planning and, in particular, how they have informed the selection of cost-effective measures. Such appraisal procedures and parameters can range from the selection of benefits to be considered to the choice of the discount rate. A recent study (European Commission, DG Environment, 2021[21]) highlighted how choices on (the modalities in) appraisal methods can have implications for climate change adaptation decisions in water management. The study concludes that the tools that have been used, often fail to grasp the full range of environmental benefits, including climate benefits.

The completeness of cost-benefit analyses differs across applications in RBMPs and FRMPs in terms of the benefits considered. Most cost-benefit analyses use ‘avoided damage’ as the main benefit category, probably as a result of data availability (e.g. Cyprus[3], Finland, Greece, Lithuania, Slovakia). Due to methodological difficulties, the ‘environmental benefits’ of measures are rarely considered in such analyses, even though they may have an important effect on the outcome of cost-benefit analyses. This is in line with findings of the 5th Implementation Report (European Commission, 2019[17]), which stresses that across all MS, there is little reference to impacts on ecosystem services.

The inclusion of environmental benefits in economic appraisals is especially important for the evaluation of nature-based solutions as they reduce flood risk and produce different co-benefits as a result of their multi-functionality. Examples include natural flood protection measures, natural water retention measures, or green infrastructure. To consider potential co-benefits in economic assessments, some MS combine cost-benefit analysis with multi-criteria analysis (e.g. Bulgaria, Finland, Ireland, Lithuania, Romania). Multi-criteria analyses are particularly relevant when only part of the environmental (and other non-market) benefits can be captured in monetary terms and when it is expected that these impacts will be significant for assessment results and measure prioritization. At the same time, how to properly assess the significance of an environmental impact that defies monetisation remains an open question. Thus, there is a need to build a coherent analytical framework to better support decision-makers in their choice amongst green, grey and hybrid infrastructure solutions (European Commission, DG Environment, 2021[21]).

Overall, full-fledged CBAs are very scarce in both RBMPs and FRMPs. This is particularly relevant for the selection of natural water retention measures with high adaptation potential: in fact, the general outcome is that green infrastructures and water retention measures are widely underused in MS’s PoMs (see also (European Commission, DG Environment, 2021[21])).

There is hardly any discussion on the choice of discount rates even when decisions on climate change adaptation and long-term sustainable water resource management are to be made. When it comes to climate change adaptation, in particular, the lack of an adequate use of discount rates is problematic, particularly with measures addressing water quality and with investments aimed at addressing climate change adaptation, whose benefits may need decades to be evident. Discounting is used as a technical

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[3] Note by Turkey: The information in this document with reference to “Cyprus” relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the “Cyprus issue”.

Note by all the European Union Member States of the OECD and the European Union: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the Government of the Republic of Cyprus.

process to weigh up costs and benefits occurring in the future against those occurring now. It shows the weight we give today to impacts happening in the future. Choices on discounting are sometimes important to properly assess the expected benefits and costs of policy measures, especially in cases where the most relevant outcomes would be expected in years or decades rather than immediately (European Commission, DG Environment, 2021[21]).

2.2 Scenarios and strategic planning approaches to prepare for an uncertain future

The previous section highlighted the importance of planning for an uncertain future, particularly related to climate change. Scenarios can inform today's thinking about strategic decisions through exploring their impact under alternative possible futures. They examine a range of internally consistent, plausible futures, focussing on the policy area under scrutiny, in order to provide a mechanism for thinking through the challenges and opportunities that can arise. Scenarios are most useful when there is uncertainty about some of these exogenous factors that may significantly shape the future and when a range of outcomes is deemed plausible (even if some are more plausible than others).

Scenarios are not attempts to predict the future: rather, a set of scenarios collectively explores the parameter space in which the future might plausibly sit. This allows decisions to be stress-tested against their sensitivity for future developments. This includes to test whether they are robust to alternative directions and whether they risk a lock in to trajectories towards less desirable end states. Given the uncertainties about how long land and water systems can be maintained on their current unsustainable trajectories, this avoids strategic lock-in to "business-as-usual, plus-or-minus" thinking and to wishful thinking (i.e. assuming a future conducive for the specific strategy under consideration).

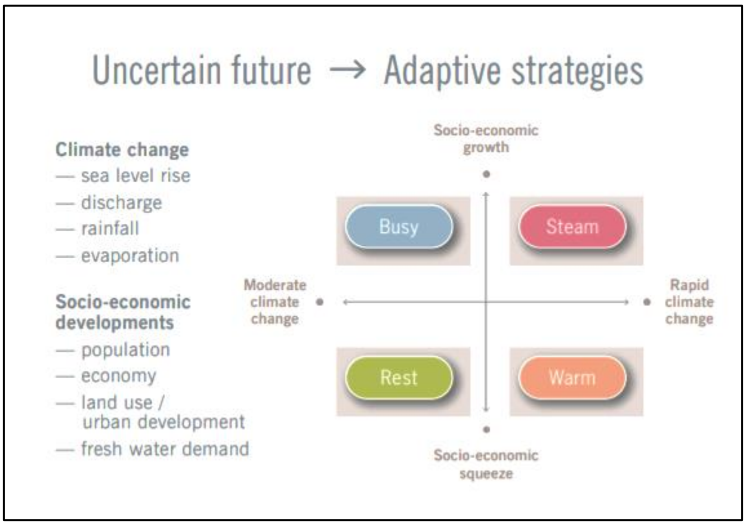
Strategic planning in practice

Several countries already use or develop scenarios or strategic planning for resilience to future threats. The following section discusses selected examples of both the water sector and broader strategic planning approaches as source of inspiration.

Netherlands: The Delta Programme and the associated Delta Fund

The Delta Programme, established with the Delta Act, sets out plans to protect the Netherlands from flooding, mitigate the impact of extreme weather events, and secure supplies of freshwater (Government of the Netherlands, 2020[22]). It is an **adaptive strategy developed to tackle an uncertain future** – Figure 2.2 illustrates uncertainties to be faced, on the one hand, and possible adaptive strategies, on the other hand. (CLC, 2020[23])

Figure 2.2. General adaptive strategies based on climate change and socio-economic parameters



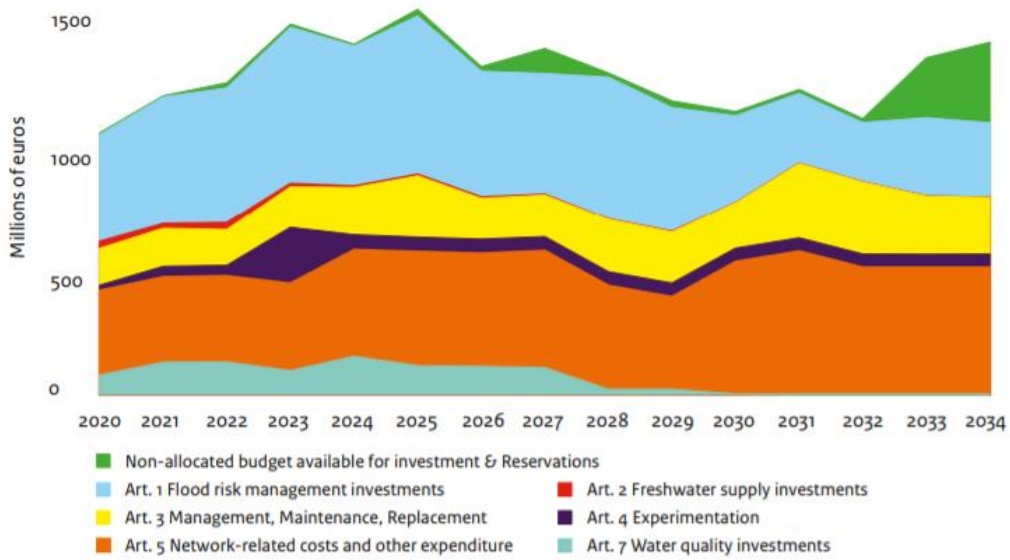
Source: (CLC, 2020, p. 3[23])

Planning for the long-term is integral to the Programme, which also integrates climate change considerations. The Programme has a 2100 planning horizon, while aiming to ensure that the country will be climate-proof and water-resilient by 2050, with standards and guidelines to be progressively implemented under its supervision.

The Programme focuses on integrated master planning that combines flood risk management, freshwater supply and spatial planning. Where feasible, the integrated approach links flood protection to spatial development along the coastal region, with the objective of maintaining a safe, attractive and economically strong coastline. These efforts require an effective governance framework that coordinates across different levels of government, businesses, researchers and the community. To foster this multi-stakeholder collaboration, all stakeholders involved embrace three core values - Solidarity, Flexibility and Sustainability - as mutually binding beyond dispute to guide the organisational and collaborative processes. The strategies used in the planning process are: **(1) Starting now:** Monitoring changes and increasing knowledge; **(2) Using scenarios which show tipping points; (3) Checking robustness and flexibility** of strategies and **(4) Adaptive delta management.** (CLC, 2020[23])

The Programme is financed by The Delta Fund, for which a fixed budget is earmarked each year by the central government, topped up by funds provided by water boards, provinces and municipalities. In the period of 2022 - 2035, the average annual budget is EUR 1.4 billion, with 50% allocated for investments and 50% for organisation, management and maintenance costs (Government of the Netherlands, n.d.[24]). Measures implemented within the Delta Programme are forecasted and budgeted over the long term, as well as the sums to be set aside each year, as shown in the Figure 2.3. Non-allocated budgets generate new scope for investment and in 2034, EUR 309 million will be available for water-related priority policy tasking's. Furthermore, a proportion of the non-allocated budget will be added to ongoing policy reserves, which will be allocated in an adaptive manner, based on ongoing processes such as the assessment of primary flood defences, the Integrated River Management Programme, the Delta Plan on Freshwater Supply, and the Delta Strategy regarding Water Quality and Freshwater Supply (Government of the Netherlands, 2020[22]).

Figure 2.3. Delta Fund Budget up to 2034



Source: (Government of the Netherlands, 2020, p. 122[22])

UK: Water Resources Strategy for England and Wales

The UK Environment Agency used a **scenario-based approach** to develop a Water Resources Strategy for England and Wales. The approach is based on the **two key drivers** for water resources - governance and demand - and overlain with assessments of water availability under climate change projections. The plots for the four scenarios were centred on international governance systems (sustainability led-governance and growth-led governance), and on societal attitudes and behaviour around consumption (dematerialised consumption and materialised consumption). Importantly, the scenarios reflected the breadth of pressures on water systems, from changes in demand across all sectors – municipal, agricultural, industrial and environmental – to different societal attitudes to water use and governance, and under different socio-economic scenarios.

The demand-led scenarios provided an indication of the effects of different socio-economic policies and external evidence. They were then overlain with four climate change scenario assessments of the impact of a changing climate on water availability in each river basin, in order to understand the spatial implications for water availability. Finally, environmental flows were considered; England and Wales use a sophisticated assessment based on Environmental Flow Indicators for each water body, which sets e-flows on a variable basis. The concern for future assessments of water availability for human use under climate change is how much water needs to be left in the river for the ecology. Maintaining e-flows at their current level in the face of declining availability would significantly reduce volumes available for abstraction. However, given the uncertainty regarding what environment will need to be protected in a warmer, lower flow hydrology, it was appropriate to also use scenarios for e-flows, allowing them to adjust pro rata – or not - with resource availability. (OECD, 2018[25]; UK Environment Agency, 2017[26]; UK Environment Agency, 2009[27])

Belgium: Blue Network Strategy in Brussels and 3P-strategy in Flanders

The Brussels Capital Region in Belgium has set up the **Blue Network Strategy** in 1999 as a long-term water strategy, which serves as a guiding principle to reach the objectives of the WFD, Natura 2000, spatial Planning and a Sustainable Development Strategy in an integrated and holistic approach. The measures under the Strategy go beyond the classical wastewater management solutions and include actions for river restoration of the river Senne and its tributary Molenbeek, examining possibilities to reopen the river, rainwater management at the source, in both public and private areas, and the establishment of recreational facilities through the integration of water in the city and the living environment (European Commission, DG Environment et al., 2019[16]).

