

THE TRANSITION TO A CIRCULAR AND A LOW CARBON FUTURE IN A LARGE WATER UTILITY

May 2020

Interreg 
EUROPEAN UNION

North-West Europe

WOW!

European Regional Development Fund

WONDERFUL ON TAP



Pete Vale
Severn Trent Carbon Architect.



SEVERN TRENT

- We provide c.8m people across our region with water and wastewater services. Employ over 7,000 people and are supported by an extensive supply chain of around 2,800 direct suppliers.
- £1.5bn on environmental initiatives including our Great Big Nature Boost. This plans to restore peatland, revive 12,000 acres of land, plant 1.3m trees, and restore 2,000km of rivers by 2030.
- Have signed the Carbon Triple Pledge to be operationally net zero by 2030. Our proposed Scope 1,2 and 3 emissions targets accepted by the Science Based Targets initiatives.
- A dedicated resource recovery and innovation centre test bed

Midlands based FTSE 100 company



4.6m
households and
business served

2.0bn
litres of drinking water
supplied each day

3.2bn
litres of waste water
treated each day



OUR INNOVATION FOCUS AREAS

We need to innovate – now more than ever!



Our innovation portfolio is organised around these pillars, which helps us to remain focussed on delivering tangible value for all our stakeholders.

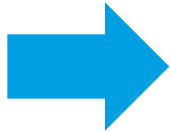
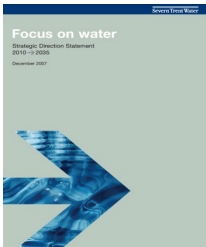
THE NEED FOR TRANSFORMATIVE WASTEWATER INNOVATION

- The way we treat wastewater today is not dissimilar to the way it was done 100 years ago:
 - the technologies in use now - TFs, ASPs etc - have been developed and improved incrementally, but are little different to what you would have seen at WWTPs in the early 20th Century.
- The argument for transforming the way we treat wastewater, however, is increasingly compelling:
 - The energy intensive, linear treatment flowsheets in use now are not compatible with a **low carbon, biodiverse** future essential for combating the climate emergency we face.
- Transitioning to **circularity** and to **carbon neutrality** is key and demands a rethink and a paradigm shift in how we treat wastewater
- How as an Industry do we encourage the necessary innovation and then validate and implement this change?



Carbon Strategy

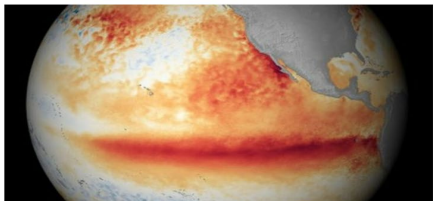
Carbon Reduction isn't a new ambition...



“We believe we can deliver a leading position in sustainable operations... minimising our carbon footprint
2007 Strategic direction statement

“Leading the race to make our emissions net zero carbon”
2022 Strategic direction statement

...but the pace we need to move at is



World likely to warm beyond key 1.5C limit by 2027
 The world is likely to hit 1.5C of warming within the next five years because of rising carbon emissions.
 © 21h | Science & Environment

We recognised this in 2019 with our Triple Carbon Pledge

By 2030 we will reach:



Net zero carbon emissions across the business



100% of our power from renewable sources



100% electric vehicles, availability of vehicles permits

Before bringing the sector together for a joint commitment



“The 2030 target will not simply demonstrate that the water sector is taking its role seriously. It will also serve to provide leadership in the delivery of a net zero UK economy”

