Road to a Net-Zero Utility

EPCOR Edmonton Water & Wastewater Treatment Plants Case Study

This case study contributes to knowledge mobilization for the CWN project "Charting the course to Net Zero Water: Mobilizing Canada's municipal water network for greenhouse gas mitigation in the public water sector" funded by the Environment and Climate Change Canada Implementation Readiness Fund.

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Key Insights

- **Background**
  - EPCOR is actively working towards net-zero operations in response to increasing public and regulatory pressure to address climate change while promoting sustainability.
  - Water utilities are facing the challenge of balancing emissions reductions with maintaining high-quality, affordable services in rapidly growing communities.
- **Approach**
  - To achieve the net-zero goal by 2050 set by EPCOR, a 3-step plan was created to implement net-zero initiatives.
  - The 3-step process in the net-zero plan includes developing an energy and emissions baseline, strategic planning, and building a road map to net-zero.
- **Impacts**
  - EPCOR has significantly invested in renewable energy projects with solar and wind farms to accelerate progress towards net-zero emissions.
  - The integration of advanced systems such as the battery energy storage system (BESS) and distributed energy resource management system (DERMS) is crucial for optimizing energy use.
- **Lessons Learned**
  - Water utilities will benefit from utilizing net-zero pathways and knowledge sharing networks like Canadian Water Network (CWN) in building resilient systems.
  - There are government grants available to accelerate greenhouse gas emissions reduction through adoption of new technologies.
  - Scope 3 emissions are a challenge due to lack of disclosure by third-party suppliers.
  - Technology continues to be developed to measure and mitigate impacts of greenhouse gas emissions from the wastewater sector.

Background

Signs of climate change are increasingly present in North American communities where severe weather and economic stringency can impact the delivery of core utility services. Developing opinions on climate change have led the environment, public health, and economy to become key discussion points centred around a transition to sustainable operations. As such, increased public and regulatory pressure is being placed on water and wastewater utilities to decarbonize, promote sustainability, and develop plans for decreasing future emissions.

EPCOR first began voluntarily tracking and disclosing greenhouse gas (GHG) emissions in 2008, and has published regular updates ever since. With the intention of strengthening environmental leadership, EPCOR sought to redevelop new goals to guide the transition to net-zero operations.

At the same time, international accords on climate change were being ratified by major governments across North America. In 2016, the Government of Canada signed on to the Paris Agreement, and committed to lowering GHG emissions within the combined effort to limit global average temperature increases to under 2°C. Municipal governments followed suit with endorsements such as the Edmonton Declaration in 2018. Signed by over 3,400 municipalities across North America, the

declaration highlighted the role of city governments in achieving goals set out in the Paris Agreement.

Edmonton, Alberta is the primary community served by EPCOR Water Services. Two water treatment plants (E.L. Smith, Rossdale) and the Gold Bar Wastewater Treatment Plant provide clean drinking water as well as safe wastewater collection and treatment services to Edmonton's entire metropolitan area.

Challenges

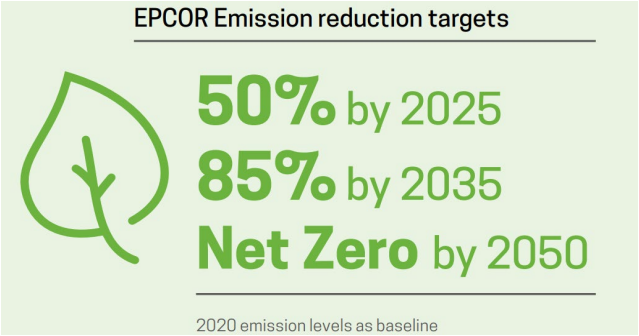
A difficulty in transitioning to net-zero is minimizing environmental impact while maintaining high-quality, affordable service for customers. EPCOR operates in growing communities across North America, and **balancing the growth of new service areas with overall emissions reductions** is key to achieving climate change mitigation goals and keeping affordability in mind.

At EPCOR sites, there are three primary sources of energy present: electricity, natural gas, and biogas. The type and amount of energy present affect the strategies required to mitigate environmental impact, as the targeted energy source will influence the necessary pathway to net-zero emissions.

A comprehensive review of the emissions footprint of Edmonton water and wastewater services was necessary to understand how improvements should be applied to maximize impact.

