Water Climate Discussion

CLEAN TRANSPORT

Report from the discussion held on 5 August 2021

edited by:
Jane O'Connor, Neil Edwards, Laura Fonseca, Paul de Hoest & Laura Currie

organised by:

IChemE Institution of Chemical Engineers · IWA the international water association · Royal Society of Chemistry · Institute of Water · Water UK · British Water · Future Water Association Informing, Innovating, Influencing · Royal Society of Biology · SocEnv Society for the Environment · ice · WaterAid

Welcome

The Water Climate Discussion series creates a space to come together and help the water sector build its leading role in addressing the climate crisis.

This series is the result of close collaboration between water institutions who recognise climate change as an existential threat and wish to have a voice promoting a key message: **water is climate**.

This report is based on the recorded fourth discussion of the series: Clean Transport, which was aired on Thursday, 5 August 2021. The discussion was hosted by Martin Currie and led by Annesley (Anna) Crisp of Anglian Water, Frank Rogalla of Aqualia and the interaction of the participants.

Chapter numbers in the report refer to chapters marked in the recording.

Front cover: Biomethane filling station, biogas upgrading (ABAD Bioenergy®) and biomethane duty van at Lleida WWTP (Spain) – SMART GREEN GAS PROJECT

Biomethane filling station, biogas upgrading (ABAD Bioenergy®) and Electro-Stimulated Anaerobic Reactor (ELSAR®) installed in Guijuelo WWTP (Spain) – INTERCONECTA ADVISOR PROJECT

Annesley Crisp

Shop Window Project and Engagement Manager, Anglian Water

At Anglian Water, Anna is responsible for engaging both internal and external stakeholders in the delivery of projects within the Shop Window. The Shop Window is a real location in Anglian Water's region - a platform where they can accelerate innovation for the business. The aim is to create an incubator of Anglian Water's business for the future, by removing barriers to innovation, implementing innovative solutions and testing new ways of working across the whole water cycle. One of the six Shop Window priorities focuses on 'tackling climate change'. Within this priority, Anglian Water works directly with teams and individuals to develop distinct focus areas, which deliver short and long term results, adding real value for the business. One of these focus areas is looking at EVs and hydrogen infrastructure for decarbonising the water sector fleet. This work is being delivered in collaboration with Northumbrian Water and Yorkshire Water, as part of the annual Innovate East event.

Frank Rogalla

Director of the Department of Innovation and Technology, Aqualia

Frank Rogalla has been working for 30 years on technology transfer, managing large projects for major water companies and engineering consultancies in France, US, UK and Brazil (Veolia, Severn Trent Services, Metcalf & Eddy and Black & Veatch). He is the holder of many patents in advanced water and wastewater technology. As leader of around 35 people involved in R&D programs and projects in synergy with the regional and international activities of Aqualia, Frank is responsible for a budget of circa 25 M€ in external funding, for projects co-financed by the European Union (H2020 and Life programs), the Spanish Government and Regional Funds from various sources.

Q&A

1 **Ideas:** What do you think are the main drivers to support innovative ideas in order to achieve Clean Transport?

2 **Data:** How can we use data to reduce transport emissions?

3 **Zero:** How can we achieve net zero in line with public interest and commercial viability?

4 **Contribute:** How can the Water Industry contribute to achieving Clean Transport?

5 **Excess:** If a WWTP can be self-sufficient, what should it do with excess energy produced?

6 **Credits:** Does it make sense to buy carbon credits when you can produce renewable energy to achieve Clean Transport?

Charging an Anglian Water electric vehicle - Photo by Anglian Water

Anna Crisp: Electric and hydrogen-powered vehicles for water utilities

Anna Crisp began the session, discussing electric and hydrogen-powered vehicles for water utilities.

Transitioning the UK Water Industry's existing transport fleet towards electric or alternative fuel vehicles is one element of reducing operational emissions, contributing to the net zero goal by 2030, as part of its Public Interest Commitment (PIC), (chapter 5).

Anglian Water has commenced its strategy for decarbonising its fleet of some 1800 vans and 700 cars (chapter 9-10).

Mick Farmer, Fleet Manager at Anglian Water, joined Anna and described several of the steps being taken.

Initially, 33 mid-range electric vehicle (EV) vans are being trialled across a wide area and different types of operation. By the end of 2021, another 43 smaller vans will commence trials.

Operational teams are working to test practical ranges linked to weight and driving conditions.

