

Sustainability First

New-Pin

**Innovation in energy and water:
What is an appropriate role for Government and
regulators in delivering desired long-term public
interest outcomes?**

DISCUSSION PAPER

FINAL

This paper has been written by Sharon Darcy with contributions from Judith Ward and Maxine Frerk. Thanks to Jon Bird for his comments, those we interviewed in our research and attendees at the New-Pin innovation workshop on 15th November 2017

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About the New Energy and Water Public Interest Network

Background: New-Pin brings together stakeholders active in the energy & water sectors to help secure greater focus in company, investor, regulatory & policy decisions on **long-run public interest issues**. It aims to:

- **Build understanding between the energy and water sectors and their stakeholders.** New-Pin explores areas of similarity and difference, leverages learning and identifies practical steps all actors can take that could better serve long-term public interest issues;
- **Strengthen stakeholder engagement.** New-Pin seeks to increase public participation in decisions by water & energy companies, investors, regulators and policy makers through developing lasting capacity and thought-leadership among ‘public interest’ advocates; and
- **Stimulate a more ‘inclusive’ perspective on governance.** The Network is exploring what governance in the public interest looks like for energy and energy companies.

New-Pin was established by the charity Sustainability First in 2015. The New-Pin Network is made up of consumer, environmental, citizen, academic and investor interests, a small group of energy and water companies, regulators and government departments.

Sustainability First arranges and facilitates carefully structured New-Pin workshops to discuss relevant long-term public interest issues through a ‘deliberative engagement’ approach. Network members decide which topic to focus on at each workshop. Prior to the workshops, Sustainability First holds bilateral discussions with members and other interested parties to discuss what they think are the key public interest issues in that topic area and to identify appropriate case study material. Following a literature review, this information is then used to draw up a draft paper for consideration at the workshop. After the session, the paper is revised to take on board comments. All final workshop papers are placed in the public domain.

New-Pin papers

- Towards a definition of the long-term public interest, August 2015
- Long-term affordability: who should pay for our infrastructure resilience and renewal and the move to low carbon? October 2015
- Trust and confidence: what does this mean for the different stakeholders in the energy and water sectors and what can be done to build and maintain this? March 2016
- Long-run resilience: Long-run resilience in the energy and water sectors. Are twentieth century approaches for securing resilience relevant for citizens and consumers of the twenty-first? June 2016
- Consumer, citizen and stakeholder engagement and capacity building, October 2016
- Market approaches and the long-term public interest, February 2017
- Tomorrow’s world consumer and citizen check-list, August 2017
- Check-list for energy and water board effectiveness, September 2017

The New-Pin Network Current New-Pin public interest advocate members include: Citizens Advice, The Consumer Council for Water, Green Alliance, The Centre for Sustainable Energy, Water Wise, ShareAction and The iGov Programme at Exeter University. Company members include, from the energy sector; Electricity North West, Northern PowerGrid, RWE NPower, Scottish and Southern Electricity Networks and Western Power Distribution; and from the water sector; Affinity Water, Anglian Water, South East Water, Southern Water and United Utilities. Regulatory members include: The Environment Agency, Ofgem, Ofwat and the Water Industry Commission for Scotland. Government representatives are: BEIS, DEFRA, the Scottish Government and the National Infrastructure Commission. Other individuals with a relevant interest are invited to specific Network meetings.

Executive summary

In the digital world, we can ‘all be innovators now.’ Starting up a new business and experimenting with the services provided, how they are delivered and the business models through which this is done has in many ways never been easier – or more exciting – and the costs of entry never lower. However, in energy and water, the topic of innovation poses some specific challenges.

This paper explores what an appropriate role should be for Government and regulators in terms of innovation in the energy and water sectors if long-term public interest outcomes are to be met. It aims to help monopoly companies, regulators and Government consider their approaches to innovation in the forthcoming price reviews (PR19, SRC21, RII02) and beyond. For retail, it should help all actors consider what the reasonable expectations may be for regulatory and Government action regarding innovation if public interest outcomes are to be delivered.

In competitive markets, we would normally expect to see companies innovating in order to grow or maintain their market share, in the process delivering services that meet consumer needs. Even well-functioning markets, however, can struggle to innovate in some of the areas that are difficult to put a price on – such as long-term resilience, fairness and robust communities / places. Change in these areas may also lead to distributional impacts for consumers and citizens that raise ethical questions for Government - and indeed wider society – particularly if the early adopters of change are only the affluent. These areas are the main focus of this paper. To get innovation here, Government and regulatory action may be needed. And in situations of imperfect competition or where there are monopolies delivering essential services, as is often the case with energy and water, innovation is unlikely without some degree of Government or regulatory action.

Existing Government and regulatory initiatives have done much to encourage incremental innovation in energy and water companies in the short term (~5years and within price control periods / electoral cycles). Many of these initiatives were designed for a pre-digital world to support innovation in big tech / assets and not necessarily the consumer facing, commercial and institutional innovation that may be needed in a more uncertain and ‘flexible’ future. Some companies have, of course, also innovated outside of their regulated asset bases in these riskier and previously ‘non-core’ wider areas of operations and some of these innovations may well have a positive trickle-down impact on their regulated businesses.

Whilst recognising that innovation is not an end in itself, this paper asks whether incremental and technologically focused innovation is sufficient to deliver the full range of the desired long-term public interest outcomes. The energy and water sectors currently find themselves at different ‘moments’ here. Within each sector, there are also differences in the main innovation challenges and opportunities - depending on the part of the value chain in question. In energy, there is sight of a ‘burning platform’ for change and a widespread recognition that more transformative innovation may be needed. The very survival of institutions, businesses and roles is in question. In water, the need for transformational

innovation that is more than incremental is less acute, except in resource constrained areas where many would argue a ‘burning platform’ does exist around resilience and sustainability.

To get more than incremental change in the energy and water sectors is problematic. Price review mechanisms by their very nature can be seen as ‘controls’ that discourage risk-taking and inhibit significant disruptive innovative activity. This can have a self-fulfilling impact. The investors who are attracted to the sectors tend to be looking for ‘slow and steady’ returns and be relatively risk averse – and less likely to want to undertake transformational innovation.

If transformational change is needed, what’s the most appropriate way of going about this? This paper proposes a **tool kit** for Government and regulators to use to select the right approach in a given set of circumstances and to **view innovation ‘in the round’**. This should help avoid potential duplication or confused / contradictory signals.

Firstly, the tool kit identifies the importance for **Government to frame the challenge(s), identifying desired outcomes and signaling priorities**. Considerable activity is already taking place to develop a high-level narrative and direction of travel, particularly in energy, and the different pieces of the jigsaw are starting to come together through measures such as the Industrial Strategy and the Clean Growth Plan. However, there is still much work for Government to do in terms of integrating different measures and signalling where change is needed.

It is important to acknowledge that the business of innovation entails ‘learning by doing’ and going on a journey where the destination is not always known. However, to help ensure that innovation delivers public interest outcomes, Government signals need to meet the test of **Sustainability First’s ‘5 Cs’**:

- **Culture** of innovation supported that ‘gives permission’ to companies to think creatively, accepting that things will not always work and an iterative approach is important that allows **space and time** for experimentation;
- **Clear** high level **challenges and priorities** flagged for short, medium and long-term. Strategic clarity is needed to give investors a ‘firmer footing’ and line of sight for their plans on which to undertake riskier novel activities – both in / outside their regulated asset base. This needs to be outcomes focused and is not the same as picking winners;
- **Co-ordinated** and joined up between Government and regulators, particularly on wider social and environmental outcomes that require cross sector, and even cross economy, focus;
- **Collaboration** enabled to pull in new, and more diverse, ideas and approaches. Clarity is needed as to **when this can and can’t be done** within competition law constraints; and
- **Consistent** over time. To enable this is in a fast moving environment, an **adaptive approach** can help ensure any interventions are more ‘predictable.’

The second tool in the kit is that Government and regulators need to consider what they can do to create appropriate **enabling frameworks to facilitate transformational change**. Simplifying, clarifying and better communicating the basic rules of the game can help both existing players and new entrants innovate. Principles based regulation is starting to address the need to reduce prescriptive regulation and remove regulatory barriers, in areas such as access arrangements to core systems, which may often largely be down to ‘custom and practice.’

For transformative innovation to happen, however, there may also need to be a rethink of **consumer protection arrangements** to ensure that these are fit for purpose in a dynamic world. A review is needed of: the minimum levels of consumer protection that may be needed on a sector-by-sector basis for *all* consumers; the consumer safeguards that are needed in both sectors specifically for customers in vulnerable circumstances; where general consumer protection legislation may be sufficient; and how regulators and other partners could work together to ensure consumer redress arrangements are as simple as possible, yet work across the complex and fuzzy chains of liability that are now emerging. For consumer confidence to be maintained, regulators also need to grapple with questions of data protection and ownership as digitisation continues at an exponential rate. Helping consumers understand what to expect regarding their data is an issue that has relevance across the economy.

The third tool in the kit is the Government and regulatory **incentives and funding mechanisms** that can support disruptive change. Government recognise the need to fund long-term R&D (~15 years +) and ‘blue skies’ technological innovation, and are committing significant funds (particularly on the energy side). A high level overview and greater co-ordination of different funding mechanisms is needed, with a far stronger focus on long-term public interest, as well as commercial, outcomes.

Our research for this paper has identified that the really challenging area for transformative innovation is how to get this in the medium term (the ~ 10 year view) in monopolies, where innovation straddles price control periods / electoral cycles but isn’t quite ‘blue sky.’ This difficulty is greatest where the innovation involves a mix of technological, commercial and consumer facing change. To get a range of often disparate actors to act in concert to take risks and change their practices can require a determined, pro-longed effort – and hence the need for a worthwhile reward / adequate resource plus, potentially, specific incentives to collaborate. ‘Place’ based decision-making can also help address this challenge.

Regulators are actively looking at this issue in the context of the frameworks for PR19, SR21 and RII02. But it is hard; the public don’t want essential services, and monopolies in particular, to make profits nor to fail – either of which may happen if genuine transformative innovation is to be encouraged. Many consider that parts of the sectors are already ‘overpaid’ and therefore have no incentive to do anything differently and that what is needed may be to push down prices further. Regulators and their virees are also not necessarily well set-up to deal with a multiplicity of decentralised and heterogeneous interests who may have innovative ideas but also multiple objectives of their own (e.g. on heat, local energy and water quality).

In these circumstances, what more can regulators do to incentivise disruptive and transformative change by monopoly businesses? Few things are currently 'off the table,' particularly in energy. Regulators are currently actively using or exploring the following options for monopoly activities:

- Questioning the merit of explicit allowances or incentives for innovation per se, rather than for specific and narrowly defined outcomes.
- If possible, separating out riskier disruptive innovations from the rest of the price review. Depending on how 'big' the innovation is, this could be (in order of magnitude) through a sandbox process, an ex-post funding challenge / prize or an ex-ante innovation fund or discrete investment appraisal or 'contract for customers'. The method chosen may have implications for how 'intrusive' regulation is – but digitisation and real time data may start to change this.
- Identifying the 'tram-lines' or risk and return that are acceptable in this area. This can be done by building an evidence base of how much risk 'the public' is willing to accept to get transformative change. This isn't necessarily asking consumers directly – they may just want a 'faster horse' – but through consumer forums, civil society groups etc. Present bias means that many may also often undervalue long-term innovation.

The last and fourth tool in the kit is **direct interventions**. Even with the above changes to the regulatory framework, there are still likely to be some restrictions on innovation through existing licences and vires for both monopolies and retail activities. This is often because existing licences were constructed for a time when the sectors were more stable and supply and demand were separate. As these increasingly come together and both sectors look to developments that will enable and facilitate more optionality and flexibility in terms of how services are delivered - changes to existing licence arrangements may well be necessary to enable transformative innovation.

In energy, a fundamental re-think of the scope of licensing arrangements may be needed to: get rid of the brake that supply licences are having on innovation in the retail space; and to allow networks to enable transformational change – rather than just being passive recipients of change happening around them.

All this raises questions for the roles and responsibilities that need to underpin any new licensing arrangements. Greater clarity is needed in these areas so incumbent companies can seize the day and new entrants and capital come in. Given that the future is uncertain, a certain degree of agility is needed so that roles and responsibilities can evolve in response to change. One size is unlikely to fit all. Identifying what is the core, minimum level of licence responsibility needed by a given group of actors to unleash medium term innovation would be a starting point. Agreeing what will / won't change in the future may help.

This paper proposes a set of principles for Government / regulators when considering innovation that should enable a more adaptive future approach to transformative change:

1. Innovation activity needs to be focused, inter al, on the desired long-term public interest outcomes.
2. Incentives for innovation need to align with these outcomes.
3. Interventions for innovation activity need to incentivise collaboration across and between systems.
4. The outcomes sought should be framed in terms of tomorrow's problems, not today's and focus on long-term objectives.
5. Access to innovation support, incentives and funding needs to be transparent, simple, clear and co-ordinated.
6. The timing, form and durability of any innovation interventions need to be clear.¹ Any interventions should be time limited.
7. To enable evaluation, innovation activity needs to be measurable. It is important to be able to: identify the counterfactual (the world doesn't 'stand still'); and honestly assess the positive and negative quantitative and qualitative impacts of the innovation activity (including around cultural change / lessons from failure).
8. The potential distributional impacts of any innovation interventions need to be recognised and taken into account by Government and regulators.
9. Clear red lines are needed of where interventions for innovation do not serve the wider long-term public interest / are outside the public 'risk-appetite' for change.
10. Government and regulators need to be able to articulate what success and failure look like in terms of innovation in the sectors / systems.

¹ Nathan Cortez (2014) Berkley Technology Law Journal
New-Pin: Innovation workshop – Discussion Paper, FINAL 20.12.17

1. Introduction

1.1 Overview

To meet the challenges of demographic and climate change in an affordable way will require the energy and water sectors to adopt new ways of working. New developments in technology along with innovative commercial arrangements offer opportunities to reduce costs. There is also a 'pull' from consumers for more 'modern,' digital and seamless services (although this may be weaker for customers in vulnerable circumstances).

All this has implications not just for customers, companies and investors but also for Government/regulators. Some consider that Government and regulators should have a very limited role in terms of innovation and just 'get out of the way' – only intervening if and when a clear harm materializes. This New-Pin discussion paper explores how proactive Government / energy and water regulators might need to be if the desired long-term public interest outcomes for the sectors are to be delivered for households and citizens.

Government and regulators are not 'sitting on their hands' here. For example, through the Industrial Strategy Challenge Fund, in April 2017 Government announced that it will be investing to drive innovation in cutting-edge new technologies such as Artificial Intelligence and batteries for energy storage.² In regulation, Ofwat has said that innovation will underpin the next price review, PR19, as a way of delivering more affordable and resilient water services.³ In energy, very early thinking on the proposed future regulatory framework for network price controls, RIIO2, identifies innovation as necessary to deliver solutions that are lowest cost over the long-term.⁴ Ofgem has also recently introduced an 'Innovation Link' providing support on energy regulation issues to businesses looking to introduce innovative propositions.⁵

This paper covers the full range of innovation in the sectors from changes to 'big kit' to consumer facing developments but with a strong focus on transformative and disruptive rather than incremental innovation. More active customers, decentralized approaches, collaborative ways of working and new business models are already disrupting the current landscape for energy and water companies – and much of the rest of the economy. The environment, particularly for energy, is becoming increasingly dynamic, stretching and challenging the boundaries of existing vires and responsibilities. With this in mind, the paper is primarily future focused rather than a detailed assessment of what has happened in terms of

² <https://www.gov.uk/Government/news/business-secretary-announces-industrial-strategy-challenge-fund-investments>

³ <http://www.ofwat.gov.uk/consultation/delivering-water2020-consulting-on-our-methodology-for-the-2019-price-review>

⁴ https://www.ofgem.gov.uk/system/files/docs/2017/07/open_letter_on_the_riio2_framework_12_july_final_version.pdf

⁵ <https://www.ofgem.gov.uk/about-us/how-we-engage/innovation-link>

innovation in the sectors to date.

1.2 Scope

Innovation can deliver many public interest benefits including for economic policy and skills development. This paper does not specifically look at these wider benefits of innovation.

Market led approaches to delivering public interest outcomes were covered in the New-Pin workshop in February 2017.⁶ In this paper, we build on this thinking and mainly focus on how Government and regulators can help deliver innovation in terms of public interest outcomes where markets struggle to do so on their own. In the February workshop we identified these areas as being around long-term resilience, fairness and place.

To keep the discussion manageable, the paper does not cover financial innovation.

1.3 Method

We have carried out desk research including, but not limited to: recent Government/regulatory announcements and plans for innovation in the sectors; recent Sustainability First work on innovation (GB Electricity Demand Project Paper 11 and *Project Inspire*)⁷; the UKRN's Innovation in Regulated Sectors report; and other reviews of innovation activity in energy and water.

This has been supplemented with 18 bilateral interviews with New-Pin Network members and others active in this field. To provide some wider insights, the paper makes references to innovative practices in other regulated sectors and includes case studies from innovation in the US energy and water sectors.

A draft of this paper was discussed at the New-Pin workshop on 15th November 2017. This was attended by 36 people from the New-Pin Network, including consumer and public interest groups, regulators, representatives from Government and energy and water companies. Although most of the companies present were incumbents, there were also a few new entrants. The draft paper has been revised to take account of the comments made through this deliberative engagement approach.

1.4 Purpose of this paper

This paper seeks to shed some light on the challenges and opportunities for transformative innovation in the energy and water sectors and what this means for the role of Government and regulators.

⁶ http://www.sustainabilityfirst.org.uk/images/publications/new-pin/New-Pin_Market_approaches_workshop_22_Feb_2017_FINAL_REVISSED_SLIDE_SET.pdf

⁷ <http://www.sustainabilityfirst.org.uk/index.php/inspire>

We recognize that Government and regulators are already engaged and active in these areas. Much has been achieved and there is a lot of valuable thinking and work going on. However, **our research has highlighted the difficulties that all sides face in getting transformative innovation in complex systems.** We are also aware that in the past, significant attention was placed on enabling technological innovation in the sectors. Whilst this is clearly starting to change, enabling the consumer facing, commercial and institutional innovation that will be needed for future flexibility and to maximise energy and water saving, can require a different approach. Not least innovation policy needs to factor in place, fairness and long-term resilience and take any resulting distributional impacts into account. This paper is intended to be a constructive contribution to this on-going work.

For monopoly activities, the paper is intended to help thinking around the frameworks that are currently being developed for the forthcoming price reviews RII02, PR19 and SRC21 and beyond. For retail activities, amid concerns that regulation can ‘get in the way’, the paper seeks to ask how regulatory approaches can better facilitate a more service-led and innovative future. It explores some of the barriers and bottlenecks that current rules and processes may create and identifies some of the opportunities that may exist to address these.

To stimulate debate, the paper highlights a number of innovation ‘myths’ that, in the context of energy and water, it may be helpful to debunk. These myths were tested in a lunchtime exercise at the New-Pin workshop on 15th November. As a result, one of the myths that we had originally proposed, where a wide range of views were expressed, has been removed from the paper.

1.5 Outline

Section 2 of the paper provides a high-level overview of what innovation is. As well as **defining some basic terms** for the purposes of this paper, it examines the different time frames over which innovation can happen and sets out some technological, consumer facing, commercial and institutional road maps that can be used to better understand the innovation journey. To aid discussion, it also includes an illustrative example of what an innovation cycle could look like.

Section 3 of the paper outlines **why Government / regulatory action may be needed** in terms of innovation in the sectors. With reference to our New-Pin long-term public interest outcomes for energy and water, it identifies those areas where markets on their own may struggle to deliver innovation; outcomes relating to long-term resilience, ‘place’ and fairness. It then moves on to summarise at a very high level the differences that exist between energy and water in terms of innovation.

