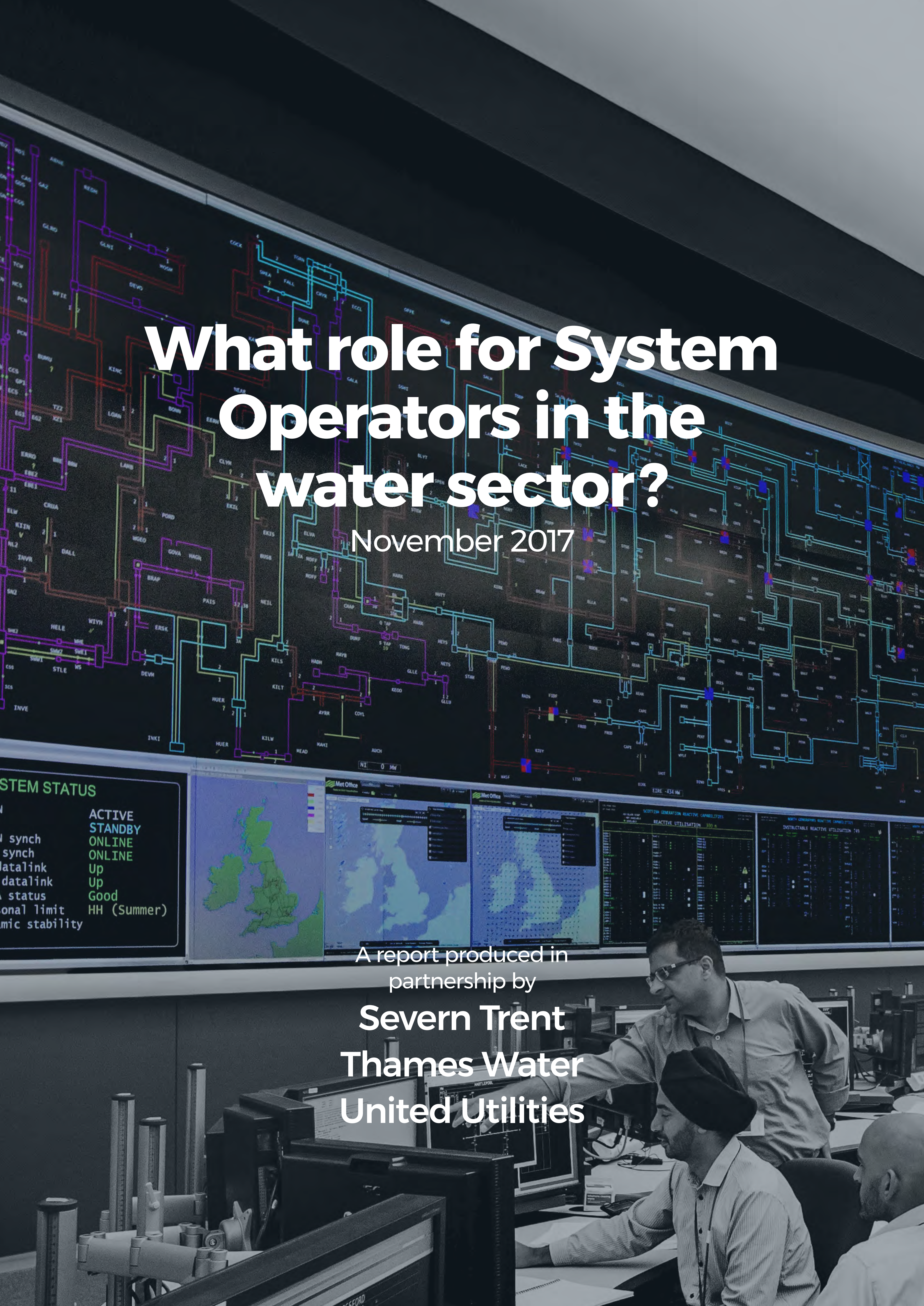

What role for System Operators in the water sector?

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A report produced in partnership by

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System Operators (SOs) are institutions whose primary purpose is the achievement of coordination efficiencies when a network is being used. They have been particularly associated with the energy sector, but a range of institutions in other sectors can also be regarded as SOs, such as air traffic management providers and payment System Operators. They can differ in terms of the scope of their responsibilities (what they are charged with increasing efficiency in relation to, and over what periods), their institutional form (their structure, ownership, governance etc.), and how exactly they go about undertaking their duties (what it is they actually ‘do’). But the core feature SOs share is their primary focus on delivering coordination benefits.

Much of the attention given to the role that SOs could play in the water sector has been directed at the case for having separate SOs within water companies as part of enabling a more disaggregated model of network usage to emerge. However, in other sectors, the development of SOs has often been driven by a different motivation: the need to fill an identified coordination ‘gap’. Air traffic management and payment systems provide examples of SOs being developed to address particular coordination issues.

In the water sector, two ‘gaps’ where there are significant coordination challenges, and where SOs might have a key role to play, are:

- The efficiency with which water resources can be developed, accessed and traded; and
- The efficiency of coordination between water company network development decisions (and the development of interconnectors for water trading between companies).

Interconnector developments are particularly useful to consider in this context. They raise questions of network development coordination, but also derive their value from the underlying prospects for water trading (such that water could flow through the interconnector). There are two key phases in which an SO could provide coordination benefits:

- Facilitating the development of new interconnector projects (including securing necessary regulatory approvals and assurances to underpin financing); and
- Facilitating access to the interconnector (once built) and facilitating broader water trading (that affects usage of the interconnector).

Potential coordination issues and SO roles at different stages of the interconnector development process

Stage of the development process	Coordination issues and potential SO role
Identifying and selecting a preferred option	An SO could provide for a better informed and coordinated option identification and assessment process.
Assuring the feasibility of the preferred option	Efficient options may be identified, but if their feasibility cannot be assured to a sufficient degree, then the project cannot be expected to progress further. An SO could seek to: • Assess and manage/mitigate uncertainty over the future treatment of trades by environmental regulators; • Establish the likely permissibility of the project, given relevant planning and environmental constraints; • Assess and manage/mitigate uncertainty over the future treatment of the interconnector and bulk supply agreements by Ofwat. • Identify and develop procurement arrangements for delivery of the preferred option.
Operating the interconnector once built	An SO to coordinate access to, and manage usage of, the interconnector by (at least potentially) multiple parties.
Broader market engagement post-construction	An SO could potentially facilitate more efficient water trading while guarding against adverse environmental outcomes.

The establishment of new Catchment System Operators (CSO), made responsible for undertaking a range of coordination activities in place of environmental regulators, has been proposed as a potential way forward in this area. However, the need for legislative change to establish CSOs, and the complexities likely to be associated with identifying and specifying the appropriate reforms, mean that even if such a model were to become a preferred option, it may take many years for suitable legislation to be brought forward.

The role that ‘bottom-up’ company-led development of SO-type institutions could play – with SOs established as joint ventures between water companies looking to develop interconnection – merits particular attention. Importantly, this wouldn’t require legislative change, given its limited likelihood in the near future. The approach aligns well with the focus that SOs tend to have on the detailed practicalities of how systems operate and are used, as companies typically are better placed than regulators to identify how those operational activities might best be structured and undertaken. Bottom-up development of SOs is also attractive as it could allow for experimentation and evolution in the development of SOs in the sector, in a context where it is difficult to define up-front precisely how SOs may be best able to generate coordination benefits.

While the wide range of initiatives concerned with related matters makes for an already fairly crowded context, the core purpose of SOs is important here: to facilitate more efficient coordination between other actors. Development of SOs should therefore be targeting key identified gaps, which concern coordination between actors and not the underlying allocation of responsibilities within the sector (for example in relation to matters such as security of supply or resilience). Experience gained from bottom-up SO activity could then inform subsequent developments. This could include other bottom-up developments, but it may also involve better informed consideration of the case for the statutory introduction of other top-down SO models.

The most challenging and novel part of the bottom-up SO model considered here is the potential for an SO to facilitate water trading on an ongoing basis. But this is also an area where there may be significant opportunities for desirable institutional innovation. For example, one could envisage an SO developing some additional types of monitoring and reporting that could provide greater confidence (to environmental regulators and other interested parties) that relevant trading would not be conducted in ways that generated material environmental harm. This could help facilitate movement towards a form of ‘outcomes’ approach, with trading permitted in areas where sufficient safeguards were in place in relation to potential adverse outcomes. If this allows environmental outcomes to be met in less costly ways, it could also facilitate the more rapid improvement of those outcomes.

Bottom-up development of this kind of SO would inevitably face some significant challenges. It would be heavily dependent on relationships with regulators and other stakeholders: e.g. to what extent will regulators seek to facilitate/constrain this type of development? And in the absence of legislative change, the scope for powers to be delegated to SOs may face significant legal constraints. While these challenges should not be understated, realistic opportunities for the bottom-up development of SOs nevertheless remain. If an SO can provide a standardised source and basis of monitoring and assessment within a given ‘system’, then this could benefit and form part of the decision making of environmental regulators in a number of different ways. It is common, for example, for regulators to make use of privately established industry standards and codes of conduct, when setting regulatory requirements. Such practices allow regulatory decision making to remain more ‘high level’, as the existence of the standardised practices and processes are consistent with a risk-based regulatory approach.

In the current regulatory framework, Ofwat would not appear to have a direct means of regulating an SO. Experience with energy interconnectors suggests that some relatively straightforward institutional design features – e.g. concerning capacity availability and transparency – could be put in place to guard against potential concerns. However, further work on the identification of what those concerns might be could help unintended or unnecessary cost implications arising from regulatory uncertainty. This work could explore the commercial and regulatory incentives shaping the delivery and operation of an SO and include the up-front development of principles that should guide future regulatory treatment.

Bottom-up company-led development of SOs, therefore, has potential to be a highly productive form of institutional innovation in the water sector. It could help address a number of practical coordination issues concerning the assessment and progressing of interconnector developments, and also facilitate the development of more efficient trading arrangements.

Executive summary continued

The bottom-up development of an SO with interconnector development: Potential characteristics

SO characteristic	Possible form
How is the SO established?	• SOs could be established through Joint Ventures between affected businesses (e.g. by two or more water companies).
What is the scope and form of its duties?	• Ahead of construction, an SO could play a key development role in the identification of a preferred interconnector option, and in the assurance of its feasibility (as above, given uncertainties over e.g. future regulatory treatment). • An SO could then be responsible for managing access to and operation of the interconnector once built. However, an SO could also be charged with seeking to engage beyond the direct scope of the interconnector and to facilitate trading that might affect usage of the interconnector. (See also Figure 1 on page 33)
What powers does it have when seeking to meet its duties?	• Direct powers would arise through the contracts with interconnector developers and users. • For actions aimed at facilitating water trades (that might affect interconnector flows), powers and/or the effectiveness of activity in relation to trades would depend on engagement with relevant regulators and potential contracting parties.
How separated is the SO from other activities?	• Given the potential for discrimination concerns to arise (for example, over access to interconnector capacity), separation mechanisms that adequately address such concerns are likely to be important.
What is its institutional form?	• This would depend on the parties to the JV and may vary in term of the stage of the development. It may be, for example, that in the option identification and assurance stages, ahead of construction, a not-for profit vehicle was considered appropriate. A for-profit business may then be established to operate the interconnector once built and to facilitate its efficient usage.
How is it regulated?	• Absent legislative change, the SO would not be subject economic regulation by Ofwat (but would, of course, be subject to general competition law). The significance of this is likely to be heavily dependent on the form and conduct of the SO (including, for example, the extent to which the capacity provision and transparency arrangements that are put in place guard against potential sources of concern). • The SO would have to comply with relevant environmental regulation, and a key part of its role could be to try to facilitate the allowance of more flexible approaches to water trading that were consistent with outcomes acceptable to environmental regulators.

