Module: Energy from Waste, Durham York Energy Centre

Introduction

Students will learn how the Durham York Energy Centre (DYEC) produces energy from the combustion of residential garbage that remains after maximizing waste diversion programs – rethink, reduce, reuse, recycle and compost – in Durham Region and York Region. Students will also explore how the DYEC is managed to ensure environmental compliance.

Learning Objectives

1. Describe historic landfills and how waste was managed in the past
2. Identify where Regionally owned landfills are located
3. Identify and describe the potential environmental impacts from historical landfills
4. Describe the Region's role in landfill monitoring, mitigation, and rehabilitation
5. Make a connection between the waste we create and the potential long-term effects of the waste
6. Identify and explain how waste management in the Region has evolved over time

Resources

- Durham York Energy Centre Website
- Energy from Waste Process Overview
- Durham York Energy Centre Virtual Tour

Background

Durham Region pursued an energy from waste facility (EFW) based on objectives in the Long-term Waste Management Strategy Plan, 2000 to 2020 to consider energy from waste for disposal of garbage. While the Region was developing its Long-term Waste Management Strategy Plan, Council also directed that there would be no new landfills in the Region.

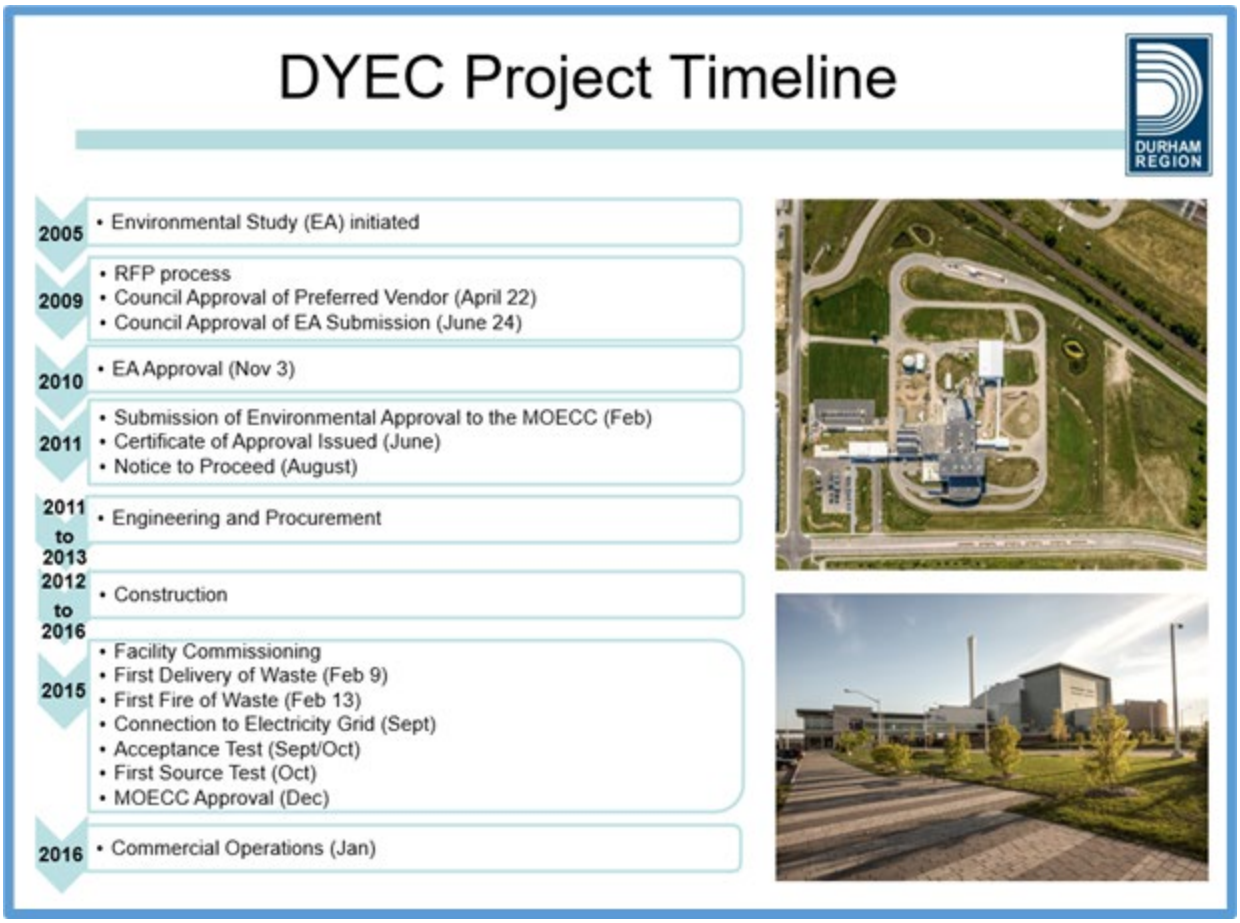
In 2005, both Durham and York Regions started a joint Environmental Assessment (EA). An EA is a legislated process that is used to predict and evaluate the potential environmental effects of a proposed project before the project begins. The EA must be reviewed and approved by the Ministry of the Environment, Conservation and Parks (MECP) prior to beginning the project. The EA included extensive public consultation to determine the preferred alternative for managing residential waste that remains after diversion, considering social, environmental, and economic factors.