"a one-size-fits-all approach won't work"

Vans from Anglian Water's electric vehicle fleet - Photo by Anglian Water

"ensure the vehicle fits the job or the job fits the vehicle"

The objectives are:

- to "ensure the vehicle fits the job or the job fits the vehicle"
- and that the fleet services team can provide any necessary support to the operational team.

Mick mentioned that the way some things are done may need to change. He said that the culture will certainly need to change – that it's not just about swapping vehicles over. For example, the existing fleet vehicles all have clutches and gearboxes, whereas EVs are automatic, requiring a different driving style.

Analysis of telematics data over a 3-year period will allow the deployment of EVs with minimal, if any, business disruption. Trials are in place to understand the best locations for, and numbers of, charging points in depots to minimise downtime per day.

Currently the most pressing challenges are:

- the vehicles available;
- range anxiety (given current performance uncertainty);
- some staff will not be able to charge EVs at home - there might be scope for hybrids as well as fully decarbonised vehicles;
- practical operations in which a vehicle is left running to power ancillary equipment.

It is evident that 'a one-size-fits-all approach won't work'.

Currently, EVs are not available at some of the weight capability/range combinations

Anglian Water electric vehicle fleet - Photo by Anglian Water

in the existing fleet. In future, they, or hydrogen versions, might be - so addressing that niche will be in the plan later.

Anglian Water is about to install its first home charging unit for vans - this will be a smart device so that the bill for van charging goes to Anglian Water, not the employee.

Although the primary reason for transitioning the vehicle fleet is the net zero target, the financials need to be considered. Payback on the capital cost is estimated to be within 5 years - through tax, maintenance and fuel cost savings.

Northumbrian Water, Yorkshire Water, Anglian Water and Aiimi have developed a collaborative initiative within 'Innovate East', drawing on the alternative transport solution experience of SMEs (small and medium-sized enterprises), (chapters 11-13).

A short video presented by James Robertson, outlined ideas from a hackathon by Northumbrian Water and Aimii.

A first step was to develop a traffic light (Red, Amber, Green) assessment for suitability of replacing an existing vehicle with an EV.

Three factors identified were:

- Time left on the vehicle contract;
- CO_2 emitted per vehicle per day in use;
- Feasibility - how often the journey being done by the vehicle could be achieved by a currently available EV.

Subsequently, this assessment was refined to include the replacement of *high-emission* diesel vehicles (whose role could not currently be met by an EV) by repurposing existing *low-emission* diesel vehicles within the fleet, whose original role could immediately be replaced by an EV.

The collaboration is currently seeking to progress a data-driven fleet management service and decision support tool for the utility sector. This is to include consideration of infrastructure placement, journey type, fuel type, weather, as well as shared infrastructure and job optimisation. The tool will evolve as more data are obtained, allowing revision of the fleet landscape.

"We're all in it together and it's absolutely the right thing to do."

Anglian Water Shop Window - Graphic by Anglian Water

It is evident that not only will the transport decarbonisation contribute towards the net zero goal, it will also improve the lives of staff.

In Anna's words, "We're all in it together and it's absolutely the right thing to do".

Biomethane filling station and biogas upgrading (ABAD Bioenergy®) installed in Lleida WWTP (Spain) – SMART GREEN GAS PROJECT

Frank Rogalla: Using wastewater as an energy source for clean transport

Frank Rogalla's presentation was themed around using wastewater as an energy source for transportation. Frank described the varied base of services offered by Aqualia, operating in 20 countries.

Aqualia began measuring its carbon footprint earlier than most and was one of the first Spanish companies to certify its carbon footprint in Spain.

While clean transport is very important, even essential, for utility companies, it is not the core business of treating and distributing drinking water, and safely removing and treating wastewater, and returning it to the aquatic environment.

For drinking water, the main energy needs are in pumping and distributing the water, while for wastewater the principal energy uses are in pumping and aeration.

Smaller plants would use proportionally more energy than larger plants.

For Aqualia, transport is a small proportion of the company's overall energy usage, at 7%, but using water to be self-sufficient for transportation is a greater challenge than replacing traditional vehicles with electric vehicles (EV). "Most of the energy used is used in the electric equipment we have - to pump, to aerate, and the transport is a very small percentage of the energy consumption, less than 10%."

"On the other hand, we do have renewable production, and that's what we're focussing on. Can we, as a water company, provide enough energy for our own services? We produce a lot of biogas at 25 big digestion plants. We also now try to put solar collectors on many plants to cope with some of the energy needs, and we can even have some hydroelectric production at some falls and in some pressure reduction devices.

