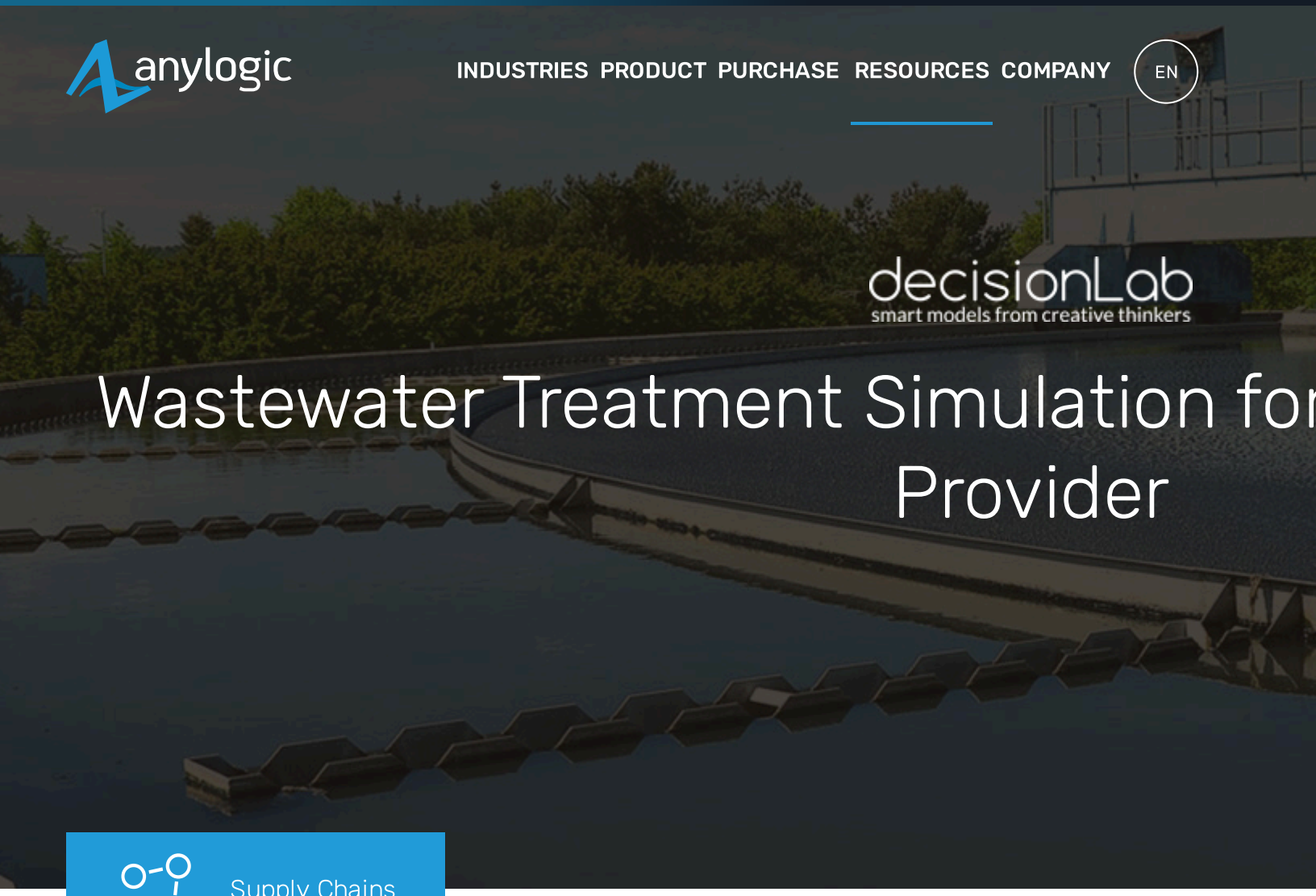
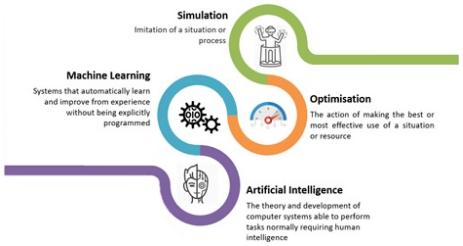