Section 4 examines what can and can’t be delivered in terms of transformative innovation in energy and water **under current structures and with current licences.** This section looks at the issues from the perspective of different parts of the value chain. It also contains case studies from innovative practice in UK energy and water companies and other sectors and from the US energy and water sectors.

Section 5 of the paper provides the core analysis. This examines what the appropriate **future role of Government and regulators** may be in terms of innovation in the sectors. It proposes a **tool kit** for different Government and regulatory approaches. This can broadly be broken down into four key areas:

1. Framing the challenge(s), identifying desired outcomes and signaling priorities
2. Enabling frameworks and facilitation
3. Incentives and funding
4. Direct legal / licence interventions

Section 6 puts forward a set of **principles** that could be developed to underpin Government and regulatory approaches to innovation in the sectors to help and enable a more adaptive approach to change.

Finally, **Section 6** contains our conclusions and recommendations. These include a summary of the possible 'myths' around innovation that we hope this paper may possibly have helped debunk.

Annex 2 contains some **case studies** from innovation in energy and water in the US.

2. What is innovation?

Innovation is not an end in itself. By its very nature it is a multi-dimensional, dynamic and difficult to 'pin down' experiment or journey. It is not always clear what will come out of it and like all experiments, it will not always succeed in its stated intention.

Despite this elusive quality, defining innovation at *a high level* can help distinguish between what is novel and what may be seen just as 'business as usual' (BAU) – particularly in terms of delivering public interest outcomes. For the purposes of this paper, we will therefore use the following **terms**:

- **Disruptive or transformative innovation** (e.g. Uber, Bitcoin and block-chain) – 'doing things differently'. Can significantly lower costs and / or develop new functionality in a way that reshapes existing markets and creates new ones. **This will be the main focus of this paper.** As the goals and outcomes of potential disruptive change are less clear, and it can often be driven by '**existential threats**' across the economy, be driven by global change, and / or lead to disintermediation, it tends to be more contentious. At the workshop there was a strong feeling that although transformative change may be attention grabbing and exciting, in energy and water, some of the most valuable changes from a public interest perspective may be the 'boring' and dull ones that to some extent take place 'behind the scenes;'
- **Incremental innovation** – 'doing things better.' Can lead to marginal increases in productivity and / or fringe developments for existing activities, often enabling the 'over serving' of higher paying customers. Most would agree that incremental innovation is desirable and necessary for a well-run business to meet the evolving expectations of its stakeholders. It may be particularly important for innovation around **vulnerability** where the risks are often higher (both in terms of cost and reputational risk from failure); and
- **Enabling innovation** – 'paving the way.' It is important to recognize that the difference between disruptive and incremental innovation isn't black and white. One can lead to and **enable** the other.

These broad terms can be further subdivided by the **types** of innovation, including:

- **Technical.** Given their heavy asset bases, it is not surprising that much of the attention in the energy and water sectors around innovation has traditionally been in this area. However, there is increasing recognition that innovation around large assets and large-scale kit is not the only game in town. **Digitisation**, big data, AI and robotics are opening up new possibilities at a rapidly increasing rate. This includes 'social technology' such as apps that can help people budget and save money. **Materials innovation** (eg graphene lining in pipes) and **bio-engineering / 'biological' solutions** in water, waste water and gas are also starting to provide new solutions that may require a different approach. Technical innovation can also clearly enable other types of change. For example,

water metering may be a necessary precursor for consumer innovation in the water sector;

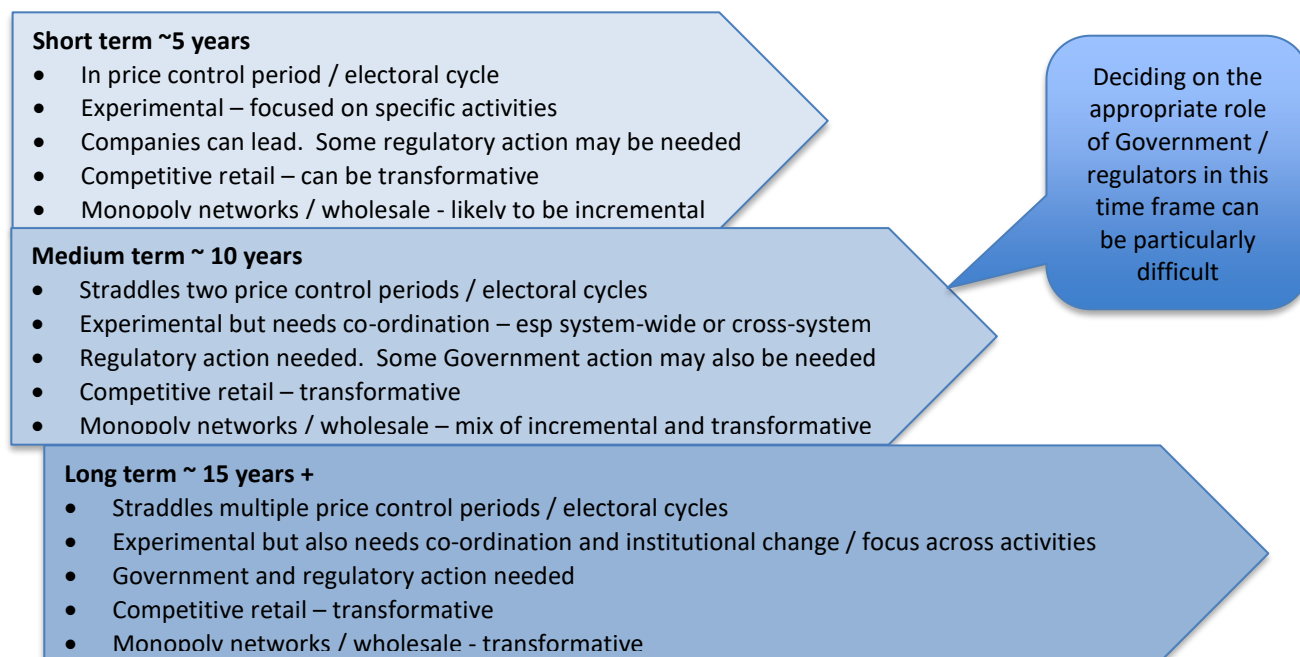
- **Consumer facing.** Helps improve services and / or efficiency and **enables** demand side response. Consumer facing innovation can be focused on individuals or groups (eg through the sharing economy, community or place based solutions);
- **Commercial (process and business model).** Innovation in this area can provide flexibility, **enabling** a range of approaches and keeping ‘options open.’ It can also lead to more integrated and circular business models. However this type of innovation can often have dependencies outside of the sector in question;
- **Institutional.** This area of innovation has perhaps received less attention. However, with the increasing acknowledgement that energy and water are part of complex ‘**systems**’ the arrangements surrounding current institutional structures (such as governance codes) and new Challenge funding are increasingly being examined to see how these can help or hinder transformative change at a system level; and
- **Financial.** Different types of funding arrangements can be seen as a type of innovation (e.g. holding company structures, crowd sourcing, green bonds⁸ etc.). To make the scope of this paper manageable, we will **not** cover this type of innovation.

When thinking about the intellectual framework needed when considering innovation, it is important to ask whether the activity in question is a **monopoly or contestable**. This will have a considerable impact on the appropriate approach for Government or regulators to take.

Different types of innovation clearly take place over different time frames. These are summarized at a simplified *high level* and for illustrative purposes only in Diagram 1 below. It is important to note that different parts of the value chain can have different ‘glide-paths’ for change. Even for innovation that is only likely to have a long-term impact, it may well have a long ‘run-in’ and activity is likely to be needed in the short-term to start the journey.

⁸ Anglian Water issued the first ever utility sterling Green Bond on the London Stock Exchange in July 2017

Diagram 1: High level view of different types of innovation & different time frames



Source: Sustainability First

There are numerous ‘**innovation roadmaps**’ for technical innovation (see Table 1 for an example). Funding bodies and researchers use these to identify where a proposal sits on its innovation journey. Although innovation roadmaps are rarely definitive, they can provide a useful illustration of an innovation ‘journey’. Roadmaps can help ensure a common language and means of objective categorization and to identify barriers or gaps in funding provision etc. This kind of analysis supports consensus on where the main challenges may lie in an innovation journey. Roadmaps provide a reference point for considering where Government / regulatory action may or may not be needed⁹.

Although technology roadmaps are the most common, even with these, there are questions over how applicable any one roadmap may be to different types of technology. Many digital tech companies often don’t follow this more structured and linear approach. For example, Google Ventures popularised the use of **Design Sprints** to help them ‘fail fast’ and innovate more quickly. These programmes move from problem discovery through to hypothesis, prototyping and testing in only five days. This approach is now used by Slack, Facebook and McKinsey.¹⁰

⁹ BEIS is currently consulting on a revised methodology for its Energy Innovation Needs Assessment

¹⁰ Emma De Vita, FT (2016) Need Fresh ideas? Spark innovation with a Google style Sprint

Table 1: The UK Water Partnership’s mapping of different innovation technology road maps¹¹

Innovate UK Technology Roadmap	UKWP LITSoN model	EU Horizon 2020 Technology Readiness Levels
Problem identified	Fundamental research	TRL1: Basic research. Principles postulated and observed but no experimental proof available
Principles understood		TRL2: Technology formulation. Concept and application have been formulated.
Proof of concept	Applied research	TRL3: Applied research. First laboratory tests completed; proof of concept
Realistic demonstration		TRL4: Small scale prototype built in a laboratory environment ("ugly" prototype)
		TRL5: Large scale prototype tested in intended environment
System prototype	Development	TRL6: Prototype system tested in intended environment close to expected performance
		TRL7: Demonstration system operating in operational environment at pre-commercial scale
Limited scale production	Commercialisation	TRL8: First of a kind commercial system. Manufacturing issues solved
		TRL9: Full commercial application, technology available for consumers

TRL 1-4: Gov. & academic funded - markets support

TRL 5-8: In energy funded by LCNF / NIC

Companies > role in funding but 'valley of death' may necessitate Gov. / Reg. help

In order to ensure that discussions about innovation are not ‘framed’ purely by technological solutions and ‘fixes’ in the sectors, and a technical language that it may be difficult for third parties to access, it is worth considering what such roadmaps may look like for other types of innovation. In **Annex 1** Sustainability First has therefore developed some ‘straw-man’ roadmaps of consumer facing, commercial and institutional innovation. Clearly, many innovations will entail elements of experimentation in *all* of these areas and therefore, if of interest, the roadmaps may need to be combined. These are being shared to aid discussion only - rather than to provide a definitive assessment of the different stages of various types of innovation.

Recent research would seem to indicate that the way organisations innovate does not necessarily vary by whether the innovation is disruptive or incremental, or whether it is focused on a process or a product, but is driven by the ‘**ideation**’ rate; the rate at which ideas emerge in a system divided by the rate by which they are approved by management. According to this theory, the keys to successful innovation are: more participants coming up with ideas; people more frequently having ideas; more people evaluating ideas; and a greater diversity of people contributing.¹² However, it is also worth noting that innovative ideas often come from outside the system in question and in our global world are increasingly internationally driven.

Finally, it is also worth noting that **frugal innovation** – ‘doing things leaner’ - *across* physical, financial, human, intellectual, social and natural capitals¹³ is seen by some as a way of delivering long-term sustainability outcomes. It may also help achieve

¹¹ UKWP / Mott MacDonald (2017) LITSoN Linking Innovation to Societal Needs, Proof of Concept Report

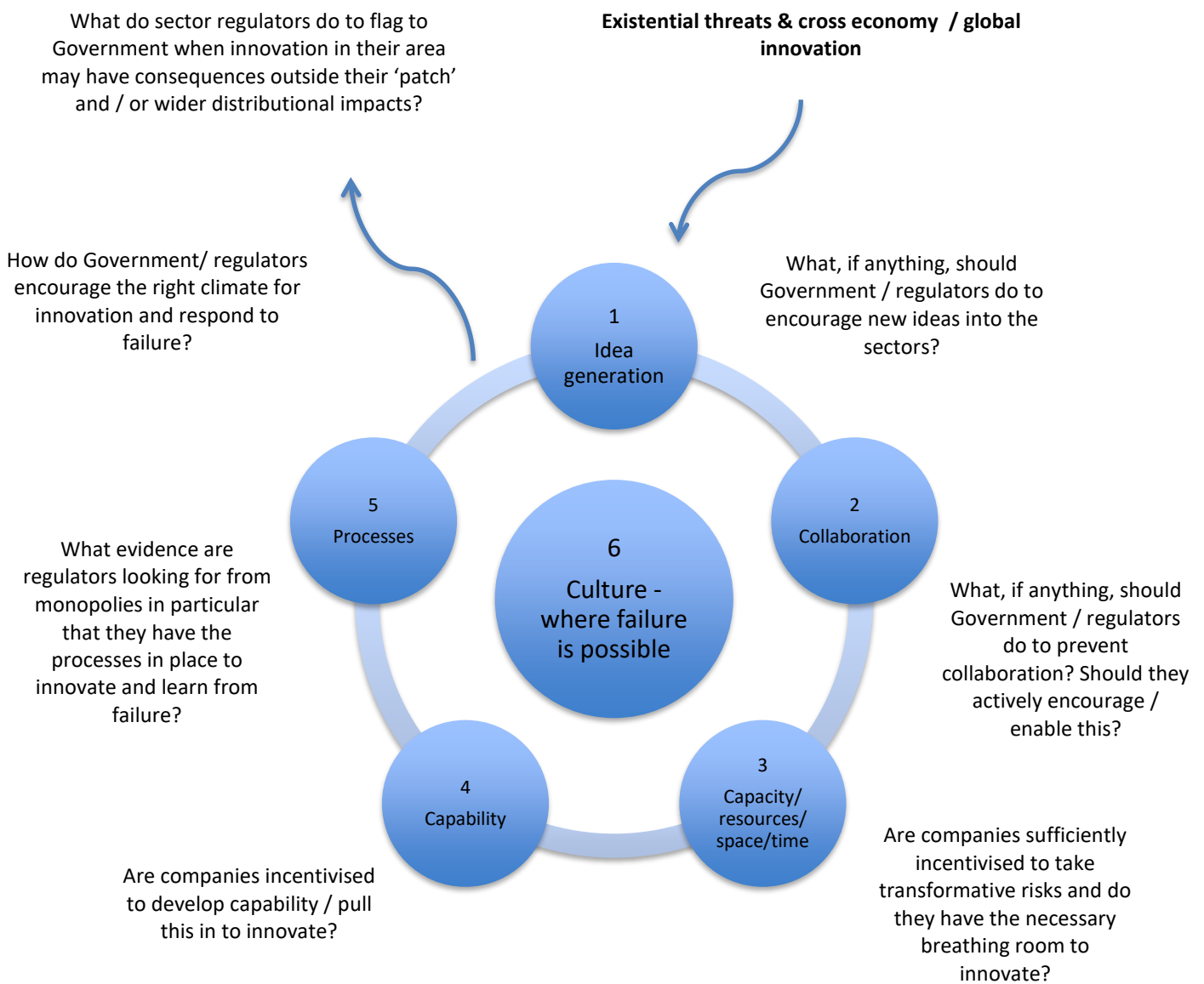
¹² Minor, Brook and Bernoff (2017) Data from 3.5 million employees shows how innovation really works, Harvard Business Review

¹³ Volans (2016) Breakthrough business models

the ‘fast failure’ that is possible in digital and commercial innovation.

Diagram 2 provides a possible illustration of an iterative innovation cycle within a company. Every organization will clearly have its own approach to innovation that meets its own circumstances. This diagram is provided to aid discussion in terms of where Government and regulatory action in terms of innovation may be beneficial. It is important to note that this diagram is circular for a reason; to emphasize that innovation is normally an iterative process where things are rarely got ‘right’ first time.

Diagram 2: Iterative innovation cycle and associated questions for Government and regulators



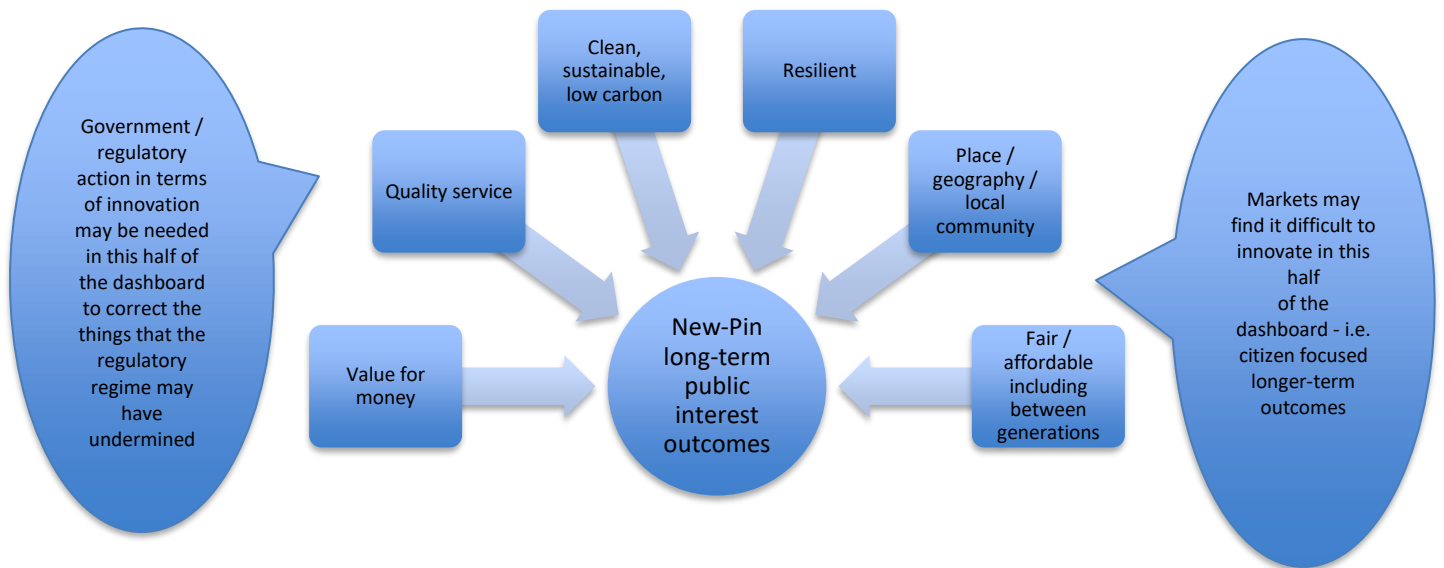
Source: Sustainability First

3. Why may Government/regulatory action be needed in terms of innovation in the energy & water sectors?

Innovation and disruption are not an end in themselves. Innovation can help overcome some of the significant challenges faced by the energy and water sectors including: climate change; aging assets; a growing population; and changing customer expectations.

In previous New-Pin workshops, we have identified that that **the long-term public interest is the aggregate well being of the general public, both short and long-term, combining the total interests of consumers, citizens, investors and the environment for both today and tomorrow.** In the New-Pin workshop in February we highlighted a more specific set of desired long-term public interest outcomes for energy and water - our public interest 'dashboard' - that innovation can help deliver. This paper will build on, and not repeat, this thinking. These outcomes are illustrated in the diagram below:

Diagram 3: Dashboard of New-Pin long-term public interest outcomes



Source: Sustainability First

At the workshop, some participants noted that without having an agreed definition of what the public interest is, it can be difficult for Government and regulators to know how best to respond to innovative opportunities and challenges. It was also recognised that the public interest extends beyond what individual market actors can deliver and into the wider energy and water systems - and beyond.

