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# Bio-resource Logistics Modelling

Developing industrial ecology solutions in  
AnyLogic over a three day data hack sprint



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south east water



Dŵr Cymru  
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Environment  
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Affinity Water

UK  
Power  
Networks

love  
every  
drop  
anglianwater

[dstl]

GENERAL  
DYNAMICS

NORTHERN  
POWERGRID



Canal &  
River Trust



BAE SYSTEMS

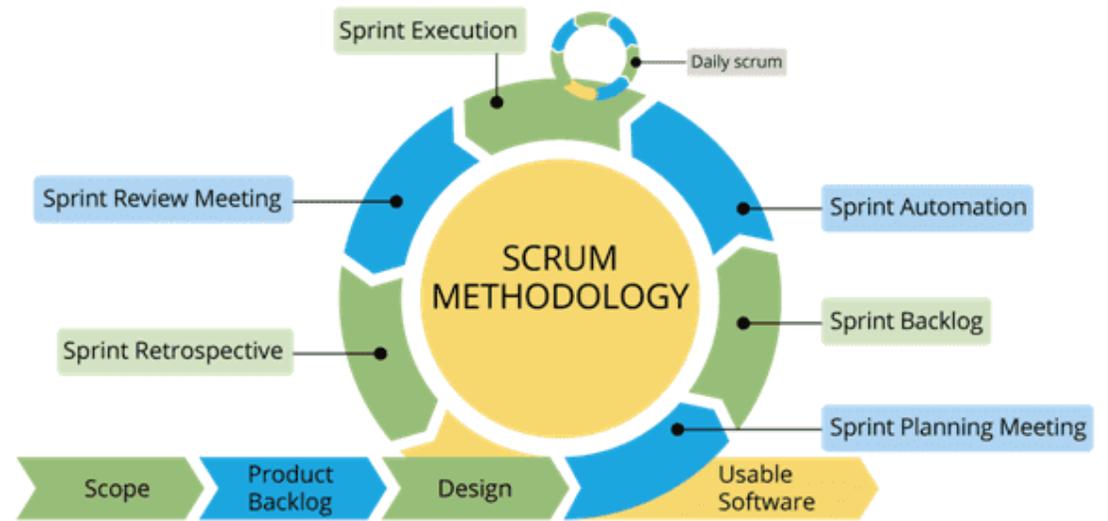
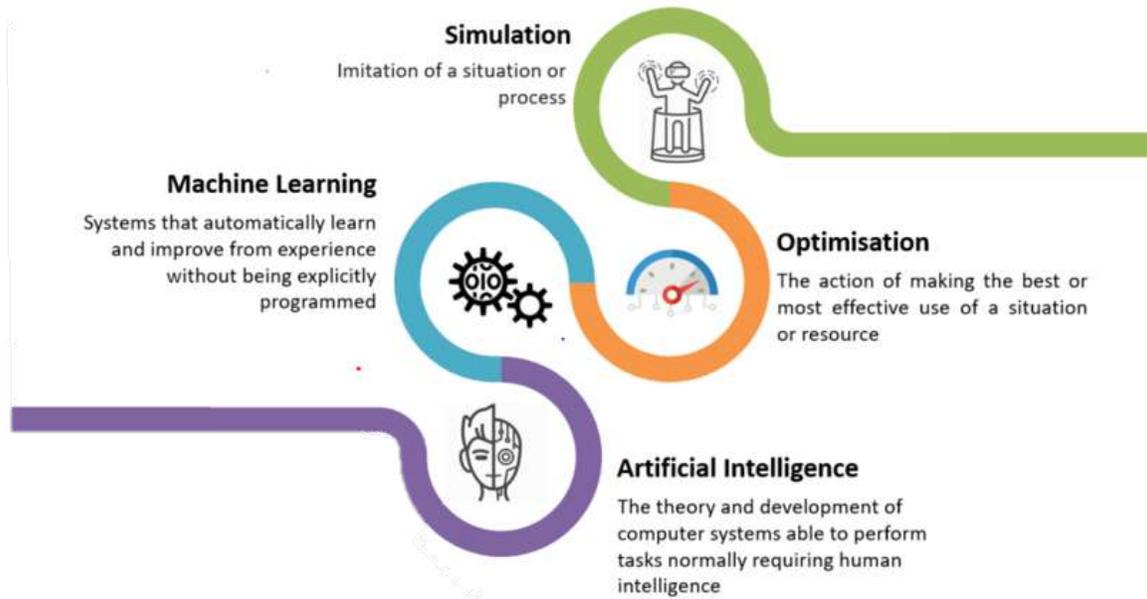


