

CASE STUDY

Municipal Water Consortium

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Adaptive planning for bioresources: Lessons and perspectives from practice

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Igniting interest.
Inspiring action.



Introduction

On December 8, 2025, AtkinsRéalis presented to Canadian Water Network's (CWN) Bioresources Strategic Sharing Group. The community of practice brings together Municipal Water Consortium members to exchange knowledge, stay ahead of emerging biosolids management trends and issues, and identify evolving solutions.

This brief summarizes key lessons and perspectives shared during that session, drawing on the company's experience supporting utilities in developing adaptive bioresources strategies. While grounded in practical project work, the insights reflect not only project-based learning, but also wider shifts in how the sector is responding to increasing complexity and uncertainty.

Utilities managing biosolids are operating in a rapidly evolving context shaped by emerging contaminants, changing regulations, shifting market conditions, climate commitments, and growing public expectations. Many of these factors are difficult to predict with confidence, yet they have significant implications for long-term infrastructure investments.

Adaptive planning has emerged as an approach to navigate this uncertainty. Rather than seeking a single optimal solution based on a forecasted future, it emphasizes developing flexible strategies that remain robust across a range of plausible conditions and can evolve as new information becomes available. This shift—from prediction to adaptability—was a central theme of the discussion and underpins the lessons summarized in this case study.

Key insights

- Adaptive planning reverses the traditional approach by prioritizing strategy and uncertainty first, and technology selection second.
- Biosolids strategies must be tailored to local context; approaches that work in one jurisdiction may not translate directly to another.
- Successful implementation depends on alignment between technology, markets, regulation, and institutional readiness.

Decision context and drivers

Utilities responsible for biosolids management are operating in an increasingly uncertain environment. Emerging contaminants such as PFAS and microplastics are attracting growing regulatory and public scrutiny. At the same time, net zero commitments, evolving environmental regulations, changing energy markets, and growing affordability pressures are reshaping decision-making.

In the presentation, AtkinsRéalis emphasized that many of these uncertainties cannot be predicted with confidence. Future regulations, market opportunities, and public expectations are often unclear. Despite this, utilities must continue making long-term infrastructure decisions today. This reinforces the need for planning approaches that explicitly account for uncertainty rather than assuming it can be eliminated through better forecasting.

Catalyst for adaptive planning

A key message from AtkinsRéalis was the importance of shifting away from technology-led planning. Historically, biosolids strategies have been developed around a preferred technology or disposal pathway.

As resource recovery opportunities expand and regulatory expectations evolve, utilities are increasingly seeking approaches to preserve flexibility while avoiding premature investments in technologies that may become less attractive under future conditions. This need for flexibility has become a key driver behind the adoption of adaptive planning principles in bioresources strategy development.

Adaptive planning is not a standalone planning exercise—it is a decision-making approach that can be applied across virtually any utility function where uncertainty, risk, and long-lived investments intersect.

Framing the planning challenge

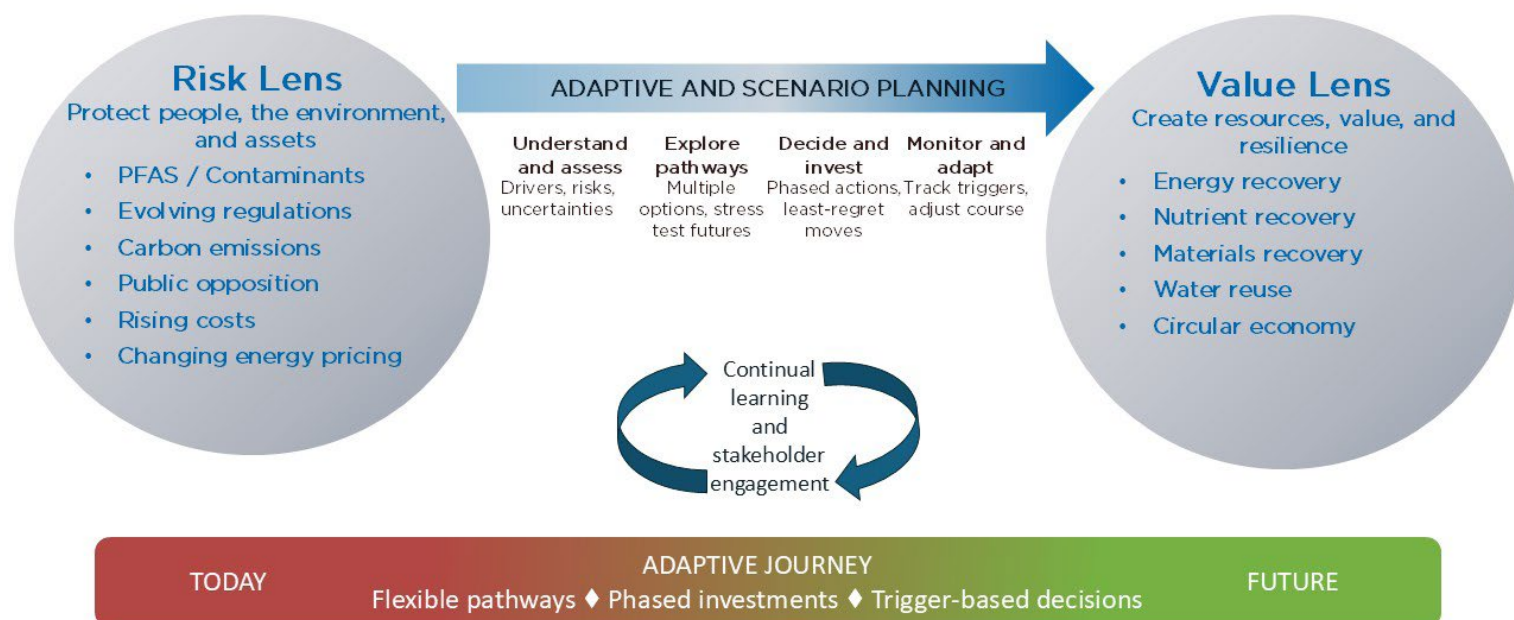
Bioresources management can be viewed through two complementary lenses of risk and value:

- The risk lens focuses on protecting public health, the environment, and utility assets by addressing contaminants, regulatory exposure, carbon emissions, rising costs, and public acceptance concerns.
- The value lens considers opportunities to recover energy, nutrients, water, carbon, and other resources that can contribute to a more circular and resilient economy.

Rather than focusing exclusively on one perspective, the adaptive planning approach provides a framework for balancing both perspectives over time (see Figure 1). This allows utilities to reduce risk while remaining positioned to capture future opportunities as technologies, regulations, and markets evolve.

Traditional planning often starts with a preferred technology and then develops a strategy around it. Adaptive planning reverses this logic by first understanding risks, opportunities, and future uncertainties, then identifying pathways that remain viable across multiple plausible futures.

From Waste Stream to Strategic Resource: Adaptive Planning for Bioresources



“Technology should follow strategy—not the reverse.”

Richard Landcaster, AtkinsRéalis

Figure 1: Adaptive planning helps utilities navigate future uncertainty by balancing two complementary perspectives – managing risk and creating value. Source: Canadian Water Network.

Adaptive planning in practice

In the presentation, AtkinsRéalis shared examples of adaptive planning in practice, drawing on international experience and global benchmarking of bioresources management approaches. This included agricultural reuse programs in countries such as the United Kingdom and Australia, thermal treatment approaches used in Europe and Japan, and emerging resource recovery models focused on nutrient recovery, biochar production, and bio-refineries.

These examples illustrated the range of viable approaches currently being implemented, as well as how local context (i.e., regulatory frameworks, market conditions, resource availability, and public expectations) influences strategy selection. A consistent takeaway was that there is no universally optimal solution.

Building on this, the presentation emphasized the importance of evaluating alternative pathways rather than converging too quickly on a single option. Different pathways are stress-tested using multi-criteria assessment approaches that consider environmental performance, carbon impacts, affordability, stakeholder priorities, regulatory scenarios, and technology readiness. Rather than identifying a single preferred end-state, the objective is to understand how options perform under different conditions and to identify pathways that remain viable across a range of plausible futures.

Adaptive pathways and strategic flexibility

Adaptive planning is translated into a practical decision-making process through a series of structured stages: understanding key drivers and uncertainties, exploring alternative pathways,

