

Innovation in the Water Industry

Aim

Our project that aims to remove and recycle phosphate from water is envisioned to be used in wastewater treatment plants. To determine the feasibility of our project, we had a number of detailed discussions with the water industry to answer the question: how does innovation work in the water industry? The answer to this question would be important to determine whether water companies would be willing to adopt new technology such as synthetic biology to treat water. By talking to various experts, we were able to understand the background of the water industry in innovation and the requirements our synthetic biology device would need to meet in order to successfully sell it to water companies.

Privatization of the UK Water Industry

In 1960-1970, problems with planning of water resources prompted a restructure of the industry in the UK. The Water Act 1973 by the government established 10 new regional water authorities that is responsible in managing water resources and sewage services. The central government was largely in control of these regional water authorities as they set performance aims for each authority and were one of the two sources of capital for the regional water authority, the other being revenue from the services provided ([Ofwat, 2006](#)).

The presence of economic instability in the UK and tighter fiscal controls by the government between 1970-1980 have led to insufficient government expenditure to meet the water industry's capital maintenance and investment requirements. In addition, increasing public awareness on the environment and tighter legislation by the European Union prompted the government to introduce some changes through the Water Act 1983. The Water Act 1983 introduced changes such as reduced role of government in decision making and gave authorities access to private capital markets. However, these changes failed to address the ongoing issue. With the rise of privatization of other public services and the unwillingness of the government to provide any additional funding, it was concluded that privatization of the water industry was a reasonable outcome. The water industry was finally privatized in 1989 ([Ofwat, 2006](#)).

In theory, privatization of industries have various positive effects in increasing efficiency and performance. The incentive of private companies to generate profit pushes them to cut down cost and be more efficient. Also, there is an incentive for companies to keep pursuing innovation in order to stay ahead of other competitors in the industry and market. In addition, the lack of government control allows private companies to work efficiently without any political interference ([Pettinger, 2011](#)). As the water industry requires high levels of investment, privatization was a way to obtain these investments to improve existing systems for increased efficiency without increasing government borrowing ([Hall and Lobina, 2008](#)). A 2006 performance report by Ofwat stated that a total of around £50 billion have been invested in the 15 years since privatization,

an average of £3.3 billion per year. This has resulted in “significant drinking water quality, environmental improvements and other service enhancement improvements” and “quality of services delivered to customers is at an all time high...” ([Ofwat, 2006](#)).

However, privatization have several disadvantages as well, especially when it involves a natural monopoly like the water industry. A natural monopoly occurs when one firm dominates the whole industry and any attempt to increase new entrants or competitors into the market would only lead to a loss of efficiency. The water industry is one example because it requires an expensive infrastructure to deliver an essential and important service and allowing competition would be a wasteful duplication of resources ([Economics Online, n.d.](#)). Thus, privatization would simply create a private monopoly where consumers can be exploited and charged for higher prices. It is feared that privatization of essential services such as the water industry would shift the priority of companies from being motivated by the public interest to being motivated by profit alone. In fact, privatization of the water industry have already led to higher water bill prices for consumers. According to a report by University of Greenwich, privatization have cost consumers in the UK £2.3 billion per year, equivalent to £100 per household ([Hall and Bayliss, 2017](#)).

“Because they [water companies] are regional monopolies, to prevent them from giving poor service and make an enormous amount of money by charging high prices for something that everybody needs, the sector has to be regulated.”

- Jonathan Abra from Knowledge Transfer Network

Although there exist a government regulator called Ofwat in the water industry that sets the price cap for water companies, Ofwat has often been criticized in “consistently overestimated suppliers’ financing and tax cost when setting price limits” and thus, allowing water companies to charge higher prices to consumers ([TheGuardian, 2016](#)). To alleviate this problem, Ofwat has designed a new regulatory framework with a goal to address several challenges in the water industry by 2020, one of which is lower water bills for consumers ([Ofwat, 2015](#)).

Regulators in the Water Industry

Ever since the privatization of the water industry in 1989, water regulation in the UK is regulated in a non-competitive environment by three main regulators:

1. The [Drinking Water Inspectorate](#) (DWI) is responsible in overseeing drinking water and ensures that water companies are supplying safe drinking water that meets the standards set by law to consumers in England and Wales
2. The [Environment Agency](#) (EA) is responsible in the protection and enhancement of the environment in England and Wales. Their responsibilities include overseeing water in the environment and ensures that water companies treat water to the standards set by law before release into the environment

3. The [Office of Water Services](#) (Ofwat) is the economic regulator for water and sewerage services in England and Wales and is the main regulator that water companies have to address. They are responsible in determining the amount that water companies can charge their customers

Ofwat is the main regulator that water companies have to address. It regulates the water industry through a periodic review process every five years. Water companies would have to produce a business plan that covers the following five years which will be assessed by Ofwat through 3 criterias: value of money, innovation and ambition. Any investments made by the company would have to be shown in the business plan and companies will have to demonstrate that they will be able to recoup back the cost of their investment within five years to justify the price increase laid to consumers. There is also a level of performance that water companies will need to achieve and failure to achieve this level will lead to penalties.