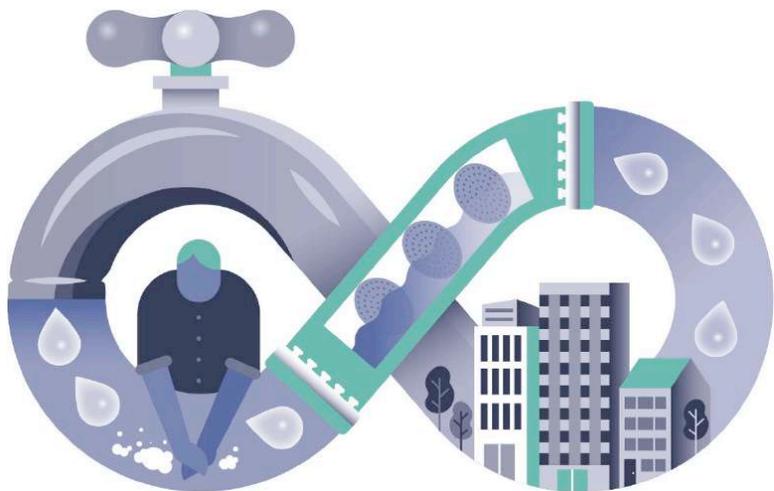
Ministry  
of Defence



POOL RE  
REINSURING TERRORISM RISK

# How we do it





Rethinking wastewater, whether via resource recovery, data and technology, or decentralised assets, is key to a sustainable water future

# Welcome to the Frugal Resource Revolution

The first step on a water utilities path towards industrial sustainability. Configuring waste water logistics networks to transform bio-resources into useful bi-products like energy makes economical and environmental sense. It is a key resource and contributor to maintaining and potentially improving our quality of life.

Waste water is valued at £8.7 billion and employs 42,000 people. With over 16 billion tons of waste water and sewage treated everyday

Achieving resource efficiency in the water sector requires novel modelling and systems thinking that optimises existing infrastructure to minimise CAP-EX