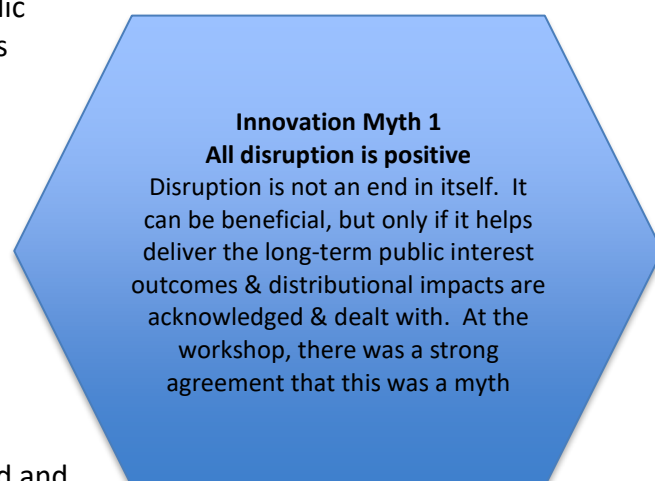
The Sustainability First dashboard highlights that those elements that are most likely to feature in customers' purchase decisions – value for money and quality of service – should be capable of being delivered through the market. Competition should in theory then drive innovation in those areas. Where market values can be put on

other public interest considerations, such as carbon pricing in energy generation, then again competition should work to innovate and deliver those benefits.

Similarly, in price controlled sectors the price controls are designed to give incentives for efficiency and for customer service (including interruptions and leakage), which then drive companies to find creative ways to deliver those goals. In our February New-Pin workshop we identified that the key outcomes that markets struggle to deliver are **place, fairness, and the more long-term elements of resilience**. Getting innovation to meet these outcomes can be difficult for the following reasons:

- Markets can struggle to put a price on outcomes around place, fairness and long-term resilience as these are characterised by **social and environmental externalities**. Companies are often being asked to do more to deliver in these areas as other public services come under pressure from austerity;
- It may **not be commercially attractive** for any players, existing or incoming, to innovate to meet these outcomes without Government or regulatory action to incentivise them to do so;
- Outcomes around place, fairness and long-term resilience can have significant **distributional impacts for consumers and citizens** and involve trade offs between generations (long-term resilience may suffer if investment is 'put-off' to maximise short-term efficiency) and within generations (Sustainability First's *Project Inspire* has identified that innovation for those on low incomes and / or in vulnerable circumstances has been sorely neglected in energy).¹⁴ 'Smart' systems may accentuate some of the distributional impacts further if they are only accessible to those able to afford them.¹⁵ Given the almost 'public good' nature of energy and water, it is important that it is not only those early adopters and those that are able to engage (e.g. those that can afford EVs or PV) that are the ones that are able to benefit from disruptive innovation.

These distributional impacts raise '**ethical**' questions. In some areas, Government representatives (local, regional and national) who are elected and regulators who are accountable, may need to take the lead in working together with consumers and citizens in defining the outcomes sought, 'framing' the ethical problems in the most appropriate way and creating the frameworks needed to deal with them;



¹⁴ <http://www.sustainabilityfirst.org.uk/index.php/inspire>

¹⁵ http://www.sustainabilityfirst.org.uk/images/publications/other/Sustainability_First_-_Discussion_Paper_by_Jon_Bird_-_Smarter_fairer__Cost-reflectivity_and_socialisation_in_domestic_electricity_prices_-_FINAL.pdf

- Innovation can open the door to **multiple market actors and competing interests**. Third parties and new entrants bring welcome challenge to the status quo but add to the number of interests and stakeholders. The outcomes desired by different market actors, sectors, vectors and parts of the value chain are not the same. There are different communities of interest and different ideas around what is 'fair.' Although some win-wins are possible, a balance of interests will often need to be struck. Dealing with 'the losers' from innovation in essential services requires attention (e.g. gas networks, incumbent retailers etc.). Different parts of the value chain may also have different innovation 'run-up' periods and 'scale' challenges. Creating an environment for innovation that suits all therefore also involves judgements that need to stand up to scrutiny. In the absence of clear public interest priorities articulated by government and if change is needed at multiple points, innovation can stall;
- Given that transformative innovation is likely to impact on the wider energy and water '**systems,**' multiple actors need to be involved for these outcomes to be delivered. This requires: a rethink of the most appropriate **institutional arrangements** to deliver the outcomes; and co-ordination between different actors. Individual innovators are unlikely to be able to lead here. A fragmented and disaggregated view of challenges and outcomes may lead to an incremental, silo and sub-optimal approach and may not be able to identify where the opportunities for transformational innovation in energy and water systems are to be found.

In energy, the challenge is most acute around cross-vector change and low carbon heat. In water, it is currently most challenging around catchment management. For institutional innovation to succeed and be seen as 'legitimate' in areas characterised by social and environmental externalities, Government involvement (local, regional and national) is essential. The BEIS Secretary of State has indicated that the Government will consider institutional responses following a new Call for Evidence on the Helm Review; and

- In both the energy and water sectors, the need to enable **local / community / place based approaches** will be key. Much innovation focus and support has previously been 'top down.' There is a growing amount of research that place based leadership and institutional governance can reveal new opportunities for innovation.¹⁶ At the workshop we heard that Bristol Smart Energy City Collaboration had demonstrated that different strands of activity coming together in a locality across 'normal' boundaries and systems can reveal new opportunities for innovation and doing things differently. The Cities and Local Government Devolution Act 2016, which has opened the way for **devolution deals and innovation zones**, should help in this area. New

¹⁶ See, for example, Robert Hambleton (2015) Leading the inclusive city - Place based innovation for a bounded world

funding mechanisms may be needed to get place based innovation which put social, commercial and cultural change at the local level ahead of technological change. Workshop participants discussed how governance arrangements may need to evolve for place based innovation to work and that having a ‘loose collaboration’ at an early stage could be beneficial and that there were risks with trying to formalise governance arrangements, or introducing potentially onerous reporting requirements, too quickly.

Despite these general observations about both sectors, it is important to note that for very valid reasons the **energy and water sectors are at different ‘moments’** in terms of innovation and what this means for their regulators and Government. Table 2 attempts to summarise this at a high level. The points raised in this Table are explored in more detail throughout this paper.

Table 2: Some of the key similarities and differences between the innovation challenges in the energy and water sectors

Issue	Energy	Water
External, cross economy & global pressures?	External pressures and existential threats from big data, digitisation, AI and robotics, and potentially also from developments in materials and bio-engineering, are likely to change both sectors whether they embrace this or not. Brexit, austerity, potential increases in the cost of capital and the rise of the ‘sharing economy’ are also leading to cross economy changes. The counterfactual for any innovation in energy and water is not the status quo	
Burning platform in the sector?	The low carbon transition means significant innovation is needed system-wide and cross-sector	There are different perceptions of whether there is a burning platform in water. Some consider that alternating droughts and floods make it difficult to build momentum and a rallying call for change. However, in certain parts of the country (South / South-East) water resource pressure means there is at the very least there is a ‘smouldering deck.’ If more responsibilities were given to water companies around flooding in the future, this could potentially also become a burning platform. The big future question is whether incremental change in the sector will be sufficient to address the challenge of resilience in an affordable way.
Extent of change happening in the sector	Transformative innovation happening now. Digitisation and the need for flexibility to reduce costs/cope with intermittent renewables are redefining the value chain. The clear/rigidly defined world of supply, generation, distribution and transmission licences is being blown apart. The significant opportunities for new entrants, and the fact that many of these may have wider interests beyond utilities, and may be offering bundled products and services, is leading to a world of multiple and dynamic actors.	Much incremental innovation across the sector. Competition for Non-Household retail is starting to reveal opportunities around services / big data/digitisation but the change isn’t perhaps transformative. Partnership working - with a wide range of actors is now common place and this could be where the biggest opportunities come from for transformation – both on the water and waste water sides (e.g. sludge) – and in communities and localities

Is co-ordination necessary?	The energy sector is currently geographically networked, and there is a <i>national</i> retail market. Change in one area impacts on others. Co-ordination is therefore vital to maximise opportunities but also deal with downside risks (e.g. stranded assets, potential death spiral of networks)	As <i>regional</i> businesses, the need for co-ordination in terms of wholesale and waste water activities is currently limited. A greater push for eventual abstraction reform and trading arrangements could clearly change this. Non-Household retail competition clearly requires an element of sector-wide co-ordination. Water licenses are currently simpler than those in energy
How unique are the challenges each company faces?	Although each network faces their own challenges, there are many common issues & national standards that mean replicable innovation at a local scale can potentially have national if not global benefits	Each company faces their own catchment challenges, but some common issues mean that innovation in one company could eventually potentially benefit all
Summary of current Government / regulatory approach	Government and regulatory approaches are currently evolving in both sectors. There are lots of moving parts and good work going on. The situation is not static	
	High-level vision in place (Industrial Strategy, Clean Growth Plan) and other detailed new government interventions in 2017 to help markets and innovation significantly change the shape of the sector. Priorities and roles and responsibilities within these need to be developed. Regulatory mechanisms are starting to enable change	High-level vision. Priorities need to be developed. Regulatory mechanisms encourage a 'hundred flowers to bloom'
Funding	Electricity and gas are in different places in terms of the need for innovation stimuli and funding. Significant new Challenge funds available for innovation: grant funding; innovation funding through allowances, licence incentives and competitions; and Government funds	Currently no specific licence incentives for innovation or regulatory innovation funding mechanisms. Compared to energy, there are also limited grant funds and Government funds available for innovation in the water sector

Source: Sustainability First

4. What can and can't be delivered in terms of innovation in current structures and licences

In this section of the paper, we summarise recent activity designed to deliver change in the energy and water sectors and assess what can and can't be delivered by innovation within these current arrangements. It is important to note that there are many moving parts in this picture, particularly in the energy sector, and that the situation is fluid. Government, regulators and companies are already questioning different frameworks and processes and starting to think very long-term (i.e. RII03, SR21+ and PR19+ and beyond). These discussions, particularly on the energy side, are potentially 'shape shifting.' In section 5 of the report we examine what more may need to be done to support transformative innovation in the future.

In this section we provide some brief case studies of current innovation activity in UK energy and water companies. **Annex 2** also contains some **examples from the US** that explores transformative regulatory approaches there. In energy, these are perhaps as a result of US regulatory arrangements supporting alternative business models with a particular focus on local energy. The case studies also highlight how 'events' (for example Hurricane Sandy or flooding) can affect the weight that is given to different elements of the public interest and the drive for innovation in those areas. It is important to note, however, that lessons from the US always need to be treated with a degree of caution due to different ownership structures and the fact that in energy, many states do not have retail competition.

4.1 Sector analysis: energy

The role of Government intervention and regulation in driving innovation is different in the competitive and monopoly parts of the energy market, albeit there are some common threads. What stands in the way of the theoretical vision of what markets can deliver and what additional steps do Ofgem and Government need to take to ensure innovation happens in the public interest?

4.1.1 Current Government innovation activity in the energy sector

In the last year, Government has made significant strides to develop its strategic long-term narrative and vision for the energy sector. It has moved from playing 'catch-up' in this area to developing a whole range of policy initiatives. Taken together, these many initiatives could amount to full structural reform of the sector, from production through to the end consumer. They provide a 'better line of sight' about future directions. Got right, and with the detail in the necessary accompanying road maps emerging, these changes could pave the way for deep transformation of the sector, including cross-vector.

The stated aim is for this transformation and innovation to be realised in market led ways. The various initiatives suggest that there may in practice be few constraints

in how far we can begin to imagine or reformulate future activity in the service of particular long-term public interest outcomes. Some of the main initiatives are:

- Industrial Strategy – prioritising battery development, storage, EVs, alternative fuels – plus outcomes around ‘place’;
- Clean Growth Strategy – trajectory on 5th carbon budget to 2032;
- BEIS Call for Evidence on Energy Efficiency¹⁷ - has asked whether electricity and gas distribution networks should be incentivised or required to deliver energy efficiency savings;
- Smart Systems & Flexibility Plan – 29 actions (storage, balancing mechanism - new actors, smart meters & households etc.);
- Dieter Helm – Cost of Energy Review (future directions) – and government Call for Evidence on Helm Review; and
- On-going work: Single buyer CfDs, Capacity Market, Strategic options to decarbonise heat.

These different initiatives are starting to pave the way for a more joined up approach to change between Government and regulators. For example, the hydrogen innovation strategy has identified that HSE and Ofgem need to de-risk innovation in the distribution network upstream of the meter and that BEIS and HSE need to de-risk innovation in buildings and appliances downstream of the meter. Once this is done, an occupied consumer trial is planned.¹⁸ Greg Clark has also recently announced that BEIS will look at ‘institutions and roles’ in the energy sector in terms of innovation and future systems development.¹⁹

Various pots of Government (and regulatory) funding exist to support energy innovation. Table 3 summarises these. These have as their goal facilitation of the low carbon transition – but also wider industrial policy goals of developing the UK as a leader in a particular technology field. As such, they can sometimes appear to be ‘picking winners.’

Government has always funded academic research through the research councils and can be a source of breakthrough R&D innovation. Within the energy sector there are then a range of different sources of funding to support projects at various stages of the innovation road map. The Smart Systems and Flexibility Plan and the Energy Systems Catapult have specific funding pots for their respective areas and the Scottish Government also provides funding for local energy projects (these are summarised in Table 4 in section 5 of the paper).

¹⁷ BEIS (12 October 2017) Call for evidence on energy efficiency

¹⁸ Professor John Loughhead (2017) The role of innovation and collaboration in delivering a resilient energy sector (at Utility Week Conference, 12 October 2017)

¹⁹ Greg Clark lecture to the Institute of Energy Economics, 31st October 2017

Table 3: Government and regulatory investments in clean growth technology 2015-2021

	Forecast clean technology innovation spend £m (across Innovate UK, Research Councils, BEIS, DfT, DfID, Defra and Ofgem)			
	Basic & applied research	Technology Development	Technology demonstration	Total
Innovation in smart systems (incl. storage)	175	43	47	265
Innovation in power sector (incl. renewables)	209	276	154	638
Innovation in homes (incl. heat & energy effic.)	100	31	53	184
Innovation in transport (incl. EVs/batteries)	296	413	132	841
Innovation for business/ind. (incl. CCS)	57	47	58	162
Innovation in natural resources (incl. storage)	69	30	0	99
Cross-sector clean tech innov. (incl. for entrepreneurs)	234	62	91	387
Innovation for gas/electricity networks (Ofgem)				720
TOTAL £m	1,140	902	534	3,296

Source: BEIS Clean Growth Strategy, adapted to include regulated expenditure being made available by Ofgem

Note: All figures are indicative and are subject to competitive bidding processes across sectors and value for money tests

Given the multiplicity of sources of funding there has been a long-standing need to coordinate. A new **Energy Innovation Board** has recently been established to build on the former Low-Carbon Innovation Co-ordination Group. Under the Chair of the Government Scientific Adviser, the Board will include representatives from DfID, DoT, BEIS (and through them, Innovate UK and the Research Councils), DCLG and Defra. Its wide remit should enable a more joined up approach in some areas.²⁰ However, as with its predecessor the Board may have a strong technology focus with limited perspectives on the wider public interest. This can mean that innovation to support wider public interest outcomes, including, support for consumer facing

²⁰ Professor John Loughhead (2017) op cit

innovation, particularly for vulnerable consumers, for example, may not be a priority.

4.1.2 Current regulation innovation activity in retail energy markets

In the retail market, there are a range of reasons why companies may not deliver innovation to meet the full range of long-term public interest outcomes and steps that Ofgem is taking to respond to this.

First, suppliers will only deliver public interest goals if customers individually value those aspects and can judge performance. Where that isn't the case regulation needs to set regulatory standards (in areas that might otherwise not be valued by individuals such as de-carbonisation) and publish performance information (in areas where performance might not otherwise be visible for example on treatment of vulnerable customers or complaint handling). This should then drive suppliers to find new ways of meeting customers' needs. As Ofgem has highlighted recently with its move to **principles based regulation**, requirements need to be expressed in terms of outcomes rather than prescriptive rules to provide space for companies to innovate in how they deliver those outcomes. However, the inclusion of an over-arching vulnerability principle in these new arrangements is an indication that some groups of consumers may still need protections.

However, even with this flexibility, the level of regulatory-driven change in the sector is, according to some players, limiting their ability to pursue commercially or customer driven innovation.

An additional challenge comes from the fact that truly innovative approaches, including **new business models**, are likely to come from new entrants or even from outside the sector. But in energy, the need to make a complex system work end-to-end means that there are complex market rules, currently subject to industry self-governance. For innovators who want to offer different sorts of service such as peer-to-peer trading (which, if local, could come closer to hitting the 'place' element of the Sustainability First dashboard on page 18), they can find that their new business models simply don't fit within the existing regulatory framework or their new approach to "supply" (such as energy as a service). And in some cases, new business models also throw up challenges around the requirements for consumer protection (for example should low income customers be allowed to opt for lower reliability but cheaper services?).

Ofgem are trying to address this through their Futures work, their **Innovation Link** initiative (which provides a route through Ofgem to help understand the framework) and their **Sandbox** (which can provide dispensation from some rules to enable tests and trials). These mechanisms have helped a wider range of parties participate in the energy market. For example, only 17% of businesses that recently used the Innovation Link were involved in the energy sector already.²¹ However, in many

²¹ https://www.ofgem.gov.uk/news-blog/our-blog/enabling-innovation-energy-sector?utm_medium=email&utm_source=dotMailer&utm_campaign=Daily-Alert_02-10-New-Pin: Innovation workshop – Discussion Paper, FINAL 20.12.17

cases the barriers that new entrants face isn't a particular rule but the whole commercial model which requires revenue streams that aren't there currently (for example for community energy projects providing services to the DNO). This was recognised by Dermot Nolan in a recent speech where he questioned the future of the supplier hub model with regard to the feasibility of peer-to-peer trading or orchestrated mass switches for SVT customers.²²

Finally, there is a challenge around some elements on the right-hand side of the Sustainability First dashboard, around distributional issues in particular. This is arguably more for Government than Ofgem. When Government is designing subsidy schemes to encourage new technologies it needs to think about the balance of costs on current versus future generations and how to ensure that those on low incomes see their fair share of that funding. There can be a tendency for Government to fund more "sexy" innovations – smart appliances not smart storage heating, for example. The design of any subsidy can also have an impact – with support for upfront costs (rather than on-going payments) more likely to encourage take up by those less well off.

4.1.3 Monopoly energy networks and regulation and innovation

Some similar issues arise in relation to the network companies but with the added complication that the price control in and of itself can be a barrier to innovation. Where companies know that any efficiency gains will be recouped by the regulator at the next price control, this can act towards the end of a price-control as a disincentive to innovation with a longer-term payback.

One of the aims of the **RIIO price control regime** is to drive innovation focussed on the transition to a low carbon economy. This was the thinking behind moving to an 8-year control – to encourage longer-term thinking – and to provide specific funds for innovation projects through network innovation competitions and allowances. Specific innovation funds were established partly due to concern that R&D expenditure in the sector had fallen over the years since privatisation to as low as around approximately £0.5m in around 2000. Ofgem's funding is predicated on companies sharing their learning (which probably would not happen otherwise as they look to outperform each other) and hence helps the industry *as a whole* achieve public interest outcomes.