	2018	2019	2020
GHG t CO2 eq	521 000	449 000	480 000
GWh /yr	907	877	949
Water M m3 /yr	626,8	674,3	673,7
Kwh/m3	**1,45**	**1,3**	**1,4**
M Giga Joules			
Electric	**3264**	**3157**	**3416**
Diesel	191,5	197,9	242,6
Gasoline	3,65	3,27	4,1
Renewable		824	1002,7
Biogas		809,8	847,4
Hydroelectric		14,3	17,8

Figure 1: Aqualia Yearly Energy and GHG Balances - Graphic by Aqualia

"We need to go a little further in changing the paradigm"

But, as you can see, (Figure 1) nowadays we can almost cover a third of our energy needs with renewables, and that is the effort we're making, trying to reduce the consumption on one hand, and trying to enhance the renewables production, so that, in the end, we will be energy neutral in our services."

Aqualia has been reducing energy consumption over many years through technological innovations and customer engagement (chapter 23). One example is a 25% reduction in water consumption at Santander, which generated opportunities for network optimisation and reduced energy requirements by 30%. In wastewater applications, new control systems used to predict and optimise treatment, delivered an almost 20% reduction in energy usage and improved quality parameters, but this is still not energy neutral.

"We need to go a little further in changing the paradigm."

Frank mentioned that while EVs can make significant reductions in fossil fuel consumption and greenhouse gas (GHG) emissions, even if all of Aqualia's vehicles were replaced with Evs, Aqualia would still not be carbon neutral. So Aqualia has been looking for innovative ways of treating wastewater, so that the company becomes a net generator of energy, rather than a consumer, and develops these into full-scale solutions.

One approach to minimise energy is with the Anammox process, which Aqualia have been successfully developing further with the University of Santiago.

This involves combining anaerobic treatment of wastewater with membrane separation, in an anaerobic membrane bioreactor (AnMBR), and yields biogas and a disinfected effluent (Figure 2). This technology has been trialled by Aqualia and has been operating as a full-scale trial at Alcazar for two years. The process is energy neutral, apart from the energy required for cleaning the membranes, and has a significantly lower carbon footprint compared with conventional aerobic treatment. Excess energy produced by either Anammox or Anaerobic MBR processes can be used for clean transport or passed to the grid, once site energy requirements are met.

A further illustration of a treatment process with net positive energy benefits, is the application of microalgae ponds (Figure 3) for wastewater treatment (chapter 28).

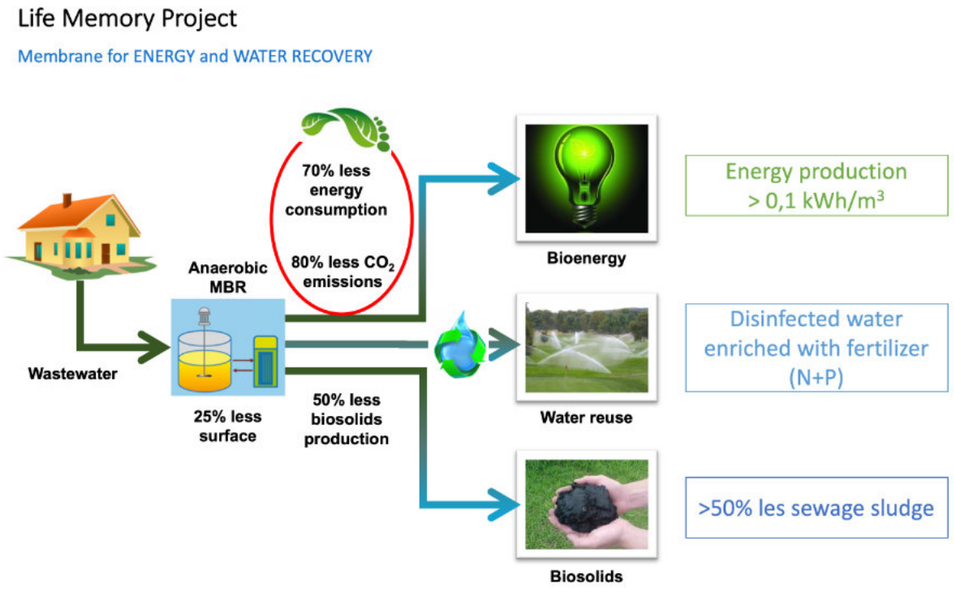

Figure 2: Anaerobic Treatment to Convert Wastewater to Methane - Graphic by Aqualia

