Every Drop Counts

Reducing the Energy and Climate Footprint of Ontario's Water Use

EXECUTIVE SUMMARY

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Environmental Commissioner of Ontario

Annual Energy Conservation Progress Report 2016/2017 (Volume One)

Energy, Greenhouse Gas Emissions, Fresh Water and Money (Chapter 1)

Most Ontarians take clean, cheap, safe, ample water for granted. This is particularly true for the 85% (about 11.6 million) who have unlimited clean water delivered to their taps by their municipal governments, and who can flush unlimited wastewater "away" into municipal pipes. Tap water is a much better energy and climate choice than bottled water – 40 to 1000 times better, in terms of fossil fuel use.

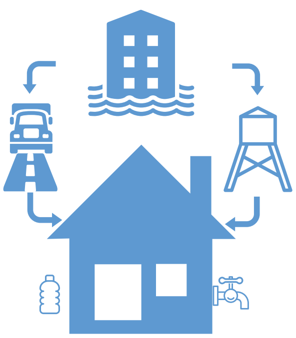

Figure 1.5. Greenhouse gas impact of tap water versus bottled water

But Ontario's **municipal water and wastewater systems have unnecessarily high energy use, greenhouse gas emissions, and fresh water demand.**

All levels of government are planning major investments in water infrastructure renewal in the coming years. This gives Ontario **a once-in-a-generation opportunity to cut energy costs and reduce the environmental footprint of municipal water and wastewater systems.**

Energy

Municipal water and wastewater systems are usually a municipal government's largest energy uses, consuming, on average, 38% of the energy. In 2011, water and wastewater systems used about 1,815 gigawatt-hours (GWh) of electricity (enough to power about 200,000 homes) and 40 million m^3 of natural gas (enough to heat approximately 15,000 homes). This energy use may rise, due to ever-more stringent treatment requirements, but these systems also have many opportunities to become more energy efficient, and even to generate renewable energy.

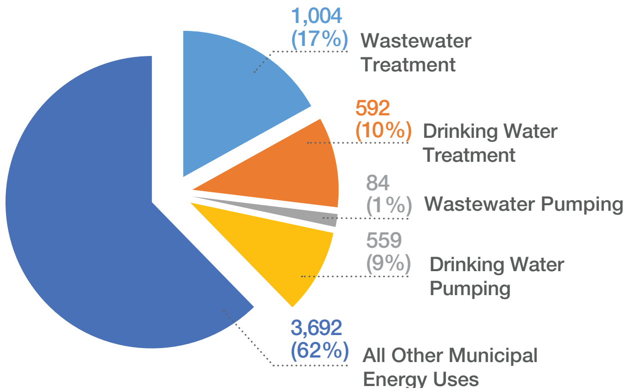

Figure 1.1. Ontario municipal energy consumption by facility type (eGWh), 2011

Note: "Other energy uses" include police stations, administrative buildings, community centres, and so on. It does not include municipal fleets or transit systems, for which energy use reporting is not yet required.

Source: O. Reg. 397/11, 2011 normalized data.

Greenhouse Gas Emissions

As shown in *Facing Climate Change*, the ECO's 2016 Greenhouse Gas Progress Report, Ontario urgently needs to reduce greenhouse gas (GHG) emissions and transition to a low-carbon economy. Municipal water and wastewater systems account for 32% of reported municipal GHG emissions; almost half of that comes from energy-intensive sewage treatment. The actual climate impact of these systems is even greater, because reported emissions only include GHGs from the energy that municipal systems purchase. Powerful GHGs from wastewater, such as methane, are not reported or are understated. These systems have many opportunities to reduce their direct and indirect GHG emissions.

Fresh Water

Water demand, land use development, and climate change are having significant impacts on Ontario's fresh water resources. Hotter, drier summers reduce the supply of water available to humans and to natural ecosystems precisely when municipal water demand peaks. Drought affected many Ontarians in 2016. Ontarians, especially those whose water does not come from the Great Lakes, can no longer assume they will always have as much water as they want whenever they want it. Better water conservation, and fewer leaks, could reduce the stress on our fresh water resources.

Money

Municipalities pay about $260 million dollars per year for the energy they use to operate water and wastewater systems. These costs are likely to rise, due to population growth, rising electricity rates, more energy-intensive treatment; and the ageing and historical underfunding of much existing infrastructure. Better energy and water efficiency could help keep costs down.