The most significant RIIO funding was originally channelled through the **Low Carbon Network Fund (LCNF)**. Between 2010 and 2015 a total of £250m was provided to DNOs whose projects were considered to meet the LCNF criteria. The LCNF has now become the **Electricity and Gas Network Innovation Competition (ENIC and GNIC)**. Taken together these funds are very significant. As they are ultimately paid for by electricity and gas users, it is crucial that they are able to demonstrate that the outcomes of the funding are brought into business as usual.

²² Dermot Nolan (19th October 2017) Speech to Energy UK Conference
New-Pin: Innovation workshop – Discussion Paper, FINAL 20.12.17

The LCNF, and associated Ofgem Network Innovation Allowances (NIA) in the price controls, have widely been credited with stimulating network modernisation and a change in culture. The case study on page 30 provides an example of the types of project that have been funded and the positive outcomes that are now being delivered. Although there are some limitations in the programme and there is still a way to go, in 2016 an independent review of the LCNF²³ concluded that:

- the LCNF has succeeded in encouraging DNOs to innovate and has served to move the level of innovation within the DNOs from a 'low' base to a 'moderate' level;
- LCNF has encouraged DNOs to include innovation as core business, with encouraging sign of transfer to business as usual – but this work is still progressing;
- current benefits are estimated to be approximately one third of the total funding cost;
- the potential future net-benefit from the LCNF projects is significant and is estimated to range from 4.5 to 6.5 times the cost of funding the scheme;
- projects which focus on the connection of distributed generation (DG) and flexible demand have a high potential value and are the most likely to be readily incorporated into current-day business practice; and
- there is insufficient high-level overview and co-ordination of individual projects to ensure alignment with the overall direction of the industry.

The other feature of RIIO is a focus on **'outputs' with incentives** on companies to deliver. Regulators therefore have a powerful tool for driving company behaviour in support of wider public interest goals – but it is dependent on the regulator articulating the right outputs (or companies proposing them in their business plans). In general companies will respond to those incentives in the way that one would expect. With clear outputs and incentives, the companies should be motivated to innovate to find new and better ways of delivering those outputs. However, **where the changes required are linked to fundamental transformation of the system it is harder to set specific outputs and incentives to drive that.** The innovation funding was therefore also of value in helping industry move towards a goal that could not so readily be captured in terms of outputs and incentives.

As with the retail market there is an assumption that third parties may be better placed to push more radical changes to network operations. As such Ofgem has been looking at how to encourage more third party led innovation in its innovation competitions, while recognising that the RIIO funding has to be targeted at network benefits and hence needs the participation of network operators.

One of the issues that this raises is where the risk and reward lie. In a normal competitive market companies can take risks knowing that if they win out they can expect good rewards. In a regulated sector – both in the price controlled monopolies, and given the political sensitivity around energy prices in retail too - companies are not going to be allowed to exploit any innovation advantage they

²³ Poyry and Ricardo (October 2016) Independent evaluation of the LCNF
New-Pin: Innovation workshop – Discussion Paper, FINAL 20.12.17

might gain and as such will be more reluctant to take a risk. LCNF / the NICs have used consumers funded innovation up front to address this issue but alternatives may be explored as part of RIIO2.

Three of the key approaches specified by Ofgem for delivering Ofgem's over-arching objective for RIIO2 (to 'ensure regulated network companies deliver the value for money services that consumers want and need') are:

- Incentivising companies to drive consumer value by shaping or proactively responding to changes in how networks are used and services are delivered;
- Using the regulatory framework, or competition where appropriate, to drive innovation and efficiency; and
- Greater coordination across traditional network boundaries will be required and companies will need to adapt and play their part in meeting the challenges that the changing energy system presents.²⁴

Discussion is on-going about different elements of the future framework for RIIO2, but with regard to approaches to long-term efficiency and innovation, Ofgem is particularly focused on three areas: approaches to the duration of the price control (possibly including differential periods for different elements of the control); introducing more competition 'for the market;' and, future approaches to development of innovation allowances and incentives.

²⁴ Ofgem, 12th July 2017, RIIO2 Open Letter

Driving to a smart future? The journey of an EV and electricity network innovation project

Different, exciting and through leasing arrangements becoming increasingly accessible, EVs are in many ways acting as a 'catalyst' for change in the electricity sector. My Electric Avenue, a project funded by Ofgem's Low Carbon Networks (LCN) Fund, was a pioneering study of the impact of electric vehicles (EVs) on local electricity distribution networks. Through an innovative customer engagement approach, it studied the impact of clusters of EVs on the network (potential overload in network 'hot-spots') and how Demand Side Response (DSR) could be used to manage this. The journey and evolution of this project is a good example of how innovation across sectors and with a range of third parties can work.

The project was novel not only in terms of being one of the first to look at this area but also because of the lead role that SME EA Technology Limited played in its delivery. Although LCN Fund support was secured and channelled through Scottish and Southern Electricity Networks (SSEN), the licensed network operator hosting the project, EA Technology was the sole trusted third party delivery body under contract. All the delivery sub-contracts (i.e. the project partners), including with an Original Equipment Manufacturer, another DNO and two universities, went through EA Technology. The company thus played a pivotal role in pulling in third parties, co-ordinating multiple activity streams – and sharing the risk.

My Electric Avenue delivered a new commercial framework and suite of contract templates for third party delivery of Ofgem innovation projects. It also established that clusters of EVs across one third of GB Low Voltage networks will need some form of smart intervention to avoid costly and disruptive reinforcement works up to 2050. Finally, it proved that managed EV charging works, and that customers accept it. My Electric Avenue leaves a legacy of two further innovation initiatives – Smart EV with SSEN, and the EV Network Group.

Smart EV is developing a new standard mechanism for managed EV charging, with cross-industry buy-in through consultation with key stakeholders such as the Office for Low Emission Vehicles (OLEV), BEIS, Distribution Network Operators, Energy UK, BEAMA and Citizens Advice to achieve consensus. The project will also deliver a coherent and accessible customer messaging strategy for smart, or managed, EV charging.

The EV Network brings together those and other critical players such as National Grid and the AA, to offer a collaborative platform to facilitate EVs on our electricity networks in the UK. As the proliferation of EVs, with increased charging rates and battery capacities, continues, technical barriers are also being explored. The wealth of learning from My Electric Avenue is now feeding through into Western Power Distribution's (WPD) Electric Nation project. Electric Nation is investigating the benefits which smart charging could provide for local electricity networks, where additional demand from local clusters of EVs could require reinforcement of these networks. Over 40 different makes and models of EVs are taking part in the trial, with between 50 – 700 home smart chargers being installed across WPD's licence area. Electric Nation's initial findings are based on almost 70,000 hours of charging data, and show that 48% of plug-in events begin between 5pm and midnight. On average, these vehicles are plugged in for 12 hours, but are only charging for just over two hours. This suggests that there is likely to be sufficient flexibility to manage charging away from peak electricity demand periods. This will be explored in detail through the smart charging trial taking place during the rest of 2017 and 2018. Further understanding customer acceptance of smart charging will be a key output of the project, together with a Network Assessment Tool to allow DNO planners to evaluate and plan for mass adoption of EVs on our roads.

Source: Dave Roberts, EA Technology - Delivering Innovation in Power Engineering, November 2017

In response, the Electricity Networks Association has produced an Innovation Strategy and has launched an 'Open Networks Project' that brings together electricity networks with academics, NGOs, Government representatives and Ofgem

to take a *whole systems approach* to future DSO / TSO service and operational issues.²⁵

4.2 Sector analysis: water and waste water

The current potential to look for transformative innovation in the water sector is probably less than that in the energy sector. The role for Government and regulators is accordingly therefore slightly different.

4.2.1 The role of Government in terms of innovation in water

The Government's recent **Strategic Policy Statement for Ofwat** gives the regulator a priority to '*promote markets to drive innovation and achieve efficiencies*' in a way that takes account of resilience and the protection of vulnerable consumers.²⁶ Defra says that Ofwat should challenge companies to deliver an innovative and strategic mix of solutions to do this. The forthcoming **25 Year Environment Plan** and **National Policy Statement** for water should also provide more details of Government thinking for the sector.

Government policy towards the water sector in recent decades has been heavily shaped by **EU Directives**. Some of these, such as the Urban Waste Water Treatment Directive, have been quite prescriptive so although they have sent clear signals that something needed to be done, in some ways they may have stifled innovative approaches. As many of these Directives have operated in 'silos' and were conceived before climate change assumed its central role,²⁷ these may not always have facilitated innovation in the sector (or indeed elsewhere). Government plans to introduce a new **agri-environment system** to support the future of farming and the countryside post Brexit, which promises a strong focus on delivering better environmental outcomes, including mitigation of and adaptation to climate change, may well stimulate further innovation in the sector.²⁸ However, it is as yet unclear what this will look like and how it will support innovation in the water sector and its partners in this area.

The BEIS **Clean Growth Strategy** has also identified some 'innovation challenges' that may be relevant to water including: bioengineering; homes (including efficient appliances such as water heating equipment); waste (e.g. anaerobic digestion); and land use (including fertiliser use). The strategy identifies that funding from the National Productivity Investment Fund should also be available for water and flood defence infrastructure. It also identifies almost £100m Government Innovation Investment on 'Innovation in Natural Resources' and £387m 'Cross-sector Clean Tech Innovation'. The plan highlights **land-use** as an area for Clean Growth Innovation Challenges to meet the 5th Carbon Budget and beyond (post-2032). It is likely that

²⁵ <http://www.energynetworks.org/electricity/futures/open-networks-project/open-networks-project-overview/>

²⁶ Defra, 13th September 2017, The Government's Strategic Priorities and Objectives for Ofwat

²⁷ Analysis from Dieter Helm (October 2017) Cost of Energy Review

²⁸ BEIS, October 2017, The Clean Growth Strategy

this will create a new look at R&D funding-gaps for this area. In the Plan, DEFRA actions to enhance the benefits and value of our natural resources include, for example: to set up a stronger and more attractive carbon offset market e.g. through tree planting; commit £200m to support rural communities; boost low-emissions fertiliser uptake; Courtauld Commitment 2025 – to deliver a 20% reduction in impact associated with water-use in the food supply chain'.²⁹

Compared to the energy sector, however, it would appear that there is significantly less Government funding available for water specific innovation. Funding may potentially be available through Innovate UK or possibly through Industrial Strategy Funds focused on robotics and AI (e.g. for pipeline repairs).

4.2.2 Non-Household retail water market and the role of regulation and Government in innovation

The Scottish Non-Household water supply market has been open to competition for almost a decade, providing a challenge to publicly-owned Scottish Water and an indication as to what innovation is possible in this part of the value chain. By contrast, the Non-Household retail market in the English water sector was only opened to competition in April 2017. It is therefore early days in terms of the extent to which that market has started to deliver greater innovation in customer services. Business retail price controls are also in operation until competition becomes effective to provide backstop protection for default existing tariffs and also in Wales where competition has not been introduced.

Government and regulatory action was instrumental in setting up the new English market, with the Open Water Programme being set up to deliver competition led by Defra, Ofwat and Market Operator Services Limited (MOSL), the private company owned by the water companies participating in the market. MOSL now provide monthly market performance reports that should help identify opportunities and encourage innovation in this market. Given the small margins available, once the very low hanging fruit of marginal innovation are seized (e.g. single bills for multiple sites), the extent to which smarter and more disruptive or innovative approaches are forthcoming remains to be seen.

The limited experience from England and Scotland to date shows that the market may be able to deliver public interest outcomes around VFM (in terms of increased efficiency and lower prices – partly driven by consolidation) and quality of services. Resilience may also have been improved through the development of market 'offers', including water efficiency / saving services. New and niche players have also emerged that are able to address public interest requirements around locality and place. The issue of fairness, between the tariffs offered different types of Non-Household customers (particularly those offered to smaller businesses), may be the public interest outcome that the market perhaps unsurprisingly may struggle to deliver.

²⁹ BEIS, October 2017, The Clean Growth Strategy
New-Pin: Innovation workshop – Discussion Paper, FINAL 20.12.17

4.2.3 Current regulatory innovation activity in wholesale water, wastewater and residential retail water

English and Welsh companies are currently incentivised in PR14 through Outcome Delivery Incentives (ODIs) to focus on delivering what their customers want. In theory, this should support the long-term public interest goals, as companies are also required to listen to their customers' views on both short and long-term issues and embed this thinking into their decision-making.

In the proposals for the next price control period, PR19 (2019-24), the expectation has been set that water companies should innovate to address challenges around **affordability and resilience**. Companies have also been actively encouraged to collaborate with others and through partnerships bring in new skills and ideas. Indeed, innovation is one of the three characteristics that Ofwat has said it will look for in PR19 business plans. For its forthcoming price control methodology, Ofwat has made the following early proposals in terms of innovation:³⁰

- To incentivise innovation by promoting markets in areas of wholesale service provision;
- For direct procurement *for customers* allowing new players to bring new ideas and approaches to deliver key discrete large-scale projects (where the water company will tender for its services and the appointee thus becomes the buyer of services for its customers);
- To consider three-year retail price controls to give an earlier opportunity for learning to spread from the business retail market; and
- To set challenging cost allowances to encourage innovation.

The monopoly water and wastewater businesses, however, face many of the same challenges as energy networks in terms of innovation. Efficiency gains can be recouped by the regulator for customers in the next price control period, so there can perhaps be a limited incentive to innovate, especially if there are long pay-backs, unless company performance is at risk of being non-compliant (which could lead to a direct financial hit). A relatively short price control period also means that the company has less time to enjoy the efficiency benefits of their innovation.

The strong focus on comparative competition means that there is a limited incentive to be a first mover and push the efficiency frontier outwards; this will just make the goal of being a top quartile performer in the next price review period more difficult to reach. It can also make companies less willing to share the operational detail of innovative good practice.

On VFM, existing regulatory arrangements have successfully delivered innovation in terms of short-term efficiency, quality of service (many water companies have national award-winning customer service scores across different types of industry) and, in most cases, on quality. As regional businesses, water companies have also

³⁰ Ofwat, 11 July 2017, Delivering water 2020: consulting on our methodology for the 2019 price review

been able to innovate around 'place' outcomes - and many now have good collaborative arrangements with a wide range of local stakeholders. The question of what is 'fair' within the current generation has been recognised to a large extent by the ban on disconnections and the use of social tariffs. However, the resulting levels of bad debt (~44% of the retail bill) and the fact that the costs of this are smeared across all households, may be viewed by many as 'unfair.'

The areas of greater challenge for water companies are around innovation outcomes in terms of long-term resilience and inter-generational fairness. Whilst assets in the water sector are clearly aging, in both these cases, uncertainty around the pace of change needed makes it difficult to assess if additional incentives are required.

Back in 2009, a review of competition and innovation in the water sector carried out by Professor Martin Cave concluded that *'the current system of economic regulation, innovation tends to be incremental, rather than the kind of step-change innovation the industry needs to meet the future challenges of climate change and demographic change. I believe there is also insufficient joined-up thinking and a lack of critical mass for research.* He identified a misalignment between small-scale pilots and large-scale implementation in the sector. In response, he recommended the creation of a national water research and development body and that this should agree a shared research and development vision for the industry. He proposed that the body would be supported by funding, which could be of the order of £20 million a year, to be allocated on a competitive basis.³¹

The above work is now clearly somewhat dated and the sector, and its regulators, has moved on. However, more recent research would seem to indicate that some water companies still rely on *'external parties, either research institutions or supply chain companies, to perform the research work and deliver pre-tested advances. The lack of direct participation in research by water utilities makes it difficult for them to fully integrate innovative practice into the company culture.'* The result would appear to be *'a focus on the regulator'* rather than proactive management of a company's own risks.³²

To bring some greater clarity around the opportunities for innovation in the UK water sector, albeit at the global level, the UK Water Partnership is currently undertaking a review of innovation in the sector. Early work has collected data on over 350 projects from 20 partners spanning the full range of organisations involved in research and innovation in the UK water utilities industry. Although this work has a firm eye on international opportunities, it is clearly also relevant to the UK public interest outcomes. It has found that areas of relative weakness in the current innovation programme are around zero water poverty and zero leakage and that potential opportunities for further knowledge sharing and collaboration could be in: smart infrastructure, aerial and satellite leakage detection, metaldehyde and treatment by-products, and energy recovery. The initiative has noted that a Water

³¹ Martin Cave (2009) Independent review of competition and innovation in water markets

³² Vanessa L. Speight (2015) Wiley Interdisciplinary Reviews: Water, Innovation in the water industry, barriers and opportunities for US and UK utilities

Catapult / Catalyst / Demonstrator supported by Innovate UK could provide a valuable focal point in supporting SMEs across the UK water industry. Whether the relatively new funds highlighted in section 4.2.1 address this gap remains to be seen.

Unlike in energy networks, there are currently no plans for a discrete regulatory innovation funding stimulus package from Ofwat. There is some limited funding available through schemes such as the Environment Agency's Partnership Funding for projects addressing flooding and coastal erosion. This limited funding is designed to enable more local choice in these areas and encourage innovative cost-effective options to come forward in which civil society plays a role. Despite the good examples in the following box, in our research, some people said that *if* more transformative innovation is needed in the sector, a specific competition challenge fund (either administered by the regulator or Government) may be needed.

New ideas and partnerships in the UK water sector

Small scale and incremental innovation has been a feature of the water sector for some time. For example, in 2010 and 2012 **United Utilities** (UU) received recognition from Business in the Community for its Sustainable Catchment Management Programme (SCaMP), the first England and Wales water industry sustainable land management initiative to restore and enhance water catchment and to introduce more sustainable land management practices. SCaMP brought together UU's tenant farmers in an innovative way to change practices to protect water quality (<https://www.bitc.org.uk/our-resources/case-studies/united-utilities-plc-sustainable->)

In the last few years, approaches to innovation in the water sector have become more systematic. For example, this September **UU** launched its Innovation Lab. The company is using this ten-week programme to identify innovative businesses to partner with. The UU Board have sought ideas in 5 areas: protecting water and customers; proactive customer actions; health and safety for workers; predictive asset maintenance; and future of water. Successful candidates are being co-located and mentored by UU leaders and will be able to test and demonstrate their services in live customer environments. (<https://www.unitedutilities.com/corporate/about-us/innovation-lab/>)

Other water companies are also active in this area. For example, **Northumbrian Water** (NW) routinely encourages innovative ideas from its own staff which have led to novel ideas being invented by people at home such as the 'porcupine' to deal with sewer blockages. This summer the company took this approach to a different level by holding an Innovation Festival. Partnering with companies including BT, IBM, Ordnance Survey and Microsoft, the festival directly engaged hundreds of local people and wider stakeholders. At its core were 6 innovation sprints running concurrently to speed up the development of ideas. The festival focused on areas where the company had greater environmental and social challenges including flooding and leakage. (*Heidi Mottram, Leading innovation with a purpose, Utility Week Conference October 2017*)

5. What is an appropriate future role for Government / regulators in terms of innovation in energy & water?

In 2015, the UK Regulators Network (UKRN) identified that the need for regulatory intervention around innovation was likely to be greater when there was an identified market failure - and that the degree of intervention needed would increase from cases of significant market power and monopoly (where interventions were likely to be focused on promoting competition and price controls) to cases where there were also negative externalities. In the latter cases, UKRN found that stimulus packages (in terms of funding or facilitation) might be needed to encourage innovation **that may not have a commercially positive impact on a company short to medium term, even though the innovation may be socially – or indeed environmentally - beneficial.**³³

There is clearly no single ‘right’ Government or regulatory approach to innovation in the energy and water sectors. A mix and match approach is probably needed depending on the part of the value chain under consideration. Our research suggests that the choice of approach on intervention by Government or the regulator in any given area will depend on a number of factors:

- the extent of identified **market failure** (as per the UKRN report) for that **part of the value chain** or the difficulties that market approaches on their own may face in delivering the **long-term public interest outcomes** (as per section 3 of this paper);
- whether there is a **mutually agreed ‘burning platform’** in the sector requiring transformative change that may necessitate a more active approach from Government / regulators. If there is no such rallying call for change, and no evidence base from wider stakeholders of the need to do something different, the appropriate approach may need to be lighter touch;
- whether innovation delivered through market approaches in a particular area is likely to cross any **‘red lines’** or lead to ‘no-go risks’ (e.g. in water, quality, and safety). In such cases, Government or regulatory action may be needed to shape, restrict or curtail innovation;
- the extent of any clear and agreed long-run **economies of scale** that may entail a more interventionist approach now – rather than leaving innovation to incrementally take its course;
- the **public appetite for different or new outcomes**. If this is limited, and yet innovation in a specific area is in the long-term public interest, Government and / or regulatory action may be needed; and
- the **volume, pace and choreography of change** currently going through ‘the system’. If the ‘bandwidth’ of companies and other stakeholders is already stretched, their ability to innovate to deliver a desired public interest outcome may be reduced. This may make the need for a more active and **prioritized** approach from Government and regulators greater.