By managing waste through the waste hierarchy, which establishes preferred program priorities based on sustainability and climate change mitigation impacts, the Regions can help ensure that disposal remains the least preferred option when managing waste. The Region of Durham recognizes the following Waste hierarchy: Rethink, Reduce, Reuse, Recycle, Recover and Disposal. EFW was selected as the most environmentally sound, sustainable, and cost-effective solution that allows the

Region to manage the garbage within our own regional boundaries. This solution was approved by both Durham and York Regional Councils in 2006. The EA was completed in 2009 and approved by the in 2010. In addition, the project required an Environmental Compliance Approval (ECA).

In Ontario, an ECA is required for all activities that discharge, or may discharge a contaminate to the natural environment. Simply put, an ECA is a legal document that a company must comply with its terms and conditions and all applicable regulations. In 2011, the MECP issued the Environmental Compliance Approval for the facility and engineering, procurement and construction commenced. Covanta (Operator) was the selected company to design, build, operate and maintain the DYEC that is located at 1835 Energy Drive in Courtice.

When construction was completed in 2016, commercial operations began which allowed the Region's to start processing waste at the facility. The facility is 100 per cent publicly owned by the Regional Municipality of Durham and the Regional Municipality of York. The DYEC project timeline from the 2005 EA initiation to commercial operations in 2016 is shown below.



DYEC Project Time, 2005-2016

Waste Processing at the DYEC and Electricity Generation

EFW is a process that takes waste and combusts (burns) it at extremely high temperatures (greater than 1,000°C). The resulting thermal energy (heat) produces steam, which turns a turbine generator

to produce electricity. After the garbage is completely burned, metal can be recovered and recycled from the ash that remains, reducing the need to mine raw materials to make new products.

The approved EA and ECA for the DYEC specifically directs that only household garbage remaining after Durham Region's and York Region's aggressive composting, recycling and reuse program, collected by our waste collection operators, can be received and processed at the DYEC. Therefore, the facility does not accept waste from other municipalities, sectors, or private haulers.

The ECA for the DYEC currently allows the facility to process up to a maximum of 140,000 tonnes of residential garbage per year - 110,000 tonnes of Durham garbage and 30,000 tonnes of York garbage per year. The Facility operates 24 hours a day, 7 days a week, 365 days a year (except for outages when planned and unplanned maintenance occurs). On average, 24 trucks arrive at the site per day. This includes garbage delivery trucks (approximately 20), trucks that supply required treatment material to the site and the trucks that remove ash and metal from the site.