Flood risk management in *Flanders* in recent decades has been inspired by a growing awareness that protection alone by raising the existing dykes and controlled inundation areas will not be sufficient to deal with existing and future flood risks. Instead the **3P strategy**, whereby a combination of **protection, preparedness and prevention** measures, is applied to set up flood risk management plans. In addition, public authorities and stakeholders have become aware that **participatory approaches** are more successful in the long run, whereby a shared vision on the different functions of river systems (nature, agriculture, urban development, recreation) is developed (European Commission, DG Environment et al., 2019[16]).

France: Creative scenario building for threats in the future

In 2021, the French Ministry of Defence gathered a writers' collective, named the Red Team, to support the country to prepare its defence for threats in the future (Rérolle, 2021[28]). The collective is composed by science fiction authors and scenario developers and worked in close collaboration with scientific and military experts, with the objective of imagining the threats that could endanger France and its interests. This work is expected to allow for anticipating technological, economic, societal and environmental aspects of the future which could potentially generate conflicts to the time horizon 2030 – 2060. In Season 0, the scenario "P-Nation" imagines that, in 2030, climate change causes a series of natural disasters, including a vast desertification of inland areas and rising sea levels; in Season 2, a 100-year flood exacerbates the effects of a biological attack. The scenarios are illustrated in multi-media web pages including videos, simulations and articles. (Red Team, 2021[29]).

Questions for discussion

- Which policy and institutional frameworks are needed to strengthen resilience-based planning for water resource management? Which barriers do you face in your country?
- Which data, knowledge and tools would you consider essential for resilience-based planning for water resource management? Which ones are you using? Which gaps and barriers do you face?
- How to strengthen the link (or consistency) between water resources & flood risks management and national climate adaptation strategies or plans in your country? Do you see potential tensions or misalignments of the WFD and FD approaches with wider time horizons, long-run objectives and general orientation of the adaptation strategy (RBMPs and FRMPs, the selection of measures to comply with the WFD, and longer term horizon for adaptation)?
- How could the European Commission support scenario building and planning under uncertainty? How could such approaches be further used in RBMPs and be reflected in PoM?

3 Water infrastructure investments: from individual projects to investment pathways

Water-related infrastructure investments can lead to both positive and negative impacts on the water resource, through the operation of the resulting facility and through the consequence on the other users of the water resource, e.g. through abstraction, retention, discharges and pollution. It is vital to ensure that infrastructure investments account for all impacts on the entire water system in order to achieve a sustainable and resilient use of water resources. At the same time, a comprehensive understanding of the value created by water-related investments in a catchment or landscape can support financing opportunities.

This chapter focusses on the strategic sequencing of water-related investments, accounting for co-benefits and synergies between multiple projects for a water system. Considering water projects in connection with one another, rather than individually, can provide a more comprehensive assessment of the aggregate value they create, the potential to maximize benefits for the whole system. For example, individual projects could be financially profitable, but still contribute to the deterioration of shared water resources. A project-by-project approach with a narrow focus on "bankability" (the appropriate balance of risks and financial returns (OECD, 2020[30])), forming a pipeline of bankable projects, is not sufficient to account for the full range of potential positive and negative externalities arising from water-related investments nor the long-term implications. Further, the value created by a particular investment for the community, the environment and the economy is best assessed at the level of a sequence of projects defined so as to capture synergies as well as the positive and negative spillovers and because one single project may facilitate - or preclude - the materialization of others. Arguably, the WFD recognizes the importance of coordinating investment projects, as the prescribed economic analysis in WFD Annex III should contain both "long term forecasts of supply and demand for water in the river basin district" and "estimates of relevant investment including forecasts". However, the WFD uses a six-year planning / programming cycle, which may be conducive to coordinating investments in that period, but perhaps less so for investments in the longer term.

Government authorities and project developers could benefit from **sequencing projects** and situating project pipelines within broader strategic investment pathways in order to ensure they are resilient and contribute to sustainable water resource management and sustainable growth over the long term (OECD, 2020[30]). One can consider the River Basin Management planning as a step in that direction, and in particular the Program of Measures as promoting a holistic approach to investments and other measures (European Commission, DG Environment, 2021[21]), but, as discussed above, the longer-term climate change consequences require that this planning takes explicit account of the water sector performance and related investment imperatives beyond the PoM time horizon.

This chapter discusses an analytical framework that can support the design of strategic investment pathways. It can serve as a source of inspiration and basis for a discussion on the strategic planning of water-related investments in EU Member States.

3.1 Strategic Investment Pathways: An analytical framework

The OECD defines a "strategic investment pathway" (SIP) as a way to situate a pipeline of projects that affect exposure and vulnerability to water-related risks within a strategic planning framework, accounting for the spatial and temporal dimension of water resources and related infrastructure investments (OECD, 2020[30]). The SIP approach aims to inform the planning, prioritization and sequencing of projects to achieve long-term resilience and reliable performance of investments over their operational lifetime. In the context of water systems, strategic investment pathways refer to planned and adaptively managed sequences of investments and policies that aim to strengthen long-term water system resilience (Brown and Boltz, forthcoming[2]).

The strategic sequencing of water system investments aims to capture the synergies of aligning multiple, complementary projects across social, ecological and technological domains. Sequencing also considers the long temporal horizon for many water projects, related to the time-to-build and ensuing life-time of the realized water facility as well as to the long-term policy targets and objectives. This allows to make further investment as uncertainties evolve over time, thus strengthening a water system resilience. The "option value" of investments realized in the near term requires consideration of the possibilities that they enable in the future (ibid.).

Strategic investment planning offers value to planners and investors in comparison to project-by-project investment planning methods. In the latter approach, projects address the immediate service gap while consideration of how they may interact with future needs and related investments are not or insufficiently considered. Often, the analysis focuses too much on the immediate follow-up project. In addition, investments are typically evaluated in terms of performance against historical climate conditions, single assumptions as regards other uncertain factors such as demand for water services, and with a narrow, project-confined emphasis on the financial dimension. Now, due to the increasing uncertainty of the future and hence the potential value of planning and carrying out investments in stages so as to adapt to evolving circumstances, the standard investment approach of project-by-project seems set to underperform relative to expectations and to more strategic investment approaches. (ibid)

The synergies and benefits possible through a more strategic planning appear significant in water investments, and for this reason, there is an increased interest in improving the method of river basin planning. Recent large scale examples outside of the EU include analyses of possible investments on the Nile River (Jeuland and Whittington, 2014[31]), the Mekong (Wild et al., 2019[32]), and the Indus (Yu et al., 2013[33]). These studies illustrate the potential for synergies across a cohort of investments. They also highlight methods to incorporate multiple futures and to evaluate various objectives in the design of dam investments at the river basin scale.

In the European context, the WFD specifically introduces the key principles of integrated planning processes at the scale of river basins, ranging from the characterization of river basin districts and water bodies therein to the definition of measures to reach environmental objectives. While Member States have improved in identifying and implementing relevant measures, more work is needed for a better refinement and prioritization of relevant measures. Further, financial planning seemed to be a major challenge for MS, since the lack of finance has created obstacles to the full implementation of the PoMs in 79% of all River Basin Districts (European Commission, 2019[34]).

Brown and Boltz (forthcoming[2]) develop an analytical framework for the design of strategic investment pathways. It is informed by the potential benefits of optimized investment portfolios but remains compatible with the reality of political, discontinuous planning processes that are true almost everywhere (Brown and Boltz, forthcoming[2]). The approach uses a "feedforward" approach, creating strategic investment pathways incrementally, thus aiming to be consistent with typical planning processes.

The analytical framework presented below enables users to:

- understand the water system and set goals for its management, in line with the policy objectives, in Europe, the ambitions and processes of the WFD
- evaluate alternatives for achieving these goals
- determine optimal, adaptive pathways for strategic investment to achieve those goals
- mobilize investment across the value chain and through blended finance of public, private, and philanthropic funding
- navigate resilient strategic investment pathways, through monitoring, forecasting, and adaptive management relative to system changes and key thresholds.

The framework follows five general steps, which are described in detail below and depicted in Figure 3.1.

Figure 3.1. The Sustainable Investment Pathways process in five steps

Source: (Brown and Boltz, forthcoming[2])

Step 1. Setting the stage for analysis

The initial step for water investment planning is to define the water system, as regards its spatial boundaries, main components, stakeholders, and main features of its economic and ecological performance. Several considerations need to be made:

(1) Define the water system under consideration and set spatial boundaries

Defining the water system is a precondition, both for the articulation of goals for that system, and the identification of key system drivers, dependencies and externalities. In view of the latter, the investment planning need to take a systemic approach. Failing to do so can result in system-wide vulnerabilities. In a European context, the River Basin Districts, set out in the WFD, set clearly defined spatial boundaries based on hydro-morphological features.

(2) Engage stakeholders

Participatory planning and decision-making processes are essential to effective actions increasing water system resilience and sustainable water resource management. They enable the identification and negotiation of water system interests and demands from a wide range of stakeholders. To note, the WFD, sets out clear guidelines on stakeholder engagement.

(3) Set goals for water system management and define performance metrics

Setting goals for the water system is, in effect, the translation of the overall policy goals and stakeholder preferences for water services to specific expectations for their provision. The WFD, for instance, provides common goals for water quality across MS. Performance metrics serve as the basis by which project development and management options may be identified, monitored and adaptively managed. Metrics of water system service provision also serve as the basis for understanding and measuring water system resilience.

(4) Address conflicting goals and trade-offs

A single metric cannot do justice to the policy goals and the full diversity of stakeholder preferences in the water sector and it would perform poorly in conveying the unavoidable trade-offs in pursuing them. It is more effective and transparent to understand such trade-offs in their relevant terms (e.g. economic rate of return, distributional equity, species conserved, sustainable water management) (see for instance (Hellegers and Davidson, 2021[35]).

(5) Gather data and select model tools

There is a large and ever-growing number of possible modelling tools that may be used for water investment planning, a few main ones of which presented below in Box 3.1. Next to direct availability for use and resources to use and further develop, two important considerations in model selection are the computational requirements and the predictive uncertainty.

Computational requirements refer to the amount of computing power that is needed to execute the model or models used. Predictive uncertainty is the range of possible differences between the model result and what will happen in reality. It is important to characterize the range of uncertainty in models so that differences in the estimated benefits of different projects can be interpreted appropriately to avoid the mistake of “false precision”.

Step 2. Option Evaluation and Stress Testing

This step describes the process of evaluating the alternative investment options. In the European context, most MS carried out a cost effectiveness analysis to identify relevant measures for the RBMPs. However, limited information is available on the specific methods used across Member States to prioritize measures, and little progress has been made on this aspect since the first PoMs (European Commission, DG Environment, 2021[21]).

Looking at the analytical framework discussed in this chapter, the novel feature of this option evaluation guidance is that it accounts for deep uncertainty, such as related to climate change, and for the effect of sequencing possibilities on each option. Options are evaluated in terms of their individual performance using stress testing to assess performance comprehensively over a wide range of possible futures (for a more detailed description, see the Annex). Step 3 below will look at the effect of sequencing possibilities, namely through evaluating the most promising projects in terms of the strategic investment pathways that they enable as well as those they preclude. The resulting evaluation data is used to design strategic investment pathways.

Step 3. Designing Strategic Investment Pathways

Optimization and stress testing (Step 2) are used to evaluate the full investment pathway for the purpose of selecting the best next investments. The prioritization and sequencing process consists of evaluating each project individually first and then evaluating the most promising projects in terms of their influence on future investments and conversely, the influence of future investments on those projects. By doing so, this approach addresses the concern that the investment pathway overly influences and constrains the specific decision at hand, which is the most immediate investment need. A more detailed description of the approach is presented in the Annex.

Box 3.1. Water resilience analytical approaches and toolkits

Water System Assessment and Planning Tools

River Basin Report Card (RBRC) compares ecological, social, and economic information against predefined goals or objectives, synthesizing large, and often complex, information into simple scores to provide performance-driven numeric grades that reflect the status of a river basin.