Approach

To support EPCOR's initiatives on environmental stewardship, company-wide targets for reducing GHG emissions were set. As of 2020, EPCOR committed to meeting the following goals in GHG emission reductions:



Currently, emissions reporting and targets focus only on scope 1 and scope 2 emissions. Scope 3 emissions are also present in operations and produced during the manufacturing of purchased materials (consumable or otherwise). EPCOR is reviewing emissions data from suppliers as it becomes available, and has plans to include **scope 3 GHG emissions** in future reporting.

Scope 1 Emissions:
Direct emissions from owned or controlled assets.

Scope 2 Emissions:
Indirect emissions from the creation of purchased energy.

As part of this commitment to GHG emission reductions, a 3-step plan was created and applied to streamline the implementation of net-zero initiatives. EPCOR completed an audit of water treatment plants — E.L. Smith and Rossdale, the Gold Bar Wastewater Treatment Plant, water reservoirs, and booster stations in the Edmonton region.

Step 1: Developing an Energy and Emissions Baseline

The first step in planning for net-zero is to quantify current energy usage and GHG emissions through detailed audits. **Energy auditing** will define a baseline for future benchmarking from which improvements can be established.

Once electricity consumption is known, scope 2 emissions can be calculated by converting energy usage into carbon dioxide equivalents (CO2e) using grid intensity factors[1] published by the Canadian federal government. EPCOR reports GHG emissions annually by source. In 2023, approximately 72% of all GHG emissions were scope 2, while the remaining 28% of emissions are

scope 1, inclusive of building heating, fleet vehicle operations, and methane and nitrous oxide emissions from wastewater treatment.

The source of imported electricity has major impacts on the environmental footprint of utility operations. In areas where power is already generated from renewable sources, such as hydro or wind, the carbon intensity of the grid will be significantly lower than areas where the primary source of energy is natural gas or coal. As of 2024, approximately 19% of the electricity generation capacity in Alberta is from renewable sources. Although the energy grid continues to decarbonize as investments are made in renewable energy generation, the rate at which this progresses has a large impact on net-zero planning. Utilities in other regions could encounter an extra burden to reduce emissions due to lower grid decarbonization rates. EPCOR adjusts estimated GHG emissions from energy imports annually, accounting for a 2-year lag in the availability of grid intensity values reported by the Canadian federal government.

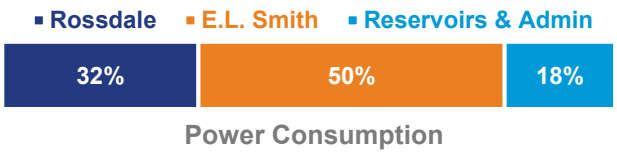


Figure 1: Overall power consumption in 2020 by water treatment asset.

Energy auditing of Edmonton WTPs *[figure 1]* showed E.L. Smith as the majority power consumer across all EPCOR Water Services, in line with the larger volume of treated water the plant produces. Further analysis of individual treatment processes *[figure 2]* highlighted both highlift and lowlift pump stations as the largest power sinks at each WTP.

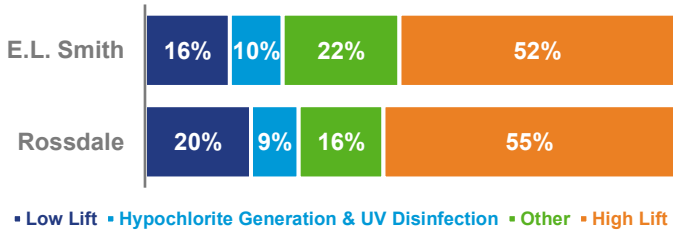


Figure 2: Energy usage in 2020 at both Edmonton WTPs categorized by individual process.

At the Gold Bar WWTP, energy auditing *[figure 3]* revealed aeration and UV disinfection equipment as primary electricity consumers. Biogas is also produced during the wastewater treatment process, and can be utilized as process and building heat to decrease reliance on purchased natural gas.

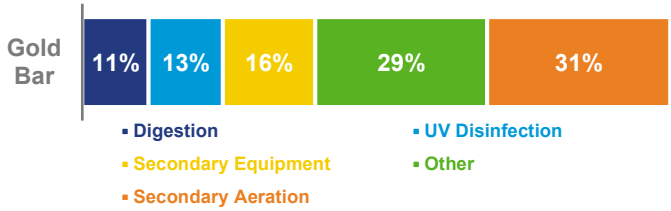


Figure 3: Energy usage in 2015 at the Gold Bar WWTP categorized by individual process.