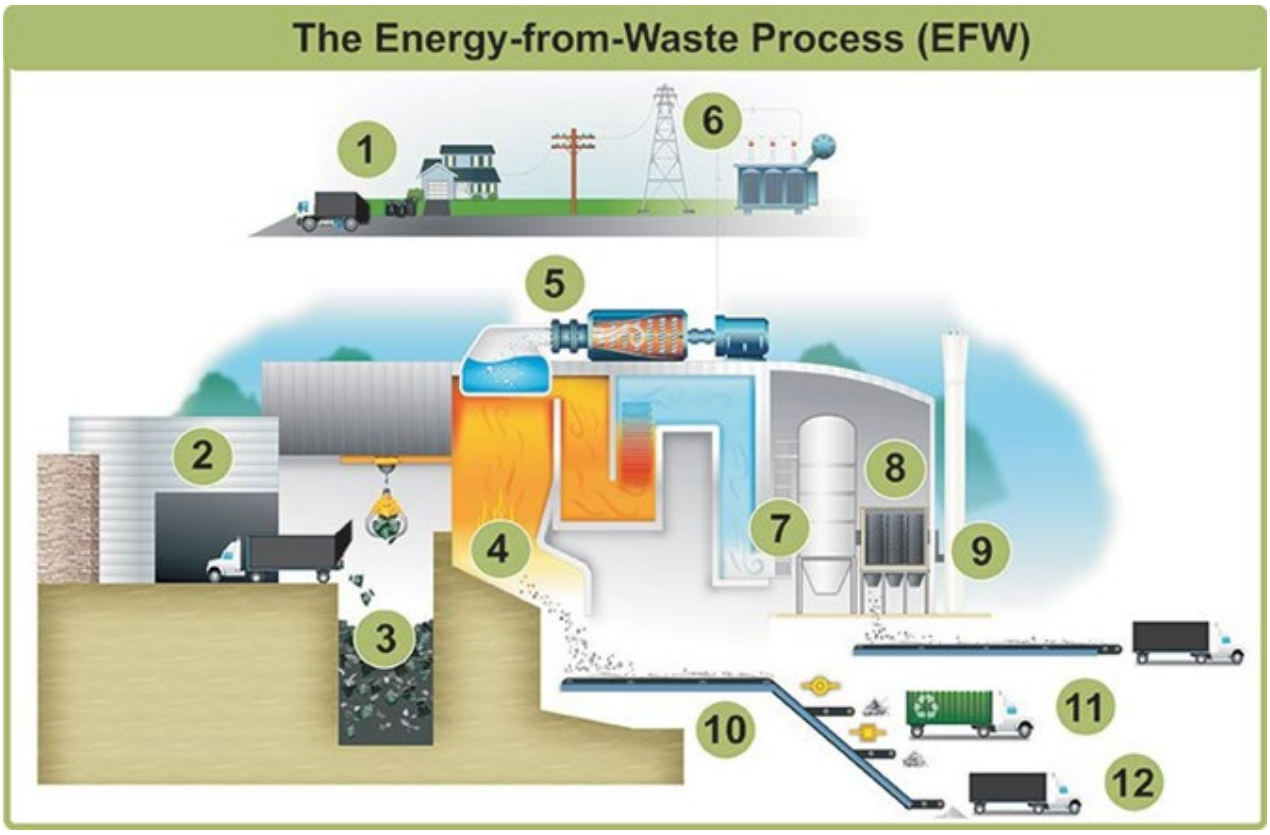
The EFW process reduces the volume of residential garbage by approximately 85 to 90 per cent. The largest portion of the garbage remaining after processing is, non-hazardous bottom ash, which resembles crushed rock. The smaller portion is fly ash with lime and carbon residue from onsite treatment which is captured in the air pollution control equipment. Ash at the DYEC is tested to ensure that it is non-hazardous before being shipped offsite. Bottom ash and treated fly ash are transported to landfill and used as daily cover material, reducing the need for soil or other cover materials.

Overall, the facility generates up to 17.5 megawatts of renewable energy. A portion (approximately 2 megawatts) of the electricity is used to power the operation of the DYEC. The remaining electrical energy is sold to the provincial grid. The energy is then delivered to the community – enough to power approximately 10,000 homes per year. The amount of electricity generated depends on how much garbage is combusted.

FUN FACT: Approximately 750kwh (net) electricity is generated from the combustion of 1 tonne of garbage.

Virtual Tour

Take our virtual tour to learn how garbage is processed to make energy. Some of the key stages of the EFW process are outlined in the diagram and description below:



Energy from Waste Process Overview

1. After you've sorted your recyclables and compost from your waste, only the garbage that is collected from your home is sent to the DYEC for processing.
2. After being weighed, delivery trucks unload the residential garbage in an enclosed building which is maintained under negative pressure to prevent potential odours from escaping the building.
3. The garbage is contained in a large concrete storage pit and mixed with an overhead grapple crane.
4. The crane feeds garbage into a combustion chamber where it is burned at extremely high temperatures (greater than 1,000°C) in a self-sustaining process.
5. Heat from the combustion process boils water to create high-pressure steam. The steam turns a turbine-driven generator to produce electricity.
6. Electricity is sold to the provincial grid and used to power homes and businesses.
7. Air pollution control equipment is used to cool, collect, and clean combustion gases. This equipment operates under stringent regulatory standards. The table below shows the pollutant control devices used for flue gas treatment at the DYEC. Additional information regarding these pollutant control devices can be found on the DYEC website.