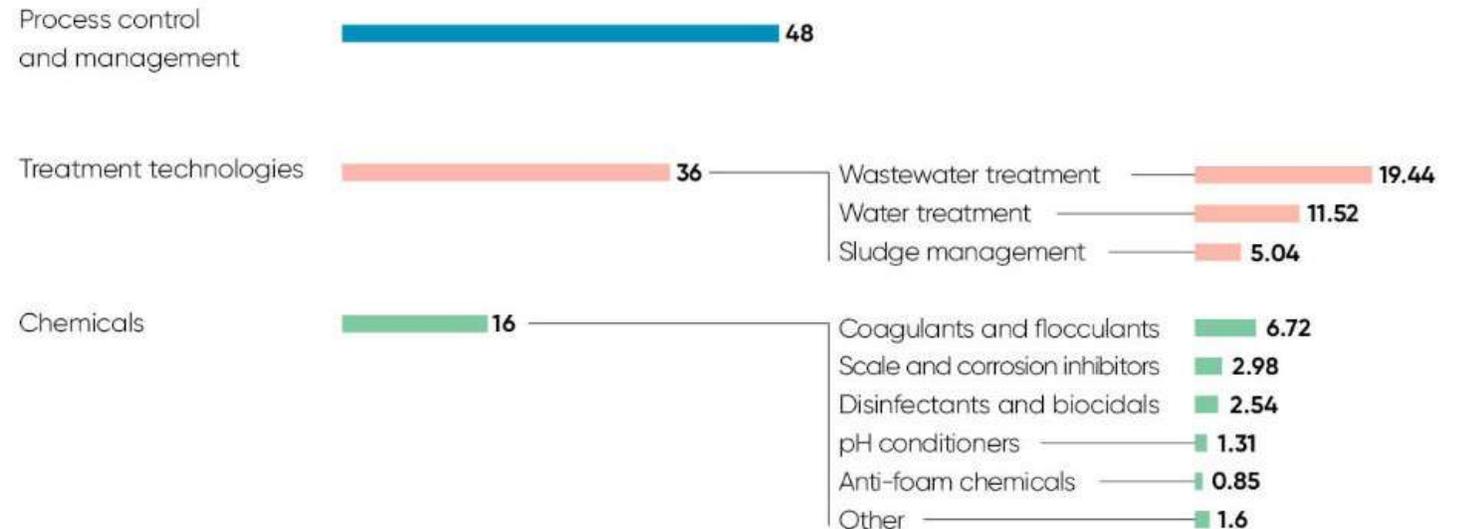
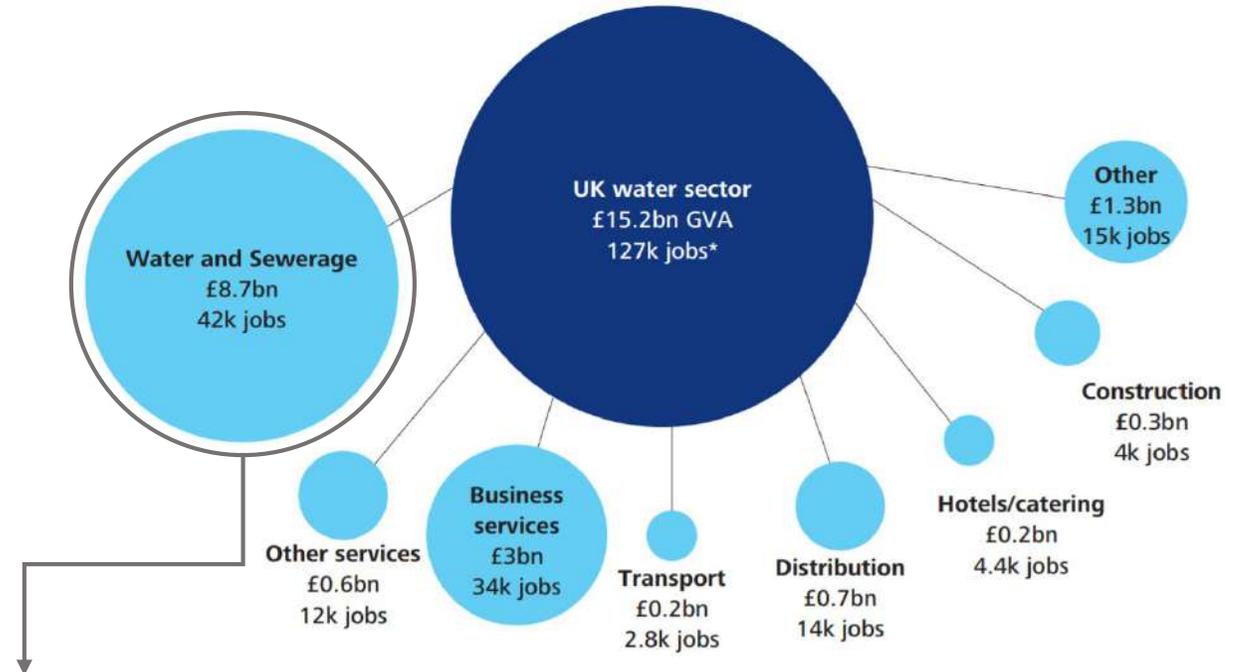
A proof of concept model which could be used to support network planning was achieved using decisionLab's patented 'agile data-hack' concept in 3 days

This works provides an example of the speed to answer using simulation, and the influence of coarse data granularity on the final network solution's triple bottom line sustainability