An audit of gas consumption at Gold Bar *[figure 4]* concluded that **53% of the total gas used for heating was sourced from biogas**, while 40% of the total gas consumed on site was flared. Applications exist which could potentially utilize excess biogas as a fuel source beyond heating, such as upgrading to renewable natural gas or on-site cogeneration.

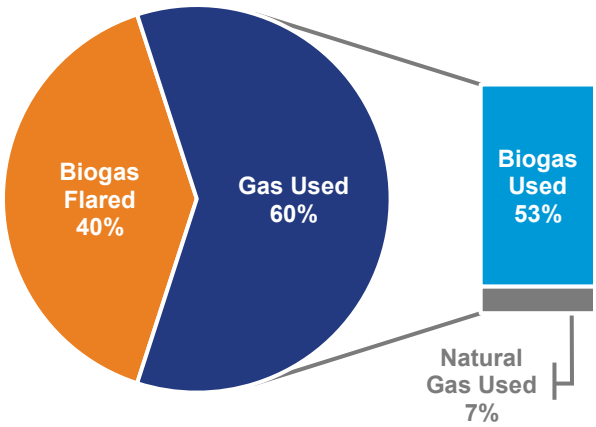


Figure 4: Total natural gas and biogas utilization at the Gold Bar WWTP in 2022.

Energy audits are a vital resource for long-term planning. Without knowledge of where energy is consumed along the treatment chain, it is difficult to identify inefficiencies and evaluate potential technologies for improvements. By identifying processes that consume the largest amount of energy, recommendations can be made as to what efficiency upgrades can be implemented for maximum effect.

Results from energy and emissions auditing were shared across business areas to assist with decision-making. With an understanding of how treatment plants are impacting EPCOR's overall energy usage and GHG emissions, a strategic plan was developed to make improvements.

Figure 5: Gold Bar WWTP, with biogas flaring visible.

Step 2: Strategic Planning

The guiding principle of strategic planning is to ensure investments into specific sites are aligned with organizational net-zero goals. In this step, additional studies are completed to determine which emissions and energy reduction pathways will be feasible for implementation at the plant scale.

Carbon Neutrality:
The complete elimination of all carbon dioxide (or equivalent GHG) emissions into the atmosphere.

Energy Neutrality:
Achieved when the energy required for operation is being met in equal measure by energy recovered.

Multiple pathways towards energy neutrality are explored as they relate differently to existing equipment or procedures. Initiatives can be adjustments to regular maintenance, such as replacing old lighting with high-efficiency LEDs. More advanced projects, once evaluated for use, can be included in successive capital budgets. Timeline and scope of pathways are also considered. Some projects may take significant time to implement, while others can be completed concurrently. An understanding of the long-term nature of capital upgrades is vital to ensure climate adaptation milestones are met, and reinforces the importance of early planning for net-zero.

After investigating options for energy pathways, the GHG reduction potential of each is calculated. The key to choosing the most effective combination of improvements comes from gap analysis, where the energy baseline determined in step 1 is compared with possible GHG emission reduction potentials.

Through gap analysis, the cumulative energy recovered through the implementation of all initiatives is compared with the current footprint of operations to determine the functional "gap" which must be met to achieve energy neutrality. As multiple pathways are explored simultaneously, the gap reduction potential for different combinations of improvements will be used to develop a road map to net-zero.

Step 3: Road Map to Net Zero

For the final step, multiple road maps to net-zero are created to encompass all prior planning and studies. Critically, **road map development allows for the prioritization of initiatives** based on available budget, existing planned upgrades, and available technology. Simple projects, such as operational changes or monitoring initiatives, are prioritized first, followed by upgrades that present the greatest value in terms of achievable emissions reductions.