Section 1: what are System Operators?

SOs and the achievement of network coordination benefits

1. The role that System Operators might play in the water sector has been considered for several years, but remains very much an open question. This report aims to promote discussion of how SOs might evolve in the sector, and in particular highlights the potential role that 'bottom-up' company-led development of SO-type institutions might have.
2. While the term 'System Operator' (or SO) has been used in a range of different ways and contexts, the core defining feature of SOs can be understood as their engagement in some form of coordination activity. That is, System Operators are institutions whose primary purpose is the achievement of coordination efficiencies when a network is being used: they can provide a means of addressing risks of coordination failures arising, or – put more positively – of increasing the extent to which potential coordination efficiencies are realised.
3. Similarly, the term 'System' can be interpreted in a broad range of ways, as it is intended to capture the set (or subset) of interdependencies between parties that the SO is, or could be, focused on. So, in a water context, the meaning of the term 'system' will depend on the circumstances being examined: in some cases it will refer to a water company's physical supply network; in some others to a broader catchment-inclusive view; and in others to intermediate sets of interdependencies (such as those that might be directly associated with a particular interconnector development).
4. Coordination failures can arise when interdependencies of one form or another are not taken into account sufficiently by different parties in their decision making. When that happens, overall outcomes can exhibit a range of problems (including potentially safety and/or security of supply problems, as well as other forms of inefficiency) even where individual actions – when viewed in isolation – may be regarded as 'optimal'. Networks by their very nature can give rise to significant and multifaceted interdependencies between users, and so the potential for coordination failures to arise can have a particularly significant bearing on the desirability of different structural approaches to allocating roles and responsibilities.
5. In principle, affected individuals and organisations could seek to contract bilaterally to try to address the kind of 'externality' problems that network interdependencies can give rise to. In practice, though, a range of institutional and (transaction) cost-related factors can constrain the effectiveness of such responses. Given this, coordination failures can persist even when significant (de-centralised) efforts are made to resolve them. System Operators are institutions that are responsible for lessening the risk of such coordination failures arising.
6. The novelty of, and regulatory interest in, the System Operator 'model', comes in part from what it is not. That is, a well-recognised alternative way of responding to concerns over coordination failures is consolidation. This approach removes disaggregated decision making through organisational integration. The underlying interdependencies between decisions will remain, of course, but coordination becomes a matter of internal management (of network optimisation), rather than of contracting between organisations.
7. The SO model can be viewed as intermediate as it clearly involves some centralisation (and thus some 'consolidation'), but the scope and nature of that centralisation is limited to – or at least rooted in[1] – a number of core coordination-related functions. It can be understood as sitting on a spectrum between a disaggregated model with multiple system users where system interactions are managed through bilateral contracting, and a monopoly model where there is a single user that also owns and operates the network (such that relevant interactions are internal).

How do SOs differ?

8. System Operators have been particularly associated with the energy sector, but a range of institutions in other sectors can also be regarded as SOs, such as air traffic management providers and payment System Operators. While they share a primary focus on delivering coordination benefits, SOs can differ in a number of significant ways. Some key sources of difference are outlined in Table 1, and these differences are illustrated by reference to some examples in Section 2.

[1] The roles that institutions described as SOs end up playing in practice can clearly extend beyond these 'core' SO activities, depending on the extent of integration with other activities such as asset management.

Section 1: what are System Operators?
continued

Table 1: Summary of some key ways in which SOs can differ

SO characteristic	Some examples of how SOs can differ
How was the SO established?	• Unbundled from an existing monopoly business? • Established through regulatory/government action? • Developed through inter-company coordination?
What is the scope and form of its duties?	• What is the SO charged with delivering coordination efficiencies in relation to? • What is the geographic scope? • Short term and/or longer term responsibilities?
What powers does it have when seeking to meet its duties?	• To what extent are users required to contract with the SO? • How (pro-)active can the SO be?
How separated is the SO from other activities?	• What other activities does the SO owner undertake (network provider, user, etc.)? • Is there regulatory, accounting, functional, legal separation, or 'full' independence?
What is its institutional form?	• Is the SO publicly or privately owned? • Is the SO for-profit or not-for-profit? • How are user interests reflected in SO governance?
How is it regulated?	• Through public ownership (with no explicit regulatory oversight)? • Through a form of self-regulation? • Subject to direct regulation (e.g. a licensed service provider)?

9. System Operators will also differ in terms of how exactly they go about undertaking their duties (that is, what they actually 'do'). In broad terms, though, SOs can be understood as seeking to deliver coordination benefits in two main ways:

    a. **Facilitating more efficient contracting between others:** For example, SOs can develop and maintain frameworks, rules and procedures that facilitate more efficient contracting between others that are system users (or that are affected by system usage). This often includes the use of a common multilateral contract that all users (must) sign up to and that provides an over-arching operating and governance framework. Importantly, this type of facilitating behaviour can lessen the extent to which coordination failures would be expected to arise.

    b. **Directly intervening to guard against harm from coordination failures/increase the extent to which coordination efficiencies are realised:** SOs can intervene directly in order guard against coordination failures that would, or might, otherwise arise having harmful effects. For example, in electricity networks SOs typically have a 'residual' balancing role, buying and selling electricity close to real time to address any balancing issues that remain notwithstanding the set of bilateral contracts that buyers and sellers have entered into[2]. And SOs can also actively seek to identify ways in which their actions can directly improve coordination efficiencies, for example, through the development and use of more sophisticated network constraint management techniques.

10. Markets can give rise to a wide range of different types of institutions that – one way or another – seek to facilitate more efficient contracting between others (as in (a) above). While such facilitation activity is core to what SOs do, System Operators are typically characterised by the fact that they also have some broader and 'backstop' responsibilities in relation to the efficient operation of a given system (as well as often other matters such as safety, security of supply, etc.), and it is those responsibilities that underpin the direct interventions under (b) above.

[2] The importance of this residual balancing role stems from the complexities that would be involved in relying only on bilateral contracts to guard against the different ways in which imbalances can arise (e.g. plant failures, network constraints, external (e.g. weather-based) shocks, etc.), in a context where imbalances can have major adverse effects, including loss of supply to customers and damage to infrastructure (which can itself then prolong supply losses).

Section 2: what roles have System Operators played in other sectors?

11. Table 1 highlighted a number of ways in which System Operators can differ. These differences are illustrated by considering SOs in three other sectors: energy, air traffic management and payments[3]. In each case, an overview some key features of SOs in the sector is provided, and some aspects that may be of particular relevance in a water context are highlighted.

System Operators in the energy sector

12. Table 2 below summarises some key characteristics of the electricity System Operator role in Great Britain, which is currently undertaken by National Grid Electricity Transmission plc.

Table 2: Summary of some key characteristics of the electricity SO in GB

SO characteristic	Summary comments for the electricity SO in GB
How was the SO established?	• The SO role was identified separately from NGC's transmission business in England and Wales, and Ofgem has applied SO incentives since 1994[4]. • NGC was appointed by government as SO for GB transmission networks in 2004[5].
What is the scope and form of its duties?	As SO, NGC has been responsible for:[6] • Ensuring the system stays within safe operating limits, and the pattern of generation and demand is consistent with system related constraints; • The residual purchasing and selling of electricity to keep the system in balance in real time; • New connections to GB transmission systems and for collecting use of system charges from users; • Assessing new transmission investment requirements, and potential responses; and • The development and governance of industry codes (where it has had a central role).
What powers does it have when seeking to meet its duties?	• Users of GB transmission systems have to be signatories to relevant industry codes, and this gives the SO significant powers. • Flexibility for SO responses was initially relatively limited (with processes for SO actions quite tightly defined), but has been increased over time where that has been considered beneficial.
How separated is the SO from other activities?	• The SO role has been integrated with NGC's transmission business in E&W, but independent of transmission ownership in Scotland. • Separation requirements have tightened over time. In January 2017, Ofgem and the Government announced the intention that the electricity SO should become legally separate[7] (a requirement for an Independent SO is not being progressed at this point).
What is its institutional form?	• The SO is privately owned by NGET plc (part of National Grid plc), a for-profit business. • Ofgem set incentives that can allow the SO to earn profits. • User interests are reflected in governance processes for industry codes that are overseen by Ofgem.
How is it regulated?	• The SO is currently operated under NGET's transmission licence, and will hold its own transmission licence following legal separation. It is regulated by Ofgem.

[3] Experience with SOs in some other sectors (including railways) and contexts (including European gas markets) is reviewed in: Stern, J., Cave, M. & Cervigni, G. (2012) The role of System Operators in network industries.

[4] An early example of Ofgem's work on SO incentives is: Ofgem (December 1999) *NGC System Operator incentives, Transmission Access and Losses under NETA: Consultation Document*.

[5] This was part of the introduction of the British Electricity Trading and Transmission Arrangements (BETTA), which extended the extended the new electricity trading arrangements that had been introduced in England and Wales to provide GB coverage.

[6] A more detailed description of current and potential future electricity SO roles can be found in: Ofgem (January 2017) *Future arrangements for the electricity System Operator: its role and structure – consultation.*

[7] Joint BEIS, Ofgem and National Grid *Statement on the future of Electricity System Operation*: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/582899/Statement_on_the_Future_of_Electricity_System_Operation1350.pdf

Section 2: what roles have System Operators played in other sectors? continued

13. A notable feature of the GB electricity sector is the relatively long period over which the SO role has evolved, with SO incentives having been first introduced in 1994. It has only been in 2017, 23 years later, that a decision to require legal separation has been made. In practice, the evolution of the role of the electricity transmission SO over time has been responsive to the emergence of new and different priorities over time, and a new requirement for legal separation can be understood as part of this (and, in line with this, a similar requirement has not been introduced for National Grid as the gas SO in GB). That is, SO legal separation is now considered important[8] in order to strengthen protections against harm from conflicts of interest in a context where the SO is to be charged with promoting economic and efficient 'whole system' solutions, that may include the use of 'smart' solutions, with coordination across the transmission-distribution interface, in place of traditional transmission network investment.

