

RETROFIT OF THUNDER BAY GENERATING STATION - UNIT 3, CANADA

BEST PRACTICE FACT SHEET

KEY INFORMATION

Plant owner:	Ontario Power Generation (OPG)
Plant name:	Thunder Bay Generating Station
Location:	Thunder Bay, Canada
Industry sector:	Fossil firing power
Main product of plant:	Electricity and heat
Retrofit measure:	Change from coal combustion to combustion of advanced biomass pellets
Beginning of retrofit:	2014
Start-up after retrofit:	2015
Capital Expenditure:	3 Million Canadian Dollars (approx. 2 Million EUR)



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TECHNICAL DATA

Electricity production capacity [MW]
Heat production capacity [MW]
Main fuel
Calculated annual GHG emissions [tCO ₂ eq]
Estimated specific GHG emissions [gCO ₂ eq/kWh _e]

INITIAL STATE

160
-
Coal
Not available
1018

AFTER RETROFIT

160
-
Advanced pellets
Not available
78

INITIAL STATE

The Thunder Bay Generating station began operation in 1963, with a 100 MW unit. Two additional units (Unit 2 and 3), each one with a nominal capacity of 160 MWel, entered service in 1981. Unit 2 and 3 include a four-corner tangentially fired boiler, equipped with RP 783 pulverizers. The plant was initially designed to burn Western Canadian lignite coal and in 1996 was converted to Northern Powder River Basin coal.

“The use of advanced pellets resulted in significant CAPEX savings and a shorter project schedule.”

RETROFIT

MOTIVATION AND DECISION

OPG began a significant biomass test program in 2006, in response to the Ontario provincial regulation O. Reg. 496/07 “Ontario’s Cessation of Coal Use”. This regulation prohibited the use of coal as a fuel to generate electricity in the province of Ontario as of 31/12/2014. Engineering studies were conducted for all OPG coal-fired stations to evaluate the feasibility of converting to natural gas, wood pellets or a combination of the two. The evaluation of 2nd generation wood pellets began in 2010. In December 2012, OPG was asked by the Ontario Ministry of Energy to explore the potential to convert Thunder Bay Unit 3 from coal to 100% biomass firing using a low capital cost approach.

PLANNING AND EXECUTION

In 2013, after detailed testing on different feedstocks, thermally treated wood pellets from the company Arbaflame AS (Norway) were selected as fuel for the retrofitted plant. The thermal treatment provides properties similar to coal, therefore pellets can be used in coal plants with limited plant modifications. At Thunder Bay, modifications were necessary for the material handling systems (unloading, conveyance, transfer points for dust and fire control) and to the combustion systems (pulverizers, controls and burners) to optimize combustion of the fuel. The retrofit project was carried out in 2015 and was completed under budget and ahead of schedule. In February 2015, Unit 3 entered service as the first unit worldwide to employ thermally upgraded wood pellets.

1981

UNIT 3 STARTS
OPERATION

2012

DECISION TO
RETROFIT UNIT 3

2015

RETROFIT

2015

START OF
OPERATION BASED
ON BIOMASS

CURRENT STATE

Thunder Bay-Unit 3 is fired with steam exploded pellets. The thermal treatment improves three characteristics of the pellets:

- **Weatherability:** An exterior film makes the pellets water resistant, allowing the storage outdoors. This avoids most capital expenses that are necessary for a white wood pellet conversion project.
- **Dust generation:** The increased durability creates less dust and allows to handle the pellets like coal, using the same fuel handling system
- **Milling:** Advanced wood pellets are more brittle than a traditional white pellet, offering the potential for some degree of additional size reduction in an existing coal pulverizer.
- **Energy density:** the higher energy density improves transportation economics and production capacity

At Thunder Bay Generating Station, pellets are delivered by truck from the harbor and stocked on the yard. From here they are scooped or pushed by a front-loader into a ground-level receiving bin that evenly feeds the fuel onto a conveyor belt. The belt takes the pellets into five 800 m³ hoppers located in the boiler house. From the hoppers, pellets are fed via rotary valves into the pulverizers that grind the pellets to a pre-determined particle size. The pulverized pellets are then fed into the boiler.

The Thunder Bay Station currently provides peak power to supplement the base generation that comes from OPG's nuclear and hydroelectric power plants. Therefore, because of a lack of demand, the plant is operated on average for only 2.5 days/year. In May 2018, significant corrosion damage was found in the boiler, making the plant non-operational. This corrosion was not related to biomass operations. However, given the high capital repair costs and limited time remaining on the contract, it was decided to shut down the station.



Steam exploded pellets used at Thunder Bay Generating Station
(Copyright of photo: Arbaflame AS)



View of the fuel yard
(Copyright of photo: Ontario Power Generation)

IMPACT

The ability to use thermally treated pellets with only minor modifications to the plant enabled a low capital cost project approach that is not possible with conversions based on traditional wood pellets. This resulted in significant savings for OPG. Moreover, a recent study estimated that, thanks to the retrofit, the GHG emissions of the plant were reduced by more than 10 times.

“In April 2014, OPG burned its last piece of coal to generate electricity in Ontario. This move off coal was North America’s single largest climate change initiative, equivalent of taking 7 million cars off the road”

SOURCES

<https://www.iea-coal.org/worlds-first-coal-to-biomass-conversion-using-advanced-wood-pellets/>

<https://bioenergyinternational.com/heat-power/worlds-first-advanced-biomass-power-plant-conversion-nears-completion>

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Mager R, Task 32 and Wood Pellets Association of Canada 18-22/09/ 2017, Ottawa, Canada

Marshall, The Worlds First Coal to Biomass Conversion Using Advanced Wood Pellets, Power-Gen International, Las Vegas, USA, 5-7/12/2017

MORE INFORMATION ABOUT THE THUNDER BAY GENERATING STATION

Website <https://orsted.com> Contact info@orsted.com

ONTARIOPOWER
GENERATION

THE BIOFIT PROJECT

This best practice factsheet was prepared within the BioFIT project. The project aims to facilitate the introduction of bioenergy retrofitting in Europe’s industry. Target industries are

- First-generation biofuels
- Fossil firing power
- Pulp and paper
- Combined Heat and Power (CHP)
- Fossil refineries

Success factors of the best practice case studies are used as basis to develop **10 concrete bioenergy retrofitting proposals** (2 per industry sector) and to facilitate the two-way dialogue with industry in dedicated working groups. The overall target is to integrate bioenergy and biofuels in existing industrial installations and encourage others to follow the existing examples.

Project website <https://www.biofit-h2020.eu> Contact reumerman@btgworld.com

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 **BIOFIT**
Bioenergy Retrofits for Europe’s Industry