Net Zero Route Map – Water UK

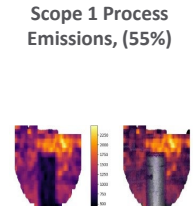
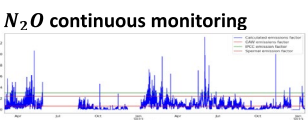
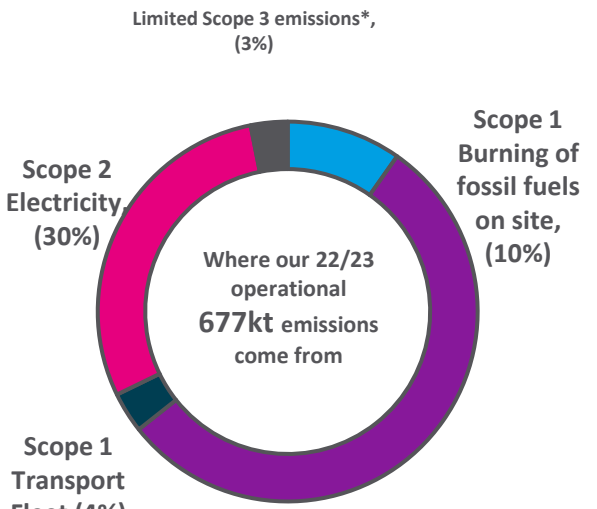
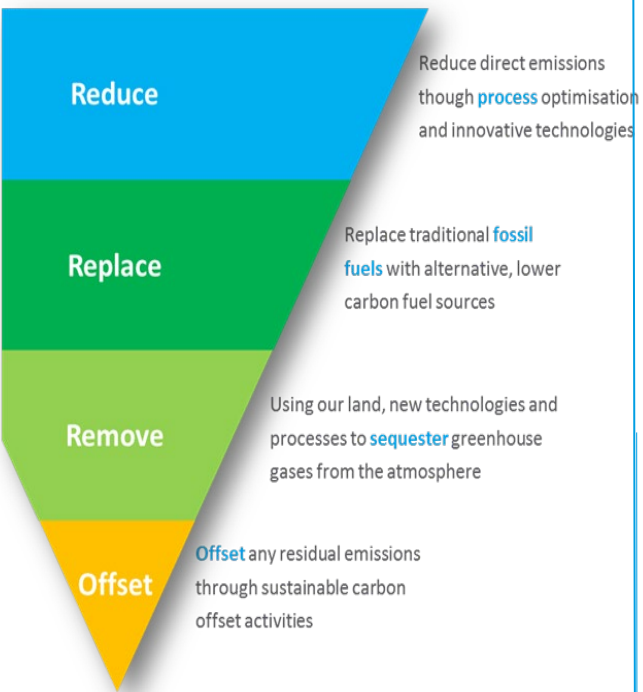
OUR APPROACH

Reduction hierarchy aligned to Ofwat

A clear understanding of our baseline

AMP 7 – *Leaning in* to tough questions

Hierarchy of carbon management priorities



CH₄ leak detection & repair and flux monitoring

- CH₄ & N₂O**
- Tackling the most lethal emissions first
 - Leading science on identifying true baseline emissions
 - Attracting global partnerships
-
-

AMP 8 – *Leaning in* to delivery



2030

- Lead sector on toughest Net Zero challenges
- Invest where others don't have the financial or delivery capacity
- Keep our 2030 commitment while delivering more than our share

DEVELOPING OUR CARBON PORTFOLIO

We have scoured the world to find the best solutions to measure and then remove, reduce, replace and offset operational emissions.



- Knowledge sharing through WWIF
- International carbon technology scouting in Nordics
- Engagement through international funding partnerships
- Collaborative international partnerships
- Sponsored academic research
- Targeted international seminars



RESOURCE RECOVERY AND INNOVATION CENTRE

R2IC



Resource Recovery and Innovation Centre

Our plug and play wastewater development and demonstration facility.

Resource recovery and innovation centre

WONDERFUL ON TAP



- Net zero emissions by 2030 and the transition to a circular approach to sewage treatment requires technology innovation.

- We've made a substantial investment (~£5 million) in our R2IC located on our Spernal WWTP near Redditch

- This test bed allows us to evaluate and validate the range of innovative technologies and processes we need to deliver on this commitment.

- We have the ability to run multiple large scale technology trials (up to ~500m³/d) in a way that wasn't possible previously.

R2IC Recent Trials



Resource Recovery and Innovation Centre

Our plug and play wastewater development and demonstration facility.

Enhanced Primary Treatment (Enviplan Micro-bubble DAF)

Resource recovery and innovation centre

WONDERFUL ON TAP



AnMBR:

- UASB
- UF membrane
- Membrane degas

Other Trials (not in photograph)

- MABR
- N2O
- Photocatalytic covers
- Tertiary P removal
- N2O monitoring
- Sludge to fertiliser (Minworth WWTP)

Cellulose Recovery (Cirtec)

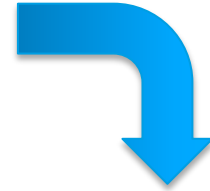
INNOVATION EXAMPLES: MABR & ANMBR

MABR - FROM SMALL BEGINNINGS..