Water Governance Indicator Framework (WGIF) considers water governance indicators and direct interview data to inform multi-stakeholder water system assessment and planning for improved water governance. It is applicable across governance scales and water services. See for instance the OECD Water Governance Indicator Framework (OECD, 2018[36]).

Water Supply and Sanitation Utilities Resilience Roadmap (WSS-RR) supports utilities to incorporate resilience in their choices through a 3-step process of – 'knowing the system, identifying vulnerabilities, choosing actions'. The roadmap is adapted from the Decision Tree Framework (described below) to address the needs of WSS utilities.

City Water Resilience Approach (CWRA) is a five-step process and toolkit guiding stakeholder engagement, governance diagnosis, city water system assessment, action planning, and adaptive management of urban water systems, nested within the river and groundwater basins that serve them.

Design Analytics & Decision Support Tools

The Decision Tree Framework (DTF) incorporates climate change and uncertainty into decision-making, through discovery of climate changes likely to affect the water system and their probabilities of occurrence, in order to identify system design options robust to plausible futures.

Climate-Risk Informed Decision Analysis (CRIDA) combines an assessment process with decision guidance. The former concerns a collaborative process for establishing stakeholder priorities through a 'bottom-up' vulnerability assessment of the water system, and the latter decision-guidance that is based upon the robustness and flexibility of alternative system design options.

Eco-Engineering Decision Scaling (EEDS) quantitatively explores trade-offs using engineering and ecological performance metrics as defined by stakeholders, across a range of possible management actions under uncertain future hydrological and climate states.

Resilience by Design (RbD) applies methods of decision making under deep uncertainty to an optimal control approach for resilient water systems analysis, design, and stress-testing. The method generates design options for specific resilience capabilities at least cost and reveals optimal choices for water system performance over a wide range of possible futures.

Robust Decision Making (RDM) is a decision analysis methodology that focuses on identifying and addressing the failure scenarios for different decision alternatives. It uses sensitivity analysis and "scenario discovery" for this purpose. It is specifically designed to address situations of deep uncertainty, where decision makers do not have or cannot agree on a single set of probability distributions to characterize uncertain variables.

Dynamic Adaptive Pathways and Policies (DAPP) couples 'adaptive policy making' - a planning process with different types of actions and signposts to monitor adaptation needs - with 'adaptation pathways', an approach to exploring adaptive actions relative to scenarios of change.

Hydro-economic Modelling Tools

Hydro-economic models are computational software programs that are designed to run a model of water resource systems. Unlike typical hydrologic models, which are constrained by a single set of governing equations (e.g., geophysical principles of hydrodynamics and thermodynamics), hydro-economic models link the geophysical processes to socio-economic processes and constraints, such as human demand for water, infrastructure operations, water withdrawals and return flows, and water allocation policies. Examples include: ECHO, WEAP, and RiverWare. See also Harou et al. (2010[37]) for a conceptual review of approaches.

Source: (Brown and Boltz, forthcoming[2])

Step 4. Mobilizing finance in SIPs

To this point, the SIPs process has focused on evaluating and selecting specific investments based on their expected performance. However, additional considerations are necessary if the investment pathway is to be strategic from a financing perspective as well, in order to reduce risk and inefficiencies in the investment pathway.

There are a range of bottlenecks that hinder the mobilisation of the full range of sources of finance that can contribute to sustainable water resource management. These bottlenecks include weak enabling environments, insufficiently robust strategic planning and prioritisation (which SIPs aims to address), a lack of attractive risk-return profiles for specific projects, and the local, small-scale nature of many investments (OECD, 2022[8]). The following steps address and account for these bottlenecks.

(1) Diagnose the enabling environment for attracting finance

It is widely recognised that water-related investments need robust public policies, regulations and institutional frameworks to function effectively, given the common pool nature of water resources and the public good dimensions of selected water policies and services (OECD, 2019[38]). Such frameworks also have a profound influence on the water sector’s ability to recover costs and thus on its attractiveness to (commercial) investors which helps to secure sustainable financing (OECD, 2022[8]).

A diagnostic tool to assess the strengths and weaknesses of the enabling environment to attract commercial capital is currently under development by the OECD. An indicator scorecard has been designed to collect data from a range of financial actors with indicators grouped into the three categories: *liquidity*, *bankability* and *capacity*. Such a diagnostic tool can be applied in a given country context to highlight the extent to which it may be possible to mobilise domestic commercial finance and where the enabling environment may need further strengthening. A preliminary draft of Money’s paper (forthcoming[39]) provides more detail on this tool.

(2) Map benefits, beneficiaries & potential revenue streams

The benefits from investment in SIPs accrue to distinct sets of beneficiaries. At an aggregate level, investments in sustainable water resource management should seek to maximise social welfare. But determining how such investments should be financed and how benefits can be used as a basis for cost recovery requires an understanding of what types of benefits an investment generates and who benefits from them. This can help to distinguish between investments (or parts of investments) that generate public goods where the benefits (should) accrue to society broadly, such as water resources management and ecosystem preservation, and investments that generate private goods and services, such as some flood protection measures, or water supply and sanitation services that directly benefit households and firms who enjoy the service. Many investments, most notably multi-purpose infrastructure, provide a number of these public and private goods at the same time. Chapter 4 discusses a number of options and instruments to monetise the value of water-related investments.

(3) Tailor financing approach to distinct conditions & design an appropriate financing vehicle

In service of strategic investment pathways, combining finance from various sources enables a targeting of the risk and return profiles of a diversity of investors. Deploying public or development finance, including national or EU funds, and philanthropic capital to reduce investment risk or to enhance returns (for example via blended finance), can attract and leverage commercial capital in certain contexts. Risk mitigation and enhanced returns can inform the prioritisation and sequencing of investments. Appropriate financing vehicles can also help overcome the specific financial features of water-related investments (see Chapter 4).

Step 5. Navigating Resilient SIPs

The creation of a Strategic Investment Pathway is an important final product but not the conclusion of the process. The SIP's ability to adapt and respond to the evolution of external conditions remains only effective with active foresight, i.e. a continuous monitoring of trends and scanning of the future. Therefore, organisations or dedicated bodies with clearly defined roles and responsibilities are needed to ensure regular monitoring, managing and ultimately deciding on actions.

3.2 Concluding remarks

The water investment community in the EU would benefit from enhanced water investment planning, by moving further away from a project-by-project approach and taking more account of synergies between projects over a long period of time. Strategically sequencing projects allows to maximise co-benefits and to reduce negative externalities. It also allows to improve investment performance and to strengthen water system's resilience for future shocks and uncertain conditions. This translates into an improved cost recovery, through enhanced cost discipline and revenue flows, and thus it can also support harnessing new sources of finance, building on the additional value created by a SIP.

Analytical approaches can support the development of strategic investment pathways which detail a pipeline of integrated projects, accounting for flexibility and long-term planning. A pathway approach assesses the investment benefits of the combination of individual projects which accrue to all stakeholders, the economy and the environment, thus accounting for externalities. The analytical approach developed by Brown and Boltz can inspire innovative and more effective planning strategies in Member States. It can help to account for uncertainties and changing climate conditions, in line with developments in chapter 2.

Step 4 of Brown and Boltz' approach discussed how to mobilise investment for SIPs. The following chapter discusses the topic of the mobilisation of various sources of finance for water-related investments and points out challenges and opportunities for private investment in the sector.

Questions for discussion

- What is your experience with the limitations of the current practice for water-related investment planning? Do you recognise the bottlenecks flagged in this chapter, such as a lack of synergies across water-related investments over time and across segments of the water sector inconsistency across geographical scales; the difficulties to reach the WFD objectives while taking account of the long-term)?

- Would you consider the approach of strategic investment pathways an improvement in planning and managing water-related investments in your country? Which difficulties and barriers would you anticipate and how could they be addressed?

- To which extent does the investment planning in the (set of) PoM(s) allow for or promote investment coordination?

- What kind of governance arrangement would be required to implement SIP in practice? Who might lead as enabler or facilitator? What should be the relation between the water sector and the (planning) authorities?

- Should / Can distinct policies provide an incentive towards strategic investment pathways? Is there a role for the European Commission, in the context of water regulation or else?

4 Harnessing multiple sources of private finance

4.1 The financing challenge

Achieving the objectives under the WFD requires significant investments, now and increasingly in the future. The total capital investment costs of measures planned in the 2nd RBMPs of the WFD reach at least EUR 142 billion and total flood risk mitigation costs planned in the 1st FRMPs reach at least EUR 14 billion[4]. Operation and maintenance costs of measures[5] from 2016 - 2021 amount to at least EUR 14 billion annually (European Commission, DG Environment, 2021[21]). Data on funding and financing needs, however, are scattered, heterogeneous and incomplete across EU Member States and few countries report on future investment needs. The need for flood protection will also rise in the coming decades - without adaptation action, flood damages from the combined effect of climate and socio-economic changes are projected to increase from EUR 6.9 billion/year to EUR 20.4 billion per year by the 2020s and EUR 45.9 billion annually by the 2050s (European Commission, DG Environment, 2021[21]).

Currently, investment levels are insufficient to achieve and maintain compliance with the WFD and significant investment gaps persist. In France, for example, the investment gap that needs to be filled to achieve good status of water bodies is estimated at EUR 66.65 billion (European Commission, DG Environment, 2021[21]). As of 2019, 64% of the River Basin Districts in the EU had yet to secure finance for all relevant sectors to implement their second programmes of measures (PoMs) (European Commission, DG Environment et al., 2019[16]). 79% of RBDs name the lack of finance as an obstacle for the full implementation of their first PoMs (European Commission, 2019[34]). While the previous chapter explored how to generate more value with available finance, the point remains that new sources of financing will need to be identified to supplement existing (sometimes limited) funding (European Commission, DG Environment et al., 2019[16]).

Private finance can play an important role to close and bridge the financing gap, but to the present has been tapped into only marginally (OECD, 2020[40]; OECD, 2019[38]). The most widely mobilised sources of funding for water management in Europe includes EU funding (present in 92% of the MS), revenues from water supply and sanitation (WSS) tariffs (92% of MS) and public budget (85% of MS). Private funding was reported in only 41% of the MS, whereas surely absent in 11% of MS (European Commission, DG Environment, 2021[21]).

Private sector investment requires a conducive environment[6], which is partly lacking in a majority of Member States, as the water sector still presents various specific challenges for private investment. While

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[4] Note that this comes in addition to projections on financing needs for water supply and sanitation (see OECD, 2020).

[5] Measures needed for Articles 11(3)(a), 11(3)(b-l), 11(4) and 11(5)

[6] An enabling environment for water-related investments includes robust policies, regulations and institutional arrangements related to the delivery of water and sanitation services, ensuring water resources allocation and

they cannot on their own overcome all barriers to private finance and a healthy investment climate, public funds can be used strategically to foster an enabling environment, support the preparation of bankable projects and mobilise private finance.

This chapter discusses (1) options to mobilise additional private finance for water management across the EU, presenting mechanisms to generate revenue streams related to water investments and to address risks. It further investigates (2) the role of intermediaries to match supply and demand for private finance and discusses (3) the implications of taxonomies for sustainable finance for the water sector.

4.2 Mobilising additional sources of finance for water-related investments

There is a range of options to harness various sources of capital for water projects, such as direct investments from private actors (e.g. investments in water quality from beverage companies), risk financing instruments or repayable finance from commercial investors. However, despite a strong economic case, private investments in sustainable water resource management remain limited. Private and institutional debt finance, for example, is available in all MS, but represents only under 6% of estimated total expenditures for WSS, and even about 1% in the EU-13 (OECD, 2020[40]).