14. This new separation requirement will fall short of requiring the establishment of a wholly separate Independent System Operator (ISO) of the kind seen in US electricity markets, although further movement towards that model remains a possibility depending on experience under the legal separation approach. US electricity markets have been notable for their use of not-for-profit ISOs that function effectively with a form of public interest objective[9]. As will be highlighted below, Payment System Operators can be understood as adopting a similar approach to this in some respects.

15. The following highlights three aspects of energy sector SO arrangements that may have particular relevance when considering the water sector: Electricity and Gas Ten year statements; network complexity and balancing (and the distinction between notional and 'real' balancing), and, interconnector developments.

Electricity and Gas Ten year statements

16. National Grid, in its role as System Operator of the GB electricity and gas systems is required each year to produce an Electricity and a Gas Ten Year Statement[10]. These statements include:

- A review of future energy scenarios (these having been developed through separate SO consultation); and,
- An assessment of current network capabilities against future requirements.

17. In many respects, the Water Resource Management Plan process could be understood as playing a similar role to this in the water sector. However, the process is of particular interest in relation to electricity transmission, as NGC is the SO for transmission networks for the whole of GB. It therefore provides an assessment of current network capabilities against future requirements that goes beyond the network that it owns and manages, and includes also the two transmission networks in Scotland (owned and managed by SP Transmission and SHE Transmission). The Electricity Ten Year Statement (ETYS) includes an assessment of boundary capabilities, and the identification of where power flow limitations may be encountered.

18. Following Ofgem's Integrated Planning and Regulation Initiative (which concluded in March 2015),[11] potential network capacity deficits identified in the ETYS now trigger the initiation of the Network Options Assessment (NOA) process. The NOA process involves NGC assessing and then recommending options for addressing the identified capacity deficits, including deficits that might relate to interconnectors with other parts of Europe. In its first NOA, NGC assessed more than 70 transmission system investment options across GB, and recommended proceeding with the development of 8 of those options in 2016[12].

Network complexity and balancing

19. The complexity of network interdependencies can create significant difficulties for identifying what capacity might be available for a given network user to have access to, and how balancing should be defined when inputs and offtakes are being made. For example:

- Inputting an amount X at point A on the network may not mean that the same amount X becomes available at point B on the network: geographic substitutability may raise balancing difficulties.
- Inputting an amount X at time t on the network may not mean that the same amount X becomes available at time t+n on the network (where n may be, for example, a few hours, a day etc.): temporal substitutability may raise balancing difficulties.

[8] See, for example, Section 3 of: Ofgem (January 2017) *Future arrangements for the electricity System Operator: its role and structure – consultation*.

[9] A review of US ISO arrangements and experience is provided in Pollitt, M.G. (2011) *Lessons from the History of Independent System Operators in the Energy Sector, with applications to the Water Sector.*

[10] Electricity Ten Year Statements can be viewed at: http://www2.nationalgrid.com/UK/Industry-information/Future-of-Energy/Electricity-ten-year-statement/ Before 2012, NGC produced a 7 rather than a 10 year statement for electricity.

[11] https://www.ofgem.gov.uk/electricity/transmission-networks/integrated-transmission-planning-and-regulation

[12] National Grid (November 2016) *Electricity Ten Year Statement 2016*.

20. More generally, the availability of capacity to offtake from a network at any given location and point in time may be contingent on a range of other decisions and factors. Access to water resources can give rise to this kind of complexity and contingency issue. One approach to dealing with this complexity is through the application of a series of bespoke conditions that tightly specify and constrain how input and off-take rights can be used, and by whom. However, such an approach can greatly limit the flexibility of market participants to make efficiency enhancing adjustments over time (which may rely on the ability to make changes to the pattern of how much is input/off-taken, when, where and by whom).

21. The development of the balancing and trading arrangements in the energy sector provides an interesting illustration of how the actions of an SO can significantly lessen the extent to which this kind of underlying complexity and contingency needs to be faced by users. This has involved the use of balancing zones and balancing periods: defined areas and time periods within which flows can be treated as interchangeable, subject to a number of conditions having been met.

22. For example, third-party usage of the National Transmission System (NTS) for gas developed (for the most part) on the basis of a single 'notional' balancing point, and end-of-day balancing. The use of a notional balancing point meant that all supplies brought onto and taken off of the NTS during a given 'gas day' (a 24 hour period starting at 0600 each day) were treated as equivalent for balancing purposes (subject to some other requirements, including e.g. in relation to gas quality being met).

23. Of course, location and timing do matter for 'real' network flows, and constraints can emerge within the system. But the management of these constraints has been treated as a matter for the SO. That is, the SO would directly intervene to manage the relationship between the 'real', physical network, and the 'notional' network to which usage rights had been sold. For the GB gas transmission system, in practice, this involves monitoring expected pressure levels on the system to ensure they can be expected to remain within safe and efficient upper and lower thresholds, and responding when a risk of threshold breach is identified (for example, by adjusting the way compressors were being used, by paying to bring more gas onto the system at a relevant point, or by invoking rights to interrupt some industrial customers in a constrained area). This SO activity is supported by a range of requirements and incentives including, for example, that market participants must submit information on their planned input and off-take levels and locations ahead of time.[13]

24. This kind of simplification can be strongly efficiency enhancing in some circumstances, because the System Operator may be in a position to identify and exploit a range of coordination efficiencies that would otherwise be unlikely to be available to network users (because of the difficulties of contracting to achieve them). One standard example of this concerns the likelihood of 'peaks' being coincidental. Where that likelihood is 'low', it may be more efficient for an SO to sell rights to capacity that - if simply summed on the basis of peak usage - would exceed the amount likely to be physically available. It would then for the SO to manage the risk of that eventuality arising (for example, through securing some rights to interruption).

25. Where the gap between the real and the simplified notional network is 'too great', significant inefficiencies can arise. For example, users may face poor economic signals and indeed may seek to game the arrangements to try to trigger SO responses that they may benefit from (e.g. if the SO could be expected to pay a high price for additional supplies at a given location). However, in practice, the GB energy SOs have tended to develop more effective signalling mechanisms over time, aimed at avoiding such perverse effects. This experience has highlighted that the development of more sophisticated mechanisms for monitoring and responding to system conditions and usage can potentially offer significant benefits by allowing the more efficient utilisation of existing capacity.[14]

Interconnector developments

26. Table 3 considers how an interconnector operator such as IUK, the operator of the gas interconnector between Bacton and Zebrugge, fits in terms of the SO characteristics set out in Table 1 earlier. Interconnector operators have not typically been regarded as SOs, with instead the interconnector viewed as connecting two existing systems. However, approaches taken to the provision of interconnector capacity provide a useful reference point. For example, as can be seen in Table 3, the Bacton Interconnector was developed as a Joint Venture of a number of gas suppliers. Each of of those suppliers secured long term capacity rights to usage of the interconnector (with the charges paid for that capacity set so as to recover construction and operating costs).[15]

[13] See, for example, National Grid (March 2016) End-to-end balancing guide: an overview of the commercial elements of GB gas balancing activity.

[14] This kind of development has been central to the achievement of what are referred to as 'smart grid benefits'. See, for example, the July 2017 joint HM Government and Ofgem document: *Upgrading our energy system: smart systems and flexibility plan*.

[15] Information on IUK can be found at: http://www.interconnector.com

Section 2: what roles have System Operators played in other sectors? continued

27. Ofgem's regulatory interest in the interconnector over time has focused primarily on the question of whether capacity is being withheld, such that the interconnector is utilised to a lesser degree than would otherwise have been expected in the prevailing market circumstances. In practice, concerns over capacity withholding have been addressed primarily through the Interconnector Operator holding auctions to make otherwise unused capacity available in a transparent manner. There has been significant trading of firm capacity rights for interconnector usage over time.

28. It is notable that IUK was not directly regulated when the interconnector was constructed and initially brought into operation. Rather the interconnector licensing arrangements were developed later in line with broader developments in EU energy regulation. In practical terms, though, arrangements to provide for auctions that would make otherwise unused capacity available had already been put in place ahead of the introduction of the licensing regime. This points to a way in which arrangements can be designed to provide a means of addressing potential regulatory concerns in the absence of formal regulatory powers.

Air traffic management providers as System Operators

29. Air traffic management[16] involves a number of distinct activities that could regarded as system operation:

- **Airspace design** can be understood as providing the network of possible routes that planes could fly through. The CAA is responsible for changes to airspace design in the UK (and thus for the long term development of the network).
- **Air traffic flow management** can be understood as the allocation of available slots to fly through the relevant network. Eurocontrol is responsible for air traffic flow management throughout Europe (as part of its role as 'Network Manager').
- **Air Navigation Service Provision (ANSP)** involves providing a range of services that support flights through the relevant network (once they have secured a slot). It can be subject to a number of 'vertical' divisions, with 'terminal' services provided in the vicinity of a given airport, and then a distinction drawn between 'lower' and 'upper' (generally above FL195: i.e. 19,500ft) airspace 'en-route' services. NATS is the largest UK provider of ANSP services.

Table 3: Summary of some characteristics of IUK

SO characteristic	Summary comments
How was the SO established?	• Developed as a Joint Venture between a number of gas suppliers each of which secured long term capacity rights to usage of the interconnector.
What is the scope and form of its duties?	• IUK develops maintains and operates the interconnector (including terminals, compressors etc.) • It makes capacity available through a range of mechanisms, including the provision of interruptible capacity to allow access to otherwise unused capacity.
What powers does it have when seeking to meet its duties?	• Direct users need to be signatories to the relevant agreements. But powers are limited to those necessary to manage operations.
How separated is the SO from other activities?	• IUK is a Joint Venture that operates as a stand-alone business.
What is its institutional form?	• IUK is a private, for-profit business.
How is it regulated?	• IUK is a licensed interconnector provider and is required to provide the maximum available capacity, to offer terms for access, and to share information. In GB it is regulated by Ofgem.

30. It will be apparent from the brief descriptions above that SO functions related to air traffic management are divided between a number of different institutions, each of which is focused on managing a specific set of coordination issues. Thus, for example, longer term network development issues are the responsibility of the CAA in the UK, while operational responsibility for providing access to, and for managing the usage of the network, lies with other separate institutions. Table 4 summarises some of the key characteristics of ATM providers as SOs.