- 2013 – 2014: First water company to work with Oxymem (technology spin-out from University College Dublin – small scale trials culminating large pilot at Minworth WwTW *Where did the bubbles go? How to reduce the energy requirements for municipal wastewater treatment. E. Syron*, P. Vale** and E. Casey*** (IWA LET 2014)*
- 2020-2021: Full scale _Side-by-side trial of both Oxymem (Dupont) and Suez MABRs in existing ASP anoxic zone
- 2022 – N₂O Emissions monitoring of Oxymem, Suez and control lane

Opportunity

- Low embodied carbon upgrade of existing ASPs to meet tighter ammonia limits and/or cater for population growth
- Lower energy (Scope 2 carbon) and lower whole life cost option for plant upgrades
- Lower process emission (scope 1 carbon) solution???



Demonstration Scale AnMBR

WASTE – AnMBR

UASB (Waterleau)



Vacuum / sweep gas
membrane contactor De-
gas (3M Liqui-Cel)

Ultra-filtration
membrane (SFC/Trant)

Europe's largest AnMBR
Up to 500,000 I/d throughput
External collaboration and funding through
H2020 NextGen
Status:

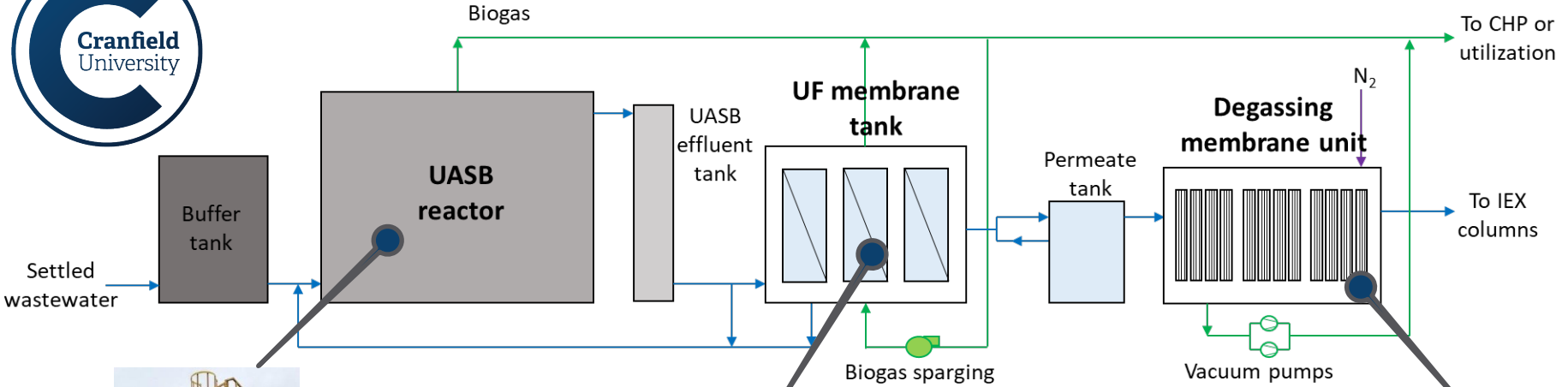
Plant successfully commissioned and
operational from late August 2022

Resource recovery
and innovation centre

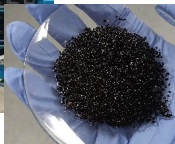
WONDERFUL ON TAP



ANMBR DESIGN



Rectangular 200 m³ reactor with 6.7 m of water height (*Waterleau*)



3 polyethylene hollow fibre ultrafiltration membrane registers with a total membrane area of 1074 m² (*SFC-Trant*)



3 polypropylene hollow fibre membrane modules with 4 contactors each (212 m² per module) – 2 operated in series, 1 in stand-by (*3M*)



ANMBR EFFLUENT CHARACTERISATION

	<i>pH</i>	<i>COD</i>	<i>soluble COD</i>	<i>BOD</i>	<i>TSS</i>	<i>VSS</i>	<i>NH₄⁻ N</i>	<i>Total P</i>	<i>PO₄⁻ P</i>	<i>SO₄</i>	<i>Alkalinity</i>	<i>VFAs</i>
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg CaCO ₃ /L	mg/L
Average	7.8	80.6	62.3	27.4	10.3	6.5	41.5	5.5	5.3	46.4	401.4	80.8
STDEV	0.3	20.9	14.9	15.3	7.0	5.7	6.1	1.5	1.4	43.6	66.3	45.1
n	44	44	43	44	44	44	17	17	17	44	17	44

COD Removal: 67% (80 – 90%) target from pilot scale reactor

Effluent compatible with nutrient recovery processes and general discharge requirements in UK

NET ZERO HUB

WHY DO WE NEED A NET ZERO HUB?