# The Size of the Prize

Deregulation and competition is increasing in the waste water market creating opportunities for innovations in process and systems level. Utilities companies are now competing against each other for bioresources. Therefore, configuring their logistics network and anaerobic digestion capacity will lead to:

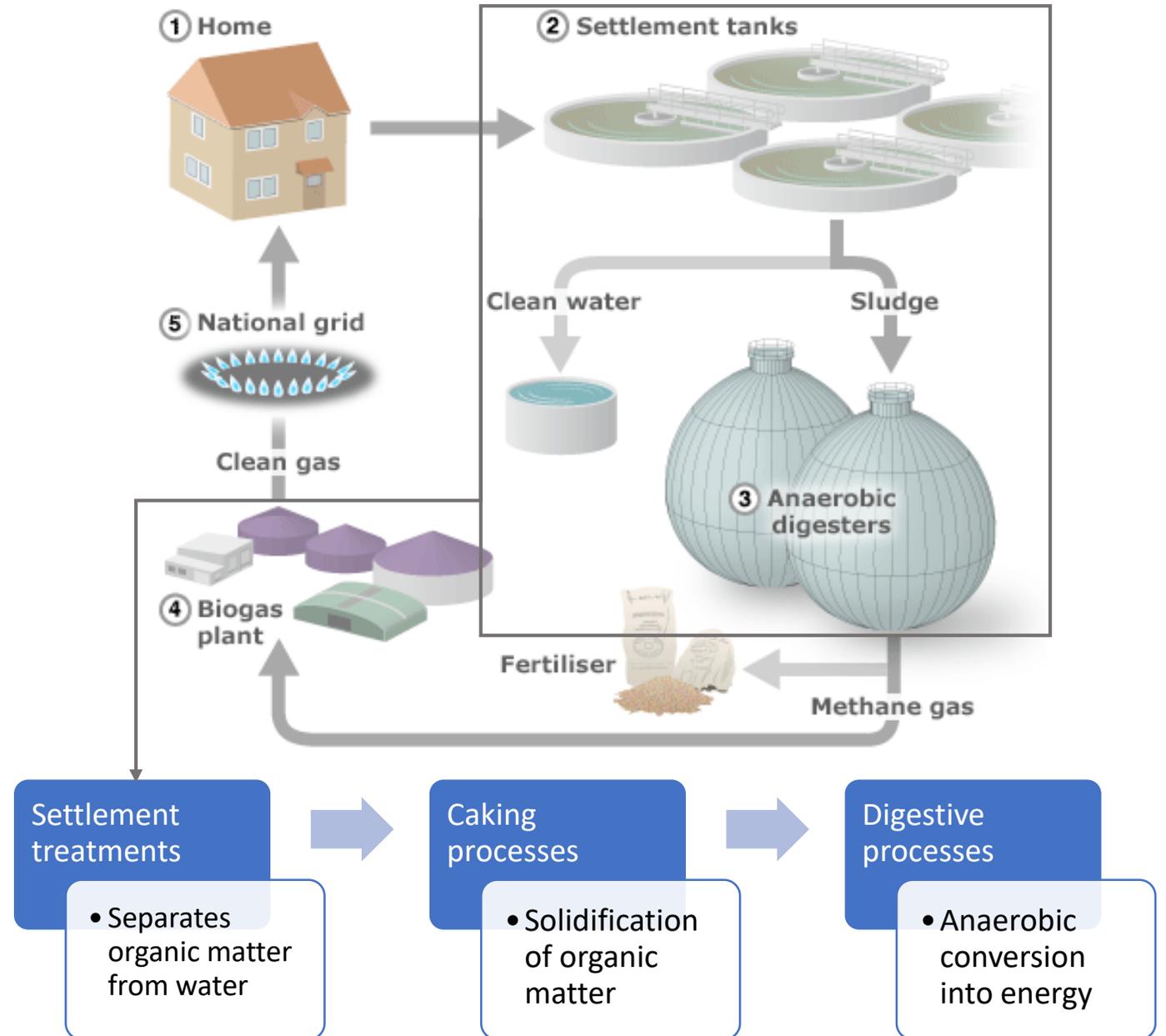
- Refined industrial ecology for the utility, i.e. a measure of waste 'upcycling loops'
- Increased collaboration with neighbouring water utilities based on anaerobic digestion capacity
- Optimised logistics routing ensuring competitive advantage
- Prove operational sustainability to industry regulators and investors