Energy Use in the Municipal Water Cycle (Chapter 2)

Municipal water and wastewater systems have opportunities to improve energy efficiency and reduce GHGs at all stages in the municipal water cycle:

- taking water from the natural environment;
- treating source water to meet drinking water regulatory requirements;
- delivering treated water to homes and businesses;
- collecting wastewater from homes and businesses; and
- treating wastewater to meet outflow requirements before discharge to the environment.

Municipal systems could save water, energy and money just by reducing leaks. They could also shift electricity demand away from peak periods, thus saving money and reducing GHGs.

Yet **municipal water and wastewater systems are energy efficiency laggards.** Their average electrical efficiency has improved only 1/10th as fast as the average Ontario customer, and reported leak rates are as high as 40%.

Why? Inadequate funding, data, incentives and attention have all played a part, plus a focus on short-term capital cost instead of lifecycle cost (including operating cost).

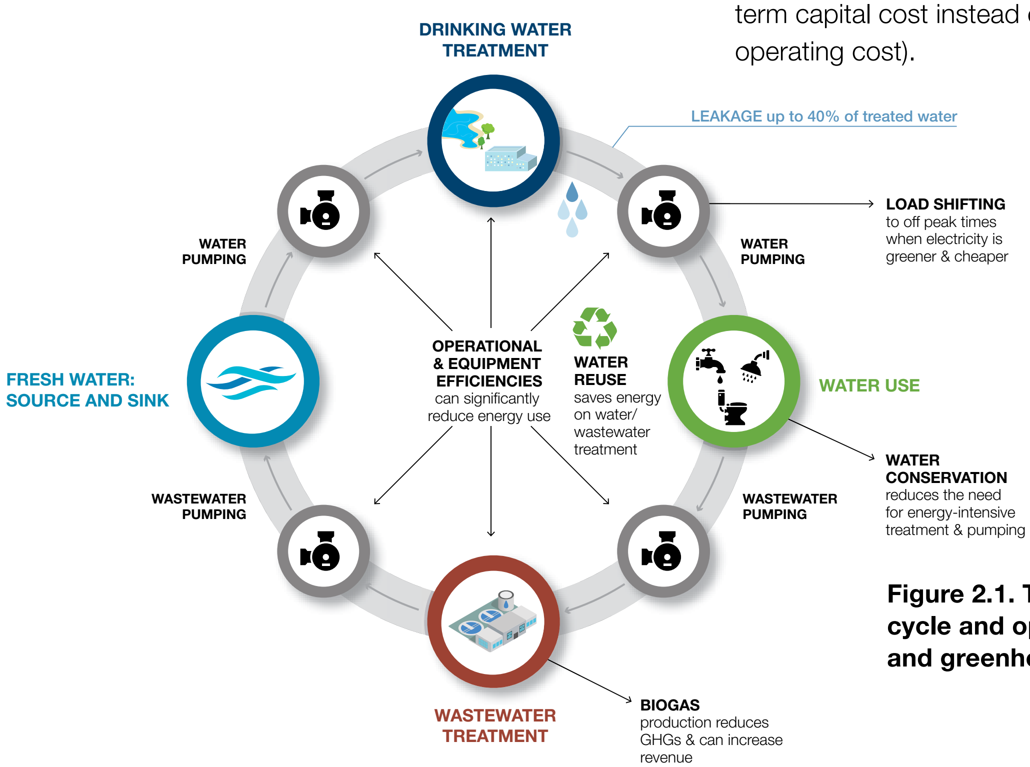

Figure 2.1. The municipal water cycle and opportunities for efficiencies and greenhouse gas reductions

Making Energy Reporting Work (Chapter 3)

Energy reporting and benchmarking are important tools for enhancing conservation. However, Ontario's energy reporting regulation for the broader public sector – O. Reg. 397/11 under the *Green Energy Act*, – does not give municipal water and wastewater systems adequate information and benchmarks.

Why? First, O. Reg. 397/11 **reporting on water and wastewater systems unwisely leaves out much of what energy managers need to know**, including:

1. Energy used in pumping facilities; and
2. Renewable energy produced at water and wastewater pumping and treatment facilities, including energy captured from wastewater.