Distinctive features of water-related investments pose barriers for investment (OECD, 2022[8]):

- Water-related investments generate a **mix of public and private benefits** in terms of valued goods and services as well as reduced water-related risks. Pervasive **under-valuing** of the resource and arising benefits for both public and private actors constrains water financing opportunities. Many of these benefits are **not easily monetised** and this undermines achieving **clearly defined revenue streams** associated to investments.
- This lack of clearly defined revenue streams, combined with a lack of viable business models and a **weak enabling environment** for investment, deters financing flows.
- Due to the nature of local service delivery and resource management, water-related investments are often **relatively small-scale and fragmented**, leading to **high transaction costs and perceived high risks** for investors.
- **A lack of data** and analytical tools to assess complex water-related investments and to document their performance track record, as well as limited sector knowledge of financiers and investors, deter investment in the sector.
- There is a **mismatch** between the needs and characteristics of the **supply and demand side** of finance: Water infrastructure is typically **capital intensive, long-lived with high sunk costs**. This calls for a high initial investment followed by a long pay-back period of about 20 to 30 years. However, a segment of private investors often favour projects with short-term horizons. Thus, long tenor finance on affordable terms or other financing instruments, which fit the specific needs of the water sector, are often unavailable (see OECD data on blended finance; OECD (2019)).

The following section discusses practical financing examples and opportunities for strategic public investment to harness additional sources of finance for water. The section focusses on ways to (1) *translate the value of water-related investments into revenue streams* and (2) to *address and finance risks.*

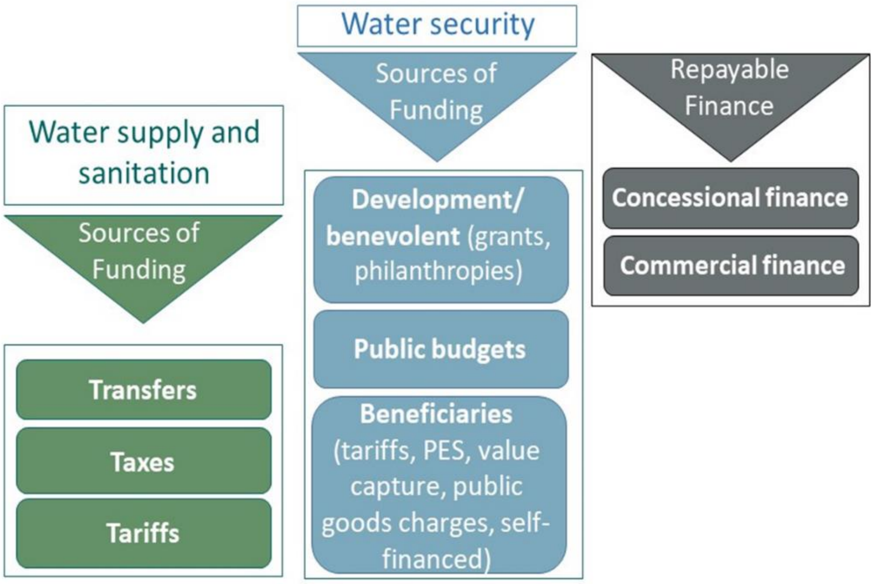
Translating the value of water-related investments into revenue streams

Finance for investments in sustainable water resource management typically stems from various sources, as illustrated in Figure 4.1. The costs of investments in and subsequent operation and maintenance of a

adequate quality. It further includes the policy framework for investment, which influences the availability of diverse sources of capital and deployment of adequate financing mechanisms. (OECD, 2022[8]) water facility are typically funded by revenues stemming from transfers, taxes and tariffs ("3Ts"). In European Member States, for example, transfers from EU funds play an important role.

Translating the value of water-related investment into clear revenue streams, boosts the bankability of such projects. It is one of the factors that attract funding from private sources.

Figure 4.1. Potential sources of funding and finance for sustainable water resource management



Source: (ADB, 2020[41])

Stable revenue streams are a pre-condition to attract repayable commercial finance. Such debt finance can stem from private and institutional investors and needs to be repaid with interest at market rate returns. For investors, the risk-return profile of an investment is crucial, which largely depends on the (1) revenue streams and the (2) risk profile and how the risk is shared with the public sector. Hence, a better access to private capital markets would first require to clearly define the revenue flows and risk profile related to the investments and subsequently to enlarge and stabilise these flows so as to conform the commercial requirements for debt and equity finance. Repayable finance can be used to bridge the investment gap for sustainable water resource management.

Instruments and arrangements to explicitly value water and the benefits of water-related investments for all relevant stakeholders across the value chain can create revenue streams and opportunity to profitable investments by monetising both explicit and implicit returns (OECD, 2019[38]). These valuations need then to inform "pricing" instruments ranging from water tariffs, earmarked taxes, charges, and permits or offset markets, which can be implemented through regulation. Such mechanisms include measures related to the idea of the beneficiary pays principle, such as specific taxes for actors who benefit from sustainable water resource management, e.g. land and property developers. This can however only apply to investments not related to the provision of water services, such as beneficiaries paying for (part of the) pollution abatement expenditures in the sectors the economic activities of which put pressure on water quality. For flood protection activities, it would mean to apply the Precautionary Principle Another key mechanism concerns the cost recovery of water services that needs to conform to the Polluter-Pays-Principle, and as regards the resource cost component to the the WFD principle of "prudent and rational utilisation of natural resources." According to this principle, where the available water stock does not have good quantitative status, the users of the common water resource should pay "a scarcity premium" on top of the water abstraction tariff, reflecting the extent of the scarcity, incentivising the use of other water sources of supply, while also warranting future availability.

Next to pricing policies, ***environmental offset markets*** are another instrument based on the Polluters-Pay-Principle, translating the value of water-related investments into revenue streams. On such an offset market, companies, governments and other actors buy carbon or environmental credits to offset their own emissions or negative environmental impacts. Offset markets can generate revenue streams for such water-related investments as wetland conservation, as wetlands are carbon sinks and can thus potentially generate blue carbon credits. The British water company Wessex Water, for example, negotiated an offset scheme with the Environment Agency and Natural England by cooperating farmers in the catchment, incentivising them to reduce nitrogen use. The offset scheme has used an auction mechanism via the established EnTrade platform, and has resulted in 153 tonnes of nitrogen savings across nearly 3 000 hectares of land by mid-2019. After successful implementation, the platform now operates as a separate entity which also aims at trading phosphorous and biodiversity offsets. Another example is the IUCN Peatland Programme set up in 2009 to promote the restoration of peatland in the UK (Trémolet, S. et al., 2019[42]) or the private investment firm Ecosystem Investment Partners (EIP) in the US, managing investments in large-scale ecosystem restoration and conservation. With committed capital from institutional investors, such as pension funds, they launch projects for flood protection, improving water system operations, etc., which generate credits that can be sold on the environmental offset market. In 2019, EIP had USD 885 million (EUR 749 million) in assets under management and has restored 180 square km of wetlands and over 280 km of streams (EIP, 2020[43]).

A similar mechanism are ***eco-labels***, e.g. established for hydropower in Sweden. A share of the traded hydropower electricity is allocated to a mechanism funding measures that aim at addressing negative impacts caused by hydropower production. This allows the use of the eco-label Milöval for the electricity supplied from hydropower and provides funding streams for environmental mitigation measures (European Commission, DG Environment et al., 2019[16])

Further, private companies, whose operations depend on water resources, also have an economic interest in investing in sustainable water resource management and could thus be motivated to take risk reduction measures (OECD, 2019[38]; Trémolet, S. et al., 2019[42]). Private companies headquartered in Europe reported in the Carbon Disclosure Project's (CDP) survey on water risks that the potential financial impacts of water-related risks reach up to 17.6 billion USD (EUR 14.9 billion), while the costs of mitigating these risks are estimated at only one fifth of this sum (USD 3.73 (EUR 3.15)). The Mestä Board Corporation, a Swedish paper products manufacturing company, for example, identified that an investment of USD 31 million (EUR 26.2 million) for the reparation of a leaking dam and other measures could avoid losses in business value of up to USD 218 million (EUR 184.4 million) while simultaneously delivering benefits for the wider community (CDP, 2021[44]). Currently government-sponsored programmes to promote private investment in water-related risk reduction are rare in OECD countries, but a good example can be found in the Loire river basin in France, where a dedicated programme provides a free vulnerability diagnosis of businesses to floods (OECD, 2021[45]). Additionally, current developments in **water-related risk assessment** and risk-disclosure requirements for companies can further drive investment decisions of private actors in favour of sustainable water resource management. The work of the Taskforce on Climate-Related Financial Disclosures (TCFD) and the Taskforce on Nature-related financial Disclosures (TNFD) is pivotal in this regard.

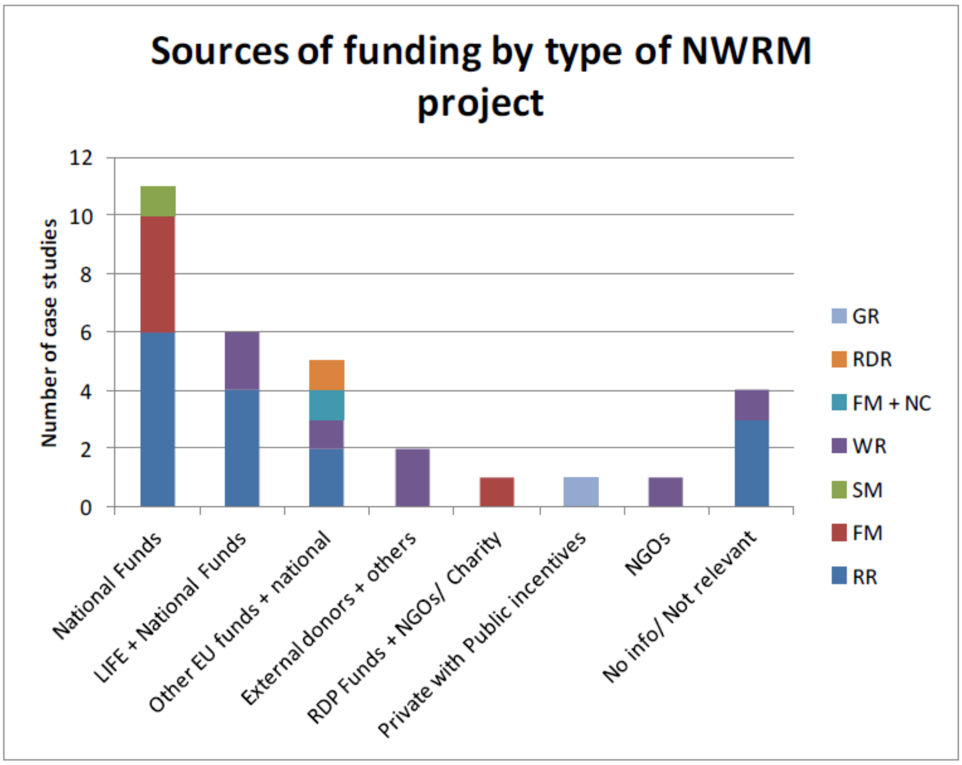
Beside risk assessment, **measuring and monetising the entire range of benefits** of water-related investments, such as enhanced biodiversity, carbon sequestration or flood protection, constitutes an additional incentive to private investment. The benefits can spill over to other economic agents than the investors. Measures with multiple benefits, such as Natural Water Retention Measures, can bring value to a variety of actors and stakeholders across sectors, such as through a higher turnover or lower expenditures because of better watershed management for a company operating in the area. Thus, local actors may be mobilised in providing private capital to improvements in water resources management that spur such operational benefits. In practice, however, the prioritisation of measures in MS seems to be biased towards measures which can be implemented by public authorities, entities or water utilities. Measures related to actions of the private sectors are less frequent or might have a voluntary nature, opening room for improvement and discussion on prioritisation decisions (European Commission, DG Environment et al., 2019[16]).

Coordination among private and public actors to fund water-related investments can help mobilise private financing by beneficiaries. Examples include arrangements between public authorities or private entities and farmers which can create co-benefits, such as improved water quality, enhanced biodiversity and landscape conservations as well as income generation for farmers. River restoration projects are one example of multifunctional measures, which can be financed through cross-sectorial cooperation: In Belgium, such integrated projects are planned and financed by a broad range of stakeholders, such as the Environment Agency, the Agency of Mobility and Public Works, the Agency of Nature and Forest, provinces, municipalities, water companies, land agencies, the department of agriculture and fishery, NGOs and farmer unions (European Commission, DG Environment et al., 2019[16]).