# Why Anylogic?

Use of Anylogic was a natural fit for the company who wished to develop this as a proof-of-concept to gain internal traction and attract further infrastructure investment. They selected AnyLogic for the following reasons:

- Adept platform for modelling the complexity of this system
- Ability for us to implement our own 'greedy' algorithm and optimise for minimum cost and maximum energy return
- Visually compelling – able to use GIS mixed with ABM of logistics

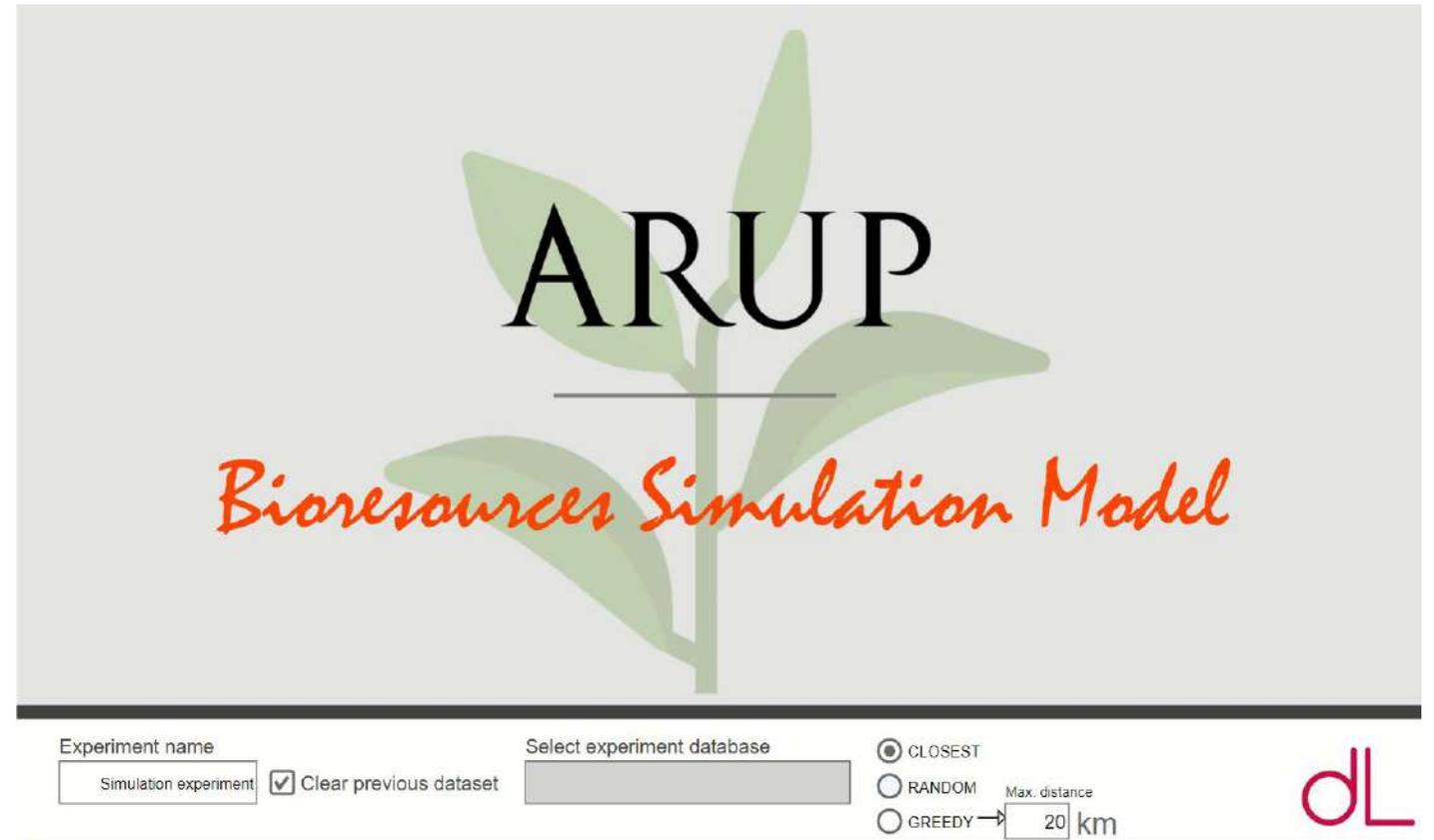


# The Solution

The key is understanding the sustainability of the operation and ensuring that there is a return on logistics costs and energy return on investment is positive.

To support one of the water companies decisionLab undertook 3 day data-hack with the aim of:

- Simulating optimised logistics routes over a year of bio-resource production