Using the UKRN model as a starting point, this section of the paper seeks to develop

³³ UKRN (2015) Innovation in regulated infrastructure sectors
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a **tool kit** of different approaches that *both* Government and regulators can take in terms of innovation in the energy and water sectors to deliver the desired long-term public interest outcomes in the future. These tools fall into four broad areas and can be summarized as:

1. Framing the challenge(s), articulating desired outcomes and signaling priorities
2. Enabling frameworks and facilitation
3. Incentives and funding
4. Direct legal / licence interventions

As we have explored in section 4 of the paper, both Government and regulators are clearly using most of the tools in this tool kit already and there is a considerable amount of activity going on across the board to re-think approaches. However, in our research, many people raised the need for these tools to be viewed ‘in the round.’ A positive action to stimulate innovation in one area could be undermined by a misjudged action in another if a holistic view is not taken. Given this point, it is also clearly important to monitor and evaluate the impact of different approaches to innovation both in quantitative and qualitative terms (including cultural impacts). Unless this is done on a regular basis, Government and regulatory initiatives may be aimed at the wrong things, duplicate each other or potentially cancel each other out.³⁴

5.1 Framing the challenge(s), articulating desired outcomes and signaling priorities

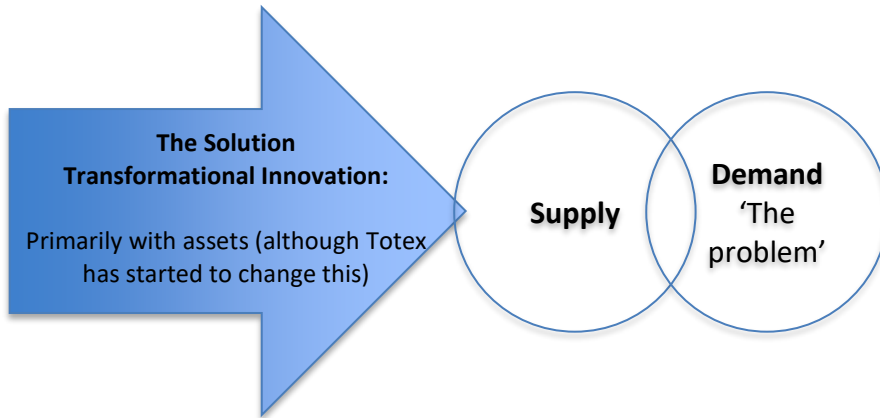
Government has a clear leadership role to play in framing the challenges that innovation can help tackle in energy and water, including with regard to the high-level long-term public interest outcomes that they expect to see in the sectors and signaling priorities for change.

The transformational change that is taking place in energy, but also to a lesser extent in water, is leading to a fundamental redesign of how the sectors work, and so leadership is critical. Existing structures, rules and processes are being challenged on multiple fronts. This is illustrated in Diagram 4 below for the energy sector. A similar diagram could perhaps be drawn for the water sector but with a slightly different group of market participants in the center of the emerging arrangements diagram (e.g. farmers, landowners, developers etc.).

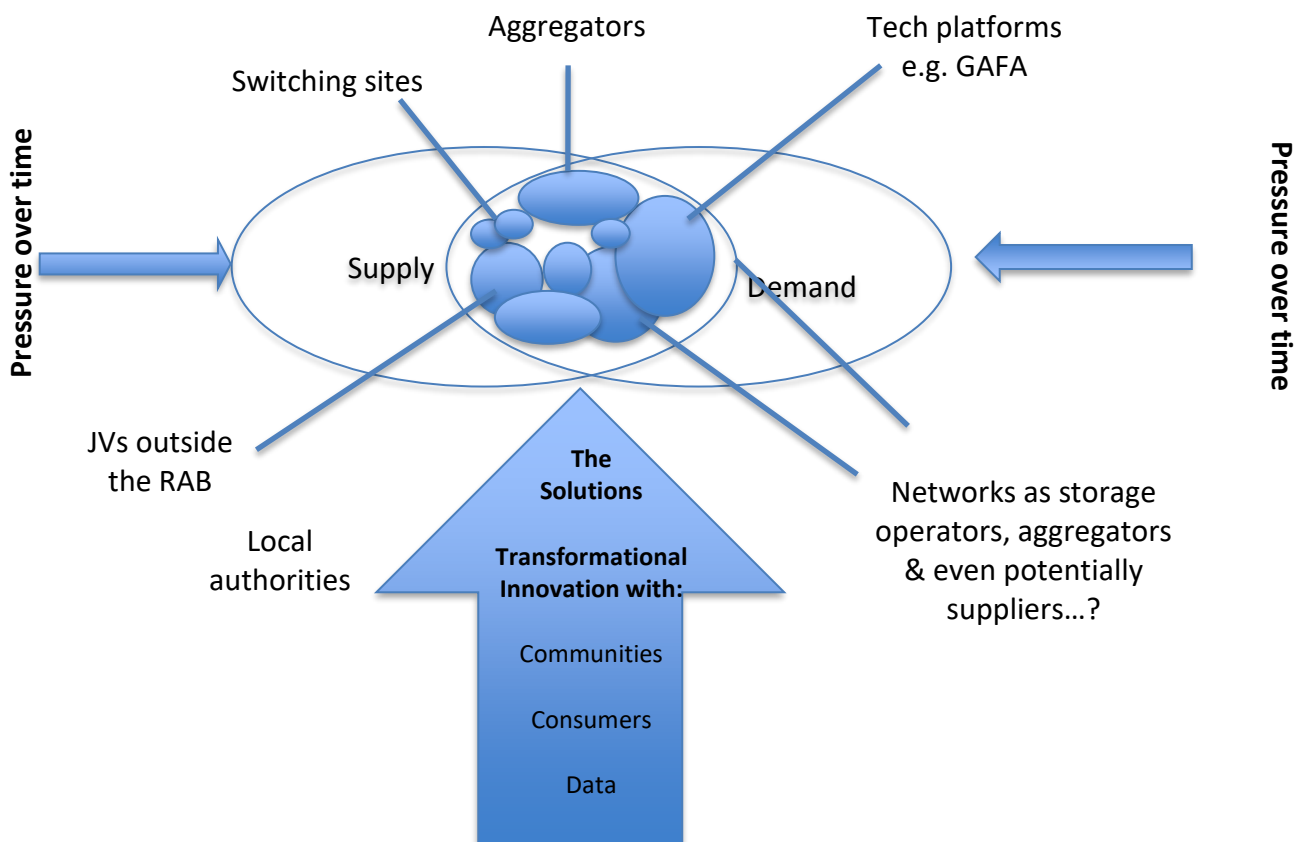
³⁴ Deter Helm’s Cost of Energy Review is very pointed on this
New-Pin: Innovation workshop – Discussion Paper, FINAL 20.12.17

Diagram 4: Schematic view of the transformational change that is taking place, and could potentially develop, in the energy sector – for illustration only to stimulate discussion

'Historical' arrangements



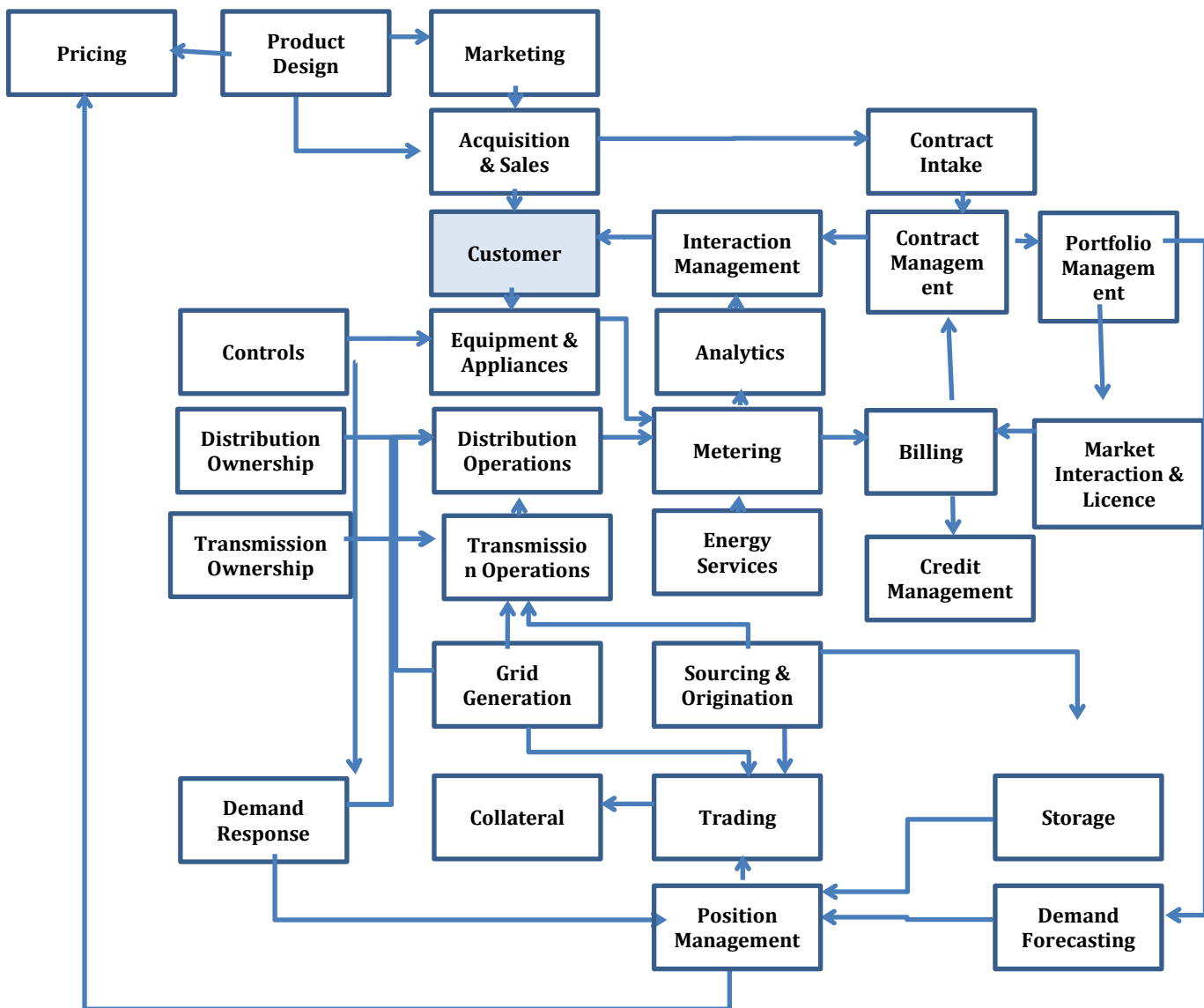
Emerging and potential new arrangements



Source: Sustainability First

The energy value chain has evolved from a clear distinction between generation, transmission, distribution and supply companies to a far more complex set of actors. For illustrative purposes only, Diagram 5 is intended to show at a high-level how these new arrangements present potential opportunities for disruptive change at multiple points (~29) that may or may not be exploited by incumbents or disruptors. At the same time these raise significant challenges for Government and regulators in terms of how – if at all - they respond. Despite this significant level of change, it is important to note, however, that there are always likely to be some significant differences between monopoly networks / wholesale activities and competitive retail activities.

Diagram 5: A ‘simplified’ view of the many new ‘entry points’ to value creation in the energy sector



(Source: Jon Ferris @fractalgrid)

Framing challenges and articulating high level outcomes and priorities in this new world (both in terms of the public interest but also in terms of wider innovation goals such as skills, economic growth etc.) is primarily a **role for Government** rather than individual sector or activity regulators (economic, environmental, quality, health and safety). In section 3 of this paper we have already explored why Government / regulatory action may be needed to deliver innovation around place, fairness and long-term resilience. Leadership from Government may also be needed to deliver these, and other public interest outcomes, because:

- Much of the innovation that is happening and is coming in the sectors is being driven by **data and digitization**. Issues around data protection, ownership and security clearly extend beyond the energy and water sectors. A strategic cross-Government approach to innovation in these areas is therefore key;
- Much of the change impacting energy and water may come from **elsewhere in the economy or across the globe**, for example, from companies such as Amazon or Tesla, that Ofgem and Ofwat don't regulate. Innovation thus challenges existing sector specific regulatory boundaries. Government needs to take an overview to ensure **institutional arrangements** are sufficiently flexible to adapt to these changes; and
- Given the **move from commodity to service provision** that technological change makes possible, there is increasing opportunity for innovation to be **customer rather than industry focused**. Viewing innovation challenges from the consumer / citizen perspective can enable solutions which involve a far wider variety of actors such as developers and housing providers, appliance manufacturers and social care providers. These actors will have relationships with different parts of Government (national, regional, local) than may routinely be involved with energy and water regulation.

The National Infrastructure Commission's work is helping to **define the challenges** that innovation needs to tackle in energy, and to a lesser extent water. By highlighting the key challenges of congestion, capacity and carbon, the Commission has brought additional welcome focus in this area.³⁵ This thinking now needs to be joined up with that of regulators and embedded and disseminated more widely. Some of those that we interviewed for this paper, whilst welcoming these developments, considered that given the dynamic nature of innovation it was important to refresh the evidence base of the case for change on an on-going basis – particularly when this would lead to significant distributional impacts (e.g. stranded assets etc.).

As discussed in section 4, there is currently a great deal of Government activity taking place to reshape the energy sector and to a lesser extent the water sector. The high level narrative and direction of travel are becoming much clearer. However, there are now many moving parts here and this can make for an uncertain period for innovators. On water, wider policy and regulatory uncertainty (e.g. changes to agricultural practices as a result of Brexit impacting on water sector and what to do

³⁵ NIC (2017) Interim National Infrastructure Assessment
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with social / environmental externalities) can lead to questions about the pace of change and add potential 'cliff edges' to this problem. The long awaited **25 Year Environment Plan**, which promises to be a sister document to the Clean Growth Strategy, should be an important step in the right direction.

The desired long-term public interest **outcomes** for the sectors, however, **are beginning to be better articulated by Government and the regulators, but also still need to be prioritised and integrated**; for energy and water consumers, the wider energy and water 'systems' and for GB Plc. Uncertainty around policy priorities and 'whole-system' approaches, including for heat, can have a **knock-on impact on regulation** and risks remaining unduly 'project' focused. Capital can end up just chasing the most clearly and visibly identified opportunities / funding pots.³⁶ Dieter Helms Energy Cost Review has started to address these issues and the future role for Government in that sector.

To maximize effectiveness, the signals sent by Government and regulators in terms of innovation need to meet the test of Sustainability First's '**5Cs.**' **These signals need to be:**

- **Culturally supportive** – It can take time to change a culture that may have previously not explicitly supported experimentation and risk taking and at the same time encouraged compliance in the drive to reduce costs and to meet quality and health and safety requirements. In our research, there was a widespread view that although the Directors in regulatory bodies understood the importance of culture change, at the operational level there was often a reluctance to accept 'different' solutions that could potentially lead to legal challenge or be seen as politically risky. Many of those we interviewed said that innovation could be stifled by often 'throw away' risk-averse comments from more junior staff in official bodies. Government and regulators can help create the right culture for innovation by welcoming the lessons of failure should these follow from genuinely well-planned experiments to try and deliver improved long-term public interest outcomes. In this context, we note with interest the recently opened Sweden Museum of Failure³⁷. A supportive culture will help ensure that innovators have the time and space needed to experiment with new ideas and approaches.
- **Clear** – the Government has recognized the need to flag up agreed challenges (eg through the National Infrastructure Commission) and strategic outcomes and show where these sit on a **high-level road map for change, that sets out priorities for innovation short, medium and long-term**³⁸. With the Industrial Strategy and the Clean Growth Plan, the Government has started to do this. High level signaling of the sense of direction that is needed and the priority

³⁶ There is increasing wider concern that current Corporate Governance and leadership models deter long-term thinking and innovation across the economy. For example, see Bower and Paine (2017) The error at the heart of corporate leadership, Harvard Business Review

³⁷ www.museumoffailure.se

³⁸ For example, Greg Clark's speech to the Institute of Energy Economists in October 2017
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given to different outcomes can reveal to investors the potential opportunities that exist / the size of the prize. A clearer sense of Government priorities will give investor plans a **'firmer footing'**, and may encourage new types of funders to take an interest in the sectors or encourage existing funders to potentially innovate outside of the regulated asset bases of a monopoly company that they already own (which may have a positive trickle-down effect on regulated company approaches). This needs to be outcome focused and is not the same as picking winners. However, it is clearly important that investors recognize that there are 'known unknowns' in the sectors and that total clarity is not possible.

Clear signals can also help develop public consensus on where innovation will add most value in terms of the long-term public interest. This can make new potentially contentious innovations more acceptable.

What's the size of the prize – at home and abroad?

Highlighting the scale of the potential opportunities from innovation can send a powerful signal to investors. For example, McKinsey have estimated that digitisation could lead to utility Earnings Before Interest and Taxes rising by 23 % (*McKinsey (2016) The digital utility: new opportunities & challenges*). Similar high-level estimates of the potential gains likely from innovation to deliver long-term public interest outcomes could help create the right environment to encourage investors and new entrants to work in these areas. Such estimates need to focus on the 'size of the prize' for UK consumers directly but also indirectly in terms of potential export opportunities for UK businesses, such as water services firms. The Catapult Centres are active in this area.

- **Consistent** – the signals sent between Government and different regulatory bodies need to be consistent and as far as possible predictable. Much innovation is a 'journey of discovery,' and it needs to be clear to all parties how Government and regulators will react as 'events' happen along the way and how they will keep other parties informed of this. In its Clean Growth Strategy, BEIS has recently indicated how it intends to take a more **'adaptive stance'** by saying *'This Strategy is not the end of the process. While this is an important milestone ...our approach will develop and adapt to changing circumstances. We will update key elements of the Strategy in line with our annual statutory responses to the Committee on Climate Change's reports on progress, ahead of setting the sixth carbon budget...'*³⁹ By agreeing to be **open and clear about changes**, and the **triggers that may prompt a 'reassessment' of position**, it should help make their work more predictive and give investors confidence – but also enable quick learning from unpredicted trends. It should thus help navigate the tension between the

³⁹ BEIS (2017) Clean Growth Strategy

need for Government to signal a clear and investable direction of travel and at the same time the need for interventions to be agile.