Another example is arrangements by water utilities and food and beverage companies, which have an incentive to pay for improved water quality. They could pay farmers to reduce their pesticides use, resulting in better water quality and enhanced biodiversity, saving water treatment costs. Eau de Paris in France, has a large scheme to engage with farmers active in catchment areas, to transition towards sustainable practices; interestingly, Ville de Paris creates markets for food stuff produced from these farms (typically in municipally managed school cafeterias)(more information is available here). UK's largest water company United Utilities, for example, established the Sustainable Catchment Management Programme aiming to protect and improve water quality and to reduce or delay the need for capital investments in additional water treatment. The programme included a cooperation with farm tenants and investments in more sustainable farm infrastructure, such as better livestock housing and fencing and woodland management. After the success of the GBP 10.6 million (EUR 12.4 million) investment programme, United Utilities launched a second phase of another GBP 11.6 million (EUR 13.6 million), with grants from Natural England and the Forestry Commission of GBP 2.7 million (EUR 3.2 million). The programme allowed farmers to access additional agri-environmental income over 10 years. (Trémolet, S. et al., 2019[42]) Another example of a public arrangement with farmers was implemented by the city of Augsburg in Germany. The utility Swa established a cooperation model with farmers in the water protection zones, providing consultation services, financial incentives, and subsidies for acquiring equipment (Trémolet, S. et al., 2019[42]).

While arrangements between farmers and private companies, PES (Payments for Ecosystem Services) and water funds exist across Europe, they remain limited suggesting that their design and implementation is challenging. Only a fraction (less than 1%) of watershed investments in Europe in 2017, for instance, were privately financed, while over EUR 5.6 billion were invested by public funds (Bennett, Leonardi and Ruef, 2017[46]). Figure 4.2 provides an overview of funding sources for a range of Natural Water Retention Measures (NWRM) until 2014. It shows that most of the NWRM measures are funded by public funds (national or EU level), while only green roofs were financed through private funds, followed by wetland restoration, financed through external donors, NGOs and other sources (European Commission, 2014[47]).

Figure 4.2. Sources of funding by type of Natural Water Retention Measures project



Legenda:

RR*= River Restoration;* ***FM****= Flood Management;* ***WR****= Wetland Restoration;* ***NC****= Nature Conservation;* ***SM****= Stormwater Management;* ***RDR****= Rural Development and Restoration;* ***GR****= Green Roofs*

Source: (European Commission, 2014[47])

One challenge of financing water-related investments, such as NWRMs, is that these measures' environmental benefits are rarely considered due to a lack of adequate economic assessment methods. Hence, the appraisals often fail to prioritise synergistic measures (OECD, 2021[48]; OECD, 2019[38]; Trémolet S and Karres N, 2020[49]; European Commission, DG Environment, 2021[21]). Further, financing mechanisms are mainly developed within the sector where water-related investments are supposed to take place, without taking much account of the investments' impact on other sectors. This can hinder the possibility to leverage funds from other sectors, as well as to adopt a holistic approach aiming to internalise all the project's benefits (European Commission, DG Environment et al., 2019[16]).

The Nature Conservancy assesses that European policies provide an overall conducive environment for investing in nature for European sustainable water resource management. However, water policy objectives need to be mainstreamed and policy coherence needs to be strengthened at MS and EU levels, in order to incentivise the combination of various sources of finance for water (Trémolet, S. et al., 2019[42]). Whereas in the UK almost all privately owned water companies are engaging with farmers at catchment level to protect their water sources, in some EU countries the policy framework is less clear or conducive. Eau de Paris in France, for example, had to seek special conditions from the EU to make payments to farmers above a certain monetary threshold (Trémolet, S. et al., 2019[42]). Establishing the status of payments for ecosystem services and how they (can be made to) interact with regulations under the new CAP should be areas for further investigation. These actions promise to deliver more financial incentives for changes in agricultural practices that can improve the status of water bodies and aquatic systems (European Commission, DG Environment et al., 2019[16]). Eco-schemes under the CAP are presented in Box 4.1.

Beside conducive policy frameworks and policy coherence, multi-stakeholder financing arrangements need further development as regards their design and implementation, performance, private sector engagement and regulation (OECD, 2021[48]; OECD, 2020[50]; Trémolet, S. et al., 2019[42]; European Commission, DG Environment, 2021[21]).

Box 4.1. Eco-schemes under the CAP

A principal feature of the next CAP is the goal of shifting the stance of the various national CAP Strategic Plans (CSPs) towards a greater 'results-orientation'. Under this 'new delivery model,' Member States are required to plan and implement all chosen CAP interventions according to their national/regional needs and align them to the nine CAP Specific objectives. Three CAP objectives cover environmental issues, including: (i) contribute to climate change mitigation and adaptation; (ii) foster sustainable development and efficient management of natural resources; and (iii) contribute to the protection of biodiversity, enhance ecosystem services and preserve habitats and landscapes. In addition, a new objective addresses broader societal concerns, namely: Improve the response of EU agriculture to societal demands on food and health, including safe, nutritious and sustainable food, food waste, as well as animal welfare.

Eco-schemes are to be based on the three environmental objectives, and the EU Parliament and some MS are proposing that animal welfare should be included as well.

The 'new delivery model' also marks a change in the planning of Pillar 1 interventions, as managing authorities must now indicate more concretely how such interventions will address their specific national/regional needs with reference to the CAP Specific objectives. At the same time, this builds on the rich history of EU Rural Development programming under Pillar 2 - a key part of the CAP since 2000. While the two-Pillar system remains, the 'new delivery model' seeks to facilitate common strategic planning and support a more results/ performance-based CAP. Overall the reform enshrines the need that all the CAP funds (e.g. EAGF and EAFRD) are used to address the scale of the environmental and climate challenges facing the agriculture and forestry sector in unison with other economic and social objectives of the CAP.

Potential agricultural practices that could be supported by eco-schemes include conversion/ maintenance of organic farming, integrated pest management, agro-ecology practices, husbandry and animal welfare plans, agro-forestry, high nature value farming, carbon farming, precision farming, improve nutrient management, protection of water resources, practices beneficial for soil, other practices related to GHG emissions.

Strategic public investment in the generation of knowledge, data and expertise through research centres, pilot projects, information hubs and multi-stakeholder platforms or arrangements and intermediary services could help scale up projects that manage to capture and monetise the benefits they deliver. Existing examples include the research and pilot application of nature-based solutions (NbS) within the EU Horizon framework, which has allocated about EUR 185 million between 2014 and 2020 (European Parliament, 2017[51]), information platforms such as the EU Natural Water Retention Measures Platform, the Natural Capital Financing Facility (see 5.2 in Annex) or PES pilot schemes (see Box 4.2). Philanthropy and other actors also play a crucial intermediary role to leverage private funding for sustainable water resource management, e.g. through the establishment of water funds, water stewardship initiatives (e.g. WWF water stewardship programme, see Box 4.2) or other arrangements. The role of intermediaries will be discussed further below.

Box 4.2. Supporting water investments through pilots and stewardship programmes

Piloting Payments for Ecosystem services in France

Within their Biodiversity Plan launched in 2018, France undertook a public tender of EUR 150 million over 3 years for PES pilot projects to protect biodiversity and water quality in over 120 regions. The most successful projects were selected by water agencies in 2021 and will be implemented with a 5-year contract between farmers and beneficiaries such as local communities, associations, national parks and private actors. These payments schemes are a mechanism to recognise farmers' contributions to the creation of direct environmental benefits, which exceed mandatory standards. In addition, French water agencies increased their financial support dedicated to the transition towards an ecological agriculture by EUR 50 million per year starting in 2020.

WWF Water stewardship programme

The World Wildlife Fund has established a Water Risk Filter as an online tool to help companies and investors assess and respond to water-related risks within their operations and investments. WWF partnered with private companies, such as EDEKA and Tchibo to establish Water stewardship programmes. The WWF and EDEKA group partnership, for example, developed a customised Water Risk Tool which supports 20 of EDEKAs suppliers to analyse and take action to mitigate their water risk on the ground in various locations in Spain, Ecuador and Columbia.

Source: (Ministère de la transition écologique et solidaire, 2019[52]; Ministère de la transition écologique et solidaire, 2018[53]; WWF, 2020[54])

Reducing and managing water investment risks

Risks related to water investments include credit risks, market risks or performance risks and affect the risk-return profile and hence the financial feasibility of water-related projects. Specific arrangements and financing approaches can be used to reduce or share these risks among financers as well as between financiers, the actual investors and stakeholders and thus attract a broader range of financiers.

Specific financing approaches can also be used to finance distinctive water risks, such as flood risks or risks related to drought and extreme events. These include mechanisms to finance protection measures (ex ante) or damage costs (ex post). The following paragraphs discuss some of the possibilities to (i) reduce and share investment risks and to (ii) finance water risk protection measures and damages costs.

Reducing investment risks

As mentioned above, one of financiers' considerations is the risk-return profile of any investment. Commercial investors are cautious about uncertainty regarding any of the risks related to an investment opportunity. Often, they have limited experience and knowledge of the sector and thus perceive water-related investments as risky. A lack of analytical tools aggravates the challenge to assess and address these risks, thus lowering the attractiveness of the risk-return profile of water-related investments. Concerns about small ticket sizes, high transaction costs and unanticipated changes in relevant regulation further dampen financiers' appetite to invest in the water sector.

Adequate contractual arrangements or blended instruments can take a certain level of risk off the financier's own book either through mitigation of a variety of these risks, or through sharing the remainder with the public sector or commercial co-investors. For example, public participation in the investment or public guarantees are effective tools to reduce credit risk and thus can result in a lower cost of capital overall. Pooled approaches can help overcome high credit risks and transaction costs of small projects, bundling multiple water service providers and allowing to tailor different risk-return profiles for individual investors. Pooled hydro bonds, for instance, allowed small-scale water utilities in the Veneto region in Italy to jointly raise EUR 500 million on the capital market (OECD, 2020[50]).

Deploying public funds strategically to de-risk investments, to generate revenues streams or to strengthen the overall enabling environment for private investment in water-related projects are major elements to mobilise additional sources of finance. EU guarantees, for example, allow the European Investment Bank to issue bonds on the private capital market and to offer loans with long term maturities for water investments with low returns – one reason why the Bank is sometimes referred to as the largest lender to the global water sector. Box 4.3 highlights an example from the US of a risk sharing mechanism between the public and private sector for a green infrastructure project to manage storm water runoff. One challenge for strategic de-risking though public funds is to set the appropriate level of risk sharing between the public and private sector. Excessive reliance on public finance (including guarantees and contractual arrangements on operation) can impede private actors to take over investment risks and create market distortions that hinder greater accountability and financial sustainability of the sector (OECD, 2019[38]).

A more structural approach to decide on the modalities for blended finance could render investments in the water sector more effective. The perception of risk is heterogeneous among actors, depending on their motivations, incentives to act and country context. Understanding these perceptions provides valuable insight in assessing the "readiness" for blended finance at country level and can help tailor financing approaches to address specific local conditions. The deployment of a strategic approach, e.g. through scorecards on country level, could be considered. As mentioned in Chapter 3, Money (forthcoming[39]) designed a scorecard to collect data on perceived risks from a range of financial actors with indicators grouped into the three categories *liquidity*, *bankability* and *capacity*.

Box 4.3. Performance-based Environmental Impact Bond for green Infrastructure in the US

An important example of a strategic financing instrument is the Environmental Impact Bond, issued by the District of Columbia Water and Sewer Authority (DC Water). As part of its green infrastructure investment strategy, DC Water issued this first of its kind bonds in 2016 with an outcome-based payment element for a large-scale green infrastructure project to manage storm water runoff – which constitutes the first use of the Pay for Success model in the water space. The bond is a 30-year tax-exempt municipal bond of USD 25 million (EUR 21.1 million) with a mandatory tender in the fifth year. At the five-year tender, there is provision for an additional payment, contingent on the success or failure of the green infrastructure project: If the storm water was reduced by more than 41% of the baseline, DC Water will make a one-time additional payment to investors of USD 3.3 million (EUR 2.8 million). If runoff is reduced less than a threshold of 17%, investors will make a Risk Share Payment to DC of the same amount. A performance between the two thresholds (17-41%) will result in no additional payment other than the basic principal and interest payable on the Environmental Impact Bond. This financing mechanism allows to share performance risk between the water authority and investors and reduces cost of capital for the issuer in the event of under-performance, while allowing additional returns for investors in the event of over-performance.