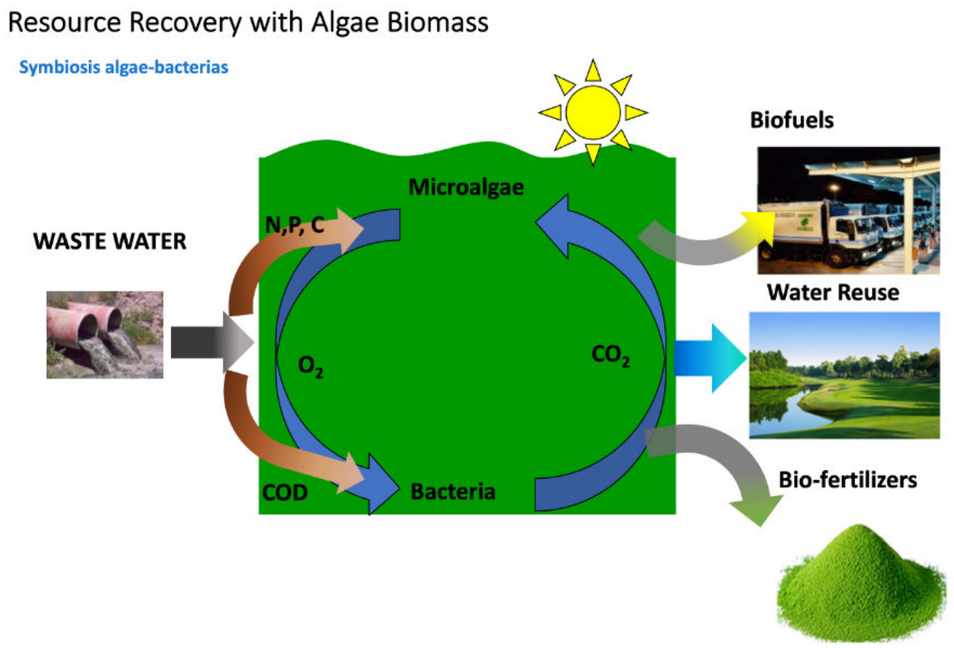

Figure 3: Microalgae Pond Resource Recovery - Graphic by Aqualia

This symbiotic process produces oxygen, absorbs carbon dioxide and generates a biofuel from the digested, harvested biomass. The entire process is completely solar powered and suits the levels of sunlight and heat normally found in southern Europe. This has been developed over ten years, from pilot to full-scale demonstration plants. A plant treating wastewater for a population equivalent (PE) of 5,000, requires a footprint of one hectare and produces biofuel (biomethane) for up to 20 cars. The energy saved, that would have been used for wastewater aeration, can power 20 households (with average power consumption). Microalgae ponds are pleasant features that can benefit local communities and do not have adverse issues such as odour, normally associated with wastewater treatment.

In conclusion, Frank shared his view that carbon credits do not address the issues we are confronted with today. He said that we should rather strive for energy neutrality and self- sufficiency. In this way, if water service providers can be net energy producers, this enables clean transport innovations.

Frank also acknowledged that life cycle analysis (LCA) is the most appropriate tool to fully capture the benefits and impacts (such as process emissions) of the technologies discussed (chapter 32).

Q&A

During the discussion, Anna posed three questions to the participants:

1. **Ideas:** What do you think are the main drivers to support innovative ideas in order to achieve Clean Transport?
2. **Data:** How can we use data to reduce transport emissions?
3. **Zero:** How can we achieve net zero in line with public interest and commercial viability?

Frank also posed three questions to the participants:

4. **Contribute:** How can the Water Industry contribute to achieving Clean Transport?
5. **Excess:** If a WWTP can be self-sufficient, what should it do with excess energy produced?
6. **Credits:** Does it make sense to buy carbon credits when you can produce renewable energy to achieve Clean Transport?

During the discussion, Anna and Frank asked 6 questions of the participants. The participants' online responses were collated and their views are shown in the following sections 1-6.

Photo by Art_Maltsev on Unsplash

1. Ideas

What do you think are the main drivers to support innovative ideas in order to achieve Clean Transport?

The first and most popular main driver mentioned was related to access.

William Soper suggested an interesting idea to change traditional models of sales, and transport ownership, towards providing easy access to transport that is clean "just-in-time," where needed.

Three participants referred to the need for electric charging points and hydrogen refuelling systems.

Participants thought that there is a need to provide a network of charging points across the country to enable staff to recharge when outside their company area, for example.