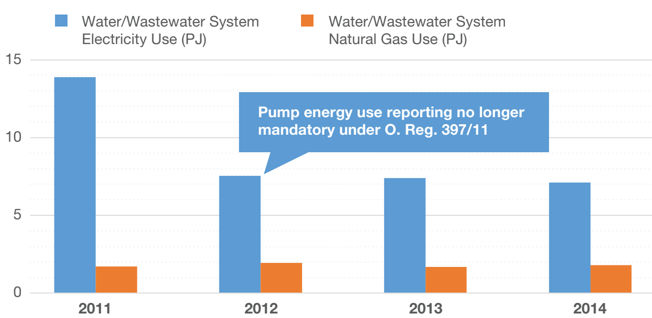

Figure 3.1. Reported provincial drinking water and sewage system energy use in petajoules (2011-2014)

Source: O. Reg. 397/11, raw data (2011-2014).

Second, O. Reg. 397/11 data are filed so late and are so poorly analyzed that they provide little value in benchmarking. Ontario should direct municipalities to submit their data via Portfolio Manager, which is online, free, and user-friendly. This tool can accept up-to-date utility data in electronic formats, and provide immediate analysis. It would help municipalities develop a meaningful energy and GHG baseline, benchmark against peers, identify savings opportunities, and monitor and verify results.

Third, the reporting system understates the climate damage of methane, by omitting methane emissions from wastewater and by underplaying the power of methane to contribute to climate change.

Can Asset Management Improve Energy Efficiency? (Chapter 4)

The provincial government now requires municipalities to have municipal asset management plans in order to receive infrastructure funding. These plans are supposed to help municipalities make "the best possible decisions regarding the building, operating, maintaining, renewing, replacing and disposing of infrastructure assets", i.e., to direct limited resources towards the most critical needs over the entire life cycle of all the municipality's infrastructure.

However, asset management planning needs adjustment to produce energy and environmental benefits for water and wastewater systems. Energy has a bigger impact on life-cycle costs for water and wastewater systems than for other municipal infrastructure. For these systems, asset management plans must:

- identify true life-cycle costs, including the long-term costs of operating water and wastewater infrastructure at acceptable service levels, including energy (and potentially greenhouse gas) costs; and
- trigger discussion on how to sustainably fund these costs.

By bringing long-term operating costs into all decisions on infrastructure design, construction, maintenance, repair and replacement, **asset management planning should motivate greater investment in energy efficiency.** It should also help provide adequate funding for such investments, by setting out an irrefutable case for higher water rates where appropriate.

In practice, asset management plans are of variable quality, are often based on inadequate data, and leave energy use out. Thus, Ontarians are rarely told the true cost of sustainable water and wastewater systems, and asset management planning does not yet drive better energy efficiency. Finding the funding for large efficiency projects remains difficult, even for projects that would quickly pay their way in energy savings.

The province is developing a new asset management regulation for municipalities. It should ensure that asset management plans incorporate long-term energy costs into all infrastructure decisions. It should also ensure that conserving water is considered before building new infrastructure.

Water Conservation (Chapter 5)

Ontario homes use a lot of water, averaging 200 litres per person per day, compared to 140 litres per person per day in water-efficient homes.

Municipalities save both money and energy when their water customers, such as households and businesses, use water efficiently. Individual water meters have reduced water waste, and could do the same in multi-unit buildings. Codes and standards for efficient products, in new and existing buildings, have done a lot to reduce indoor water use, and could do more.

Toilet	Faucet	Shower	Clothes washer	Leak	Bath	Other*	Dishwasher
24%	**20%**	**20%**	**16%**	**13%**	**3%**	**3%**	**2%**
123 L/day	**102 L/day**	**102 L/day**	**83 L/day**	**67 L/day**	**17 L/day**	**15 L/day**	**8 L/day**
TIP: Install water-efficient toilet (4.8 litres per flush or lower)	**TIP:** Install water-efficient faucets; Turn tap off while washing dishes, brushing teeth or shaving	**TIP:** Install water-efficient showerheads; Shorten showers; Reduce water temperature for energy savings	**TIP:** Choose water-efficient front-loading washer; Run with full loads; Use cold water setting for energy savings	**TIP:** Check whether water meter is running when no water is being used; test toilets for leaks using coloured dye	**TIP:** Reduce volume of bathwater; Reduce water temperature for energy savings	**TIP:** Use water-consuming appliances (e.g., humidifiers) only when needed	**TIP:** Run with full loads

*The "Other" category includes evaporative cooling, humidification, water softening, and other uncategorized indoor uses.