[16] Further information on different aspects of air traffic management can be found at: http://www.eurocontrol.int/articles/air-traffic-management-atm-explained

Table 4: Summary of some characteristics of air traffic management providers

SO characteristic	Summary comments
How was the SO established?	• NATS (the largest UK ANSP) had been integrated with the CAA, but was established as a separate company in the 1990s.[17] • Eurocontrol is an international organisation that was founded by Treaty in 1960, and it has provided for international coordination across a range of ATM issues, including increasingly in the context of the EU Single European Sky initiatives. Its Central Flow Management Unit was established in 1995.[18]
What is the scope and form of its duties?	• ANSP duties focus on supporting of flights through the network, and are divided up geographically, and sometimes by altitude. Handover protocols have been developed over time through international collaboration. • Eurocontrol's Network Manager Operations Centre has responsibilities for slot allocation across a wide area (that includes the airspace of >40 countries) • While CAAs are established on a national basis, the efficiency of airspace design is dependent on decisions taken in other airspace areas.
What powers does it have when seeking to meet its duties?	• ANSPs have very strong powers within their defined areas (users must comply or face significant sanctions). • CAA efforts to re-design airspace can be dependent on securing agreement with institutions in other jurisdictions.
How separated is the SO from other activities?	• NATS provides ANSP services in a number of different areas (i.e. en route and some terminal services), and provides other services (such as consultancy). • Eurocontrol is large intergovernmental organisation that includes an ANSP for one 'upper' airspace area, the network manager role, and a range of other international coordination functions. • The CAA's airspace design responsibilities sit alongside a range of other functions (including safety and economic regulation).[19]
What is its institutional form?	• NATS became a public/private partnership in 2001 and is for-profit. • Eurocontrol is a not-for-profit international organisation established by treaty. • The CAA is a public corporation and is not-for profit.
How is it regulated?	• NATS is licenced and regulated by the CAA, and is also covered by the regulatory framework established under EU Single European Sky legislation.[20]

[17] Further details on NATS can be found at: http://www.nats.aero/about-us/what-we-do/

[18] For further details, see: https://www.eurocontrol.int/network-operations

[19] Information on the CAA's airspace design roles and activities can be found at: http://www.caa.co.uk/Commercial-Industry/Airspace/

[20] Information on the Single European Sky programme can be found at: https://ec.europa.eu/transport/modes/air/single_european_sky_en

Section 2: what roles have System Operators played in other sectors? continued

31. There have been longstanding concerns over the fragmented nature of European airspace and the inefficiencies, in terms of resulting capacity availability and flight times, that result. The concerns have led to a range of efforts aimed at airspace re-design, and the development of Functional Airspace Blocks (FABs), which are intended to be airspace blocks that are developed on the basis of operational requirements irrespective of how they relate to national boundaries. This may have some relevance in a water context, when consideration is given to the potential for company boundaries to lessen the overall efficiency of network developments in England and Wales.

32. Efforts to develop FABs have been both top-down and bottom-up.[21] Promoting FABs has been a key part of the EU Single European Sky initiative, and Eurocontrol has sought to explore options for the development of more efficient airspace blocks for many years through review documents, feasibility studies etc. In practice, though, FABs are being developed in a bottom-up manner, with two currently having been implemented: a UK-Ireland FAB and a Denmark-Sweden FAB. That is, centralised activity has focused on helping to develop common approaches and assessment methods, explore feasibility and other practical implementation questions, and identify potential opportunities for improvement. The practical development and implementation of changes has been decentralised.

Payment System Operators

33. Payment System Operators have been developed over time as a means of delivering coordination efficiencies in the provision of payment services. A number of different systems (and System Operators) have been developed that typically focus on different types of payment.[22] The main UK inter-bank[23] payment systems are:

- Bacs: which provides for the processing of direct debits and direct credits;
- CHAPS: which consumers typically use for house purchases, but is otherwise primarily used by non-consumers;
- Cheque and Credit: primarily for clearing cheques;[24]
- LINK: which allows cash withdrawals from a different bank; and
- Faster Payments: which provides for near instantaneous transfers of funds to another account.

34. The scope for a payment System Operator to provide coordination efficiencies can be illustrated by reference to a Faster Payments transfer, such as an online payment made to another individual that has an account with a different bank. The faster payments system allows the funds to be transferred almost instantaneously, such that the funds are (almost) immediately available for use in the recipient's account. From the banks' perspective, the payment process will only be complete when they have actually settled up between themselves for the amount that has been paid. This doesn't happen instantaneously. For faster payments settling up will typically occur three times per day, but the system allows for near instantaneous payments to be made from a consumer perspective.

35. In principle, this kind of service could be developed through bi-lateral contracting. Banks could seek to develop arrangements with other banks that allowed a similar type of payment service to be provided. However, jointly developing a standard set of rules procedures, and jointly providing the infrastructure that allows those rules and procedures to be followed in an effective manner can deliver significant efficiency benefits (e.g. transactions costs may be reduced, inefficient duplication of infrastructure may be avoided, etc.). In practice, these interbank coordination issues have been addressed through the use of two SO-type organisations:

- A 'scheme': this is the organisation that develops and manages the rulebook under which the system (and its participants) operate, and is funded. It is also responsible for appointing an infrastructure provider/operator. These are often very small organisations (e.g. some payment schemes have c15 FTEs).
- An infrastructure provider and operator: this is the organisation that actually processes payments. Most UK inter-bank payments are currently processed by VocaLink.

[21] Further details on efforts to develop FABs can be found at: https://www.eurocontrol.int/functional-airspace-block-fabs-defragmenting-european-airspace

[22] An overview of the development and operation of UK payment systems can be found in: PSR (November 2014) *A new regulatory framework for payment systems in the UK*.

[23] For simplicity, attention is confined here to what are referred to as inter-bank systems. In addition, a range of card systems (such as Visa, Mastercard and American Express) have been developed and operated for many years.

[24] A separate scheme operates in Northern Ireland: Northern Ireland Cheque Clearing.

36. Tables 5 and 6 summarise some of the key characteristics of inter-bank payment schemes and infrastructure providers/operators as SOs.

Table 5: Summary of some characteristics of Payment Schemes as System Operators

SO characteristic	Summary comments
How was the SO established?	• Payment schemes have each been established by groups of banks (although notably the development of the Faster Payments scheme followed considerable government and regulatory pressure).
What is the scope and form of its duties?	• The duties of a given scheme are typically narrowly defined in terms of that payment type. Banks have developed different schemes for different payment types.
What powers does it have when seeking to meet its duties?	• Scheme powers arise through the agreement(s) with scheme members and are typically relatively limited (focused on the defined types of service provision, and basic membership requirements being met).
How separated is the SO from other activities?	• Payment schemes have been small organisations that only undertake their specified role. The consolidation of three schemes (Bacs, Cheque and Credit and Faster Payments) into a new payment System Operator is now planned as a means of reducing costs and complexity for users.[25]
What is its institutional form?	• The inter-bank payment schemes have typically been established as companies limited by guarantee on a not-for-profit basis.
How is it regulated?	• Most of the inter-bank payment systems have been 'recognised' by HM Treasury for statutory oversight of by the Bank of England, focused on the management of systemic risks. • All of the large inter-bank payment systems have been designated by HM Treasury for regulation by the PSR, whose objectives are to promote competition and innovation and to ensure payment systems are operated and developed in the interests of the people and businesses that use them.

Table 6: Summary of some characteristics of payments infrastructure providers/operators as System Operators

SO characteristic	Summary comments
How was the SO established?	• The main infrastructure provider/operator (VocaLink) was established as a Joint Venture between a number of banks. VocaLink was sold to Mastercard in 2017.
What is the scope and form of its duties?	• Infrastructure provider/operator duties are defined through the contract with the scheme.
What powers does it have when seeking to meet its duties?	• Infrastructure provider/operator powers depend on the procurement contract: focus is typically on delivery of defined services and performance levels.
How separated is the SO from other activities?	• VocaLink provides the infrastructure for three of the schemes, and provides a range of other technical and consultancy services. It is now owned by Mastercard, but the CMA has put in place some separation requirements to limit commercial information flows from VocaLink to Mastercard.[26]
What is its institutional form?	• VocaLink was established as a joint venture private for-profit business. It is now owned by Mastercard (a private for-profit business).
How is it regulated?	• As statutorily defined 'participants' of designated payment systems, infrastructure providers fall within the scope of the PSR's powers. Infrastructure providers could, for example, be subject to PSR Directions.

[25] See, for example: https://www.psr.org.uk/psr-publications/news-announcements/delivery-plan-announced-for-consolidation-of-operators.

[26] Details of the CMA's investigation can be found here: https://www.gov.uk/cma-cases/mastercard-vocalink-merger-inquiry

Section 2: what roles have System Operators played in other sectors? continued

Some observations on the roles played by System Operators in other sectors

37. The emergence of SO-type institutions in other sectors looks to have been underpinned by one or other of two rather different motivations:

    - SOs as a response to a perceived 'gap': the motivation here is to address the risk of particular types of coordination failure arising. The SO is developed as a new institution to plug the perceived 'gap'.
    - SOs as part of a liberalisation process: the motivation here is enabling a more disaggregated model of network usage to emerge in an effective manner. There isn't a 'gap' to be filled, as the incumbent already acts as SO, but concerns are focused on 'how' that role is undertaken.

38. The air traffic management and payment system examples highlight a number of ways in which SO-type institutions have been developed to fill a 'gap'. In air traffic management those developments have been heavily government (and/or international organisation) driven, but in payments the development of these new institutions has typically been much more 'bottom-up', with coordination-focused institutions formed by groups of market participants.

39. The energy examples highlighted that energy interconnectors have also been developed, and operators put in place, following this kind of bottom-up model (and in response to a market identified gap). But, for the most part, SO developments in the GB energy sector have been heavily linked to the liberalisation process, and questions of how best to regulate the operational functions that electricity transmission businesses undertake so as to promote efficient practice and address potential discrimination concerns. The 2017 decision to require legal separation of the GB SO marks a departure from this in that the key motivating factor looks to be the potential (coordination) benefits that could arise from the GB SO adopting a more holistic approach that extends beyond the transmission networks that it manages the operation of (such that, for example, transmission/distribution boundary issues may arise).

40. A notable feature of all the examples considered is the extent to which SOs in GB/the UK are private, for-profit businesses. This contrasts with the US Independent System Operator model in the electricity sector, where ISOs operate on a not-for-profit basis and can have public interest type objectives. But the not-for-profit nature of these institutions can generate significant incentive concerns, particularly in contexts where the potential benefits of discovery and innovation are likely to be an important factor.

41. Inter-bank payment schemes have some similarities with this kind of ISO: they are not-for-profit and can include specific public interest protections in their governance structures. But these schemes can be understood largely as rule making/procedural institutions. In this respect, in a GB energy context, they have similarities with the industry governance structures that have been put in place to manage code developments. In payment systems, the practical businesses of providing and operating the relevant infrastructure, and of arranging for the identification and settlement of the net positions of users, is managed by for-profit infrastructure providers.[27]

[27] Other than the Bank of England's Real Time Gross Settlement (RTGS) system.

Section 3: what water sector problems might System Operators help to address?

42. Interest in the potential role for System Operators in the water sector can be related to three distinguishable issues:

    a. The case for separating (and separately regulating) the System Operator roles that water companies currently undertake.

    b. The potential for System Operators to improve the efficiency with which water resources can be developed, accessed and traded.[28]

    c. The potential for System Operators to improve the efficiency of coordination between water company network development decisions, including in terms of the development of interconnection capacity (and for this to then also improve water resource development decisions).[29]

43. Much of the attention given to the potential role that SOs could play in the water sector has been directed at issue (a) above: the case for having separate SOs within water companies. However, issues (b) and (c) relate to potential problems that look to merit much more consideration, and also to be much more closely linked to the core roles that System Operators typically play. In line with the distinction drawn earlier, (b) and (c) concern the potential for SOs to be introduced to fill a 'gap': to lessen the significance of some existing coordination problems. By contrast, (a) is concerned not with filling a gap (the incumbent providers already act as SOs), but with seeking to facilitate liberalisation efforts.