The Regional Municipality of Durham - Waste Management Services
If this document is required in an accessible format, please contact schoolprograms@durham.ca

2022-08-25

Target Pollutant(s)	Pollutant Control Device
Nitrogen Oxides (NOx)	Selective Non-Catalytic Reduction (SNCR) aqueous ammonia injection and Covanta Very Low NOx (VLN) System. SNRC - An air pollution control method that converts nitrogen oxide into elemental nitrogen and water by injecting a chemical reagent, typically urea, or another ammonia-based solution into the flue gas. VLNTM - The Durham York Energy Centre is equipped with a patented technology to reduce Nitrogen Oxides (NOx) referred to as the VLN process.
Carbon Monoxide	Martin Integrated Combustion Control System.
Hydrogen Chloride, Sulfur Dioxide	LUHR Dry hydrated lime injection with fly ash recirculation - Lime is used to neutralize acidic chemicals compounds from flue gas before they reach the atmosphere.
Particulate Matter, Lead, Cadmium	LUHR Six compartment fabric filter baghouse - A component of the air pollution control equipment consisting of a series of fabric filters through which flue gases are passed to remove particulates prior to release to the atmosphere.
Mercury, Dioxins/Furans	Powder activated carbon (PAC) injection is used in air pollution control systems to control heavy metals and dioxins/furans. PAC has a large surface area which allows the contaminants to adsorb (e.g., stick to) the carbon.
Dioxins/Furans	Furnace temperatures >1,000 degrees Celsius for 1 second.

8. Particulate matter emissions, "fly ash", are controlled primarily through a baghouse (fabric filter). Fly ash is treated on-site to render it inert and non-hazardous. It is tested to ensure that it is safe to dispose of in a similar manner to bottom ash (see #12 below).
9. Emissions and other operating criteria are continuously monitored to ensure compliance with regulatory standards.
10. Residual material from the combustion chamber is collected for processing and metals recovery.

11. Ferrous and non-ferrous metals are recovered for recycling.
12. Remaining residual material, “bottom ash”, is inert and non-hazardous. The bottom ash is tested to confirm that it is safe to dispose of in a landfill or for beneficial reuse purposes. While the DYEC currently sends processed ash to landfill for use as alternative daily cover, some jurisdictions are recovering ash for use in construction materials. The DYEC continues to look for alternative uses for the final processed ash from the facility.

DYEC Water Consumption

The DYEC uses potable drinking water which is treated further onsite to ensure there are no fine particles remaining in the water than could damage the facility’s equipment. Water is used in many areas throughout the process, including within the boilers tube-lined walls which are heated to create the steam which is then used to produce electricity.

This facility operates with a "zero discharge" of process water to the municipal sanitary system. That means that all wastewater generated on-site is treated and reused, except for the office washrooms and kitchen facilities. The air-cooled condensers condense exhaust steam from the steam turbine back into water that is returned to the boiler without water loss.

DYEC Odour Mitigation

As required by the facility’s ECA, the potential for odours is closely monitored at the DYEC. Regular odour inspections are completed by both Regional and Operator staff to ensure there are no offsite impacts occurring due to odour from DYEC operations. In fact, the facility was designed to prevent the release of odours.

All trucks delivering waste to the DYEC are covered and the tipping hall, where municipal waste is received and unloaded, is located indoors. The air in the tipping hall is drawn through large fans and used in the combustion process. This ensures the tipping hall remains under negative air pressure to contain any dust and odours generated during the delivery and storage process. Additionally, odours are not emitted from the DYEC stack. Due to the high combustion temperatures, all sources of odour are destroyed inside the boiler.

DYEC Environmental Monitoring

Human health and the environment are primary concerns for both Durham Region and York Region. As such, the Regions have undertaken a series of detailed studies on air emissions, health, traffic, noise, groundwater and surface water to assess any potential effects from the DYEC to ensure that residents and the environment are protected.