Although these regulators are responsible in ensuring that water companies comply to the established standard regulations, our interactions with different experts in the water industry have confirmed that the government is not responsible in deciding the method to treat water. The decision making process is in the hands of individual companies as long as they can demonstrate that they are able to do it effectively and are not affecting public health. Certain technologies may need approval from each respective government regulators before use to ensure health and safety standards. For example, if the technology involves contact with drinking water, the DWI may have to approve the materials used.

Therefore, there may be a role for biological approaches to be implemented as new solutions in the water industry as long as certain safety regulations are addressed appropriately. From our interaction with various experts in the water industry, we have received the same general response: *there are no barriers to innovation using synthetic biology as long as it is safe to use and work as intended*. This is also evident through [CustoMem](#), a start-up company from a previous iGEM Team (Imperial College 2014) that has successfully employ biological solutions in the water industry to filter water.

While biological methods can often be cheaper to use and environmentally sustainable, it has not been widely used in the UK water industry. Dr. David Tompkins from Aqua Enviro suggested that the reason is because biological approaches are often perceived to be difficult to use and does not guarantee that it will work as intended.

“Biological phosphate removal has not been taken up very widely in the UK; perception being, it is not as efficient as chemical dosing. The discharge consent that people are looking at are difficult to achieve with biological approaches.”

- *Dr. David Tompkins from Aqua Enviro*

In terms of phosphate removal, he says that chemical dosing is often the preferred route as it guarantees to reduce levels of phosphate in final effluents to the concentration required which is

0.1-1 ppm. However, there are costs associated with the dosing agent and subsequent sludge / precipitate treatment. Thus, there is an opportunity for biological methods such as Phosphostore to be employed as a cheaper solution if it can be proven to work reliably as intended.

Innovation in the Water Industry

The UK is unique because it is the first and only country that privatized its entire water industry in the 1980s. Privatization of this natural monopoly has not accelerated innovation in the water industry. It takes roughly around 10-12 years for new technology to come to the market in the water sector. It is often thought that water companies have not been innovative in the past years and that they are only doing what is necessary to avoid getting penalties from Ofwat.

“A lot of people challenge this and said that water companies weren’t keeping up with the times in terms of novel technologies or scientific methodology and that they had some profits off the back of their customers without actually improving the service that they provided”

- Jonathan Abra from Knowledge Transfer Network

In addition, water is a public service and therefore, safety is a main priority that water companies would have to address. Any breach to safety would affect thousands of people within the vicinity where the company operates and may have severe consequences. Thus, water companies are often more stringent in adopting new technologies. They often act as ‘second adopters’ where they would adopt a technology if it has been tested and proved to work as intended in other water treatment plants in order to minimize the risk associated.

Yet, our interactions with innovation managers in the water industry suggest that there have been attempts of innovation to cut down cost. Yorkshire Waters, for example, have R&D activities where equipment may be codeveloped with universities or manufacturers and tested in water company operations before being commercialized. During our site visit to Davyhulme Treatment Works, we saw solar panels being used to generate electricity for the treatment plant and cut down cost. The people in Davyhulme argues that adoption of novel new technology requires a long term commitment to research and funding which is usually greater than the five year assessment period. Therefore, water companies are reluctant to fund projects that requires more than five years of development since they would not be able to demonstrate that they can compensate the cost of their investment within the next five years. Thus, it is not the case that water companies *are not willing* to innovate, but perhaps that the regulations that currently exist are not flexible enough to accommodate any novel innovation.

There is now an incentive set by the government through their new regulatory framework to push water companies to be more innovative; not only in terms of technology but also in different ways of working i.e. different business models. To address the five year investment problem, there is another change called the move to total expenditure (Totex) by Ofwat. With Totex, companies are now allowed to include the cost of operations expenditure (long term running cost) within their calculations in their business model ([Beech, 2015](#)). This means that by

considering the cost of running a technology over 15-20 years, new technology that are more expensive in the short term (cost of setting up new equipment) can have its expenditure justified if water companies can demonstrate that the cost of running it is lower than existing technology. Hence, we will likely see more novel technologies enter the water industry in the next coming years.

Conclusion

In conclusion, our interactions with experts in the water industry have enabled us to understand the force that drives innovation in the water sector. Although the water sector had a slow start in innovation, the new regulatory framework and move to Totex may change this and spur more innovation in the coming years. Therefore, there is room for new technologies such as synthetic biology to be a viable solution in improving efficiency of the sector. If we can prove that Phosphostore is cheaper, reliable and more effective in reducing phosphate than current chemical solutions, then water companies may be very interested in adopting our technology in their current system.

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