Figure 5.7: Indoor household water uses

Source: Water Research Foundation, *Residential End Uses of Water, Version 2*, 2016.

Note: Water use statistics based on a sample of approximately 1,000 single-family homes in 23 locations across the United States and Canada. Outdoor water use is not included.

Now **it is especially important to reduce outdoor water use,** e.g., lawn watering, which creates a large summer peak in municipal water demand. This peak demand is expensive to serve, and can be tough on aquatic ecosystems. It usually occurs at the same time as peak agricultural water demand, and when streamflow rates and soil moisture levels are at their lowest.

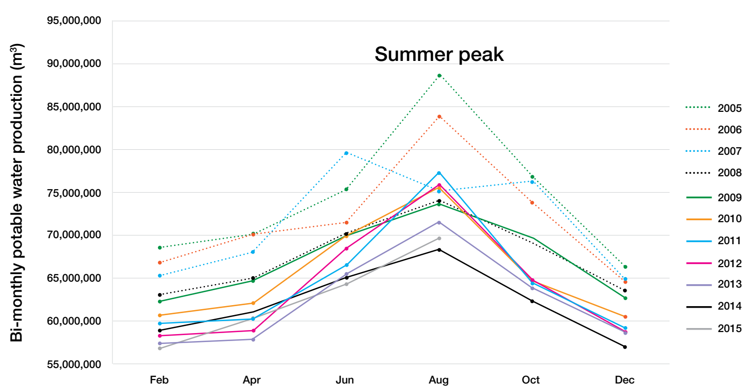

Figure 5.11: Toronto Water potable water production, 2005-2015

Source: City of Toronto

Water Reuse (Chapter 6)

Almost all water delivered by Ontario municipal water systems is treated to potable (drinking) standards, used only once, treated again as wastewater, and then discharged into surface waters. This once-through approach has substantial costs, in money, energy and GHGs, and can strain natural water sources. Yet little of the treated water is used for purposes that require potable water.

Many jurisdictions, including Israel, Singapore and California, have extensive programs to reuse partially or completely treated effluent from wastewater plants, but water reuse plays only a minor role in Ontario. Some Ontario municipalities are interested in water reuse, but are held back by the lack of clear provincial policies. In the long run, **Ontario municipalities could meet some non-potable water needs using treated wastewater effluent**, thus saving energy, money and GHG emissions, and relieving some seasonal water constraints. As part of its climate change adaptation plan, the province should set standards for water reuse.

Phosphorus (Chapter 7)

High nutrient levels (particularly phosphorus), climate change (intense rain events and rising temperatures) and land use changes are increasing toxic algal blooms in Ontario's lakes. The main sources of nutrients are agricultural and urban runoff ('non-point sources') and, to a much lesser extent, industrial and municipal wastewater ('point sources'). However, a key element of the province's response to the issue has been to require municipal wastewater facilities to reduce phosphorus effluent levels, in some cases to extremely low levels, significantly increasing capital and operating costs.

Lake Erie algal bloom, 2011.
Source: ESA Earth Online.

Meeting stringent phosphorus effluent standards at wastewater plants sometimes requires energy- and capital-intensive technology, which can be up to **five times more energy intensive** than the next highest treatment level. **Much larger reductions of phosphorus from non-point sources could be achieved and verified at a much lower cost** in energy, money and GHG emissions.