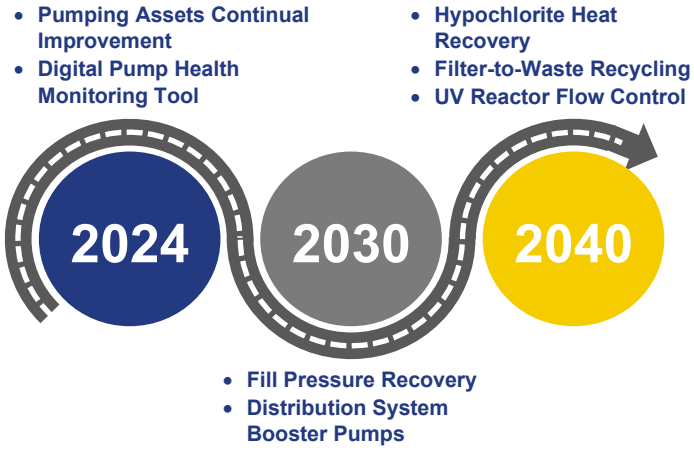


Figure 6: Initial road map showing WTP and distribution system mitigation actions identified for development.

Road maps are living documents that can be continually improved. As new information or technology becomes available, initiatives in the road map can be adjusted or re-prioritized. The first road

map introduced for the strategic plan *[figure 6]* prioritized projects that were the least costly and least complex for implementation, saving more challenging and capital-intensive improvements for further down the road map. This approach allows project teams additional time to develop plans and identify potential grant funding that can reduce the capital burden. Solution-oriented road maps act as a valuable guide for long-term planning by prioritizing the reduction of emissions and adapting responses to climate change hazards.

Impacts

Since the pathway to net-zero was implemented, EPCOR has invested in **multiple large-scale renewable energy projects**. Most notable is the kīsikāw pīsim solar farm located adjacent to the E.L. Smith water treatment plant. kīsikāw pīsim consists of over 30,000 solar panels with a peak generation capacity of over 13.6 megawatts (MW), powering the equivalent of 2,800 homes with clean and renewable energy.

Also on-site alongside the solar farm is the **battery energy storage system (BESS)**, which consists of over 1,000 batteries providing 4 MW of flexible energy storage capacity for E.L. Smith and the surrounding electricity grid. Construction of the BESS was made possible through grant funding provided by Natural Resources Canada.

An advanced distributed energy resource management system (DERMS) intelligently transfers power from the solar farm between the E.L. Smith water treatment plant, the BESS, and the local energy grid. In combination, the DERMS and BESS are crucial tools for accomplishing EPCOR's sustainability goals. The data they have generated has informed decisions on how energy can be best used to lower emissions generated across all water treatment operations.

Additional investments have been made in a **recently constructed wind farm** in Hilda, Alberta, where EPCOR has arranged to purchase 145,000 renewable attributes each year. Renewable attributes, although not reducing GHG emissions directly, are valued in their ability to offset the carbon cost of purchased electricity. Combined with the kīsikāw pīsim solar farm, **investments in renewable energy have been accelerating progress towards meeting emissions targets**.

By beginning with a three-part framework: emissions auditing, strategic planning, and road map development, the most effective improvements can be prioritized. This approach led to the successful planning and implementation of renewable energy projects and remains a key component of EPCOR's plan to achieve net-zero operations company wide.

Figure 7: The Energy Distribution and Battery Storage Systems at E.L. Smith.

Lessons Learned

- **Lesson 1:**

  As climate change continues to be a key issue, a transition towards fully sustainable operations should be prioritized. All utilities would benefit from thoughtful planning of net-zero pathways to maintain climate-resilient water infrastructure for years to come.

- **Lesson 2:**

  Many governments have introduced grant funding (e.g., the Government of Canada's Low Carbon Economy Fund) to accelerate the adoption of new technologies that reduce GHG emissions. Incorporating provincial and/or federal grant funding into a project can help make an effective business case, but keep in mind most grants require baseline energy use

reports and an energy management information system in place before an application will be accepted.

- **Lesson 3:**

  Although climate stewardship is gaining traction in mainstream industries, there are still many third-party suppliers that do not publicly report GHG emissions generated from their manufacturing process. As a result, estimating scope 3 emissions from consumable goods remains a difficult challenge to overcome.

- **Lesson 4:**

  Strategic knowledge-sharing groups such as Canadian Water Network (CWN), Water Research Foundation (WRF), and Western Canada Water (WCW) are valuable resources for water utilities. Research into relevant case studies both before and during the net-zero planning process will go a long way towards achieving realistic climate change adaptation goals.

- **Lesson 5:**

  Measuring and mitigating GHG emissions impacts from the wastewater treatment process continues to be challenging, as most technologies in this sector are still under development.