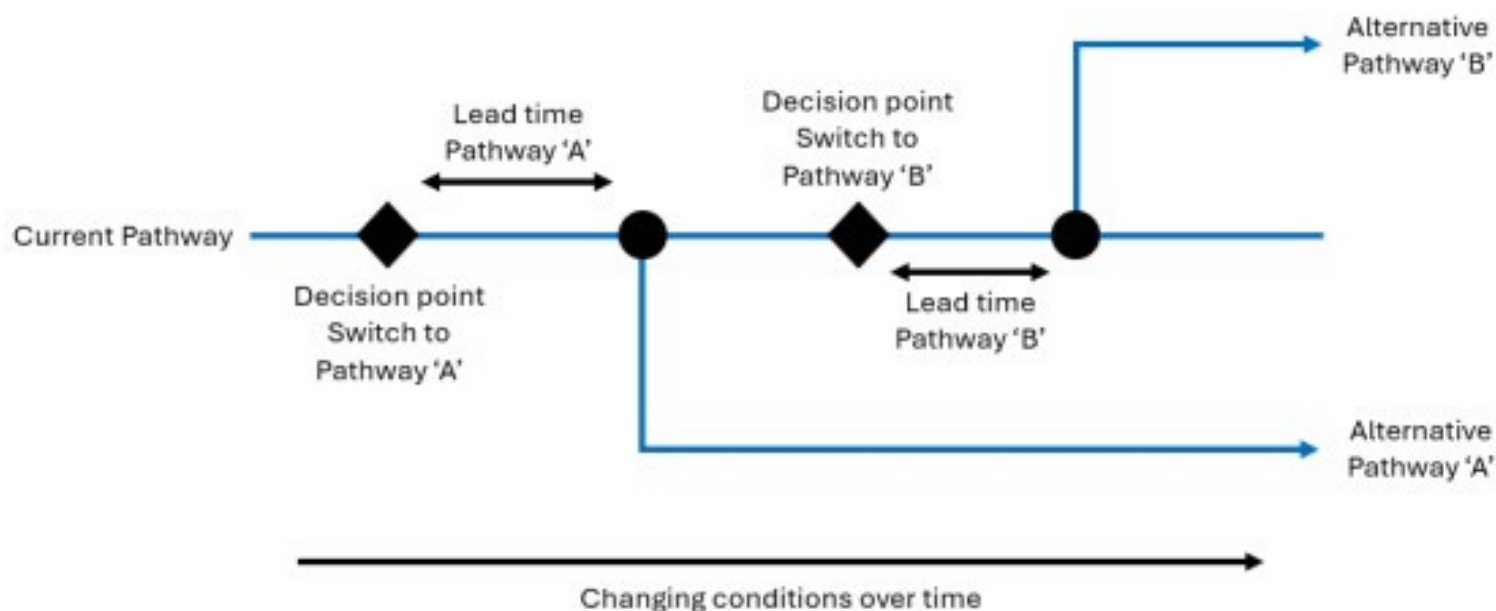


Figure 2: Simplified adaptive planning map. Mapping sequences of suitable options and actions for each selected scenario are used to build alternative pathways. Adapted from Water New Zealand.

making phased investment decisions, and continuously monitoring conditions to determine when adjustments may be required (see Figure 2).

Determining the conditions or indicators that signal when a change in the pathway is needed are used to establish decision points. To allow for sufficient time to prepare for the move to an alternative pathway, lead times are built in.

This approach shifts planning away from a fixed trajectory based on a predicted future and toward a flexible pathway that can evolve as new information becomes available. Investments are staged over time, preserving optionality while reducing exposure to technology lock-in and stranded assets.

Deployment readiness

Another lesson AtkinsRéalis emphasized is that technically successful solutions do not always guarantee successful implementation.

For this reason, potential pathways are assessed not only for technical feasibility, but also for deployment readiness. Consideration must also be given to deployment readiness, including market demand, revenue certainty, regulatory approvals, operational requirements, organizational capability, and scalability. This approach helps utilities avoid implementing technologies before supporting markets, regulations, or organizational capacity are sufficiently mature.

Triggers, monitoring, and decision points

Adaptive planning becomes operational when utilities establish clear triggers, or indicators that signal when a pathway should be reassessed or adjusted. Potential triggers may include regulatory changes, shifts in public acceptance, rising operating costs, loss of biosolids outlets, carbon pricing impacts, asset renewal cycles, or new market opportunities such as carbon credits and sustainable fuels.

By identifying triggers in advance and monitoring them over time, utilities can respond proactively rather than reactively. Alternative pathways can be prepared before critical thresholds are reached, reducing risk and preserving flexibility.

From planning to action

Adaptive planning typically results in a portfolio of strategic options rather than a single project recommendation.

Implementation may include targeted research, pilot projects, market development activities, engagement with regulators and end users, capability building within the utility, and phased infrastructure investments aligned with future decision points.

This approach has been applied across a variety of jurisdictions, including the United Kingdom, Australia, Scotland, and the Middle East. It helps utilities develop business plans and investment strategies that remain resilient under changing conditions.

Value and transferable insights

AtkinsRéalis emphasized that uncertainty should not be viewed as a barrier to action. Instead, it should be incorporated directly into planning and investment decisions. Several lessons emerge from its work:

- Strategy should guide technology selection, not the reverse.
- Resilient bioresource strategies require multiple pathways rather than a single fixed solution.
- Local context plays a critical role in shaping viable options.

Early engagement with regulators, markets, and end users is critical to successful implementation.

- Phased investments and trigger-based decisions help manage risk while preserving flexibility.
- Technical solutions must be aligned with market and institutional readiness
- Adaptive planning enables utilities to make defensible decisions today without constraining future options.

Perhaps most importantly, adaptive planning helps utilities move beyond viewing biosolids as a disposal problem towards recognizing bioresources as a strategic asset and risk portfolio that can create long-term value.

AtkinsRéalis' approach to bioresources strategy development shows that adaptive planning can also be applied to emerging challenges such as resource recovery, circular economy initiatives, and decarbonization.

Looking ahead

The discussion within the Bioresources Strategic Sharing Group highlighted the growing need for planning approaches that can respond to evolving regulations, emerging contaminants, and expanding resource recovery opportunities.

Adaptive planning offers one approach utilities can apply to navigate uncertainty, make more informed investment decisions, and position bioresources as an important component of a resilient and circular water future.