Source: (EPA, 2017[55])

Financing water risks

Water-related risks, such as floods and droughts, can cause costs related to damages and disruptions, e.g. destroyed property after a flood event or reduced agricultural yields after a drought, and can put human lives and economies at danger. Risk reduction measures thus provide both public and private goods. Therefore, specific risk financing arrangements can be made to share both the damage costs among private and public actors after a disruptive event, as well as the costs of risk-reduction measures in a pre-disaster setting. Indirectly, risk financing instruments can incentivise behaviour to reduce exposure levels and increase the uptake and efficiency of risk-reduction measures. Instruments include green bonds, weather derivatives, climate resilience bonds and catastrophe bonds and insurances, the latter being the most common RFI in Europe (OECD, 2020[40]).

Insurances

Insurances can provide financial protection against "water risks." Flood insurance provides a prime example as it protects against (excessive) flood damages and it gives incentives to reduce economically-unwarranted use of flood-prone areas, while not prohibiting land use. For example, a mandatory insurance can be required for buildings in at-risk flood areas, potentially making it less convenient to live and install businesses in such areas. They serve as a risk-sharing and risk-communication device to protect individuals against high damage costs and help them rationalise their land use choices in at-risk areas. If risks are correctly priced in premiums, insurance allows location in hazard-prone areas for those who are ready to bear the risk, without increasing a burden on taxpayers (Filatova, 2014[56]; OECD, 2022[8]). Insurance companies may also have an interest to provide repayable capital for risk reduction measures, reducing their policyholders' flood risk and thus possible liabilities (OECD, 2021[57]).

Some events, such as flooding in risk prone areas, cannot be covered by private insurances, especially in light of climate change. When climate risks become systemic, they are likely to cause market failures that affect both consumers and insurers which could make the case for mandatory insurances and public-private arrangements. Examples include the French natural disaster insurance system CatNat, a public-private compensation system. Under CatNat, it is mandatory for insurers to extend property and vehicle insurance contracts to cover damages caused by natural disasters. The premiums are not based on local natural disaster risks but are fixed by the Government following a principle of national solidarity. (Poussin, Botzen and Aerts, 2013[58]; OECD, 2021[45])

In Romania, homeowners are legally required to purchase a home insurance covering damages from floods, landslides and earthquakes. However, legal clauses exempt households from this obligation on the basis of socio-economic criteria, leading to a share of only 38% of dwellings covered by insurance (Surminskia and Hudsonb, 2017[59]).

In the case of Spain, the Consorcio de Compensación de Seguros (CCS) provides direct insurance for flood (and other catastrophe risks) as a mandatory extension to property, life, and personal accident policies issued by private companies. This leads to a relatively high-level of insurance coverage for flood risk among businesses and households in Spain. CCS is recognised in Europe as an example of good management of catastrophe risks that enables strong co-operation between public authorities with responsibilities for flood risk management (OECD, 2021[45]).

For the agricultural sector, crop insurance and weather index-based insurance can help spread the risk of income loss to farmers after drought or other extreme weather events. This can reduce the need for public compensation or support payments to farmers after extreme events. In Italy, for example, subsidised insurances are the most widely used risk management tool for the agricultural sector under their National Risk Management Plan (OECD/FAO, 2021[60]).

Resilience bonds

Resilience bonds seek to raise private capital specifically for climate resilient investments and proactive risk reduction projects, while transferring the risks to the capital market. Resilience bonds incentivize making investments in physical risk reduction projects by offering lower coupon pricings reflecting the achieved reduction in expected losses when the risk would materialise (i.e. the stronger the expected loss reduction, the lower the interest rate on bond) (Hermann, Köferl and Mairhöfer, 2016[61]; Vaijhala and Rhodes, 2018[62]). The European Bank for Reconstruction and Development launched the first resilience bond in 2019 which received an AAA rating and raised USD 700 million (EUR 592 million) from commercial banks, central banks and insurance companies. BNP Paribas, Goldman Sachs, and Skandinaviska Enskilda Banken acted as joint book runners, which saw demand from approximately 40 investors in 15 countries. The proceeds from EBRD resilience bonds can be used for investments in climate-resilient water and urban infrastructure, as well as investments in ecological systems, such as watershed management. (EBRD, 2019[63]; Global Center on Adaptation, 2020[64]).

4.3 The role of intermediaries: Matching supply and demand of finance

The previous section discussed options to generate clearly defined revenue streams and to reduce perceived high risks of the sector, which help overcome some of the sector specific barriers for investment.

An additional limiting factor for commercial investments is a mismatch between supply and demand for finance and a lack of well-prepared, bankable projects, e.g. projects for water treatment plant upgrades or water quality improvement measures through wetland restoration which are linked to a clear business case for investment. On the demand side of finance, project developers often lack the skills necessary to support their funding applications with adequate documentation. On the supply side, financiers have limited knowledge of the water sector and there is a lack of financial instruments, which fit the needs of the sector.

Therefore, **tailored, sector specific financial mechanisms and arrangements are needed to better match financiers' and project developers' needs** and thus the supply and demand of finance for the sector. Public investment in capacity building and technical assistance could increase the project developers' ability to design sound business cases, support project preparation and provide guidance on project implementation models or on documentation, including cost-benefit analyses and financial statements.

Intermediary institutions play an essential role to better link the interests and capabilities of the water and financing industries (Trémolet, S. et al., 2019[42]; Alaerts, 2019[65]) (see Annex, for illustrations in Europe). They are organisations that operate at the interface between the water agencies or service providers that need to acquire capital and the financing institutions. They come from civil society, philanthropy, field and academic research, professional water networks, service providers, financiers, financing facilities, development finance institutions and governmental and intergovernmental bodies. A recent analysis of the role of intermediaries to facilitate finance for water-related investments documented that this wide range of organisations plays various roles at the interface between demand and supply of finance (Lardoux de Pazzis and Muret, 2021[66]). These intermediaries include those fully focussing on the enabling environment for finance facilitation; transaction advisory supporting partnership development (of which financing is one component); other private sector windows of donors and international financial institutions; and dedicated financing facilities. The empirical analysis recorded in the paper suggests that these intermediaries remain below their potential to achieve transactions due to gaps, overlaps and misalignments between the different roles and action areas. Further, the extraordinary diversity of entities render it difficult to understand their individual roles and responsibilities – creating uncertainty and a lack of transparency for private investors.

The analysis documented that there is an abundance of intermediaries providing financial mechanisms with a strong focus on the transaction level, which paradoxically leaves service providers, project developers and financiers underserved, in particular those entering this business from the outside, i.e. from other parts of the economy. The intermediaries seem to focus on de-risking instruments at the transaction time (e.g. viability gap funding), while rarely creating incentives towards operational efficiency and improvement of performance of service providers and water-related projects. Additionally, the large number of intermediaries active in the provision of financial mechanisms and the preparation of investment opportunities can result in significant transaction costs for (in particular new / entrant) project developers and water service providers to identify relevant entities in a fragmented market. This risks to reinforce a "lock-in" of cooperation of the same investment partners over time, undermining any market dynamic for improvements and innovation.

Thus the water sector's financing remain overly focussed on prolonging "business as usual". As a result, provided they can afford the searching time, project developers and service providers may often be able to find non-commercial money, lowering their efforts and incentives to enhance the project's viability. The proliferation of actors focused on those activities also increases competition to facilitate financing, while the number of viable bankable projects remains limited. (Lardoux de Pazzis & Muret, 2021)

This unbalanced situation implies a lack of understanding in the water sector as regards financiers' and investors' expectations. This could be partly corrected through further awareness raising as well as stronger (regulatory) incentives to improve operational performance (including benchmarking and adequate pricing).

Overall, the identified gaps and redundancies in the value chain require **a shift to a more strategic approach and a better coordination between intermediaries based on their comparative advantages**. Governments can play an essential role by strengthening the institutional framework of the sector and improving economic regulation, generating demand for quality service and supporting initiatives to fill the intermediary gaps (Lardoux de Pazzis and Muret, 2021[66]). Further work on the national and EU level on the intermediary landscape could be considered.

4.4 Sustainable finance for water and the role of taxonomies

Investors are increasingly interested in sustainable investment opportunities, looking for projects which contribute to climate action or other environmental objectives and / or which are certain to avoid doing significant harm to the climate and environment. Therefore, demonstrating the water-related projects' contribution to sustainability or climate objectives could allow the sector to tap into new sources of finance (see Box 4.4). European green bond issuance, for example, has steadily been rising to over USD 500 billion (EUR 422.9 billion) by 2021 (CBI, 2021[67]). However, the water sector only represents a small share of green bond issuance, accounting for 15% of European issuances from government-backed entities (CBI, 2018[68]). In order to access new sources of finance and also secure an increasing share of existing finance sources, it seems a prerequisite to provide a clear definition and appraisal of the investment project's expected environmental contributions as well as monitoring the actual environmental delivery or performance.

Box 4.4. Water for renewable energy: EIB's Climate Awareness Bond for a wastewater treatment project in Vienna

Wastewater treatment offers significant carbon reduction potential and this has allowed a wastewater project in Austria to raise climate finance. The upgrade of Vienna's central wastewater treatment plant aims at reaching self-sufficiency in energy by using sewage sludge as an energy resource for in-house energy needs. It includes the expansion of the collection network and storage facilities to prevent sewerage overflows, as well as the construction of primary sedimentation and digestion towers. The project will thus ensure the continued compliance with the EU urban wastewater treatment directive, as well as generating renewable energy from methane and reducing the plant's energy costs – thus contributing to climate change mitigation efforts. Half of the EUR 300 million total project costs will be financed through an EIB Climate Awareness Bond.

Other examples of the use of proceeds bond issuance for water include EIB's Sustainable Awareness Bonds, green bonds for water issued by Anglian Water, the first utility company in the UK to issue a green bond for water, or NWB Bank, a dedicated Dutch financial institution to raise funding for water-related projects.

Source: (EIB, 2021[69]; OECD, 2020[50])

Taxonomies and standards define and provide metrics for projects to be considered "sustainable". The EU "sustainable finance Taxonomy Regulation" entered into force on 12 July 2020 and currently is still being elaborated and refined. It specifically includes water as one of its six environmental objectives ("*sustainable use and protection of water and marine resources*"). In order to be considered 'sustainable', an activity or investment must substantially contribute to one of the six objectives while not doing significant harm to any of the other objectives. Technical screening criteria stipulate thresholds and measures to define 'substantial contributions' and 'no significant harm' for each environmental objective. Technical screening criteria for economic activities contributing to climate change mitigation and adaptation apply as of January 2022. Screening criteria for economic activities contributing to the water-related environmental objective, and three other objectives, have been published for public consultation in August 2021 (see Annex) (Platform on Sustainable Finance, 2021[70]). The corresponding Delegated Act is scheduled for adoption in 2022.

Through defining which water-related investments qualify as sustainable activities, the EU Taxonomy can raise the water sector's visibility for financial market actors and thus attract new types of investors. The increased transparency eliminates uncertainty whether their investments will be recognised as "sustainable," and it provides investors with more information on what they consider investing in, facilitating comparison with similar investment projects. This could help to attract more retail as well as institutional investors into water-related investments.

The taxonomy could help insurers by providing clarity and reducing reputational risks. For issuers and project-developers, companies and regulators, the EU Taxonomy can provide clear guidance on how to capture environmental performance in specific contexts, how to distil and take into account the relevant economic activities and to define thresholds. Projects that improve water quality, biodiversity or pollution control could gain prominence due to the taxonomy, and more generally the set of European Green Deal policies, since it encourages cross-cutting investments contributing to multiple environmental improvements (OECD, 2020[71]).