The case for separate SOs within water companies

44. Ofwat recently (in December 2015)[30] considered whether requiring separate System Operator functions within water companies – either through accounting or through functional separation – might be desirable. Under each possible approach, it was envisaged that specific incentive schemes targeted at system operation would have been developed. However, Ofwat decided not to pursue either of these options for PR19 (as it had done for PR14).

45. The potential for coordination failures to arise did not feature as a major consideration in Ofwat's assessment. Rather, the key 'problem' – or rather concern – that drove the potential interest in SOs was the potential for discrimination to arise: that is, for system operation decisions to be made that unfairly disadvantaged a competing provider (as against the incumbent). Ofwat considered that neither accounting nor functional separation[31] would be likely to address discrimination concerns adequately, but both would be costly to introduce.

46. Ofwat's assessment of these options seems unsurprising. At present, water companies can be understood as having responsibility for, and undertaking, some SO-type roles in relation to their own pipe networks. In particular:

    - Water companies have been required to develop a number of frameworks aimed at facilitating the use of their networks by third parties (i.e. setting out terms associated different forms of access).
    - Water companies would have responsibility for guarding against harm from coordination failures arising as and when third parties used their networks.

    But at present these SO activities are necessarily very limited because there has been no third-party usage of water company networks. Rather, water companies manage the networks they own in a vertically integrated (consolidated) manner.

47. The case for developing distinct and (in some way) separate SOs to manage existing water and wastewater pipe networks looks likely to depend heavily on the scale and form of third party usage of those networks over time, and how that can be expected to evolve. It would also depend on the effectiveness of less intrusive measures aimed at alleviating concerns associated with undue discrimination, and on the costs that different types of SO separation might give rise to. This latter point is important, as separating an SO from an existing broader organisation has the potential to undermine existing modes of coordination, and so can generate inefficiencies (over and above any transition costs that might arise).

[28] This has included proposals for the development of Catchment System Operators alongside environmental regulators (considered below).

[29] Existing efforts to provide for this kind of coordination include the work of Water Resources in the South East (WRSE). See, for example: http://www.wrse.org.uk/wp-content/uploads/2017/10/WRSE_File_278_An-overview-of-the-WRSE.pdf.

[30] Ofwat (December 2015) Water 2020: Regulatory framework for wholesale markets and the 2019 price review – Appendix 5: System Operation.

[31] The more stringent options of legal separation, and of the creation of an independent System Operator were identified but not assessed, as they fall outside the current statutory framework.

Section 3: what water sector problems might System Operators help to address?

continued

48. Concerns with the potential adverse effects of SO unbundling have persisted in the energy sector even in a context where there has been extensive international experiences over many years[32]. In the energy sector, this issue has been considered mostly in terms of the difference between Independent Transmission System Operators (ITSOs) – that is, where the SO activities remain bundled with transmission, but that bundle is provided independently of other activities – and Independent System Operators (ISOs) (i.e. where the SO is separated also from transmission). But in the water sector, understanding of how the boundary between what should be regarded as 'network' and 'non-network' activities is itself relatively limited (as indicated by the use of the term 'network +'). This suggests that there may be significant risks associated with SO separation options that would merit careful consideration.

49. It may be that third party usage of water company networks becomes a major feature of the sector over time. But it is also possible that the role played by third-party usage will be relatively limited. Given the extent of uncertainty in relation to both the benefits and costs in this context, one would expect an incremental approach to be adopted to potential discrimination concerns, with each step judged in terms of proportionality. Ofwat's decision to not proceed with SO separation options for PR19 looks to be consistent with this.

50. A second potential problem that Ofwat has raised in the context of considering the case for separate SOs within water companies is the effectiveness of existing approaches to network optimisation.[33] However, arguments for interventions aimed at directly influencing the ways in which water companies undertake their network optimisation activities should be treated with considerable caution. In PR14, Ofwat – for very good reasons – sought to shift its regulatory approach away from more detailed involvement in operational decisions, and towards greater reliance on outcome-based incentives within a total expenditure framework. In the absence of strong evidence indicating otherwise, then, one would expect any concerns over the effectiveness of network optimisation approaches to be addressed through the broader outcomes framework, rather than through more prescriptive interventions. Ofwat's decision not seek to develop separate SO-type incentives for PR19 looks to be consistent with this also.

The potential for SOs to improve the efficiency with which water resources can be accessed and traded

51. A potential role for System Operators has also been considered in relation to water resources. Dieter Helm[34] has argued for the establishment of a Catchment System Operator for each main catchment to undertake a range of coordination activities in place of the relevant environmental regulator.[35] This approach can be understood as unbundling two different tasks that environment regulators effectively carry out at present:

    a. Environmental regulation: aimed (in this context) at protecting the environment in relation to a given water source, such as a river.

    b. Catchment System Operation (CSO): aimed at facilitating the efficient use of available water resources by others, while guarding against the constraints arising from environmental regulation being violated.

52. One underlying problem, or concern, here is that the current abstractions and water trading arrangements can frustrate the achievement of more efficient water resource usage outcomes (and similar concerns can arise in relation to other aspects of the water environment, including in relation to water quality and flooding). Problems with the current abstractions regime have been long recognised. A key source of tension is that there is an existing problem of over-licensing and/or over-abstraction in some areas, trading can provide an opportunity for environmental regulators to claw back usage rights to some extent, as a condition of the trade progressing.

53. This has been described as effectively imposing a 'tax' on water trades, as the costs of the actions to lessen over-licensing/over-abstraction are targeted only on those seeking to engage in trades (rather than on relevant license holders/users more generally).[36] The discretion available to environmental regulators to 'claw back' resource usage rights in this way may make the value of the potential projects that would rely such trades very difficult to predict, and this uncertainty may deter the undertaking of desirable investments.

[32] For example, Pollitt has noted that: '*There is little question that the separation of system operation from transmission operation creates interface issues which require careful management.*' (p29 in Pollitt, M.G. (2011) *Lessons from the History of Independent System Operators in the Energy Sector, with applications to the Water Sector)*.

[33] Oxera (2012) Network Optimisation, Options in setting future price limits in the England and Wales water industry.

[34] Helm, D. (2015) Catchment management, Abstraction and Flooding: the case for a catchment System Operator and coordinated competition.

[35] The potential for System Operators to play a role in delivering environmental regulation was highlighted in Keyworth, T. & Yarrow, G. (2008) Toward an intelligent design for energy and environmental regulation http://www.rpieurope.org/Publications/Intelligent%20design%20of%20energy%20and%20environmental%20policy.pdf

[36] See, for example: Appleyard, T., Decker, C., Keyworth, T. & Yarrow, G. (2008) *Competition in the provision of water services*.

54. This type of issue might be addressed by abstraction reforms of the kind that have been under consideration/development now for many years. But significant questions over efficiency may remain, such that there may be significant opportunities for a System Operator to deliver benefits. One reason for this is that an SO may be able to facilitate trading, for example by providing greater up-front clarity in terms of the basis upon which trades would be treated as admissible. The issue here concerns not the definition of specific rights per se, but rather the specification of how they may be substituted for. For example, if 1 unit was 'put' in at point A at time t, then how many units would it be possible to 'take' from point B at time t (or at some other point in time)?

55. It was noted above how the balancing and trading arrangements for the gas transmission were largely developed on the basis of a single notional (and national) balancing point, and the time period of the 'gas day' (such that a user would be in balance if their inputs and off-takes during the day were equal, irrespective of where they took place. While this national approach would clearly be inappropriate in terms of abstraction rights, there may be opportunities to develop relatively simplified balancing requirements within catchment areas in ways that facilitate trading in efficiency enhancing ways.

56. An SO may also be able increase the extent to which resources are made available while ensuring that environmental outcomes are met. That is, an SO could adopt a more flexible approach to capacity release than might be adopted by an environmental regulator, and in doing so increase the utilisation of the available resources while environmental requirements are met. Again, in line with the energy example earlier, this might be based on the development of more sophisticated monitoring and modelling of circumstances, and a more flexible (while at the same time contractual) approach to responding when constraints arise.

The potential for SOs to improve coordination between water company network development decisions

57. Substantial differences between water company areas, in terms of the identified costs of providing additional supply, have been identified for a number of years.[37] With some 'high' cost companies facing significant forecast supply/demand shortfalls, the question arises as to whether bulk water transfers between company areas might provide the most efficient response.

58. There has been interconnector capacity in England and Wales for many years that allows substantial volumes of water to be transferred between some water company areas (as, for example, with the Elan Valley Aqueduct). But new interconnectors have not – so far – been developed as a means of addressing projected shortfalls identified in recent years, notwithstanding the apparent gains from trade that could emerge from transferring water from 'low' to 'high' cost areas. This is in a context where Ofwat has identified the potential for substantial savings from greater levels of interconnection.[38]

59. This raises questions over whether decision making with respect to new interconnector development may be artificially constrained or distorted in some ways, such that more efficient options are not pursued. Put differently, does decision making with respect to interconnector development exhibit coordination failures such that 'between-area' options are insufficiently explored and developed?

60. One standard response to this kind of issue is to look to consolidation to address perceived concerns over regional 'fragmentation'. Consolidation here would make what had been interconnector development decisions part of standard internal assessment processes concerned with network development. In line with the discussion above, though, the development of System Operators provides a potential intermediate response that aims to focus attention on coordination failures, and how they might be avoided or mitigated. But what are the underlying problems that might give rise to such coordination failures, and that SOs might help overcome?

Where might coordination issues be most significant?

61. To consider this, it is helpful to identify a few indicative steps that would be likely to have to form part of an interconnector project development process:

- The potential demand for using interconnector capacity, and potential associated income streams would need to be assessed.
- New interconnector options would need to identified, their feasibility tested, and the likely costs of construction evaluated.
- A preferred option would need to be selected and finance would need to be secured to allow the development process to proceed.
- Necessary planning and regulatory approvals would need to be secured (including in terms of environmental and water quality impacts).
- 'Base' contractual arrangements would need to be developed and agreed, that established, for example, primary obligations in terms of usage of, and supplies through the interconnector.
- Construction contracts would need to be let and managed to successful delivery.
- Arrangements for the ongoing ownership, management and operation of the interconnector would need to be put in place.

[37] For example: Ofwat (2010) *Valuing Water: How upstream markets could deliver for consumers and the environment*.

[38] See for example: Ofwat (December 2015) Water 2020: Regulatory framework for wholesale markets and the 2019 price control.