Wastewater Treatment Simulation for Provider

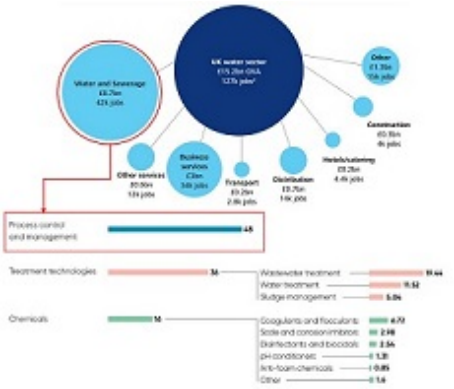
Supply Chains

Problem and context: How can utility businesses improve the efficacy of



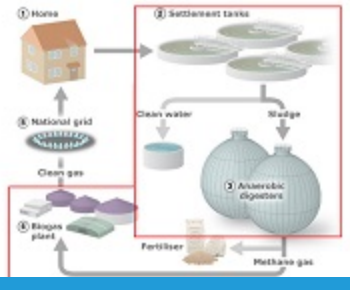
Quote reference: HM Government (2018), Our Waste, Our Resources:

Every day it deals with over 16 billion tons of wastewater. And, increasingly, some of the wastewater is transformed into bio-resources that can be used for energy or in other industries. Presently, deregulation and competition are increasing in the wastewater sector, creating opportunities for supply chain innovations at different stages of the water treatment cycle. Utility companies are now competing against each other to manage bio-resources, making wastewater supply chains, and the efficiency of their logistics networks a massively profitable industry.



Opportunities for supply chain and process control management in the UK water sector industry

For water utility providers, it can be difficult to develop the resource efficiency of supply chains and processes, especially when considering them in the context of industrial sustainability. Configuring and testing new designs for wastewater logistics networks that transform bio-resources into useful bi-products like energy is one option, which makes economic and environmental sense; especially as it is a key resource and a contributor to maintaining and



thinking. *DES*

That is why, when a UK wastewater treatment company decided to optimize the logistics infrastructure of their facility network, they sought the expertise of **decisionLab**, a London consulting company that specializes in creating decision-making tools using simulation, optimization, and machine learning. decisionLab engineers needed to simulate and test the wastewater treatment supply chain in a risk-free environment, with a specific focus on novel processes, before any capital investments were made. With a wastewater treatment simulation model, they would be able to assess the utilization of different types of settlement and anaerobic digestion facilities, and optimize their quantity based on return on energy investments.

The optimized configuration would lead to:

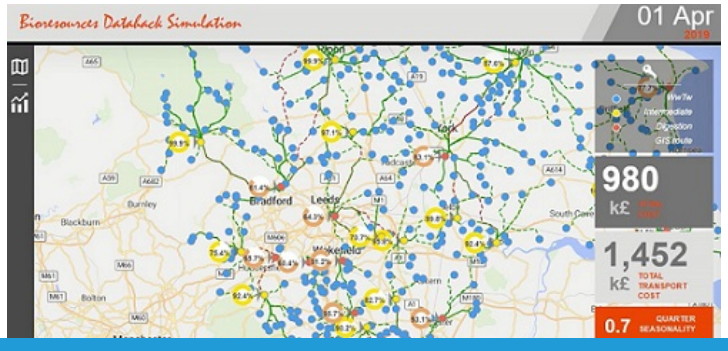
- Refined industrial ecology for the settlement, caking, and digestive processes that act as a measure of waste “upcycling loops”.
- Increased collaboration with neighboring water utilities based on anaerobic digestion capacity.
- Optimized logistics routing during the transportation of caked product, ensuring competitive advantage.
- A proof of operational sustainability for industry regulators and investors.

The key to delivering an effective wastewater treatment simulation model, in this case, was understanding the sustainability of the operation and ensuring that there was visibility of any returns on

To model a network of wastewater treatment facilities, the decisionLab team applied AnyLogic simulation capabilities. This platform was a natural fit for modeling such a complex environment, with its flexible modeling tools, enabling a combination of discrete event and agent-based approaches, so the developed model could be optimized for minimum cost and maximum energy return. AnyLogic also provided excellent visualization capabilities and enabled the engineers to use GIS functionality to better display the logistics network and make the data visually compelling.

The decisionLab consultants decided to focus on: understanding the sustainability of the operation, ensuring that there was a return on wastewater treatment logistics costs, and that the energy return on investment was positive. To support the client, the consultants simulated four scenarios:

- 'As-is' logistics routing of bio-resource production
- Industrial ecology of settlement and caking processes with fewer centralized digestion sites
- Distributed digestion sites and how these impacted the cost of logistics
- Advanced 'to-be' anaerobic digestion sites vs. current 'as-is' technologies



Centralised AD sites	Normal routing	Closest only	Greedy Routing
Transport cost (K£)	1211	966	641
Overall cost change (K£)	-1031	-1270	-1762

De-Centralised AD sites	Normal routing	Closest only	Greedy Routing
Transport cost (K£)	1291	977	730
Overall cost change (K£)	-4038	-4367	-4742