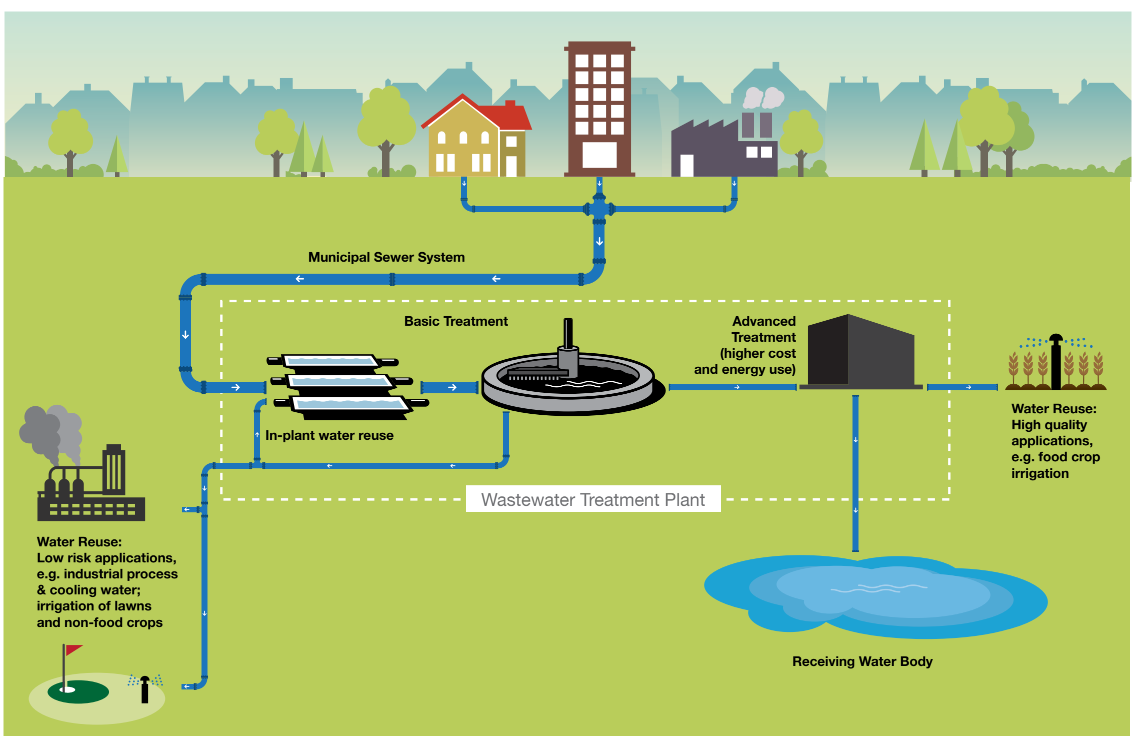

Figure 6.1. Centralized municipal water reuse

Energy from Sewage (Chapter 8)

Wastewater contains valuable energy that is now mostly wasted. Anaerobic digestion could capture much of that energy as methane (biogas) for on-site heating or combined heat and power; for vehicle fuel; or for injection into a gas utility as renewable natural gas.

Only a few Ontario wastewater plants use anaerobic digestion, and most of them flare (waste) at least some of the biogas. Wherever practical, **wastewater plants should become *renewable energy centres*** and generate biogas for productive use. This could be more cost-effective, and produce much more energy, if wastewater plants also digest concentrated organic wastes with the sewage, such as food waste, pet excrement, and/or agricultural residues. Co-digestion would also help keep organic wastes out of landfills, which is essential to Ontario's circular economy strategy, and would reduce landfill emissions of methane, a powerful GHG.

Bio-bus - showing where the fuel comes from

Source: Wessex Water/Julian James Photography.