Section 3: what water sector problems might System Operators help to address?

continued

62. These indicative steps focus on the provision of interconnector capacity. But as is recognised in the first bullet, the value of providing the interconnector capacity would derive from expectations concerning the value of supplies that could flow through it. Given this, interconnector development decisions will need to contend with the coordination issues associated with the accessing and trading of water resources (as discussed above) as well as those associated with the development of an interconnector itself. This would be particularly so for interconnection projects that rely on river networks as part of their transportation mechanism: for example, with an interconnector pipe transporting water to be 'put' into river such that a 'take' of larger volumes can be made at another location downstream. This kind of combined pipe and river transportation approach may have an important role to play if large inter-regional transfers of water are to be considered.

63. Aspects of an interconnector development process that might be expected to raise particularly significant coordination issues – and where an SO may have a useful role to play – are set out below.

i) Identifying and selecting a preferred option

64. There is already significant transparency in relation each company's supply/demand position through the Water Resource Management Process. However, there may be significant asymmetries of information between water companies that hinder the identification and selection of specific options (connection points etc.) that would be most efficient from a broader system wide perspective. This type of information issue may be particularly significant if an approach that might be most desirable from an overall efficiency perspective could be expected to adversely affect the future regulatory performance of in regulatory benchmarking exercises (for example, by bringing forward other likely expenditure requirements).

65. An SO could provide a means of addressing this kind of information and incentive issue. It could provide for a better informed and coordinated option identification and assessment process, and could potentially identify knock-on network implications in a manner that would be given (more) weight in subsequent regulatory assessments.

ii) Assuring the feasibility of the preferred option

66. This is a critical stage in the assessment process. Potentially efficient options may be identified, but if their feasibility cannot be assured to a sufficient degree, then the project cannot be expected to progress further. There look to be three key aspects to this in terms of coordination issues:

- Assessing and managing/mitigating uncertainty over the future treatment of 'put and take' trades by environmental regulators.
- Establishing the likely permissibility of the project, given relevant planning and (other) environmental constraints.
- Assessing and managing/mitigating uncertainty over the future treatment of interconnectors and associated bulk supply agreements by Ofwat.

a) Uncertainty over the future treatment of 'put and take' trades by environmental regulators

67. The underlying problems in terms of accessing and trading water resources were highlighted above. When considering an interconnector project, however, it is helpful to draw a distinction between:

   - a 'base' bulk supply agreement (or set of agreements) that drives initial interest in the economic case for the project; and
   - subsequent trading activity that could affect usage of the interconnector if built.

68. The 'base' agreement (a long-term bulk supply contract) could provide a basis for financing the interconnector project, and thus securing assurance in terms of the acceptability of the trade is likely to be key to progress being made. Coordination issues arise here (over above those considered in terms of CSO above), as there may be significant benefits from the development of a coordinated approach to securing the necessary approvals from environmental regulators. This may be particularly so with large inter-company transfers, because they can require approval from different national (i.e. Welsh and English) and regional (e.g. Environment Agency area) regulatory offices.

69. Uncertainty over subsequent trading activity is likely to be difficult to address without some form of institutional innovation. But as the efficiency with which interconnection is developed and used may be materially affected by the potential for such trading activity to develop, potential institutional innovations merit careful consideration. Some different ways in which SOs could form part of this innovation process are considered below.

b) The likely permissibility of the project given planning and other environmental constraints

70. The process of securing necessary planning, environmental and water quality approvals may be prone to a range of coordination problems. A coordinated approach to securing necessary approvals may reduce duplication of effort, and also provide a means of improving coordination between regulators where that might otherwise be a source of risk (e.g. because of the regionally-based nature of environmental responsibilities).

71. An SO could reduce duplication (and thus transaction costs), and may also be a means of increasing the perceived credibility of the project appraisal process. It may also provide a beneficial separation from other ongoing engagements that water companies have with environmental regulators (which will cover a broad set of ongoing issues). It may also be that the competencies and experience that an SO develops in relation to one project would have value that could be transferable to other projects.

c) Uncertainty over Ofwat's future treatment of interconnectors and associated bulk supply agreements

72. The key issues here concern regulatory uncertainty rather than coordination. Ofwat could seek to lessen this uncertainty, for example, by bolstering its' bulk supply pricing principles to emphasise the critical significance of the 'efficiency' hurdle, when regulatory action is being considered. That is, Ofwat could make it clearer that it would only seek to interfere with commercial agreements in relation to interconnectors and bulk supplies when, and to the extent that, those agreements could be shown to have effects that were at odds with the efficient supply of water and/or the efficient use of water resources.[39]

73. It may be, though, that the establishment of an SO could increase regulatory confidence in relation to matters that might otherwise be a source of risk of (value undermining) intervention. For example, it may be possible to develop up-front principles in relation to the conduct of an interconnector operator that materially lessened the likelihood of future regulatory intervention. The energy interconnector example suggests that these principles could be relatively high-level and cover maximum capacity provision and transparency.

iii) Operating the interconnector once built

74. The development of an interconnector clearly creates the need for an interconnector operator to coordinate access to, and manage usage of, the interconnector by (at least potentially) multiple parties. This role would involve delivering on the base contractual rights of usage that the initial contracting parties have. But, in line with the above comments, it could also involve managing access to available interconnector capacity over and above those rights in ways that could increase the utilisation of interconnector capacity.

iv) Broader market engagement post-construction

75. The existing arrangements for the access to and trading of water may create material barriers to the efficient use of the interconnector once built. As highlighted above, an SO could potentially facilitate more efficient water trading while guarding against adverse environmental outcomes.

Contractual novelty and transactions costs

76. The focus above was on specific points in an interconnector project assessment process when material coordination problems might arise. However, it is also relevant to highlight a more general transactions cost issue in this context. That is, interconnector developments, and associated large scale water transfers, can be expected to throw up a whole range of relatively novel and complex issues, and the efficiency with which those issues can be addressed may have a material bearing on the appetite of different participants to pursue particular options (given the inevitable resource constraints that market participants and regulators face). SOs can potentially allow for transactions costs to be reduced in desirable ways.

[39] This is consistent with Sections 40 and 40A of the Water Industry Act 1991 (as amended), but Ofwat could provide further guidance on how it would expect to use these powers if the pricing of newly developed interconnectors and associated bulk supply agreements was considered after construction.

Section 4: what forms could water System Operators take?

77. The case for separating (and separately regulating) the System Operator roles that water companies currently undertake was considered above, and Ofwat's decision not to pursue such an approach in PR19 was identified as sensible. But two areas were identified where there do look to be 'gaps' in terms of coordination at present, and where the development of new SO's may be desirable: SOs could improve the efficiency with which water resources can be accessed and traded; and/or, SOs could improve the efficiency of coordination between water company network development decisions (including in terms of the development of interconnection capacity).

78. These 'gaps' could be addressed in different ways. This section considers three potential types of option:

    a. the development of Catchment System Operators (CSOs);

    b. the creation of a national SO aimed at addressing inter-water company coordination issues; and

    c. the 'bottom-up' development of SOs to support interconnector development and usage.

79. Options (a) and (b) are considered briefly because they have been identified as potentially desirable. As noted below, however, both would likely require legislative change for their introduction. Option (c) is considered as an alternative that could be consistent with (and potentially help mark out a path towards) the development of a form of either or both of (a) and (b), but that might also be a means of delivering significant coordination benefits in its own right.

Option (a): Catchment System Operators

80. The introduction of Catchment System Operators – alongside existing environmental regulators – could be a means of improving the efficiency of resource usage.[40] It could focus the attention of environmental regulators on their primary areas of concern (the impacts on the environment of abstractions), while leaving the CSO flexibility to explore and develop frameworks that could allow those impacts can be managed more efficiently (in line with the comments above). Table 7 sets out some potential characteristics of CSOs, following the structure that was set in Table 1.

Table 7: Summary of some potential characteristics of Catchment System Operators

SO characteristic	Possible form
How was the SO established?	• New CSOs could be established through primary legislation.
What is the scope and form of its duties?	• Primary duties might, for example, concern the promotion of the efficient and economic use of water resources, including through water trading, in a manner that did not undermine the achievement of objectives and requirements set by relevant environmental regulators.
What powers does it have when seeking to meet its duties?	• Powers could potentially be quite wide ranging (subject to actions being consistent with the achievement of primary duties), but much would depend on how the relationship between the CSO and environmental regulators was established.
How separated is the SO from other activities?	• Given the potential for discrimination concerns to arise (for example, over how constraints are managed), separation mechanisms that adequately address such concerns are likely to be important.
What is its institutional form?	• A number of options could be adopted here and a flexible approach might be adopted. • For example, responsibility for the establishment of a CSO could be given to an existing regulator such as Ofwat, who could hold a form of competitive tender for the role. • The requirements for such a tender might focus on the high-level outcomes that the CSO would need to deliver (and demonstrate etc.) while remaining open on, for example, whether the chosen CSO was for-profit or not-for-profit.
How is it regulated?	• As with most System Operators in other sectors in the UK, it would be expected that CSOs would be regulated by an economic regulator (i.e. Ofwat). • At the same time, the actions of the CSO would need to be consistent with environmental regulation.

[40] For further information on how this approach might be developed, see: Helm, D. (2015) *Catchment management, Abstraction and Flooding: the case for a catchment System Operator and coordinated competition*.

81. The need for legislative change to establish a CSO may be a major barrier to this option progressing. Problems with the abstractions arrangements have been long recognised, and legislative change has been under development in one form of another for many years. Given the additional complexities that a movement to a CSO system might introduce, even if such a model were to become a preferred option, it may take many years for necessary legislative changes to be brought forward. Given this, option (c) below considers how progress towards the development of this kind of SO might be made in the meantime (and absent legislative change).

Option (b): A 'national' SO aimed at addressing inter-water company coordination issues

82. The idea of a 'national' SO for the water sector has arisen on a number of occasions. The key concern that looks to underpin this kind of proposal is a lack of effective coordination between water companies in England and Wales, with this leaving interconnection between companies insufficiently developed. While – as was highlighted above – there may be material barriers to the efficient development of interconnection between companies, the creation of a 'national' SO looks unlikely to be a well targeted or proportionate response, at least in the short/medium term.

83. In terms of interconnection, the coordination issues that currently arise are regional in nature. While common 'national' approaches may be desirable in some areas (e.g. to save on the duplication of effort), it is not obvious that the creation of a central SO institution would be the most effective way of developing such common approaches. For example, reviews of current practice and potential opportunities across England and Wales in terms interconnection could be commissioned where that was considered helpful without establishing an SO. The role for a 'national' SO over and above this kind of review function seems unclear given the more regional focus of the coordination issues that are likely to arise (of the kinds highlighted earlier). A more bottom-up and regional approach addressing these issues is considered below.

Option (c): The 'bottom-up' development of SOs to support interconnector development and usage

84. Options (a) and (b) involved one or more SOs being established through legislative change. However, the 'bottom-up' development of SOs that are geared towards plugging particular coordination 'gaps' is also a possibility. That is, companies could develop SOs on a joint venture basis when a strong in principle case for interconnector development has been identified. This is illustrated in Table 8 in terms of some key potential SO characteristics. This kind of development need not require legislative change to be progressed, and could allow for some experimentation in terms of approach, and adaptation over time.