Advanced VS Standard AD	Normal routing	Closest only	Greedy Routing
Transport cost (K£)	1198	1197	884
Overall cost change (K£)	-1271	-3199	-3686

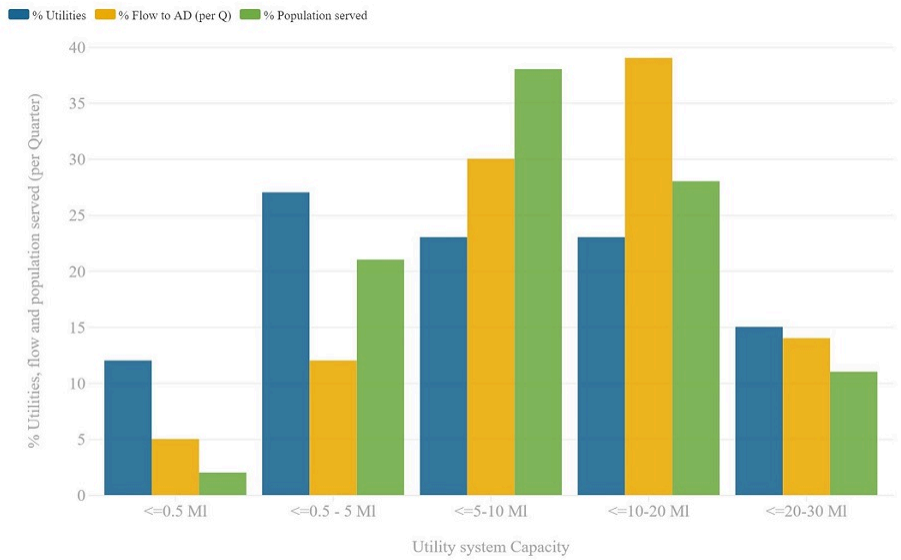
Wastewater treatment simulation results benchmarking optimal logistics routing in four different scenarios

Outcome

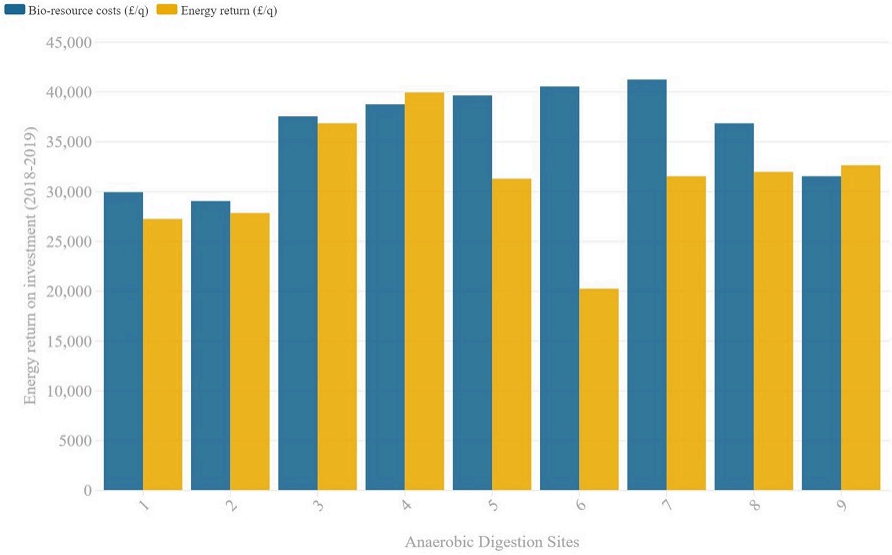
As a result of the work, a wastewater treatment simulation model for the utility provider's industrial ecology was developed. This model can be used to support network planning and prove various assumptions. It was specifically used to benchmark the following key performance indicators using the scenarios described above:

- Optimal logistic routing over a year of bio-resource production, considering seasonality
- The industrial ecology of settlement and caking processes at per-quarter granularity
- Anaerobic digestion site utilization to provide a maximum energy return on investment

The first insight was that the best-performing anaerobic digestion (AD) facilities were those with a 5-10 million-liter capacity spread out across the supply chain. This was a surprising result, as the engineering team had originally assumed, from a static analysis, that centralized larger facilities (<10 and <20-30 million-liter capacities) were more productive as they



Anaerobic digestion capacity optimization for system flow and population served



Energy return on investment in anaerobic digester sites in 2018 and 2019

DecisionLab's work in AnyLogic fulfilled the client's requirements. It allowed them to get a better understanding of their processes and of alternative approaches for optimizing their current supply chain

his presentation.

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