- Simulating the use of anaerobic digestion sites to provide maximum energy return on investment
- Simulating the industrial ecology of caked bio-resources at per-quarter granularity



The image shows a presentation slide for the ARUP Bioresources Simulation Model. The slide features the ARUP logo in black serif font, with a green plant graphic behind it. Below the logo, the text "Bioresources Simulation Model" is written in a red, cursive font. At the bottom of the slide, there is a control panel with the following elements:

- Experiment name:
- Clear previous dataset
- Select experiment database:
- Radio buttons for selection:  CLOSEST,  RANDOM,  GREEDY
- Max. distance:  km
- DL logo in the bottom right corner.

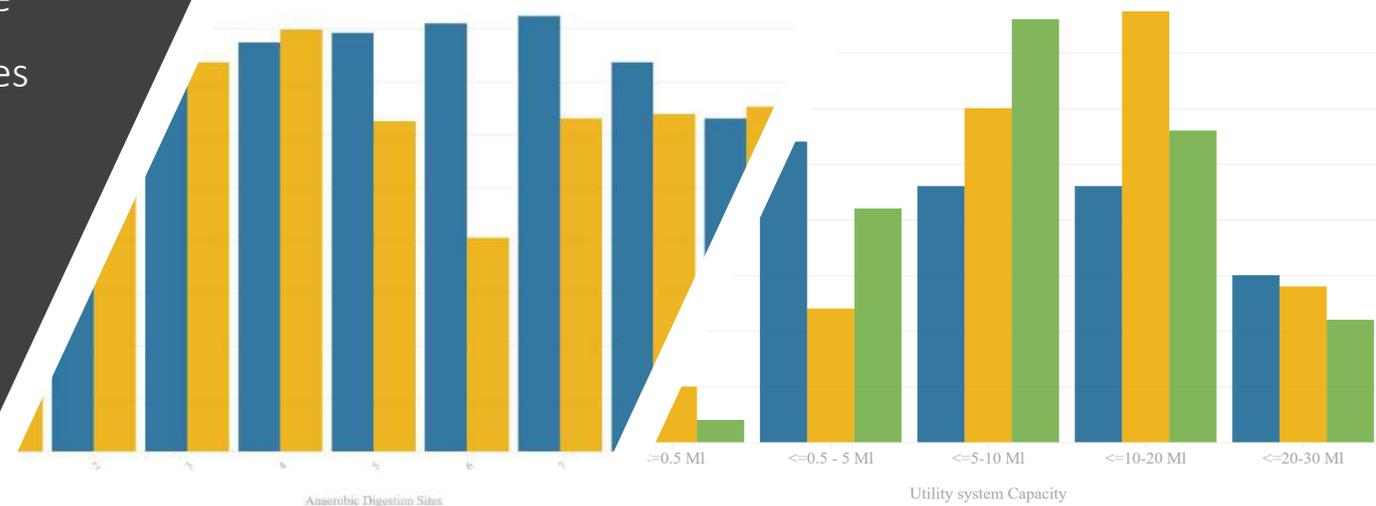
# Hack Results

The outcomes of the event included an proof of concept model which could be used to support network planning.