- The UK water industry represents between **2-5% of the UK's overall carbon emissions**
- However, the **'inconvenient truth'** is that the industry's emissions appear to be on the rise.
- Detailed monitoring of Severn Trent's Scope 1 & 2 process emissions has been reported to be 450 kTCO₂e; **300% of the Carbon Assessment Workbook**
- In addition, Severn Trent estimate a further **550kT of Scope 3** emissions.
- We need a **blueprint** for the water sector to follow and provide **clarity on the investment** required to achieve net zero
- In November last year we submitted a bid into the Ofwat Innovation competition 'Water Breakthrough Challenge' looking to secure a grant of **£10 million** to help us with this transformative project



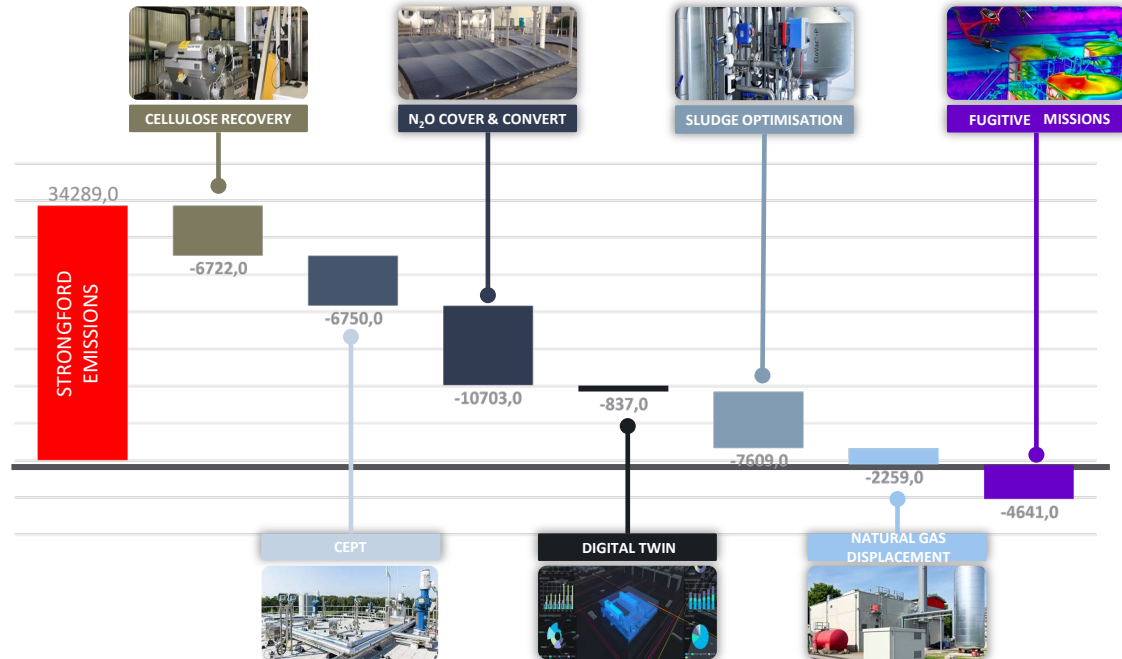
SUPPORTED BY THE WHOLE SECTOR

- Our Net Zero Hub has secured the maximum grant of £10 million from Ofwat's Water Breakthrough Challenge
- This ground-breaking project, universally supported by UK and Irish water companies plus international support from Aarhus Vand and Melbourne Water will transform a large, carbon intensive Wastewater Treatment Plant into the world's first retro-fit carbon neutral site.
- Innovative suppliers are developing technologies to reduce, remove and avoid carbon. Our plan is to integrate the most promising technologies on one site for the first time –the 'Net-Zero hub' creating
- Our biggest externally funded project to date
- Part of our wider Net Zero hub project at Strongford STW - Work has already started on site and the hub will be up and running by April 2024



NET ZERO HUB SOLUTIONS

We have trialled solutions at our R2IC at Spernal to test their feasibility, viability and desirability. We're now ready to scale them at the NZH at Strongford.