Others refer to hydrogen as key to decarbonising transport, especially heavy goods vehicles, trains and ships, but highlighted the slow roll-out of hydrogen filling stations in the UK.

As Jonathan Abra suggested, “This is a bit “chicken and egg” - we won't have underpinning infrastructure until you commit to adoption, so really you have to jump in with both feet.”

From another perspective, Martin Currie suggested that reducing transport is by far the most sustainable option and an alternative driver towards innovative Clean Transport. Most of us have tested this idea with COVID-19, which forced us to stay at home and innovate on how we can work remotely.

Finally, education and marketing should be very active in order to show people the link between the water industry and clean transport. Demonstrating and actively marketing what can be done, should encourage more innovative ideas and amplify the conversation around offsetting and essential journeys.

“This is a bit “chicken and egg” - we won't have underpinning infrastructure until you commit to adoption, so really you have to jump in with both feet.”

Photo by Alessio Lin on Unsplash

2. Data

How can we use data to reduce transport emissions?

Participants considered that data is vital for planning all kinds of aspects including pre-emptive maintenance, vehicle replacement, resources and infrastructure. It could also be useful to analyse diaries to maximise vehicle sharing and routes.

Another aspect explored has to do with accounting for carbon emissions, not only from the actual use of each vehicle but also to include the manufacturing process going back to the lithium extraction, the fabrication of batteries and of the electric vehicles.

One interesting idea was to understand axle weight in conjunction with route distance, to tax heavy 'cars' in city streets.

3. Zero

How can we achieve net zero in line with public interest and commercial viability?

As Anna suggested in her presentation, “Climate change is not just an environmental issue, it’s the defining societal and economic challenge of our time.”

Responses to this question were varied. Rob Bradley believed that having an open approach will help to reach net zero by making sure carbon accounting rules are public and transparent and by looking for more involvement from customers.

On the specific subject of vehicles, Martin Currie expressed how electric vehicles are a win-win in terms of having lower whole-life costs than their diesel counterparts, at least in the UK, and are also very compatible with the public interest. More applications like this need to be found, also ensuring commercial viability in countries that can't afford either the government incentives or the capital costs.

Regarding biofuels, the production of hydrogen from wastewater, the role of anaerobic digestion and biogas were mentioned as part of the water sector’s decarbonisation strategy.

Anaerobic preteatment (PUSH) and biogas upgrading (ABAD Bioenergy®) installed in El Bobar WWTP (Almería, Spain) – LIFE ULISES PROJECT

Biomethane car refuelling at El Toyo WWTP (Chiclana de la Frontera, Spain) – FP7 ALLGAS PROJECT

4. Contribute

How can the Water Industry contribute to achieving Clean Transport?

A wide range of ideas was contributed to the subject.

Innovation in the water sector is absolutely key to achieving high efficiencies and reducing needs for and distances in transportation. Furthermore, transport which has the longest use lifespan should be the preferred option.

Moreover, we must work with customers and society to choose solutions for clean transport which include interpreting wider life cycles and societal benefits. Many paths to transport decarbonisation are available, including electricity, hydrogen (from electrolysis, from biomethane, from (future) syngas), bio-fuels and fuel cells.

The decision making process needs to consider the life cycle impacts across carbon and other impact categories.

Assuming battery technology continues to improve, electricity generation will become increasingly important long-term and the water industry could be well positioned to be a supplier of any excess energy produced. Batteries may be less suitable for long-distance road transport, marine transport or aviation. Expanding the availability of wastewater sourced fuels may be important to plug the gap for large vehicles with no current EV alternatives, and even for smaller vehicles where the refuelling infrastructure exists.

Biomethane filling station and biogas upgrading (ABAD Bioenergy®) installed in Jerez WWTP (Spain) – SMART GREEN GAS PROJECT

5. Excess

If a WWTP can be self-sufficient, what should it do with excess energy produced?

The optimum use of excess energy from WWTPs is likely to vary from site to site.

Most participants believed that the energy should be used locally in a synergetic way with local community/industry needs, using it, for instance, as a source of community heat and decentralised or combined energy supply. At remote wastewater treatment plants, energy should be used to replace electric power and avoid transmission losses.

Others suggested that biomethane injection to the grid would be a more efficient use of energy, but that it would need accounting for power requirements of gas compression.

The alternative of on-site biogas upgrading and refuelling stations, as presented by Aqualia, was also mentioned in the comments.

Another view, shared by Rob Bradley, was to use the excess energy to source server farms and contribute to their high electricity demand with renewable energy.