- **Co-ordinated** – as more parties become involved in utility innovation, co-ordination becomes increasingly important. Many of those that we spoke to for this paper wished to see a more **whole systems** and coordinated strategic approach to get transformative innovation in both sectors. This needs to be backed up in the next layer down by greater co-ordination between market actors. For example, with the move to Distribution System Operators, contractual arrangements will be needed between different players to ensure that their roles and responsibilities are clear. Government and regulators need assurance that these are in place to manage the risks and liabilities around this type of multi-stakeholder innovation. The Smart Grid Architecture Model (SGAM) is a possible role model in the energy space.⁴⁰

Better co-ordination is also needed across different trials and experiments. Coordination can also help ensure that innovations that have longer ‘run-up’ times or may take longer to reveal the benefits, are not overlooked in the face of quick, yet possibly only incremental, wins.

- **Collaborative** – signals are needed to help communicate to a wider range of groups about the challenges that need tackling and the scope for working together to help solve them. This can encourage the cross-fertilisation of ideas (including internationally), ‘ideation,’ and reduce the risk that only those who are ‘in the right place at the right time’ can participate in and benefit from innovation. In this context, risk sharing approaches and governance arrangements need more work. Clarity is also needed as to when companies can and can’t collaborate without falling foul of competition rules so that these do not inadvertently foreclose innovative opportunities.

Automotive industry comes together to develop roadmap for change

The UK Automotive Council has brought together car manufacturers with Government and research and funding bodies to together develop a future automotive vision and technology road map on low carbon technology for the automotive sector. In our research, this activity was cited as being a good example of how a sector had developed consensus on the need for change and the pathway to be followed. Amongst other things, the Council recommended the formation of the Office of Low Emission Vehicles (OLEV) and various technology trials.

Source: Automotive Council UK, (2015) Innovation for UK Automotive Success

5.2 Enabling frameworks and facilitation

Regulators rather than government have a key role in creating the right detailed frameworks to encourage innovation **and enable the markets** that may help deliver

⁴⁰ Dr Rolf Apel, SGAM: Methodology and practical application, EPCC workshop 4 June 2013
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this. This is true of both competitive areas and monopoly networks, although in monopolies there is clearly a stronger argument for regulators to do more beyond facilitation.

In developing supportive frameworks in which innovation can flourish, regulators will seek to **reduce or remove the barriers** to innovation that may exist in the system. This is particularly important to encourage new entrants, pro-sumers and others to enter and help shape the market and when innovation requires the co-operation and collaboration between multiple parties. Regulators may facilitate innovation and the feedback loop needs closing with government.

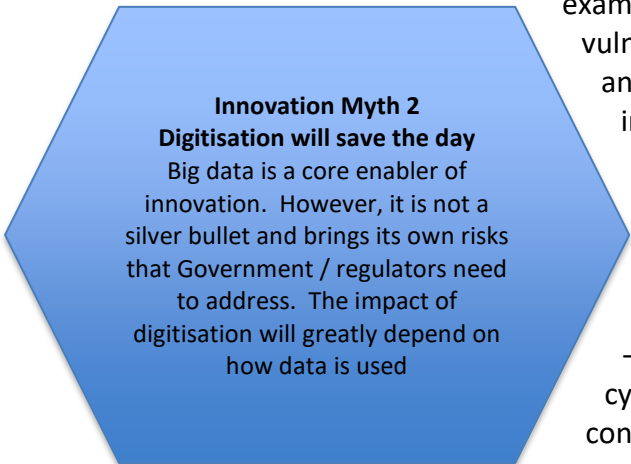
Barriers to transformative innovation that may require facilitation by regulators could include:

- **Rules and regulations that prevent companies from devoting sufficient time and space to innovation.** These could include frameworks that focus on short-term targets where there is no down time to experiment with new ideas. At the workshop, there was a clear push back that it was in a company's own interest to stay ahead of the curve and innovate despite any potential problems in this area.
- **Access to central 'hubs' / core system processes** to which new entrants / disruptors need to 'plug in' in order to operate - These central activities are often governed by statutory **multi-party agreements and rules, codes and standards** that have built up over time with good reason but may have a net result of making access to the system unduly prescriptive, opaque and difficult for all but a few insiders to navigate. In its Energy Market investigation, the CMA identified the codes as a source of market detriment. For example, new entrants in the retail energy space can struggle if they have to 'plug in' to the data sharing codes, architectures and platforms that were designed for 'old' industry structures (e.g. the Balancing and Settlement Code). Code revisions have frequently added further layers of complexity to these systems over time. Complexity may also increase if there are multiple regulators (as is the case in water where there are specific quality and environmental as well as economic regulators).

Some of the existing rules and processes may primarily be 'accepted behaviours' and not necessarily legal or licence or Code requirements.⁴¹ When this is the case, they may therefore be relatively easy for regulators to remove or at the very least streamline to make them simpler and easier for new entrants to understand. This can create a more **'level playing field'** without undue intervention. The move to a more **principles based approach** to regulation in both sectors is the start of this process.

⁴¹ Larua Sandys, Dr Jeff Hardy and Prof Richard Green (2017) Reshaping regulation: Powering from the future

- Customer data** – Data access is widely seen as a core enabler of innovation. Personal data protection is clearly a significant issue. Energy and water regulators can and are taking steps to ensure that this is not an issue that blocks innovation in the sectors when there is a customer benefit, for example, for improving support to customers in vulnerable circumstances.⁴²As data becomes an ever more valuable commodity and increasing ‘common currency’ across the economy, it will be increasingly important for all regulators to come together and develop new approaches and possible standards that can facilitate innovation through data sharing – without personal data protection and cyber-security issues. Regulators need to continue to work together to empower consumers to take more ownership of their data to build confidence if innovation in this area is to be publicly ‘acceptable.’



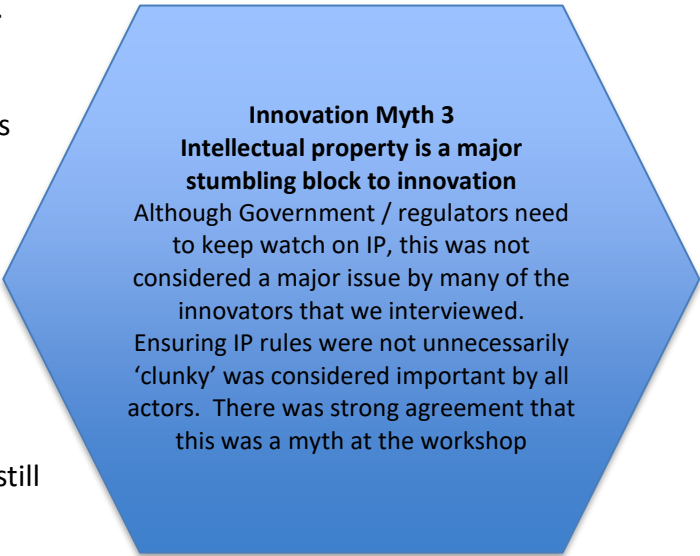
- Consumer protections and safeguards** – *Some* sector specific consumer protection measures may act as a barrier to innovation if they ‘mirror’ old industry arrangements and practices. With bundled services, blurring boundaries on service provision, and dynamic markets, in the future it is likely that *in some areas* increasing reliance will need to be placed on general rather than specific consumer protection provisions. At the same time, in more fragmented and decentralized markets, there may be a case for more bespoke and creative consumer protection mechanisms to be put in place for specific groups and to address specific local circumstances. Energy and water regulators (and indeed regulators in other areas of the economy) are actively looking at these issues on a case-by-case basis. To enable transformative innovation, **a more comprehensive review of consumer safeguards and associated redress arrangements may be needed.** This is likely to be a highly sensitive topic, so open and inclusive public debate will be important – involving companies, regulators, Government, consumer bodies and civil society groups.

This review could help identify, in a non-prescriptive way:

- The minimum levels of consumer protection that may be needed on a **sector-by-sector basis for all consumers** (e.g. not cutting off energy consumers without adequate notice or, in both sectors, helping consumers understand what they are spending);
 - The consumer safeguards that are needed in **both sectors specifically for customers in vulnerable circumstances** and how to ensure that these are as consistent as possible to enable ‘joined-up’ support;

⁴² UKRN (2017) Making better use of data: Identifying customers in vulnerable situations
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- A greater understanding of where **general consumer protection legislation** may be sufficient;
 - How regulators and other partners could work together to ensure consumer **redress arrangements** are as simple and straight forward as possible, whilst also dealing with the increasingly complex ‘chains’ of liability that now exist; and
 - How best to enable **consumer trials** (where the regulator is able to demonstrate patience in the face of potential political pressure before intervening) enabling what works and what doesn't to be identified.
- **Environmental and safety regulations** – In our research for this paper, some of those that we interviewed suggested that regulations in this area could arguably also act as a break on transformational innovation, particularly in the water sector. Some considered that any such discussion could make all parties *‘legal-challenge phobic’* – with a focus on approval and not experimentation to deliver something different or better.
 - **Other sources of data** – Government, regulators and existing industry players have access to many data sets (historic, predictive and thematic) that are not always available or immediately obvious to third parties and new entrants. This can include the sorts of ‘meta-data’ that can help unlock and make sense of other data that market actors may hold, in the process illuminating potential innovation opportunities. Some of this is already publicly available. For example, the ENA’s Smarter Networks Portal⁴³ provides access to some of this information in energy and Defra also shares significant amounts of environmental data (e.g. the ‘Catchment data explorer’).⁴⁴ To facilitate innovation to meet public interest outcomes in water and energy, and subject to privacy and cyber safeguards, more could still be done on Open Data in terms of opening up new raw data sets and proactively sharing these beyond the ‘usual suspects.’



Innovation Myth 3
Intellectual property is a major stumbling block to innovation
Although Government / regulators need to keep watch on IP, this was not considered a major issue by many of the innovators that we interviewed. Ensuring IP rules were not unnecessarily ‘clunky’ was considered important by all actors. There was strong agreement that this was a myth at the workshop

⁴³ <http://www.smarternetworks.org>

⁴⁴ <http://environment.data.gov.uk/index.html>

FCA Financial Lives survey – sharing data-sets

The FCA regularly carries out consumer research. This year, the regulator published its first fully comprehensive ‘Financial Lives’ survey at the same time publishing some of the raw data sets and tables that this is based on and pushing the research out into the wider community. The FCA has also publicly flagged the issues that it alone cannot deal with. By disseminating the data in this way, the regulator has helped to build a strategic narrative of what is taking place in the sector and made it easier for new entrants and others to know what the opportunities and risks / harm in financial services are that all parties will need to act on if innovation is to deliver public interest outcomes.

Source: <https://www.fca.org.uk/publications/research/understanding-financial-lives-uk-adults>

5.3 Incentives and funding

In discussion for this paper, it was put to us that monopoly companies and / or incumbent suppliers may not be capable of undertaking transformative innovation themselves, or at least, on their own. It was thought by some that truly disruptive innovation would only come from existential threats and beyond existing monopoly or incumbent players, and that these companies would only start to innovate to avoid going out of business. However, in contrast, there was also a widespread recognition that: in energy, existing players would need to play a key part in delivering the low carbon transition; and in both sectors, due to the fact they are ‘systems,’ there would continue to be a role for networks, wholesalers and potentially even incumbent retailers into the future, albeit that the shape of these activities and how they operate must change.

If this latter analysis is correct, encouraging monopolies to take some of the potentially downside risk around transformative innovation (a direct commercial hit or the indirect reputational hit of ‘failing’ in an experiment) becomes an important challenge. In the absence of a commercial pull, steps need to be taken if monopolies are to embrace the ‘drivers’ of innovation internally to a point that puts them in a position to do something radically different.

At the New-Pin workshop, we heard that in financial services, significant innovation had only really come on the back of strong regulatory interventions and the CMA’s Retail Banking Review.

Delivering innovation via monopolies is always likely to be difficult. Many investors in monopolies seek slow and steady returns and do not want managements to take undue risks (although to some extent, there is a ‘chicken and egg’ situation here). As discussed previously, there is also often for good reason a culture of ‘risk-aversion’ in the sectors.

Whilst there is an in principle understanding from Government that ‘carrots are better than sticks’ for monopolies, it takes a brave regulator to publicly accept that

this entails letting a licenced company gain financially from a customer-funded innovation.

To innovate, monopolies can either be incentivized under a price control, and allowed to make an appropriate return in the process, or can be funded to do so through discrete funding mechanisms (using either consumer or tax payer funds). Each of these points is explored in turn below. However, it is also worth noting that incentives can also be non financial, for example, in terms of reputational benefits or benefits in kind. At the workshop we heard how in other sectors giving companies access to data had been an effective incentive for change.

5.3.1 Incentive mechanisms

Incentives are relatively tried and tested in the energy and water sectors as a way of achieving marginal improvements in efficiency and incremental innovation. To maximize their effectiveness, and to enable them to be used to help achieve more disruptive change, regulators will be aware that the following considerations need to be borne in mind:

- **Incentives need to be aligned with outcomes** - To be effective, incentives need to be aligned with the full range of long-term public interest outcomes, including those we have identified relating to 'fairness' long-term resilience and 'place.' Incentives also need be aligned with the outcomes sought by both Government and regulators and between different regulators working in a sector. Historically, this has not always been the case and there has been more focus on incentives around VFM in the belief that greater cost reflectivity and more competitive approaches will deliver outcomes that are more efficient *in innovative ways*. This is starting to change with the increased focus on getting consumer groups and forums to help identify the outcomes sought in the sectors – which may extend beyond VFM. However, these groups may not always be able or allowed to identify the right outcomes that are needed for the wider 'system' or indeed that community.

Getting consumers and other stakeholders to help determine what the desired outcomes should be, may, however, also help reduce the risk of perverse incentives for innovation from economic regulators seeking to avoid monopoly pricing.


- **Incentives need to be high level and not prescriptive** - Incentives that encourage a 'cost monitoring' outcome rather than a wider outcome focused on culture can lead to a situation where networks and wholesalers only want to be '**fast followers**' and are **unwilling to be 'first movers'**. Regulators under political pressure on company outperformance sometimes respond by asking for increasing amounts of detail about business plan delivery. This type of intervention could stifle the creative process and discourage new ideas from coming forward and a delicate balance needs to be struck. If regulators get too involved and prescriptive in seeking to ensure that innovation from elsewhere is rolled out across the sector into BAU, it may dampen the incentive to innovate

within some companies and reduce their focus on best outcomes for their business and customers.

With digitisation and the availability of an exponentially growing amount of **operational, customer and other real time data**, the nature of this regulatory challenge should start to change as regulators should in theory be able to access information in less bureaucratic ways to get real time data and assurance on what is happening in a company. This should open up new opportunities for different and less intrusive regulatory approaches - subject to data security.

- **Incentives may be needed for collaboration** - Incentives may also be needed to reward collaboration and encourage sharing of ideas early on in the process so that a wider range of groups, including new entrants are willing to collaborate together on innovative experiments. In the research for this paper, we were told by some SMEs that this collaboration is now starting to happen and that the difficulty isn't so much the SME collaborating with a monopoly but the difficulties that small organisations face when wanting to work with large organisations per se. Incentives to collaborate may also be needed to get potential monopoly 'comparative competitors' to work together.
- **Incentives need to be strong enough** – As discussed previously, if the gains of innovation are all shared at the end of the price control period, and the 'goal posts are just moved further away' as comparative competition pushes out the efficiency frontier, there can be limited incentive to invest time and build the necessary capacity for transformative change. Some also consider that parts of the sectors are 'overpaid' and therefore are able to make good returns already without needing to innovate or do anything differently.⁴⁵ The regulatory settlement can also discourage detailed information sharing of innovative ideas or collaboration between regulated parties. In our bilateral meetings, we were told by various parties in different positions '*you get the level of innovation that you are willing to support.*' Several interviewees told us that although a tight price control may incentivize incremental innovation, it was unlikely to lead to transformative innovation or encourage first movers.

One potential way to address this is to have different levels of incentives for different activities / projects. In telecoms, this has been addressed by Ofcom adopting what is known as a "fair bet" principle (allowing higher returns for projects that in the event are successful while not guaranteeing returns for those that fail). Early thinking for the next water



Innovation Myth 4
Incumbents don't want to innovate
Incumbent companies normally do want to innovate particularly if this helps them manage the risks that they face. However, it can be challenging for them and they may lack the incentives to do so or the support from their investors

⁴⁵ <https://www.citizensadvice.org.uk/about-us/policy/policy-research-topics/energy-policy-research-and-consultation-responses/energy-policy-research/energy-consumers-missing-billions/>
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price review in Scotland is picking up some of this with proposals around investment appraisals.⁴⁶

Sustainability First's Project Inspire has found that to get innovation for vulnerable customers, where the risks are often higher (including the reputational risk of failure), incentives need to be stonger to encourage change.

- **Incentives need to enable longer-term experiments** - Regulators may be reluctant to support transformational change in a business plan if the benefits of this many not be felt within a price control period or may straddle more than one period, making it difficult for them to track progress and ensure excess profits are returned to consumers. This can deny innovators the time and space needed to test their ideas and can prevent more disruptive innovation that can be a journey of discovery and where the end point may be some way out. For RII02, discussion is starting on how best to recognise some need for long-termism across price controls – especially for innovations with long lead-times.

5.3.2 Funding mechanisms

When incentives within a price control are not sufficient or strong enough to get a company to take a risk around innovation, or the innovation coming forward is not sufficiently transformative, more discrete funding mechanisms may be needed. Funding support can clearly potentially benefit **not only monopolies but also retailers and third parties.**

In our discussions for this paper, many people told us that the **impact** of a funding mechanism extends far beyond the direct financial benefits received by those bidding into a fund. It can also act as a clear signal of the priority being given to that area by Government and regulators. Several of those that we interviewed said that the annual Low Carbon Networks and

Innovation Conference that has grown on the back of Ofgem's Low Carbon Network Fund has helped to transform the sector, creating a **sense of excitement and creativity** that was not there before.

This was viewed as being particularly helpful as a way of encouraging additional investment and collaboration from other parties. The **kudos** from winning a funding competition was also said to be helpful both externally in terms of attracting new partners but also internally in terms of changing management culture and becoming less risk averse.

Innovation Myth 5

Funding is the main problem

Within companies, funding is not always the big problem that it is often thought to be. Clear signals of the direction of travel, a supportive innovation climate etc. can often be just as important. At the workshop we heard that it clearly depends on the innovation in question (Eg for CCS funding is an issue)

⁴⁶ WICS (April 2017) Innovation and collaboration

In thinking about innovation funding mechanisms, the following points are worthy of consideration:

- **Outcomes sought** - Funding mechanisms, like incentives, need to be aligned, inter al, around the long-term public interest outcomes sought. If the criteria for the funding are unduly narrow, they will not be able to ensure that the full range of desired long-term public interest outcomes can be met etc.
- **What funds are needed for** - Different types of innovation (technological, consumer facing, institutional etc.) are likely to have different types of funding challenge and require funding at different stages of their innovation road-map (see Section 2). Much will depend on: the novelty of the approach (globally, nationally, in the sector etc.); the size and the scale of the investment needed (for example, in energy, the bulk of future spend is likely to be on generation and this is likely to dwarf that on networks/supply so innovation funding in this area would seem appropriate); the time period over which the experiment will need to take place and will deliver benefits; whether any real or perceived red-lines are crossed by the innovation (e.g. in terms of safety); and the number of parties that need to be resourced, rewarded & coordinated to enable/deliver change.

In the past, much of the discussion about funding mechanisms has focused on technological innovation in the sectors. This has been in part due to the fact that: big kit or advanced and hi-tech kit often has a high price tag; the sectors have been heavily asset focused (this has provided security and driven the regulatory asset value); and until recently, most senior management teams have been dominated by engineers.

As the demand side becomes more active, and flexibility services become more attractive in the face of uncertainty, increasing attention needs to be given to the funding needs of other types of innovation. These may have smaller initial price tags for each element, but they may also involve more partners, require more co-ordination, and be more experimental approach – all of which needs recognition in approaches to innovation funding.