Table 8: Summary of some potential characteristics of System Operators developed on a bottom-up basis

SO characteristic	Possible form
How was the SO established?	• SOs could be established through Joint Ventures between affected businesses (e.g. by two or more water companies).
What is the scope and form of its duties?	• Ahead of construction, an SO could play a key development role in the identification of a preferred interconnector option, and in the assurance of its feasibility (as above, given uncertainties over e.g. future regulatory treatment). • An SO could then be responsible for managing access to and operation of the interconnector once built. However, an SO could also be charged with seeking to engage beyond the direct scope of the interconnector and to facilitate trading that might affect usage of the interconnector. (See also Figure 1 on page 33.)
What powers does it have when seeking to meet its duties?	• Direct powers would arise through the contracts with interconnector developers and users. • For actions aimed at facilitating water trades (that might affect interconnector flows), powers and/or the effectiveness of activity in relation to trades would depend on engagement with relevant regulators and potential contracting parties.
How separated is the SO from other activities?	• Given the potential for discrimination concerns to arise (for example, over access to interconnector capacity), separation mechanisms that adequately address such concerns are likely to be important.
What is its institutional form?	• This would depend on the parties to the JV and may vary in term of the stage of the development. It may be, for example, that in the option identification and assurance stages, ahead of construction, a not-for profit vehicle was considered appropriate. A for-profit business may then be established to operate the interconnector once built and to facilitate its efficient usage.
How is it regulated?	• Absent legislative change, the SO would not be subject economic regulation by Ofwat (but would, of course, be subject to general competition law). The significance of this is likely to be heavily dependent on the form and conduct of the SO (including, for example, the extent to which the capacity provision and transparency arrangements that are put in place guard against potential sources of concern). • The SO would have to comply with relevant environmental regulation, and a key part of its role could be to try to facilitate the allowance of more flexible approaches to water trading that were consistent with outcomes that were acceptable to environmental regulators.

Section 4: what forms could water System Operators take? continued

Figure 1: Illustration of different roles that a bottom-up SO could be given

1. SO as provider of detailed appraisal of interconnection options once likely requirement has been identified
2. SO as facilitator for achieving necessary planning and regulatory approvals for the project to go forward
3. SO as developer of arrangements, frameworks, principles etc. that lessen risks associated with future regulatory decisions
4. SO as provider of access to and operation of an interconnector once built
5. SO as a broader facilitator of water trading

85. The approach envisaged here involves attention being focused in the first instance on interconnector development, but with this providing both a rationale for, and an institutional base from which, some broader water trading issues might be tackled. The scope that SO activity could have is summarised in Figure 1 in a way that relates back to the underlying coordination issues that were highlighted earlier.

86. Role (5) above – SO as a broader facilitator of water trading – envisages the possibility of an SO that is established in the context of an interconnector development seeking to engage in some of the activities that might be expected of a Catchment System Operator. The SO could aim to develop a productive interface with the relevant environmental regulators, so as to generate a context that is more conducive to the use of put-and-take based trading. For example, the SO might seek, through engagement with environmental regulators and water resource rights owners, to develop the identification of different trading 'zones' in the vicinity of the interconnector in relation to which the basis for trades that are likely to be acceptable from an environmental perspective may be relatively clearly and reliably specified up-front. That is, the SO could seek to facilitate trading (and usage of the interconnector) by promoting the development of more standardised and simplified trading conditions.

87. It may also be that an SO could seek to effectively develop a role as an intermediary for environmental regulators. That is, if environmental constraints can be identified on more of an 'outcomes' basis, then this may provide a basis for the SO to identify and respond to opportunities for more efficient resource usage that continued to satisfy those constraints. There may be some useful parallels here with the catchment management activities that water companies have engaged in for many years, in terms of the ways in which contracts with upstream parties (such as farmers) can be used to improve the way in which downstream outcomes are met.

88. At its most successful, it might be envisaged that such an SO could effectively be delegated some responsibilities in relation to ensuring that some environmental outcomes are met. For example, the SO might seek to facilitate trading by developing some additional types of monitoring and reporting that could provide greater confidence (to environmental regulators and other interested parties) that trading would not be conducted in ways that generated material harm. An SO might then also contract directly in ways that guarded against such outcomes arising.

Section 5: conclusions

89. The above sections considered what System Operators are, different roles they have played and forms they have taken in other sectors, before turning to consider whether and where the development SOs might be desirable in the water sector. Two key coordination 'gaps' were identified, and some potential ways in which those gaps might be addressed through the development of System Operators were described.

90. The role that 'bottom-up' company-led SOs could play merits particular attention. In part, this follows from the limited likelihood of water sector legislation being progressed in the near future: legislative change would be necessary for the creation of Catchment System Operators of the kind described above, and for the creation of a new 'national' SO. Given this context, the question of whether and how SO's might be developed usefully in ways that do not require legislative change becomes more prominent. The bottom-up development of SO's offers a potential way forward in this respect: SOs could be established as joint ventures between parties that have a stake in developing a means of achieving coordination efficiencies.

91. A bottom-up approach has a number of highly desirable features even if one ignores the question of legislative constraints. A key reason for this is that the starting position is far from a blank sheet. While there appear to be significant 'gaps' for an SO to potentially generate material coordination improvements, there are a wide range of actors and initiatives that already seek to address these and related concerns. For example, a wide range of actors engage in, and affect the outcomes of, the Water Resource Management Plan (WRMP) process, and – more generally – of river/catchment management processes.

92. This makes for an already fairly crowded context, and the question of how an SO could be developed that would improve outcomes in that context is not a straightforward one. The core purpose of System Operators – the achievement of coordination efficiencies when a network is being used – is important to recognise here. That is, while the development of an SO may involve the addition of a new actor to an already crowded environment, the core purpose of that new actor would be to facilitate more efficient engagement between others.

93. This narrow focus is important in a context where the key 'gaps' look to concern coordination, and not the underlying allocation of responsibilities within the sector. For example, security of supply and resilience responsibilities clearly sit with water companies at present, and that clarity has important benefits. An SO – that was focused on core coordination functions – would not change this. Rather, it would allow others to meet their responsibilities in more efficient ways. It is important here to distinguish the System Operator role from other centralised roles that can be developed such as that of single buyer. The System Operator role does not involve buying or selling of the underlying product.[41] The development of a System Operator, therefore, could be understood as a targeted response to identified (coordination) problems.

94. Precisely how SO's could improve coordination, however, is unclear and raises a number of questions. Bottom-up company-led development of SOs looks to have particular attractions in this context, as it could allow for a more experimental and evolutionary approach to be adopted to the development of SOs in the sector. It also looks to align well with the fact that SOs are concerned typically with the detailed practicalities of how systems operate and are used, and companies are better placed than regulators to identify how those operational activities might best be undertaken.

95. Bottom-up development of SOs therefore looks like a promising way of seeking to tackle coordination problems. The learning and experience gained from such activity could then inform subsequent developments. This could include other bottom-up developments, but it may also include better informed consideration of the case for the statutory introduction of other top-down SO models.

96. There look to be two key phases in which an SO could provide coordination benefits:

    a. Facilitating the development of new interconnector projects (including securing necessary regulatory approvals and assurances to underpin financing); and

    b. Facilitating access to the interconnector and broader water trading.

    Given the significant differences between these roles (one concerned with the planning and development phase, one with ongoing operation) it may be that different SO institutions would be developed for each.

97. The most challenging and novel part of the bottom-up SO model considered here looks to be the potential for an SO to facilitate water trading on an ongoing basis. But this is also an area where there may be significant opportunities for desirable institutional innovation. As outlined above, one could envisage an SO developing additional types of monitoring and reporting that could provide greater confidence (to environmental regulators and other interested parties) that trading would not be conducted in ways that generated material harm. There may be some parallels here with Smart Grid Benefits in electricity distribution networks, which can involve more efficient usage of existing capacity by having much better and more timely information on prevailing conditions.[42]

[41] Other than potentially in narrowly defined circumstances where that is considered necessary to avoid a coordination problem that might otherwise arise. National Grid's buying and selling in its residual balancing role can be understood in this context.

[42] One reason for this is that in the absence of detailed and timely information, it can be necessary to build in significant slack so to guard against eventualities that might arise. Improved monitoring may allow some of that slack to be used at times when the information flows show that concern that underpinned the holding of the slack not to be relevant.

Section 5: conclusions continued

98. This can be understood as a form of 'outcomes' approach, and the potential for benefits are similar to those that have underpinned Ofwat's adoption of such an approach. Much of the focus above has been on improving the efficiency of water resource usage, but it is important to note the broader environmental implications that improvements in the efficiency of resource use can have. If SOs, through the generation of coordination benefits, can allow water resources in a given area to be used more efficiently without undermining the achievement of required environmental outcomes, then that can provide opportunities to improve those outcomes in less costly ways (and, for example, may allow over-abstraction issues to be addressed more rapidly than would otherwise be likely).

99. Bottom-up development of this kind of SO would inevitably face some significant challenges. It would be heavily dependent on relationships with, and responses of, regulators and other stakeholders: e.g. to what extent will regulators seek to facilitate/constrain this type of development? In the absence of legislative change, the scope for powers to be delegated to SOs may face significant legal constraints. While these challenges should not be understated, realistic opportunities for the bottom-up development of SOs nevertheless appear to remain. If an SO can provide a standardised source and basis of monitoring and assessment within a given 'system', then this could benefit and form part of the decision making of environmental regulators in a number of different ways. It is common, for example, for regulators to make use of privately established industry standards and codes of conduct when setting regulatory requirements. The existence of such practices has the potential to allow regulatory decision making to remain more 'high level', as the existence of the standardised practices and processes can make this consistent with a risk-based approach.

100. As highlighted in the examples considered above, SO-type organisations in the UK have typically been private for-profit businesses. The appropriate organisational form(s) of the kind of bottom-up SO envisaged is a matter that merits further work. One important consideration here is that the context is one in which there may be significant innovation opportunities that could generate benefits that go beyond the scope of the immediate interconnector and associated trading developments. That is, if successful, this kind of bottom-up SO could provide a model that could be applied in different locations, and potentially for the development of SOs that have broader geographical scope.

101. Under the current regulatory framework, Ofwat would not appear to have a direct means of regulating an SO (although it would, of course, be subject to general competition law). Experience with the development of energy interconnectors suggests, however, that there may be some relatively straightforward institutional design features that could be put in place to provide an effective means of guarding against potential concerns. In particular, transparency and capacity release arrangements could be developed to give a reasonable degree of confidence (and ability to monitor) in the absence of formal regulatory powers. It may be that – as in the energy sector – licensing of interconnectors comes to be considered appropriate (and is legislated for) over time, but it is not obvious that the absence of a framework at present should be seen as a significant obstacle to the development of a practical set of arrangements. That said, further work on the identification of what types of regulatory concern might arise, and on the up-front development of principles that should guide future regulatory responses to such concern could help to avoid unnecessary financing cost implications arising from regulatory uncertainty.