OUR NET ZERO SITE



2. CHEMICAL ENHANCED
PRIMARY TREATMENT

4. DIGITAL TWIN

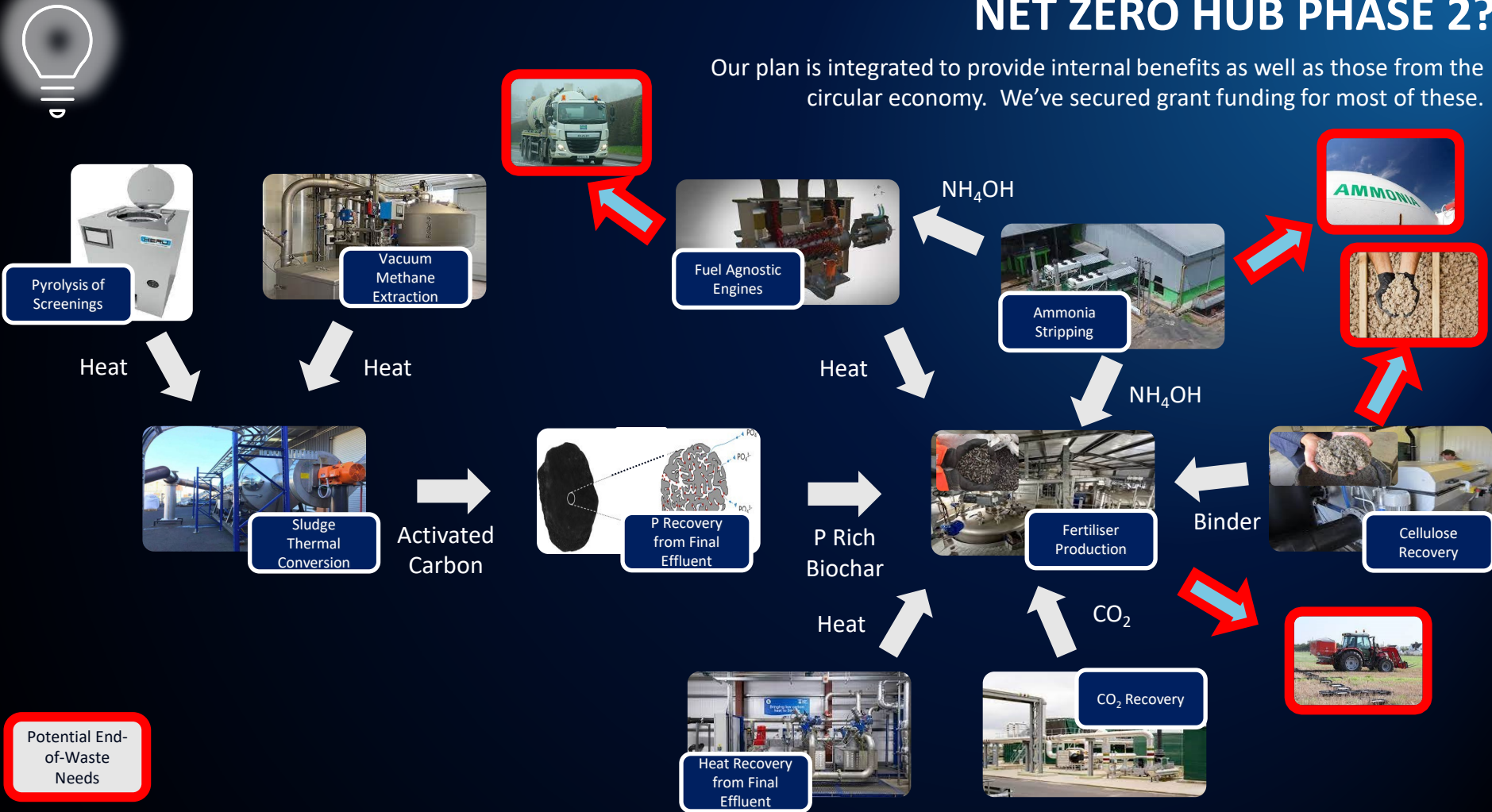
3. N₂O CAPTURE & DESTRUCTION

5. SLUDGE OPTIMISATION:
Elovac
Ephyra
CAMBI

1. CELLULOSE RECOVERY

NET ZERO HUB PHASE 2?

Our plan is integrated to provide internal benefits as well as those from the circular economy. We've secured grant funding for most of these.



CONCLUDING THOUGHTS

- We need to transform how we treat wastewater to be compatible with a low carbon, bio-diverse future (and we haven't got long to make the change)
- Luckily innovators have given us plenty of potential circular solutions, but collaboration is key to ensure widespread and rapid adoption.
- Accessing external funding and expertise and validating technologies & processes through large scale test-beds is likely to be increasingly important.
- Low carbon processes with resource recovery as highlighted in this presentation can deliver net zero carbon, effluent compliance and lower bills (by opening up new revenue streams), but utilities have long life assets and the additional capital costs is likely to make the pace of change a challenge.

ACKNOWLEDGEMENTS



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