In our research, new entrants in the retail space told us that funding was not needed to get their ideas ‘off the starting blocks’ (this was thought to be relatively easy in a world of cloud enabled services etc.) but to be able to stay the course as systems barriers and bottlenecks were addressed.

We were also told that for **community focused innovation** to succeed, money was needed so that local groups could learn by doing and people were adequately resourced to make good ideas actually happen – beyond the initial trial areas. Unless communities were able to do things themselves, and ‘own’ and embed new innovations locally, they may be less likely to stick and be effective.

Finally, funding may be needed to ensure that innovative learning, including around what works and what doesn’t, is more **widely disseminated**. Given the

unique characteristics of the energy and water sectors (essential services, part of networked complex systems etc.), there is clear benefit in ensuring that ‘other companies don’t make the same mistakes’ and that beneficial innovation is spread as quickly as possible. In our discussions for this paper, it was considered relatively easy to spread this sort of learning if it had been paid for through publicly funded innovation programmes. In such cases, questions around intellectual property tended to be relatively easy to deal with and did not stand in the way of a detailed sharing of learning.

- **Who should the funding be targeted at** – To get monopoly companies to take transformational risks, they clearly need to be able to access funding arrangements. However, this doesn’t mean to say that all funding has to be channelled through them. In the energy Network Innovation Competitions, submissions to the fund have to include at least one monopoly licenced company, although collaboration and partnership working is strongly encouraged and a third party can lead a bid. Although this has undoubtedly encouraged some very innovative approaches, it can be difficult for third parties, and particularly SMEs, to take the lead as they may not be able to carry the risk nor wait whilst system and industry governance problems are resolved.

Government funding programmes tend to be more open to a wider range of actors and to have criteria that are likely to extend beyond just meeting the needs of the energy and water sectors. This may make it easier to fund more joined up activity that may meet multiple objectives that are of interest to more than one sector / agency / department etc. This should encourage a more **holistic approach** to achieving the desired long-term public interest outcomes. Indeed, the BEIS Faraday funds are partly designed with this in mind.

To maximize effectiveness, **a better overview and co-ordination** is still needed on the many different funding mechanisms so that it is clearer to existing players and new parties alike which funds cover which activities, their relative size and who can access them. This should also help ensure that the lessons from innovation are shared as widely as possible. For energy, this is a topic that the Smart Systems Forum could perhaps usefully consider.

It is also important to look at where in the innovation cycle funding is targeted. In energy generation, for example, in the past more funding went on **deployment / learning through doing than early stage R&D** by a ratio of 10:1.⁴⁷ This is an issue as the contribution to cost reduction from deployment is unlikely to be as high as from R&D, particularly for immature technologies.⁴⁸ Examining the funding balance between different activities and ensuring more formal interaction between early R&D and deployment policies would seem beneficial.


















⁴⁷ <https://www.citizensadvice.org.uk/Global/CitizensAdvice/Energy/GeneratingValue.pdf>









⁴⁸ Jamasb, Tooraj and Kohler, Jonathan (2007). *L earning curves for energy technology*. Cambridge. <https://www.repository.cam.ac.uk/bitstream/handle/1810/194736/0752&EPRG0723.pdf;jsessionid=D39A847F2C7B851205D76A754CD1C430?sequence=1>

Table 4 is an attempt to provide a high-level funding map of some of the different sources of funding available for innovation in the energy and water sectors. It is important to note that *this table is not exhaustive*. It is quite difficult to put together a comprehensive list of all of the different sources of funding available. It is also worth noting that the size of the different funding ‘pots’ varies significantly. Some of the bigger funds, like Ofgem’s Network Innovation Competition funds, can dwarf other funds and thus make them potentially commercially irrelevant.

Such maps need to be reviewed and refreshed on a regular basis to ensure that they stay current in the face of dynamic and disruptive change. Consideration also needs to be given to developing **transparent measures for assessing the impact** of such funding streams – both what works and what does not and individually and across the piece.

Table 4: High-level map of some of the different innovation support and funding sources in the energy and water sectors

Funding / support	Applicability	Comments
Tax breaks for R &D	 	
Innovate UK	 	<ul style="list-style-type: none"> • Open programmes provide funds & support to help launch & grow businesses • Helpful fund for SMEs • Focus includes zero emission vehicles
Industrial Strategy Challenge Fund (ISCF)	 	<ul style="list-style-type: none"> • Focused on benefits to UK Plc • Faraday Challenge is specifically aimed at energy and at multi-vector and multi-agency approach • Positively, Ofgem is on ISCF panel
Clean Growth Strategy	 	<ul style="list-style-type: none"> • £2.5bn low carbon innovation funding 2015-21 (including hydrogen in buildings demonstration projects, low carbon heating innovation fund competition and Energy Catapult Smart Systems and Heat Phase 2) • Only a small proportion of this funding is likely to be channeled to the water sector
Catapults – Energy Systems, Offshore Renewable Energy, Digital & Future Cities		<ul style="list-style-type: none"> • Designed to transform UK’s capability for innovation in specific areas • Limited opp’s for water (except Future Cities?)
Network Innovation Competitions (previously LCNF)		<ul style="list-style-type: none"> • Ofgem funds for innovation in electricity (transmission & distribution) and gas networks
Carbon Trust		<ul style="list-style-type: none"> • Grant funding
Energy Technologies Institute		<ul style="list-style-type: none"> • Grant funding
Horizon 2020	 	<ul style="list-style-type: none"> • EU’s biggest research and innovation fund • Designed to drive smart, sustainable and inclusive growth and jobs • Government has continued to support this post 2019 • Significant reporting burden for this type of funds
Natural Environment Research Council		<ul style="list-style-type: none"> • Funds natural capital schemes
Engineering and Physical Sciences Research Council	 	<ul style="list-style-type: none"> • Funds projects in a wide range of areas including low-carbon, AI, cyber security etc.

Economic and Social Research Councils	 	• Funds projects on the economy, society, health and well-being, environment and governance
Partnership funding		• Environment Agency funding for projects under National Flood and Coastal Erosion Risk Management Strategy
Biotechnology and Biological Sciences Research Council		• This Council potentially may fund some innovation in the water sector or even bio-methane???
Nesta	 	• Portfolio of funding e.g. Social Action Innovation Fund (£14m) to help innovations that help people work alongside public services – could be relevant to local energy / water service innovation
Local authorities	 	• Can have cumbersome procurement processes

Source: Sustainability First

- **Who should pay for funding stimulus packages** – If funding is designed to deliver transformational innovation, there is some logic in Government (tax payers) bearing this risk and the cost of early stage R&D as it is better able to pool risks and is also more likely to benefit from changes that may have wider and potentially longer-term consequences, including to the natural environment. It is worth noting, that when the New-Pin network discussed the issue of long-term affordability, we came to a view that customers would inevitably bear most of the transition costs – especially for water.⁴⁹
- **What form should funding mechanisms take in energy and water to encourage transformational innovation** – a range of approaches are possible and the approach taken will determine who bears the risk:
 - **Ex- ante** many of the funds available in funding mechanisms administered by regulators, where consumers bear the risk, have been ex-ante. These have been most often used for innovation in monopoly companies. To protect the customer money that is used to fund such schemes, this can entail regulators setting relatively detailed funding criteria and hurdles that companies have to meet and pass and may prove restrictive in terms of the sorts of experiments that may qualify. It can also lead to a reporting burden during the experiment.

Another possible development in this area is the consideration being given by WICS to introducing an **investment appraisal** process for its next Strategic Review of Charges that would require Scottish Water to explain to the Consumer Forum why it was proposing certain innovations for key projects.⁵⁰

- **Ex-post** funding competitions and prizes normally entail the innovating company bearing the risk. As the funds are only awarded to those projects that win the prize, the reporting requirements are not therefore an issue. Although this is clearly attractive, this type of mechanism could make it more difficult to stimulate innovation in an area that may require significant up-

⁴⁹ http://www.sustainabilityfirst.org.uk/images/publications/new-pin/New-Pin_-_Affordability_Workshop_28_Oct_2015_-_FINAL_PAPER_PDF.pdf

⁵⁰ WICS op cit

front investment and may have a long lead-time. This issue is sometimes dealt with by having a 'pre-qualifying round' after which those companies that pass this initial hurdle can then access at least some development funds. It may also be difficult to get the ex-post approach to work in monopolies where companies may be unwilling, or unable given price review constraints, to bear this level of risk.

At the workshop, there was concern that prizes can lead to a focus on winning the award rather than on meeting public interest outcomes. However, it was also suggested that prizes can encourage a range of solutions to be developed when there isn't a clear direction of travel. Some participants thought that prizes were more suitable to small-scale innovations; others pointed to 'mega' prizes such as from the Bill Gates Foundation. There was also concern that incumbents could quash the ideas coming forward in prize driven innovation.

- **Who administers the funds** – some of those that we interviewed for this paper were concerned that **Government run R&D programmes / funds** in the past have suffered from frequent turn-overs of staff and a reluctance to take outside advice – or even to go 'outside London'. Whilst new funds may be taking a different approach and this may be changing, it is clearly important to ensure that they are focused on the need for practical impact. Some of those we interviewed considered that there were advantages in having **third party administered / run funds**. These were thought to enable deeper interactions with innovators that could help 'flush out' what the issues were. It was thought by some that third parties may be more trusted than Government / regulators as they have 'no axe to grind' and don't have to reconcile potential conflicts between disruptors and the need for stability in 'the system.' It was felt by several of those that we interviewed that innovators may be reluctant to tell regulators things that they 'don't want to hear' for fear of closing down opportunities.

5.4 Direct interventions and legal and licence conditions

Direct interventions can clearly be a blunt tool that it is difficult to wield successfully. Once introduced, they can be difficult to remove and may have unforeseen and long-term unintended consequences. As we have explored in section 5.2, their very rigidity can potentially deter innovation in other areas.

As the UKRN work referred to at the start of this section has highlighted, direct active interventions are most suited to areas where social and environmental **externalities** are not being adequately addressed through other means and where companies and markets struggle to put a cost / price on something. As discussed in section 3 of this paper, this is particularly the case where innovation or the lack of innovation is likely to lead to significant **distributional impacts** – either within or between generations. Interventions may be needed to speed up benefit sharing / extend the benefits of innovation to those that may not be well-off early adopters of change or may not be able to afford to participate in smart markets or to reduce

detriment at a quicker rate (e.g. to meet environmental or quality targets). For example, in his Energy Costs Review, Dieter Helm has proposed tackling the costs of stranded assets by taking legacy contracts out of the market.

As both the energy and water sectors look for more 'flexibility' in the system to give the 'optionality' that is needed for uncertain futures, the very role that network businesses should and shouldn't be able to play in the future is coming under discussion. Allowing changed and different roles for 'old actors' by flagging a willingness to change **statute and licences** can be important to build support for more transformative change across the whole range of market participants who may need to be involved. Clarifying how far integration / bundling of services will be important in the future as market actors (new and old) reposition their roles will be important.

The rigidity in current licences and permits is a recognized issue. In the research for this paper, this came up in three areas:

- **Energy supply licences** – As previously mentioned, Dermot Nolan's recent speech has questioned whether the market arrangements that put suppliers at the heart of the energy system are still fit for purpose in a world where peer to peer trading and settlement is possible.⁵¹ If the supplier hub model is no longer relevant in a smart energy system, it raises several questions. Firstly, should there be any specific licence requirements for those that have supply agreements with end-customers? Secondly, if it is considered that there should be such licence requirements, what would these requirements look like and how would they be different to general consumer protection law? And lastly, if specific licence requirements are maintained, who should be able to gain such a licence (e.g. retailers, third party intermediaries, aggregators, DNOs etc.)?
- **Energy distribution licences** – As the energy sector goes through significant transition, the scope for existing licenced distribution companies to proactively participate in some of the changes is to some extent limited by their licences. For example, they can't undertake certain activities (such as owning storage, acting as aggregators or providing local balancing services) within their regulated activities. However, there is nothing stopping their investors investing in these or other activities outside of the Regulated Asset Base. There is a key question here in terms of whether their monopoly licences should be changed to help them to **enable** future innovation.

⁵¹ Dermot Nolan (2017) Speech to Energy UK Conference, 19 October 2017
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'First banking, then everything'

Last summer, the CMA's retail banking review diagnosed significant competition failings in that market. To remedy this, the CMA is requiring the biggest banks to allow their customers to "open up" their bank accounts securely to trusted third parties, for data sharing and payment initiation. This ruling put more 'definition' on the EU's second Payment Service Directive that comes into effect from the start of 2018. The resulting 'Open Banking', delivered through standardised open APIs, has the potential to unlock significant innovation and disruption in retail financial services. It removes major barriers to entry for non-incumbents, enabling them to engage bank customers directly and develop new value propositions.

The CMA has also mandated a £5m prize to stimulate fintech innovations that use open banking APIs to benefit small businesses. This challenge prize is being run by Nesta, which runs innovation challenge prizes in a wide range of areas.

The big banks are embracing the new requirements and are now also busy innovating themselves. However, the jury is still out in terms of what this will mean long-term. In a recent article for Wired, Rowland Manthorpe noted that many consumers are worried about the resulting cyber security implications. Many will just not know or understand what "open banking" means. The banks recognise that when it comes to money, many people are too scared to change. Whether Open Banking is a big success or just leads to new monopolies emerging (GAFA related?) remains to be seen. But two things are probably clear. The status quo has gone and why should this stop at banking? The Head of Open Banking Limited told Manthorpe 'There is really no reason....why it couldn't be rolled out into energy and water.'

Sources: <http://openup.challenges.org/> and Rowland Manthorpe, *To change money, Open Banking must break banks*, Wired (16th October, 2017)

One possible example of a way round this conundrum could be to give the network monopolies a freer hand in deciding their areas of operation but at the same time to also consider an explicit **Low Carbon Incentive or Obligation**. This could be a target formulated to promote investment in carbon reduction where cost-effective and efficient (such as energy efficiency, heat networks, biomethane, hydrogen conversion etc.) but without being prescriptive. It could enable networks to focus on those activities that they considered could have the biggest low carbon impact in the most efficient way. In theory, it could help every network engage with and manage cross-vector solutions and give them the opportunity to 'make their futures' rather than just wait to potentially 'wither away' as more people go off grid. Such an intervention, which would clearly need significantly more work, could be one possible way of reducing the distributional impacts that may arise from the resulting stranded assets. At

the workshop, there was some concern that consumers might not be prepared to pay for such a scheme as gas is still the cheapest way to heat a home.

- **Water permits** – There is potential scope to increase innovation in catchment management by changing water permit arrangements. Permits are currently place specific. Making them catchment management based could give a water company greater flexibility in how they dealt with discharge issues.

Interventions may also be needed to deal with distributional issues that may result from innovations that may **transcend democratic frameworks** (internationally, UK level, devolved nations, local Government). In our discussions, several people raised whether the UK Government should do more to ensure that the benefits of UK-funded innovation stay in the UK, through interventions designed to capture innovative value within our own communities and nations. The ‘British disease’ of ‘selling off’ our best innovations to the highest global bidder was remarked on by more than one person.

Lastly, the role of the Government in protecting UK water and energy consumers in a world of **global digital platforms** that are clearly **disruptive and innovative** is also worthy of note. The need for increased co-operation between national governments and the water and energy regulators is likely to become increasingly important as the pervasive economic, rule-setting and infrastructural power of the tech-giants – as well as their dominant role in terms of data – is recognized.⁵²

⁵² Danilo Montesi, University of Bologna (2017) Digital platforms: a new dimension for competition
New-Pin: Innovation workshop – Discussion Paper, FINAL 20.12.17

6. Are there any principles that could underpin Government and regulatory approaches to innovation in the UK energy and water sectors?

Given the breadth of potential innovation across the energy and water value chains, a 'one size fits all' approach to innovation by Government and regulators is clearly not appropriate.

We have therefore identified a set of principles that Government / regulators could follow when approaching innovation in all parts of the value chain when considering how best to deliver the desired long-term public interest outcomes. The purpose of these principles is to avoid prescription or making recommendations for arrangements in what, in energy at least, is a fast-evolving value chain. We hope that by taking them into account:

- Government and regulators will be able to maintain optionality and agility in terms of innovation;
- New entrants and disruptors will be supported in their work;
- Monopolies will be able to use them as a reference point; and
- Retailers will be able to use them to help get the pace of change in their businesses 'right'.

Sustainability First's proposed principles are:

1. Innovation activity needs to be focused, inter al, on the desired long-term public interest outcomes.
2. Incentives for innovation need to align with these outcomes.
3. Interventions for innovation activity need to incentivise collaboration across and between systems.
4. The outcomes sought should be framed in terms of tomorrow's problems, not today's and focus on long-term objectives.
5. Access to innovation support, incentives and funding needs to be transparent, simple, clear and co-ordinated.
6. The timing, form and durability of any innovation interventions need to be clear.⁵³ Any interventions should be time limited.
7. To enable evaluation, innovation activity needs to be measurable. It is important to be able to: identify the counterfactual (the world doesn't 'stand still'); and honestly assess the positive and negative quantitative and qualitative impacts of the innovation activity (including around cultural change / lessons from failure).
8. The potential distributional impacts of any innovation interventions need to be recognised and taken into account by Government and regulators.
9. Clear red lines are needed of where interventions for innovation do not serve the wider long-term public interest / are outside the public 'risk-appetite' for change.
10. Government and regulators need to be able to articulate what success and failure look like in terms of innovation in the sectors / systems.

⁵³ Nathan Cortez (2014) Berkley Technology Law Journal
New-Pin: Innovation workshop – Discussion Paper, FINAL 20.12.17

7. Conclusions and recommendations

7.1 Conclusions

In this paper, we have identified that incremental innovation in both the water and energy sectors is already happening. However, in energy and to a lesser extent in water, incremental innovation may not be sufficient to deal with some of the significant challenges faced and to deliver the full range of desired long-term public interest outcomes for the sectors.

We have also seen that transformational innovation in energy and water is unlikely to come from technology alone. It will also require significant consumer facing, commercial and institutional change, if whole-system and cross-vector change is to be enabled. This is leading to an evolution in the ‘framing’ of the challenges and language around innovation in the sectors – and the approaches developed to support this.

Markets are key for delivering innovation as they enable continuous experimentation. However, in the water and energy sectors, markets on their own are unlikely to be able to deliver all of the change that is needed to meet the full range of desirable public interest outcomes - particularly around long-term resilience, place and fairness - outcomes that are difficult to price.

These outcomes are characterised by social and environmental externalities. Change in these areas may lead to distributional impacts for consumers and citizens that raise ethical questions for Government - and indeed wider society. Innovation to meet these outcomes also frequently involves a much wider range of actors than would normally be involved in energy and water issues – including at a devolved and community level. The systems nature of the sectors can also mean that innovation to meet place, fairness and resilience outcomes may necessitate potentially significant institutional change.

Much good activity to stimulate innovation in the water and energy sectors by Government and regulators is already taking place. In this paper we have sought to build on this by proposing a **tool kit for Government and regulators to use so that they can view innovation ‘in the round’**. This should help avoid potential duplication or contradictory signals. The choice of tools will clearly depend on the circumstances but is likely to be influenced by: the extent of market failure; whether there is a ‘burning platform’ for change; whether there are any ‘red-lines’ in terms of innovation in that area; the existence of potential economies of scale; the public appetite for change; and the volume of change in the system and Government / regulatory priorities.