A point of attention would be the complexities and costs of the taxonomy requirements for planners, project developers and investors. Data and knowledge on performance and project outcomes, particularly for nature based solutions, are scarce and could hinder eligibility for taxonomy compliance. Further, in practice, fragmenting distinct aspects of water resources management and water and sanitation service delivery across specific categories and criteria set out by the taxonomy could undermine efforts to take a holistic, systemic approach to financing water-related investments, not to mention the promotion of strategic investment pathways. (OECD, 2020[71])

Another potential disadvantage of the taxonomy is that it may lead to investors' shunning beneficial water-related projects because they do not meet the EU Taxonomy's high standards. As said, the EU Taxonomy is meant to be selective, namely targeting best practice and therefore only the most ambitious investment activities. Estimates put the volume of finance that would currently meet the EU Taxonomy 'green' at 1 to 5% of all financial assets (Platform on Sustainable Finance, 2021[72]). This could imply that projects with benefits for sustainable water resource management and the environment may be considered less. If finance is increasingly channelled towards sustainable investments, it could become more challenging to attract funds for types of water-related investments which cannot prove compliance with (all) the taxonomy criteria. (OECD, 2020[71]) It is not clear how the EU Taxonomy will affect projects that provide access to water and sanitation services to previously underserved communities.

The EU Taxonomy's full implications on the availability of finance for the water sector will depend on further refinement and taxonomy development in the next months and years. Current developments include the work on the Delegated Act defining the technical screening criteria for the 4 "non-climate" environmental objectives as well as a taxonomy extension to integrate transition finance as well as social criteria. The draft report on a future EU social taxonomy specifically recommends the inclusion of services for basic human needs, such as water, including wastewater management (Platform on Sustainable Finance, 2021[73]). **Consequently, monitoring and engaging in the taxonomy development process is essential for the water community** to ensure practical and realistic representation of economic sustainable activities in the taxonomy. Strategic investments in capacity building, training and awareness raising for actors in the water sector and project developers could be vital to ensure alignment with the requirements and procedures under the taxonomy for eligible projects.

The EU taxonomy serves as basis for other processes, such as the EU Green Bond Standard and financial and non-financial reporting requirements, which potentially also affect water investments. From beginning of 2022, companies falling under the non-financial reporting directive, for example, will have to disclose the proportion of their turnover or of their investments which complies with the EU taxonomy objectives[7]. In addition, above-mentioned developments on water-related risk disclosure requirements for the financial sector, such as under the Taskforce on Climate-Related Financial Disclosures (TCFD) and the Taskforce on Nature-related Financial Disclosures (TNFD) will have additional effects on investment decisions and financing flows.

[7] The first company reports and investor disclosures are due at the start of 2022 for the EU taxonomy's objectives *climate change adaptation* and *mitigation*; for the other objectives not yet developed by that date, disclosure will remain voluntary until the screening criteria of these objectives have entered into application by 31 December 2022 (European Commission, 2020[92]; TEG, 2020[93]).

4.5 Concluding remarks

Harnessing multiple sources of finance is essential to close the financing gap in the European water sector, first for achieving and maintaining compliance with the WFD and subsequently to achieve the transition to a climate- and water-resilient economy by 2050. Translating the value of water-related investments into revenue streams through mechanisms such as offset markets or multi-stakeholder arrangements, can attract additional private funding source. Developments in methodology to assess (co-)benefits and water-related risks can further effect private investment decisions for the water sector. Conducive policy frameworks are required, which allow for cross-sectoral cooperation, multi-stakeholder arrangements and adequate planning. Clearly defined and stable revenue streams as well as mechanisms to reduce or share investment risk can attract additional private repayable finance. This requires, adequate cost recovery mechanisms, also reflecting pollution and water-stress, cost discipline, as well as solid regulatory and planning arrangements setting out a path to meet long-term objectives.

Intermediaries play a central role in facilitating water-related investments through matching the supply and demand of finance for water-relevant investments. Indeed, the intermediary landscape would require to take on a more strategic and coordinated approach to guide the water sectors' efforts to sustainability, including tapping into private finance sources as well as promoting sustainable investments through disseminating financial, planning and technical expertise. However, the abundance of actors with a myriad of (overlapping) functions and an orientation to public actors are found to constitute barrier to change,

Further, developments in sustainable finance taxonomies and in non-financial reporting requirements play a role in raising the visibility of water-relevant investments for the increasing number of investors interested in sustainable or green investment opportunities. The EU taxonomy is set to provide clear standards for water-related investments to be considered as sustainable, which offers the opportunity to attract new types of investors and finance instruments and modalities. It simultaneously poses challenges, such as reporting and compliance, as well as possibly a decreased attractiveness of projects which are not considered under the taxonomy.

Overall, investments in improving the enabling environment, including expertise intermediary functions and cross-sectoral, multi-stakeholder cooperation, can be an important lever to harness additional sources of private finance to bridge and fund the financing gap for complying with the WFD.

Questions for discussion

- Can you share innovative financing arrangements that contribute to PoM in your country?
- How can measures to assess and monetise the value of water and environmental services be mainstreamed? Can multi-stakeholder engagement contribute, and how can it be encouraged in practice?
- How can water authorities and project developers be supported to comply with the EU taxonomy? How can public funds be deployed strategically to build capacity, generate data and develop projects aligned with the taxonomy?
- How can intermediaries operate in a more strategic way, to avoid overlaps and close gaps in functions and responsibilities? Is there a role for governments (local, national, European)?

5 Annexes

5.1 Analytical framework for Strategic Investment Pathways

This section gives further background on Step 2 and 3 in the five-step approach outlined in Chapter 3. Further detail can be found in Brown and Boltz' forthcoming paper and for a part in their paper (Brown et al., 2020[74]).

Step 2. Option Evaluation and Stress Testing

This step describes the process of evaluating the alternative investment options. The key rationale underlying this option evaluation guidance is the fact that the evaluation accounts for deep uncertainty, such as related to climate change, and the effect of sequencing possibilities on each option. Options are evaluated in terms of their individual performance using stress testing to assess performance comprehensively over a wide range of possible futures (see Figure 5.1). Step 3 below will look at the effect of sequencing possibilities, namely through evaluating the most promising projects in terms of the strategic investment pathways that they enable as well as those they preclude. The resulting evaluation data is used to design strategic investment pathways.

(1) Option evaluation, stress testing and performance quantification

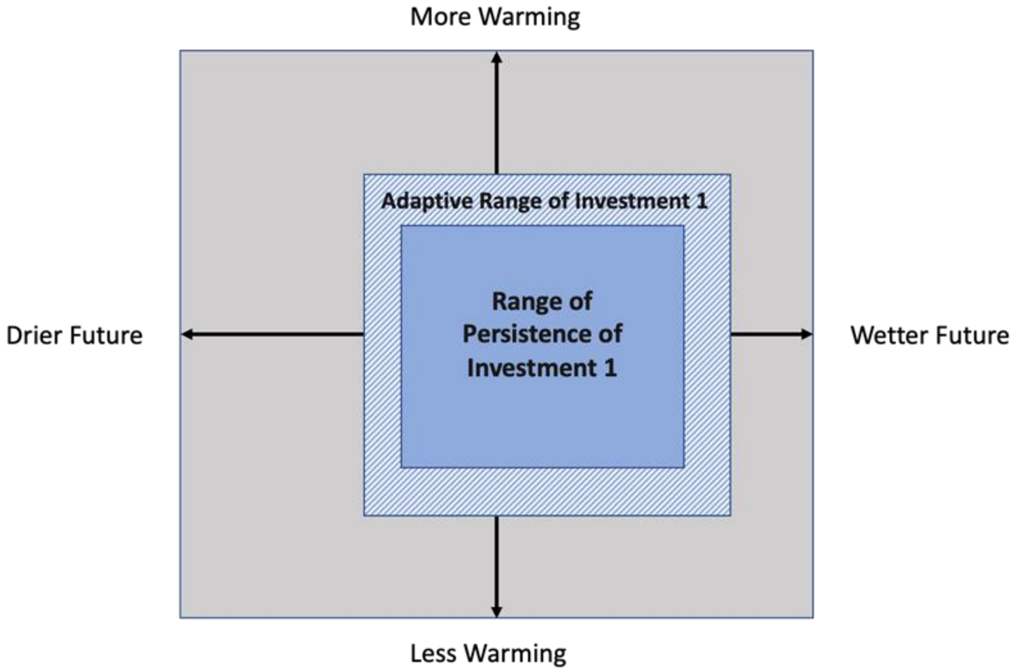
The process of option evaluation consists of assessing each option in terms of its ability to contribute to meeting the planning objectives in a wide variation of circumstances and to compare them on their relative performance in this regards. Model representations of each option are used to evaluate performance in terms of the performance objectives defined in Step 1. Each option's performance is compared to the baseline or control scenario to assess the change in performance, both as regards improvements and deteriorations relative to taking no action, and these changes serve as basis to compare the relative performance of the options.

In the case of long-lived water investments, the future over which the performance of each option is evaluated may be uncertain and involve nonstationary trends. Addressing uncertainties in investment assessment involves evaluating each investment option under different possible realizations of those uncertainties. Stress testing can be used to evaluate performance over many plausible future scenarios, creating a rigorous understanding of the project's strengths, weaknesses, and vulnerabilities. The results of the stress test are reported in terms of the performance metrics, which serve as the basis for project evaluation, including trade-off analysis, and also serve as the basis for the planning indicators, such as robustness, vulnerability scenarios, and "Sunset" or expiration date, which are used for development of the strategic investment pathways (definition of Sunset, see below). A number of modelling tools and methodologies exist for designing and executing stress tests (Steinschneider and Bown, 2013[75]; Kwakkel, 2017[76]; Ray et al., 2018[77]; Taner, Ray and Brown, 2019[78]).

Further, properly addressing uncertainty in an investment pathway requires additional information about project performance via "planning indicators." These additional results give a flavour of the comprehensive assessment the stress test provides. Planning indicators include *Mean Expected Performance, Persistence, Adaptability* or *Transformation*.

- *Mean Expected Performance* is the best single estimate of the project performance for each performance metric. The starting point for results evaluation.
- *Persistence* refers to a system's ability to maintain coherent, "normal" function without changes to design and operation. It can be quantified as the range of uncertain futures over which a project can provide acceptable performance. This corresponds to robustness metrics recently described in the literature (Moody and Brown, 2013[79]; Herman et al., 2015[80]).
- *Adaptability* represents the ability of a system to adapt to changing conditions by modifying its operation. While infrastructure is often considered rigid, operational aspects of some infrastructure can provide the ability to adapt to changing conditions. This implies that over the whole range of possible futures, the "adaptive range" needs to be larger than the "range of persistence" (see Figure 5.1). For example, dams and reservoirs are structurally rigid and difficult to modify in terms of design. However, the operating rules of reservoirs are highly flexible and can adapt as required by the realization of the current uncertain climate change . These operating rules may be changed to accommodate changes in hydrologic regimes (including changes to the volume and timing of runoff). Thus it is useful to understand the additional range of acceptable performance over which a project can provide acceptable performance through flexibility in operations.
- *Transformatio*n is required , when conditions change to a degree that a project will no longer provide acceptable performance after accounting for adaptability,. In traditional investment analysis this is the expected lifetime of a project, which is typically 30-50 years for infrastructure. However, the lifetime of a project can be less if the future conditions vary from the expected conditions used for its design. The need for transformation of a project is expressed as its *Sunset*.
- The *Sunset* accounts for the vulnerability to change that a project has, and relates that vulnerability to the expected time at which that change would occur.

Figure 5.1. The range of climate change realisations over which an investment is persistent and adaptive



Note: Beyond the blue range of climate change, the project will not be able to deliver the desired services and transformation to a new investment is needed. This transformation is guided by the SIPs.
Source: (Brown and Boltz, forthcoming[2])

(2) Selecting 'best' investment and managing trade-offs

The results of the stress test is a database of system response to all combinations of realizations of the current uncertainties, which represent possible futures. Distilling this output into plain insights to guide planning is not simple. A useful analytical device is the creation of *ex post* scenarios, also known as Scenario Discovery. This method uses a threshold on a performance metric to divide the possible futures into two groupings: those where the performance metric threshold is satisfied (acceptable performance) and those where it is not (unacceptable performance).