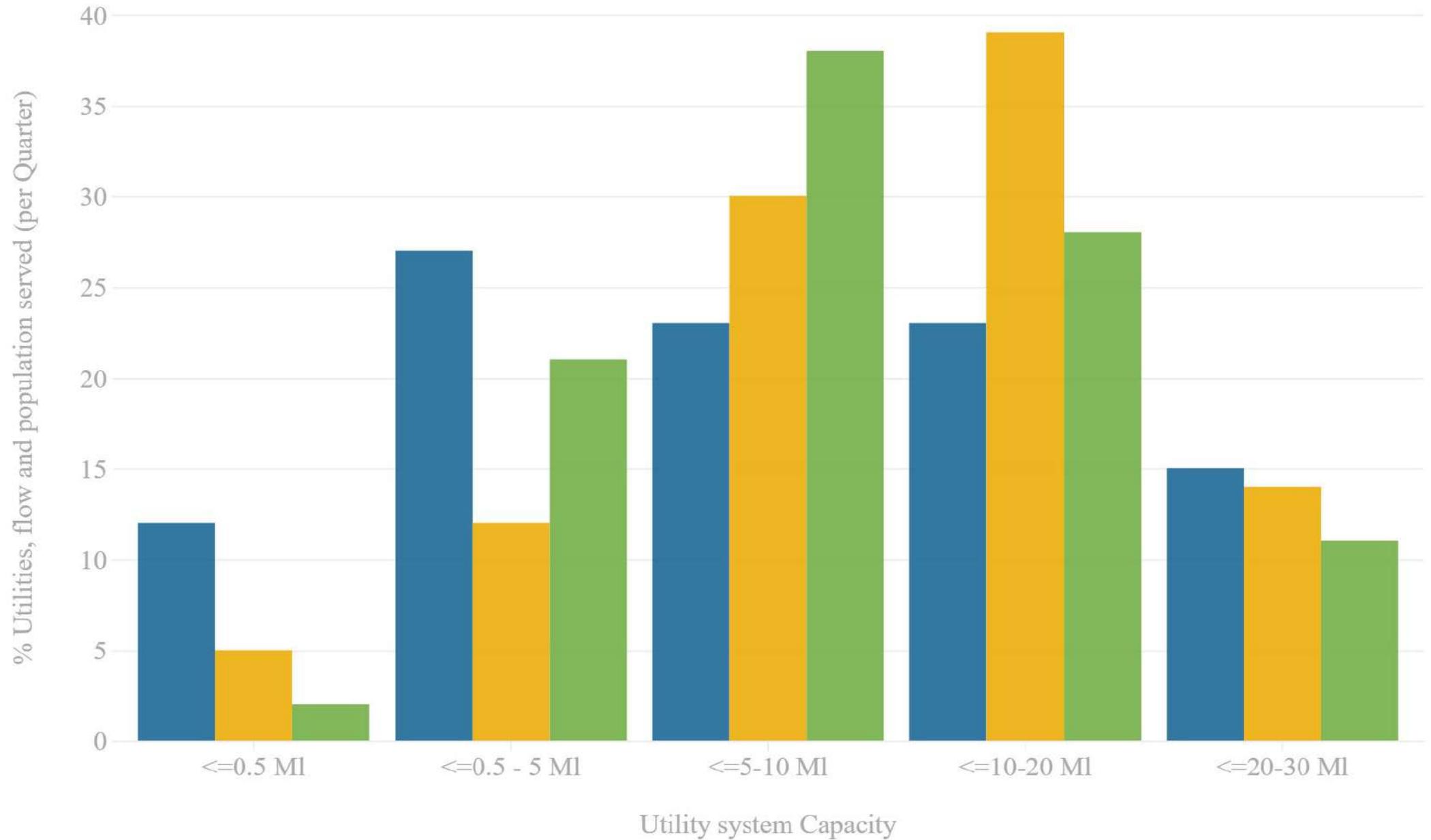
The hack event itself proved successful creating a high level of excitement concerning this problem and good stakeholder engagement across the business. With two major insights provided by the model:

- The sites that provided the most EROI refining the investment requirements in existing infrastructure
- The appropriate industrial ecology for bioresources based on flow and population served