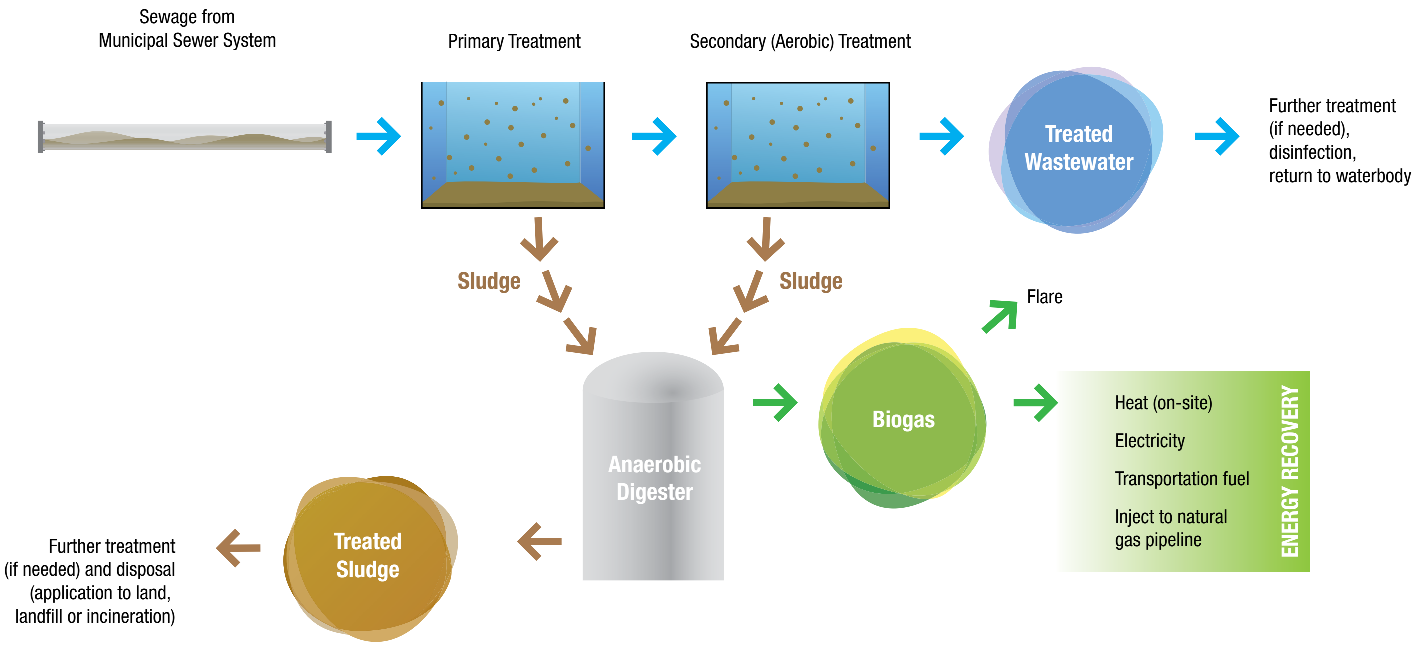

Figure 8.1. Anaerobic digestion and energy recovery from wastewater treatment

ECO Recommendations

Making Energy Reporting Work (Chapter 3)

The Ministry of Energy should make O. Reg. 397/11 energy reporting for municipal water and wastewater systems more accurate and useful by including:

- pumping facilities;
- energy produced on-site (e.g., biogas, solar), not just purchased energy; and
- methane, nitrous oxide, and fossil-source carbon dioxide emissions from wastewater.

The Ministry of Energy should enable or require municipal water and wastewater systems to report under O. Reg. 397/11 through Portfolio Manager and require municipalities to report their annual energy use on a timelier basis.

The Ministry of the Environment and Climate Change should include energy efficiency in the training and licencing requirements for drinking water and wastewater system operators.

Can Asset Management Improve Energy Efficiency? (Chapter 4)

As part of municipal asset management planning for water and wastewater infrastructure, the Ministry of Infrastructure should require consideration of:

- Energy and carbon costs in life-cycle cost analysis;
- Green infrastructure and non-infrastructure alternatives such as water conservation.

In water and wastewater infrastructure projects supported by provincial funding, the Ontario government should require consideration of opportunities to reduce energy use and greenhouse gas emissions.

Water Conservation (Chapter 5)

The Ministry of Municipal Affairs should amend the Ontario Building Code to place a greater emphasis on water efficiency and conservation, giving particular consideration to:

- Higher efficiency standards for fixtures, particularly toilets;
- Reducing summer peak outdoor water use;
- Ensuring that the plumbing design of multi-unit buildings is compatible with water metering of individual units;
- Expanding opportunities for reuse of greywater and rainwater, including greywater-ready plumbing design.

The Ministry of the Environment and Climate Change should: set water efficiency standards for toilets that apply at point-of-sale; and require water use reporting and water conservation plans for all broader public sector organizations and integrate this seamlessly with existing energy reporting requirements.

The Independent Electricity System Operator and gas and electric utilities should assess opportunities to integrate delivery of water conservation initiatives with existing energy conservation programs, particularly for whole home retrofits.

Water Reuse (Chapter 6)

The Ministry of the Environment and Climate Change should establish appropriate standards for water reuse.

Phosphorus (Chapter 7)

The Ministry of the Environment and Climate Change should implement phosphorus reduction programs that reduce loadings to sensitive surface waters, in a way that minimizes the energy use, financial costs, and greenhouse gas emissions needed to achieve reductions.

Energy from Sewage (Chapter 8)

The Ministry of Infrastructure should make anaerobic digestion and energy recovery technology eligible for water/wastewater infrastructure funding.

The Ministry of the Environment and Climate Change should, without reducing environmental protection, simplify the regulatory approvals process for energy recovery systems associated with anaerobic digestion at wastewater treatment plants, including systems that co-digest off-site organics.

The Ontario Energy Board should set a renewable natural gas content requirement and cost recovery criteria for gas utilities.

On energy use, GHG emissions, and fresh water demand, municipal water and wastewater systems can become less of the problem and more of the solution. Ontario should not waste this once-in-a-generation opportunity.