There is a growing literature on the development of tools and methods for ex-post scenario analysis (e.g. (Bryant and Lempert, 2010[81]; Culley et al., 2021[82]). Ex-post scenario analysis reveals the vulnerabilities of individual projects and pathways, and in doing so, shows their persistence, adaptability and transformation. The information revealed serves as the basis of a so called Futures Map (described below) and is the means for identifying the variables that need to be monitored.

In multi-objective decision making processes such as water investment planning, it is unlikely that a single investment option will dominate all other options across all objectives. Instead, a set of non-dominated investment options will emerge as the set of candidate investment options. Non-dominated means that for an investment no other investment offers better performance on each of the objectives than the non-dominated investment, although they may offer better performance on one or more objectives.

Because planning objectives cannot be fully represented in the quantitative terms modelling requires, the "best" investments are those selected by planners based on the analysis results and their own decision making including all that cannot be expressed in models.

The set of best performing investments is selected for pathways analysis. The process for selecting a single or small set of "best" investments will benefit from an understanding of the trade-offs between the options in terms of their performance across different objectives. In other words, how much does better performance in one objective "cost" in terms of decreased performance in another objective.

Trade-off analysis is facilitated by creating graphics of performance metrics in multiple dimensions. A number of software packages exist that can enable the design and production of informative figures (e.g. Kwakkel et al. (2017[76])).

Step 3. Designing Strategic Investment Pathways

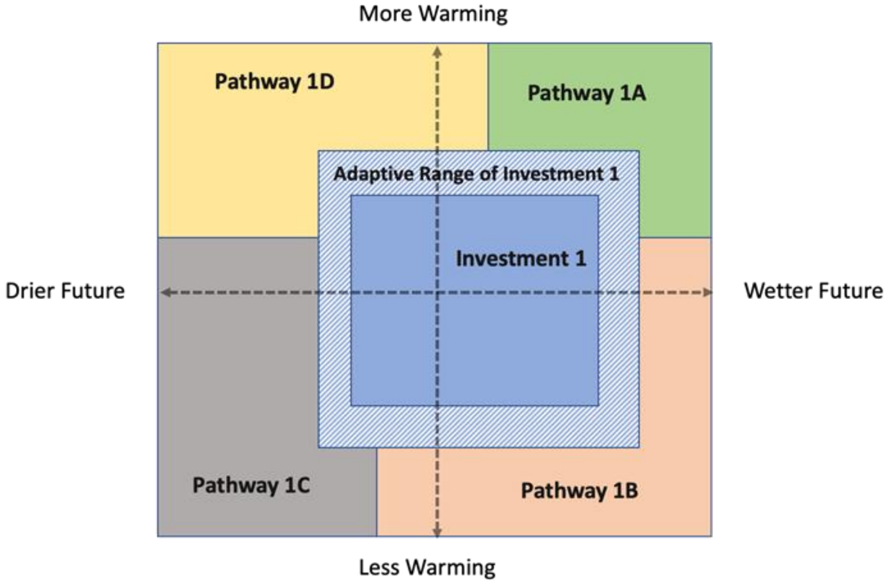
Step 2 identifies the most promising investments in terms of their individual performance using stress testing. Step 3 is the following analytical process to design the SIPs: Optimization and stress testing are used to design the full investment pathway for the purpose of selecting the best next investments. The prioritization and sequencing process consists of evaluating each project individually first and then evaluating the most promising projects in terms of their influence on future investments and conversely, the influence of future investments on those projects. By doing so, this approach addresses the concern that the investment pathway overly influences and constrains the specific decision at hand, which is the most immediate investment need.

The process uses repeated applications of stress testing to assess the projects individually and as pathways. As a result, the best immediate investment can be identified in a way that also incorporates the potential of the investment pathway that such a project initiates (and those that it foregoes). The final part of the process is to develop an understanding of the best follow-on investments and their sequencing under alternative futures. The understanding is created by using ex-post scenario analysis on each of the candidate pathways made possible by the initial investment(s). The analysis is used to identify vulnerabilities and the futures under which a pathway would not provide satisfactory performance.

With an understanding of the vulnerabilities of the initial investment and each of the possible investment pathways, a Futures Map can be created (see Figure 5.2). A Futures Map is a navigational decision-support tool that specifies under which conditions a particular pathway should be undertaken. As each new investment is made, the Futures Map must be updated because new pathways are made possible and some original pathways now precluded.

In the next step, the Futures Map serves as the basis for developing a monitoring and forecasting plan that provides the information required to turn the Futures Map into a navigation strategy.

Figure 5.2. A diagrammatic representation of the Future Map depicting pathways based on the immediate “investment 1”



Note: Futures Map for a selected investment in terms of its persistence (blue), adaptability (blue hash), and strategic investment pathways in terms of future climates.
Source: (Brown and Boltz, forthcoming[2])

5.2 Examples of intermediaries operating in the EU

The European Fund for Strategic Investment (EFSI)

The European Fund for Strategic Investment (EFSI) is an example of a dedicated financial instrument to unlock private investment for strategically important projects. It works through EU funding and technical assistance. The European Commission provides guarantees to the European Investment Bank (EIB) for projects supported by the EFSI. The projects are subject to the normal EIB project cycle governance, in addition to an EFSI specific governance structure, ensuring compliance with EFSI objectives. The residual risk of the lending products are reduced significantly, unlocking additional and affordable private finance. By the end of 2020, EFSI portfolio totalled EUR 102 billion, which are expected to mobilise EUR 545 billion of investment across the EU.

One example for a water-related project funded by the EFSI concerns a public-private partnership for flood protection in the Netherlands. The project concerned an upgrade of the "Afsluitdijk dyke, ensuring compliance with flood directives in the future, and was awarded through a tender process to the private consortium Levvel, which is responsible for the design, construction, financing and maintenance over 25 years. The EFSI has supported the EUR 550 million project with a EUR 330 million loan. Besides increased flood protection and adaptation to climate change, the project also includes components to re-establish fish migration, the improvement and maintenance of a National Motorway and the promotion of the local economy through projects on recreation, tourism, nature and innovative sustainable energy sources. Payments to the consortium are based on the availability of the infrastructure, allowing for potential performance deductions.

The Natural Capital Financing Facility (NCFF)

Another joint EIB / European Commission financial instrument is the Natural Capital Financing Facility (NCFF) for projects related to biodiversity and climate change adaptation. It targets green and blue infrastructure, including nature based flood protection, sustainable urban drainage systems, watershed management, etc. Under the NCFF, EIB offers grant-based technical assistance of up to 1 million and loans between EUR 1 – 15 million with long tenors and up to 3-year grace periods. Project requirements include a proven ability to pay back the loan either through project cash flow or city budgets, as well as additional funding sources for at least 25% of the overall project costs.

One project example is the renaturalisation project of the Alzette River in Luxembourg, aiming to reduce flood risk, benefit biodiversity and improve water quality. The re-establishment of natural conditions will improve the resilience of river systems and fosters the sustainable multifunctional use of estuaries, rivers and streams, protecting bird habitat. The project will also apply a nature-based solution to reduce the amplitude and frequency of flooding events which affect downstream locations. EUR 9 million of the total project costs of EUR 12 million will be financed through facility NCFF grant.

Les Agences de l'eau – French water agencies

The French water agencies (Agences de l'eau) are intermediaries that provide technical and financial support for the design and implementation of policies promoting integrated water resource management, in France and internationally. They are state bodies with a mandate to support stakeholders, including local authorities, and economic agents in the 3 key water user sectors (manufacturing industry, agriculture and households) as well as farmers and fishing and nature protection associations to finance, support and develop projects and initiatives aimed at preserving water resources and biodiversity in river basins. For example, the water agencies provide secretarial services to basin committees, which are multi-stakeholder platforms for local governments, consumers, NGOs, farmers and other stakeholders to democratically determine the water managing strategy for the basin. Further, water agencies foster capacity building and provide technical assistance as well support the preparation of investment opportunities though financial assistance. The water agencies collect fees from all water users according to the Polluter Pays and User Pays Principle, which are also used to provide financial aid to stakeholder projects for sustainable water resource management and water quality restoration, with a specific reference to of climate change. For their 2019 - 2024 plan, they devoted more than 40% of their aid to adaptation purposes, aiming to mobilise more than EUR 12 billion for a sustainable management of water resources in France to tackle climate change.

The Nature Conservancy and the Water Fund Network

The NGO The Nature Conservancy (TNC) supports and consults governments, corporations and the finance sector in Europe to conserve water resources, oceans and healthy lands. One focus of their work is to bring together actors and stakeholders to ensure the inclusion of nature-based solutions in investment projects for sustainable water resource management. For example, they are working with the Ministry for Ecological Transition of Spain and partners in the UK, such as the membership organisation Water Resources East, the Norfolk River Trust and Oxford University, in order to improve water allocation, to restore critical freshwater ecosystems and to create an enabling environment for mobilizing financial resources for nature-based water-related investments at scale in the UK and Spain.

In other parts of the world, TNC has developed the Water Fund Network. Water funds are collective investment vehicles, which pool together grant funding from donors, local communities and commercial actors within the spatial area and basin to finance investments in sustainable water resource management through nature-based solutions. Activities include payments for environmental services, including watershed management and biodiversity conservation, water resource management and adaptation measures to mitigate negative impacts on water resources due to climate change. Water funds offer no direct financial return on investment; instead, the profitability of the capital provision arises from the positive impacts on local actors reliant on water resources. The brewery Heineken, for instance, invests in the Monterrey Metropolitan Water Fund in Mexico, which, to date, has leveraged USD 9.1 million (EUR 7.7 million) with an implementation area of 1,387ha.

Sources: (EIB, 2019[83]; EIB, 2021[84]; The Afsluitdijk, 2020[85]; World Construction Network, 2019[86]; EIB, n.d.[87]; EIB, 2017[88]; Les agences de l’eau, n.d.[89]; TNC, 2020[90]; Trémolet, S. et al., 2019[42]; Latin American Water Funds Partnership, 2020[91])

5.3 Draft technical screening criteria for water-related activities under the EU taxonomy

This excerpt illustrates how water-related investments may be reflected in the EU taxonomy and which criteria they may need to fulfil to be taxonomy-compliant and eligible to be labelled as 'EU sustainable'. (Platform on Sustainable Finance, 2021[70])

Some suggested draft criteria for the construction or extension of water supply systems

In order to make a *Substantial Contributions* to the EU Taxonomy's environmental objective of the 'sustainable use and protection of water and marine resources', the construction and operation of a new water supply system, or an extension of an existing one, the document put up for public consultation suggested (inter alia) the following technical screening criteria:

- comply with the contamination parameters and quality parameters required as per the current Drinking Water Directive and the revised Directive
- be included in a water use and resource management plan, securing local water resource management and governance by relevant authorities, consistent with the relevant RBMP, referring to the requirements of the WFD or any other plan at river basin level
- have a leakage level equal or lower than 1.5 (Infrastructure Leakage Index), or the threshold value is established in accordance with Article 4 of Directive (EU) 2020/2184
- include metering at consumer level.

Some suggested draft criteria for nature-based solutions for flood risk prevention and protection of inland and coastal waters

In order to make a *Substantial Contribution* to the EU Taxonomy's environmental objective of 'the sustainable use and protection of water and marine resources,' the document put up for public consultation suggested (inter alia) the following technical screening criteria for nature-based Solutions (NbS) for flood risk prevention:

- be quantifiable and/or time bound measures to achieve the objectives for flood risk reduction in accordance with a Flood Risk Management Plan (FRMP) coordinated at river basin scale and developed under the Floods Directive
- demonstrate specific ecosystem co-benefits which contribute to achieving good water status in accordance with WFD and nature restoration targets defined in the EU 2030 Biodiversity Strategy
- involve local stakeholders from the outset in the planning and design phases to ensure the full delivery of multiple benefits and the successful implementation of the activity.
- Have a monitoring programme in place to evaluate the effectiveness of an NbS scheme to improving the status of the affected water body and changing climate conditions allowing for flexibility. The programme is required to be periodically reviewed by an ad-hoc committee composed of sector experts (including ecologists) and the relevant regional or local managing authorities following the cyclical approach of the River Basin Management Plans and the Flood Risk Management Plans.

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