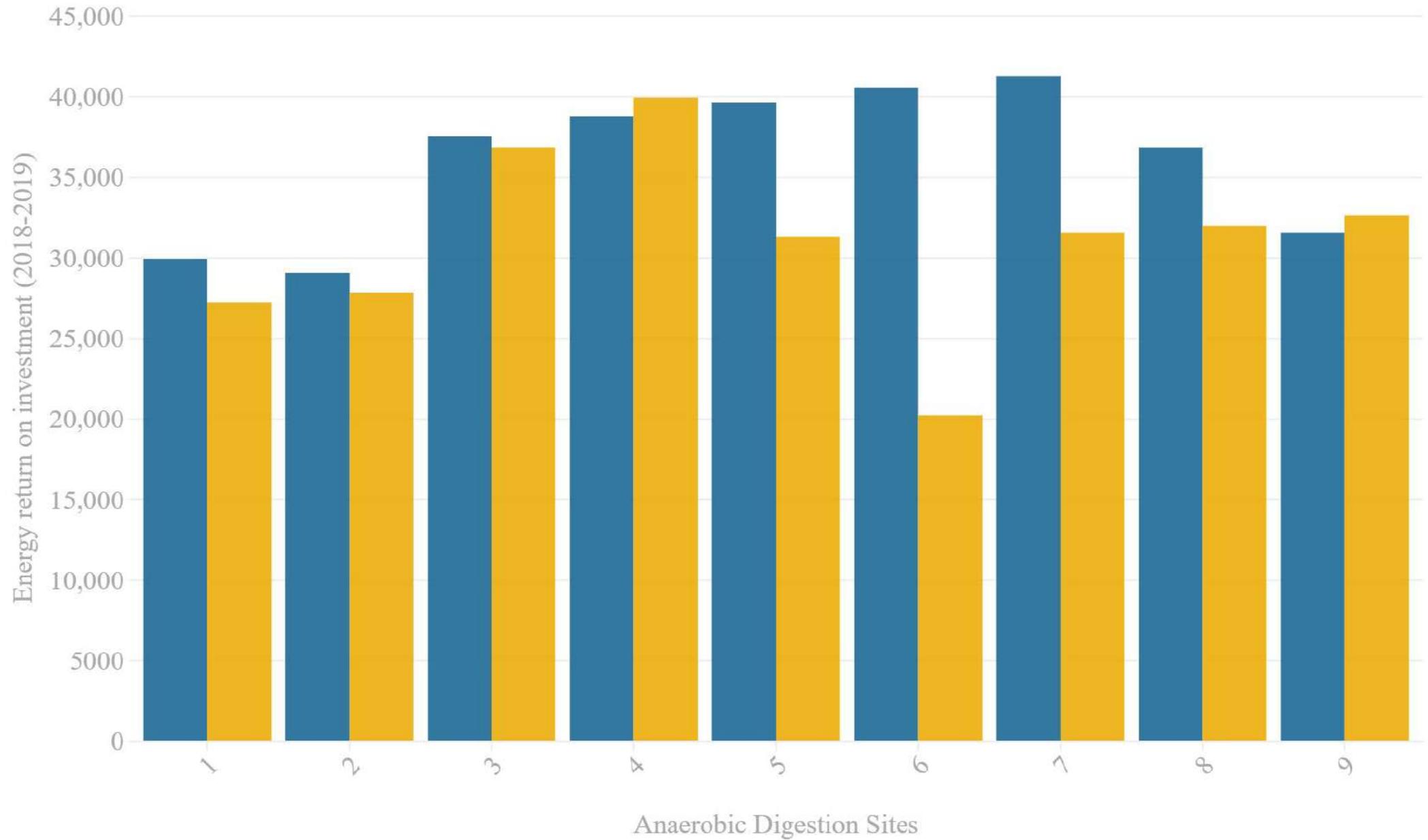
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**% Utilities**   **% Flow to AD (per Q)**   **% Population served**



Bio-resource costs (£/q) Energy return (£/q)



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