The tool kit covers the following broad areas:

- **Framing the challenges, identifying desired outcomes and signalling priorities.** The Government’s direction of travel, particularly in the energy

sector and for the wider Industrial Strategy and for growth, is becoming clearer. However, to maximise effectiveness, this activity needs to be more integrated. A *high-level* overview of different funds and support mechanisms is also needed – not just those focused on technical innovation. This needs to take into account the impact of different funds.

To create the right environment for transformative innovation to flourish, Government needs to send signals that meet the test of **Sustainability First's '5 Cs.'** These need to flag:

- clear priorities, short, medium and long-term;
 - consistent messages across Government and between Government and regulators - but as part of an adaptive strategy;
 - co-ordinated plans and funding;
 - collaborative approaches; and
 - be culturally supportive (including around failure).
- **Enabling frameworks and facilitation.** Regulators are already addressing many of the barriers to innovation. Constructive debates are being had on approaches to innovation stimuli in PR19, SRC21 and RIIO2. More can perhaps be done to ensure that regulators help facilitate transformational innovation with:
 - **access arrangements** - new entrants needing to 'plug in' to common practices that may be overly complex and restrictive;
 - **consumer data** - unless questions of data protection and data ownership are tackled consumer confidence in innovation can be undermined. Consumers need to better understand what to expect in return for allowing access to their data;
 - **consumer protection** - may need to be more flexible and bespoke. A review is needed of: the minimum levels of consumer protection that may be needed on a sector-by-sector basis for *all* consumers; the consumer safeguards that are needed in both sectors specifically for customers in vulnerable circumstances; where general consumer protection legislation may be sufficient; and how regulators and other partners could work together to ensure consumer redress arrangements are as simple and straight forward as possible, whilst also dealing with the increasingly complex 'chains' of liability that now exist; and
 - **approaches to open data in energy and water** - to identify new opportunities and pull in new players.
 - **Incentives and funding.** Incentives and funds need to be aligned with the desired long-term public interest outcomes and criteria for receiving support need to be framed appropriately (not too narrowly). To deliver the full range of public interest outcomes, additional incentives and funding may be required in certain areas.
 - **Incentives:** These need to be high-level and not prescriptive (real time data should help regulation from becoming too intrusive here). Incentives are also needed for collaboration. However, to be

- effective, it is vital incentives are strong enough and that they enable long-term experiments.
- **Funding:** Funds are needed to support consumer facing, commercial and institutional innovation – not just technological change. Public funding can be helpful in requiring the dissemination of innovative learning more widely. Ex-ante funds, where the money comes from consumers, can be helpful to stimulate innovation in monopolies, where companies may otherwise face limited incentives to take transformative risks. Ex- post funds / challenges and competitions, where the company bears the risk, may be more suitable for smaller scale or competitive activities.
 - **Interventions.** Government and regulators may still need to intervene in certain areas to change licences or vires; many of these things have been created for the ‘old world’ and are not necessarily suitable for a flexible, decentralised future. In energy, there are significant questions around the future purpose and boundaries of both supply and distribution licences. In water, there is scope for change in permits. Lastly, interventions may also be needed to deal with distributional issues. Transformational innovation will lead to winners and losers. For essential services such as energy and water it is important to consider stranding and ‘out of contract’ outcomes to arise from major innovations if public confidence is to be maintained. Some of the distributional impacts from consumer facing, commercial and tech innovation may transcend democratic frameworks and may be felt variously at the global, national, devolved and local Government levels (e.g. digitisation and global data platforms). This is likely to raise the need for complementary institutional change.

7.2 Innovation myths in energy and water

There are many ‘**accepted wisdoms**’ around **innovation** in the energy and water sectors. The research for this paper has sought to shed some light on some of these and, in the process, to ‘**debunk a few myths**’. These were tested at the workshop. A clear majority of participants agreed with all of the myths in the draft paper with the exception of one; the myth that transformational innovation can happen without monopoly networks. Views on this myth were split so it has therefore been dropped from the final paper. A summary of the myths where there was a majority agreement is included below:

Myth 1 - All disruption is positive

- Whilst disruption is clearly an essential part of transformative innovation, and can motivate ‘deep thinking’ ex-post, it can have a negative impact on some long-term public interest outcomes. Particularly in terms of resilience where longer-term relationships may be needed, for fairness where distributional issues are rife, and for place where some communities may value stability.
- The solution - Careful analysis is needed to ensure that the changes that some new entrants may be asking for in one area don’t unduly erode other

long-term public interest goals elsewhere in the wider system. The public's risk appetite for disruptive change also needs to be taken into account – at a strategic level (i.e. not necessarily through direct consumer research – people may say they only want a 'faster horse'). It is also important to consider whether all disruptors should be required to deliver the same range of outcomes as existing players.

Myth 2 - Digitisation will 'save the day'

- Big data is one of the keys to transformative change but it is not a silver bullet. It's effects depend on how data is used, data analytics etc. It is important to recognise that it also creates a whole set of new challenges in terms of the regulation of tech platforms, AI / robotics, algorithms M2M learning etc. These go beyond the energy and water sectors and are multi-faceted and global – and are almost 'too hard' for governments and regulators to resolve on their own.
- The solution – Government and regulators need to facilitate and lead an open, wider discussion - beyond the energy and water sectors - on how regulation needs to evolve in an age of big data and global data platforms. They also need to have regard to those that do not have broadband (access or capability), who may be particularly vulnerable in terms of cyber security and systemic risks.

Myth 3 - Intellectual property is a major stumbling block

- Many of those that we spoke to for this paper did not think that this was an issue that required unduly detailed rules. In UK publicly funded innovation, a basic distinction between background IP that a party brings to a project and foreground IP generated in the project, plus an arrangement to ensure that in global markets a discount is given to UK consumers, was thought sufficient. However, the position on IP can depend on whether the regulated business also owns a non regulated business that can be used to exploit any IP.
- The solution – At the workshop, several participants pointed out that lots of innovation is possible without IP problems and those we interviewed for the paper didn't consider IP was a major stumbling block. However, for some projects it could be problematic and economic analysis indicates it can be an issue, particularly for technological innovation. It is therefore an important angle to watch. Publicly funded innovation can address concerns with IP by requiring learning from projects to be widely disseminated.

Myth 4 – Incumbents are reluctant to innovate

- Our research has shown that in many cases licenced companies do want to innovate – but they may lack sufficient support to do so in a significant / transformative way - from the wider policy / regulatory environment, regulatory incentives or their investors. They may also find it difficult to spread innovative practices outside the pockets of a business into business as usual across the company.
- Solution – tighter price controls will encourage incremental innovation but are unlikely to incentivise first movers in transformative change. Incumbent monopolies need stronger incentives if they are going to undertake

transformational innovation and their investors need clear signals about the future direction of travel to give them a sufficiently firm footing to invest. Getting the right culture and climate for innovation is also key, particularly if incumbents see their asset base as being at risk of being ‘cannibalised.’

Myth 5 - Funding is the main problem

- Significant funding is now available for innovation, particularly in the energy sector. Funding for innovation really only becomes problematic when: there is significant downside risk and it isn’t clear who will carry it; there isn’t an alignment between the outcomes sought and incentives placed on different actors; or, the risk appetite of investors in a particular business becomes out of step with the risks associated with the need to transform that company.
- Solution – More thought is needed about the purpose of funding mechanisms; how to ensure that funding mechanisms are sufficiently co-ordinated; how to use other signals and incentives to get innovation and create a supportive environment for this; and how to get informed risk taking (particularly around down side risk).

7.3 Recommendations

There are a number of steps that regulators and Government can take if they want to do more to drive innovation towards delivering long-run public interest outcomes – especially on ‘place,’ fairness and long-term resilience:

Government

- Government needs to develop an integrated narrative around the long-term public interest outcomes it wants to see in the water and energy sectors as a result of incremental and transformative innovation.
- Government needs to ‘frame’ the challenges and opportunities around consumer facing, commercial and institutional – as well as technological – innovation. Getting the ‘language’ right on this should help shift the focus.
- Government needs to send signals about the innovation it wants to see to all actors – both existing and new. These need to meet the test of Sustainability First’s ‘5 Cs’ and flag:
 - clear priorities – short, medium and long-term to give investors a ‘firmer footing’ for their plans;
 - be consistent over time. To enable this in a fast moving environment, an adaptive approach is helpful;
 - co-ordinated plans and funding between Government and regulators;
 - enable collaboration to pull in ideas and new approaches; and
 - support a culture of innovation where things will not always work and an iterative approach is important.
- Provide a high level overview and co-ordination of different innovation funds – not just where this involves ‘sexy’ tech. This will help identify any funding ‘gaps’ and duplications.

- Government needs to fund early stage R&D for long-term transformative innovation to better serve the long-term public interest outcomes in the water and energy sectors – not just for wider commercial goals.

Regulators

- Regulators should ensure that the frameworks, rules and incentives they set cover the full range of public interest outcomes they want to see – including for place, long-term resilience and fairness – areas where markets struggle to innovate. Companies (in both competitive markets and price controlled monopolies) can then innovate in how best to deliver these outcomes.
- Regulators need to consider how to incentivise transformational innovation *today* that will deliver public interest benefits in the medium term. Focusing incentives on significant specific projects and engaging stakeholders on how to manage down side risk are likely to be important;
- A clear compact is needed between regulators and monopolies where companies are either incentivised to innovate within a price review mechanism (and are allowed to profit from successful innovation) or are funded through specific competitions (such as the NIC) to innovate;
- Regulators should continue to test that the regulatory framework and structures are not themselves hindering the adoption of new innovations and business models. For example, regulators need to prioritise support for incumbent actors who are forward looking, and keen to innovate to adapt their business models to support public interest outcomes – especially on place, fairness and long-term resilience.

Government and regulators

- Sustainability First's tool kit of different approaches can help Government and regulators develop a holistic and joined up approach to innovation in the sectors that maximises efficiency and avoids duplication and potentially contradictory approaches / signals.
- In providing direct funding for innovation, Government and regulators should (1) consciously reflect on the distributional impacts and (2) encourage innovation projects that would address the long-term public interest outcomes of fairness, place and long-term resilience.
- Given that innovation by its very nature is dynamic, developing an agreed set of principles for Government and regulators to use when considering innovation, such as those proposed in section 6 of this paper, would be beneficial and should enable an 'adaptive' approach to change.

Companies

- Companies should consider innovating to meet the full range of the desired long-term public interest outcomes. This is essential to build consumer/ stakeholder trust and confidence, to manage potential political and

regulatory risk and to ensure the long-term sustainability and stewardship of the business.

- Incumbents should collaborate with third parties to pull in a wider range of ideas and skills. This is in their, and their customers, best interests.
- Proactively identify to Government and regulators when they are facing barriers to innovation (individually and cross sector) and share any suggestions and practical proposals for overcoming these.

Annex 1 – Straw-man road maps for consumer facing, commercial and institutional innovation

Table 6: Sustainability First straw-man road map for consumer facing innovation

1	Basic research. Identify problem to be addressed, public interest outcomes sought & principles that the project will adopt
2	Identify any relevant representative groups / stakeholder interests and third parties in this area and seek their views on project proposal. If significant distributional or health / safety / quality impacts likely, talk to Government / regulators
3	Form collaborative partnerships with relevant representative groups / stakeholder interests to ensure good customer communications and support during the project and beyond. Ensure key stakeholders are aware of the potential benefits but also the potential risks. Resource communications and support activities accordingly
4	Together with partners, identify and segment the groups of consumers that will be affected. Iterate project proposal
5	Trial project with limited group(s) of consumers. Iterate and adapt proposal before trialing with a larger representative group to assess user acceptability
6	Commercialise & with partners continue to monitor performance for any unintended consequences

Source: Sustainability First

Important if there are questions of wider societal acceptability

Depending on the sector, trials may need to take place over 'a cold winter' or a 'hot summer' to yield relevant results

Table 7: Sustainability First straw-man road map for commercial innovation

1	Basic research. Identify the problem to be addressed, the public interest outcomes sought & principles that the project will adopt
2	Put out a call for potential partners (e.g. members of the supply chain, third parties and potentially other licenced energy and water businesses) and seek their in-put on project proposal. Together understands both the flows of resource (energy / water / waste) that are being proposed as well as the flows of money. Iterate the proposal
3	As necessary, form appropriate partnerships and test the project proposal within a part of the organization
4	Following the trial adapt the proposal accordingly and test across the organisation
5	Review relations with supply chain and other partners and adjust accordingly
6	Where appropriate, seek to change wider commercial practice, particularly in areas where there may be bottlenecks or other barriers, to ensure innovation is more widely adopted into BAU

Source: Sustainability First

Don't just engage with those close by or already known to you

Table 8: Sustainability First straw-man road map for institutional innovation

1	Basic research – using multiple data sources and stakeholder views, identify the problem to be addressed, the public interest outcomes sought & principles that will be adopted
2	With stakeholders identify and understand the system interdependencies that shape the environment in which the institution operates and how these can aid or deter innovation being carried out by others
3	Identify the institutional priorities and a clear decision-making pathway and core roles and responsibilities and accountabilities for institutional change
4	Where possible, model, scenario test or pilot as a pathfinder on a small scale the institutional change being proposed. Seek to understand how these will impact on other institutions in the ‘system’ that the organization needs to work with
5	Communicate the changes being proposed to gather further feedback and develop an implementation plan
6	Introduce new structures and processes and, with stakeholders, monitor effectiveness against the outcomes sought. Review processes on an ongoing basis

Source: *Sustainability First*

Institutional innovation clearly particularly important for Government & regulators

Annex 2 - Case studies from overseas

Innovation in the US energy sector

Community Choice Aggregators

A controversial development in the US has been the provision in a number of states (where there is not retail competition as such) for the establishment of Community Choice Aggregators (CCAs). These are not for profit organisations set up by local Government typically with the goal of providing low carbon energy, at lower tariffs than the incumbent and with a clear focus on the needs of low to moderate income customers. The incumbent continues to provide the network, metering and billing while the CCA negotiates power contracts. Customers are moved by default onto the CCA tariff although they can still opt out and return to the incumbent utility provider if they wish⁵⁴.

Unsurprisingly the incumbents are concerned about the impact this has on their business and questions around the rates that the CCA should pay – and the model has been criticised for being Government run and not real competition. However, CCAs have been credited (by for example UCLA⁵⁵) with driving the growth of renewables in their areas – and with placing a strong emphasis on local energy with the benefits that brings to the local community. CCAs have a good record on consumer engagement and responding to local priorities. This resonates with the call in GB for the democratisation of energy and the growing interest in this area from some local authorities.

For example, MCE which is a CCA in California currently provides 52% of energy from renewables including a municipal owned solar PV farm developed on a brownfield site unsuitable for other uses and employing primarily local workers, trained through a programme for low income households⁵⁶.

Shared Renewable Energy

Programmes are in place in 17 states to allow consumers to benefit from shared renewable energy resources. Around half of US homes are not suitable for solar PV and low-income households cannot afford the up-front costs. Being able to access the benefits through a community project widens the potential pool of those who can participate and helps address distributional concerns⁵⁷. For example, in an affordable housing block which has solar on the roof, the individual households can access a “virtual net metering” tariff which gives them the same benefit as if they directly owned an equivalent solar facility.

⁵⁴ <http://cal-cca.org/education/>

⁵⁵ <http://innovation.luskin.ucla.edu/sites/default/files/The%20Promises%20and%20Challenges%20of%20Community%20Choice%20Aggregation%20in%20CA.pdf>

⁵⁶ <https://www.mcecleanenergy.org/community/cca-resources/>

⁵⁷ <http://www.ncsl.org/research/energy/state-policies-for-shared-renewable-energy.aspx>

Early action on demand response

The US has had demand side response programmes in the domestic market for a long time. FERC (the national regulator) has been producing annual reports since 2006 showing the progressive levels of uptake. The latest report⁵⁸ shows 9 million customers (domestic and I&C) enrolled in incentive based programmes and 7 million enrolled in time based programmes. In part, this has been prompted by the levels of air conditioning load that drive peak electricity use and are an obvious target for such programmes. FERC has driven the agenda including the early rollout of advanced meters that would support demand response and a controversial decision⁵⁹ that set rates for demand side response equal to those for generation. A lot of work has also been done on methodologies for measurement and verification⁶⁰ that is an enabler that Ofgem has identified as necessary for the GB market to develop.

The fact that the US has this well-established use of domestic demand response means that it is well placed to adopt innovations in this space. Smart thermostats linked with demand response tariffs have been available for a few years now and domestic scale storage is just beginning to hit the market⁶¹.

“Events” and the public interest agenda

In 2012 Hurricane Sandy ravaged New York and left 8.2 million customers in the North East of the US off supply – with 1.2 million off for more than a week⁶². This experience was one of the factors in the establishment of New York REV – Governor Cuomo’s programme to transform the New York State energy system. The goals of the programme are set out as being to reduce carbon, reduce cost and increase resilience.

This focus on resilience – as distinct from simple network reliability – is much more evident in the US than it is here and has driven innovation aimed at supporting this element of the long term public interest. Microgrids are seen as a key part of improving resilience as they enable communities to operate on an islanded basis in the event of failures on the wider grid.

One strand of New York REV in the creation of NY Prize⁶³ that provides funding for communities to develop microgrid systems. Projects have to be in broad “opportunity zones” identified by the DNOs where microgrids may reduce utility constraints and allow them to defer investment. To date funding has been provided to 83 communities (typically with some sort of municipal or public facility as an

⁵⁸ <https://www.ferc.gov/legal/staff-reports/2016/DR-AM-Report2016.pdf>

⁵⁹ Order 745 - which was appealed but eventually upheld in the Supreme Court in 2016

⁶⁰ For example <https://emp.lbl.gov/sites/all/files/napdr-measurement-and-verification.pdf>

⁶¹ <https://www.greentechmedia.com/articles/read/new-pairing-energy-storage-smart-thermostats-zen-ecosystems-swell#gs.4G7eNXc>

⁶² http://www.huffingtonpost.co.uk/entry/hurricane-sandy-power-outages_n_2077407

⁶³ <https://www.nyserda.ny.gov/All-Programs/Programs/NY-Prize>

anchor load) for them to develop feasibility studies. A subset of these will be able to access further funding to do a detailed design and for support on implementation.

Innovation in the US water sector

Floods spur to Philadelphia's 'Green city, clean water' plan

The US City of Philadelphia had been looking at how to reduce the water going into its combined sewer overflows (CSO) for some time. With stretched city budgets, it wanted to avoid the cost of engineered 'grey' solutions such as overflow storage sewers and tunnels and wastewater treatment plant capacity upgrades. At the same time, it wanted to address issues such as stream restoration and local neighbourhood deterioration. Without action, it could have faced a consent decree settlement with regulators, requiring billions to be invested in infrastructure.

According to analysis from Vanessa Speight,⁶⁴ on the back of several large flooding events, Philadelphia was able to use research and outreach to successfully negotiate a Combined Sewer Overflow 25-year management plan entitled 'Green City, Clean Waters.' This included extensive investment in green infrastructure.

The key factors Speight identifies in Philadelphia's plan were the regulatory drivers to secure funding, political backing, and popular support. The city used the opportunity provided by the CSO regulatory requirements, to couple neighbourhood and environmental improvements in an innovative way.

Political support was required to pass development and planning law and to transform the generally invisible water department into a highly visible part of local Government that contributes to planning and recreational amenities. Partnership working has led to the development of green areas. Speight points out that the ability of this plan to deliver results in terms of pollution reduction remains to be proven, stressing that this case also demonstrates the ability of regulators to accept a degree of risk, which is necessary but by no means sufficient for innovation.

⁶⁴ Vanessa L. Speight (2015) Wiley Interdisciplinary Reviews: Water, Innovation in the water industry, barriers and opportunities for US and UK utilities