The DYEC follows strict monitoring and compliance requirements identified and mandated by our ECA. All monitoring plans for the DYEC have been developed in consultation and approved by the MECP.

Environmental monitoring at the facility includes:

- Continuous emissions monitoring systems
- Stack testing

- Ambient (or local) air
- Ash sampling
- Groundwater and surface water
- Odour
- Soil
- Noise

Results from the DYEC environmental monitoring program can be found on the DYEC project website.

By using pollution control systems and proven, reliable energy from waste technology, the DYEC meets the most stringent environmental standards.

Environmental Benefits of Energy from Waste

Sustainable Waste Management

The DYEC recovers valuable materials that would otherwise be lost, including ferrous and non-ferrous metals, reducing the amount of raw materials that needs to be mined and was sized to promote additional waste diversion efforts including recycling and composting.

Climate Change

EFW is recognized as a net reducer of greenhouse gas emissions by the Global Roundtable on Climate Change (GROCC), the Intergovernmental Panel on Climate Change (IPCC), the U.S. Environmental Protection Agency (U.S. EPA), the Kyoto Protocol and the European Union due to the following:

- Reduced methane (CH4) emissions from landfills. One tonne of methane in the atmosphere is equivalent to at least 25 tonnes of carbon dioxide. Garbage in a landfill will break down over several decades and release methane. The EFW process generates minimal methane emissions.
- Reduced carbon dioxide (CO2) emissions from trucks. Local EFW facilities mean that long-haul transportation methods for shipping garbage to distant landfills are avoided hence CO2 emissions are reduced.
- Reduced carbon dioxide (CO2) emissions from fossil fuel combustion. When a megawatt of electricity is generated by an EFW facility, CO2 emissions that would have been generated by a fossil-fuel fired power plant are avoided.
- Reduced carbon dioxide (CO2) emissions from metals production. Recovering metals for recycling saves energy and avoids CO2 emissions that would have been emitted if raw materials were mined and new metals were manufactured.

Energy Diversity

The DYEC generates base load electricity transferable to the provincial grid. Heat is used from the process as preheat for the waste to be fed to the facility. In addition, the DYEC has the ability to recover energy in steam for potential use in immediate vicinity for district heating / cooling.

The DYEC turbine generator allows for the extraction of steam for use in a district heating system. However, there is no business case to proceed with district heating currently. The Regions are continuing to assess the potential and business case for heat utilization at other local facilities, or within other potential projects.

Conclusion

The DYEC produces energy from the combustion of residential garbage that remains after maximizing waste diversion programs – rethink, reduce, reuse, recycle and compost – in the Regional Municipality of Durham and the Regional Municipality of York.

Energy from Waste is a sustainable waste and energy solution that ensures the materials discarded every day are utilized to their fullest potential to preserve the world's valuable resources and generate clean energy for our communities and the world we live in.

Curriculum Objectives

The Ontario Curriculum, Grade 9 and 10: Canadian and World Studies, 2018 (revised)

- Issues in Canadian Geography, Grade 9, Academic (CGC1D)
- Issues in Canadian Geography, Grade 9, Applied (CGC1P)
- Civics and Citizenship, Grade 10, Open (CHV2O)

The Ontario Curriculum, Grades 11 and 12: Canadian and World Studies, 2015 (revised)

- Regional Geography, Grade 11, University/College Preparation (CGD3M)
- World Geography: Urban Patterns and Population Issues, Grade 12, University/College Preparation (CGU4M)
- Environmental Resource Management, Grade 12, University/College Preparation (CGR4M)
- World Issues: A Geographic Analysis, Grade 12, College Preparation (CGW4C)
- Living in a Sustainable World, Grade 12, Workplace Preparation (CGR4E)

The Ontario Curriculum, Grade 9 and 10: Science, 2008 (revised)

- Science, Grade 9, Academic (SNC1D)
- Science, Grade 9, Applied (SNC1P)
- Science, Grade 10, Applied (SNC2P)
- Science, Grade 10, Academic (SNC2D)

The Ontario Curriculum, Grade 11 and 12: Science, 2008 (revised)

- Environmental Science, Grade 11, University/College Preparation (SVN3M)
- Chemistry, Grade 11 (SCH3U)
- Physics, Grade 12 (SPH4U)
- Chemistry, Grade 12 (SCH4C)
- Physics, Grade 12 (SPH4C)
- Science, Grade 12 (SNC4E)