102. Bottom-up company-led development of SOs, therefore, looks to have the potential to be a highly productive form of institutional innovation in the water sector. It could help address a number of practical coordination issues concerning the assessment and progressing of interconnector developments, and may also facilitate the development of more efficient trading arrangements.

Appendix

Appendix

How might an SO evolve? A simplified illustration

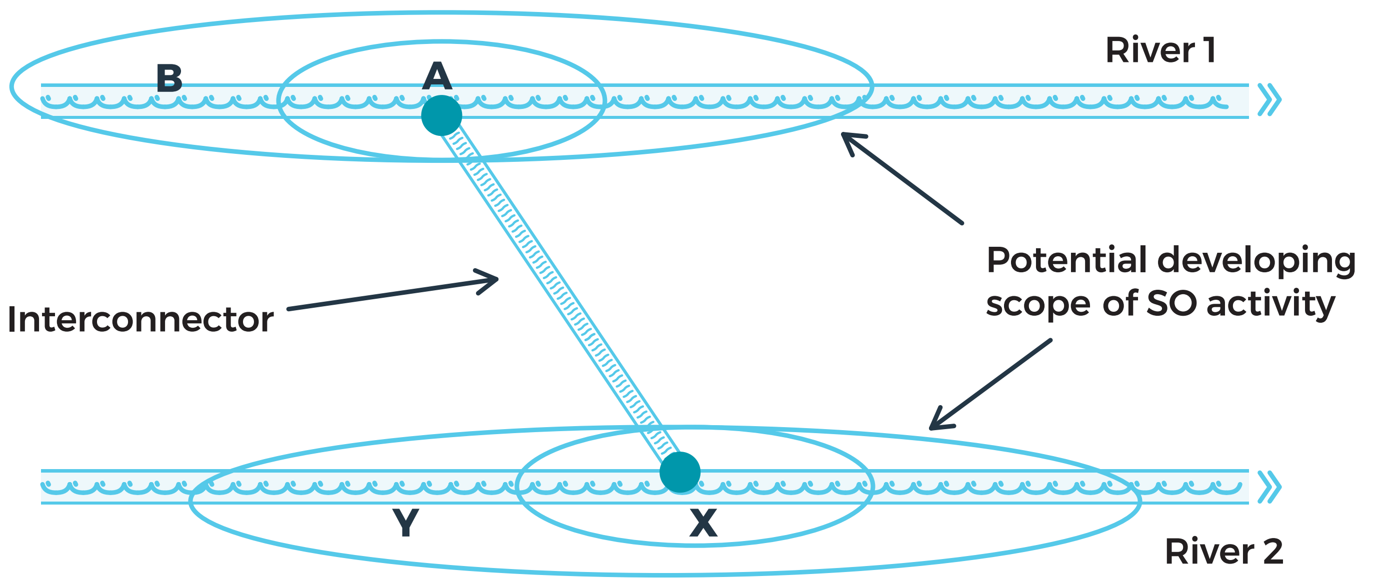
The following illustrates how the development and operation of an interconnector might provide the foundations for the development of a System Operator. A key underlying observation here is that the relevant 'system', when such a development is undertaken, will extend beyond on the physical scope of the interconnection assets being put in place. This is because the effects of the interconnector, and the ongoing viability of its usage, will be dependent on conditions (and the actions of other) in surrounding inter-related areas. The scope of these relevant system interactions will depend on the scale, nature, location etc. of an interconnection scheme, and may be open be to reassessment over time as circumstances change (for example, with increased interest in water trading). The significance of this is considered below in relation to two stylised types water transfer schemes (although, in practice, a number of other types of development might also be considered).

Figure 1 shows a stylised depiction of an interconnector that provides the potential for bulk transfers of water from one river to another. It assumes that the scheme involves: a 'take' of water from River 1 at point A; the transportation of that water through an interconnector; and, the water then being 'put' into River 2 at point X. In operational terms, this might be thought of as simply providing for the transfer of water between two point (A and X). But in order for the interconnector development, and an associated bulk transfer of water from A to X to get approval from environmental regulators, the potential implications of taking water from River 1 at A and putting it in River 2 at X will need to have been examined and tested in considerable detail (including to assess what effects the transfer might have under a wide range of different scenarios that might potentially arise). This would inevitably involve assessing the implications of circumstances and the behaviour of others that might arise away from points A and X, as the effects at points A and X – but also at a wide range of other points on River 1 and 2 – could be heavily dependent on those circumstances and behaviours.

While this type of broader assessment would be required ahead of construction, it is also likely to be important for the ongoing operation of the interconnector. This follows because the potential for adverse environmental effects to be attributed to interconnector flows may continue to be a material risk over time, and an interconnector operator would be expected (and perhaps required) to monitor and guard against such a risk on an ongoing basis. This implies that an interconnector operator would inevitably need to be monitoring and assessing the implications of conditions and flow decisions over an area that extends beyond points A and X and the interconnector itself, to ensure that the operation of the interconnector does not give rise to environmental outcomes that would undermine its ability to function. This is illustrated in Figure 1 by the oval shapes around A and X, with the different size of the shapes indicating the different geographical scope over which the interconnector operator may monitor river conditions.

This opening position – i.e. the upfront and ongoing monitoring and assessment of how conditions over given segments of two rivers are affected by a large scale take/put of water – provides a basis upon which an SO role could be developed. In particular, it provides a context within which alternative flow patterns could potentially be allowed to develop (through trading) within a carefully monitored and actively managed framework. The mechanics of this could operate in a range of different ways. For example, an SO could provide a modelling and monitoring framework that supported and provided greater credibility and assurance in relation to the activities – and engagement with environmental regulators – of others who might 'put' and 'take' water within an identified geographic scope (the oval shapes in Figure 1). Under this approach, the SO would be focused on facilitating more efficient coordination between others across areas where it has established ongoing expertise and monitoring arrangements.

Figure 1: A stylised interconnector between two rivers

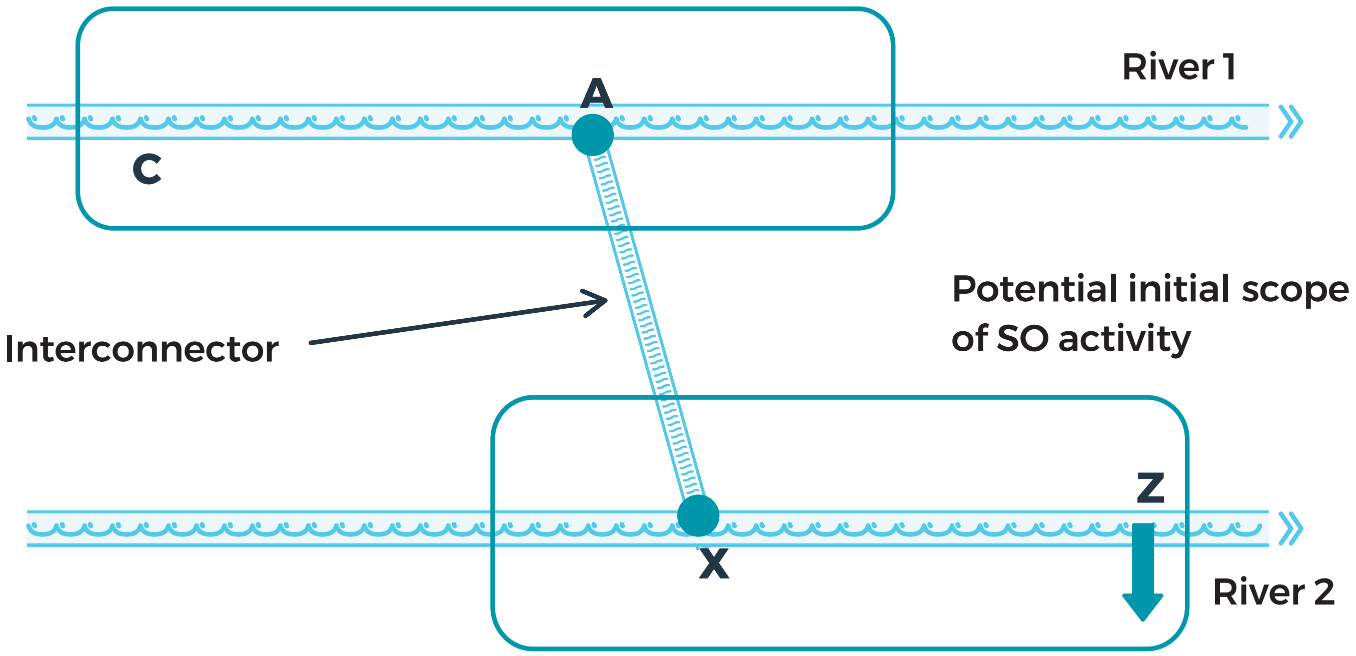


This type of role may offer significant coordination benefits. However, one could also envisage a scenario where the SO was effectively delegated some authority in relation to the management of conditions within defined geographical areas, and with facilitating the execution of trades in those areas in ways that allowed environmental regulators to focus primarily on the adequacy of the overall environmental outcomes of the 'system' that the SO is managing, rather than on the merits or otherwise of particular trades (e.g. between point B and point Y in Figure 1) within that system. For formal delegation arrangements to be developed, legislative change is likely to be necessary. However, informal options may be available. For example, the informal development of this kind of role might be thought of as akin to the development of industry standards of practice, compliance with which can then support the use of – and form part of – more 'high level' decision making by environmental regulators.

Figure 1 treats the objective of the 'base' water transfer that the interconnector is designed to allow for as though it is simply a 'take' at one end of the interconnector and a 'put' at the other. In practice, though, for large scale water transfer schemes, interconnector usage may form part of a broader chain of 'puts' and 'takes'. This can imply that the development and ongoing usage of the interconnector necessarily involves the monitoring and assessment of a relatively broad geographic area, as this may be necessary to identify and manage the risks of delivering the large-scale water transfer over time. This is illustrated in Figure 2 below, where it is assumed that there is a separate upstream 'put' (at C) which supports the 'take' of water into the interconnector, and that the 'put' of water from the interconnector supports a separate downstream 'take' (at Z).

In order to put in place effective arrangements for a large scale transfer of the kind considered here, then one would expect there to have to have been detailed assessment of flows under a range of contingencies over a relatively broad area. And ongoing operation of the transfer would seem likely to require ongoing monitoring and active management in order to ensure the supply can be provided in an effective manner as and when needed. This active monitoring and assessment role could provide the basis for effective SO development, by providing a framework with which the implications of other flow changes within a defined area could be assessed. As such, it provides a potential basis for the development of a trading framework, with the SO playing an active monitoring and assessment role and supporting the adoption of a more outcomes-focused approach by environmental regulators with respect to the 'system'.

Figure 2: A stylised interconnector with a supporting 'put' and supported 'take'



Notes

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