A word cloud of participant's ideas for possible uses for excess energy produced, is shown in Figure 4, below.

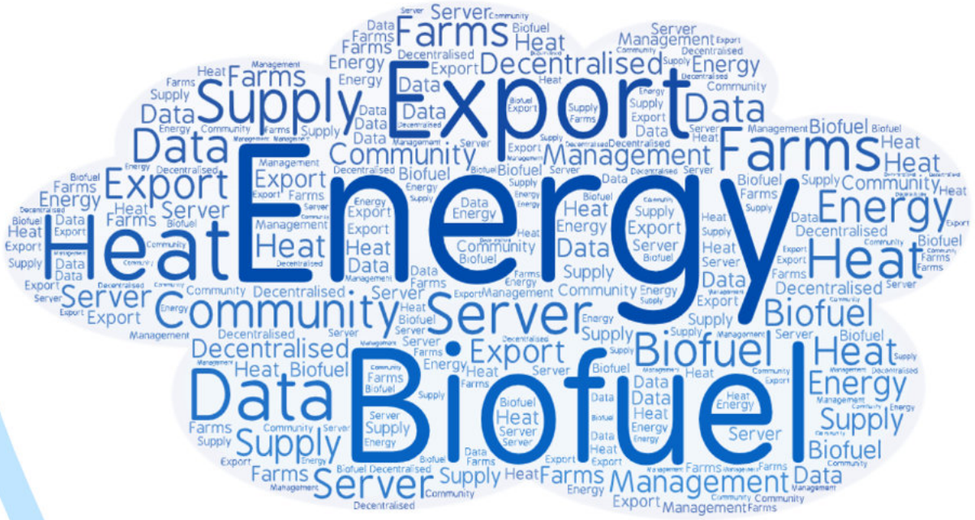

Figure 4: Word cloud from the participants' ideas for uses for excess energy - Graphic by Laura Fonseca

6. Credits

Does it make sense to buy carbon credits when you can produce renewable energy to achieve Clean Transport?

Participants addressing the subject of carbon credits, highlighted two principal themes.

On one hand, carbon credits can benefit sectors which are harder to decarbonise, boost funding to developing countries and potentially kickstart climate mitigation projects that would otherwise be difficult to finance.

On the other hand, given that the water sector deals with daily flows of energy and carbon, we should aim for absolute zero, using these to produce renewable energy and avoid offsetting, or use carbon credits as the last resort.

As Amanda Lake describes it, "In our current, drastically warming, flooding world, we should be doing everything possible to not be buying carbon credits but to be responsible for drawing down atmospheric carbon as rapidly as possible."

In addition, Rob Bradley thinks that part of the answer is ensuring carbon accounting rules are publicly understood, so that when and where energy is generated, customers are clear that using locally generated energy is better than a generic carbon credit.

Alternatives: send us your ideas for alternative fuels or approaches to wcd@andeye.com

> "In our current, drastically warming, flooding world, we should be doing everything possible to not be buying carbon credits but to be responsible for drawing down atmospheric carbon as rapidly as possible."

You can join the discussion
in the next of the

COP26
Water Climate Discussion Series

If you enjoyed this Clean Transport discussion with Anglian Water and Aqualia, then join us for future events in the COP26: Water Climate Discussion Series:

NEXT UP:

Finance

with Alan Sutherland, Chief Executive of the Water Industry Commission for Scotland and Jacob Tomkins, Co-founder and CTO of The Water Retail Company, on Thursday, 2 September 2021 from 9-10am BST

Conference

The **Water Climate Discussion Conference** on 5th, 12th and 19 October 2021, from 9:00am. The Programme and Registration details are here.

FURTHER EVENTS:

Live from COP26	TBC November 2021
Conclusion and Next Steps	1 December 2021, 9am

Please register through any of our collaborators' links:

ICE.andeye.com/WaterClimateDiscussion
RSC.andeye.com/WaterClimateDiscussion
IChemE.andeye.com/WaterClimateDiscussion
RSB.andeye.com/WaterClimateDiscussion
IWA.andeye.com/WaterClimateDiscussion
IWater.andeye.com/WaterClimatDiscussion
SocEnv.andeye.com/WaterClimateDiscussion
BritishWater.andeye.com/WaterClimateDiscussion
WaterUK.andeye.com/WaterClimateDiscussion
WaterAid.andeye.com/WaterClimateDiscussion
FWA.andeye.com/WaterClimateDiscussion

Photo by TheVerticalStory on Unsplash