

Comparing Fuel Oil and Biomass Use in Heating Systems

Objective: To explore the chemical nature of 2 heating fuels

Introduction: As concerns about climate change rise, alternate fuels are being sought out to replace some of the use of fossil fuels. In the NWT fuel oil (a petroleum product) is often used as a heating source, resulting in the production of greenhouse gases. In attempts to reduce these gases, one alternative that is being explored is the uses of wood pellets, which when processed and burned efficiently are considered carbon neutral. This lesson aims to compare the use of both of these fuels as a heating source.

Curriculum Connections:

Unit A – 1.1-1.2sts, 1.1-1.2s, 2.1-2.3sts, 2.2s

Unit C – 1.1-1.2k, 2.4k, 2.3s

Supplies / Materials:

- Materials for combustion demonstration: eye protection, reaction vessel and stopper, beaker, alcohol (See **Resource 1**)
- Computers for research and/or handouts



SCIENCE FOCUS

Lesson Subject

Chemistry 30

Topic

Comparing Heating Fuels

Location

Laboratory and Classroom

Length

50 minutes



Hook: Demonstrate combustion (e.g. **Resource 1**) and/or have students do this in the lab. If not practical, watch: https://www.youtube.com/watch?v=UygUcMkRy_c. Discuss the important components of combustion – fuel, oxygen, and ignition. Guiding questions - What is produced? (Energy/heat). This is an exothermic reaction. What can we use this for?

Intro Activity: Have students look at their community energy profile (see **Resource #2** below). Guiding questions - How much energy is coming from fuel oil? What percent of greenhouse gases? What is fuel oil? (Mainly diesel oil in the NWT (1))

¹ Standing Committee on Energy, the Environment and Natural Resources. 2014. Powering Canada's Territories. Online at: <http://nwtbiomassenergy.ca/wp-content/uploads/2015/11/Power-the-North.pdf>

Main Activity:

- 1) Have students compare the energy content of biomass and fuel oil (2): How many L of heating oil is required to match 1 tonne of pellets? How can we compare tonnes to liters? If time permits ask students to look up the density (weight) of 1 L of diesel oil.

Energy content of Heating Fuels

Wood Pellets 19,700 MJ per tonne

Heating Oil 38.4 MJ per litre

- 2) Have students look up the reactions for wood (focus on cellulose) and diesel combustion in **Resources 2 and 3**.
- 3) Have them use **Resource 4** to estimate the molar entropy of the reactions.
- 4) Have students determine the amount of carbon dioxide produced when comparable energy is created.

Conclusion / Review: Are wood pellets a feasible alternative to fuel oil? Why might they be considered carbon neutral?

Resources:

1. Combustion reaction: <http://www.rsc.org/learn-chemistry/resource/res00000708/the-whoosh-bottle-demonstration?cmpid=CMP0000523>
2. Community Energy Use Profiles – click on your community at <http://aea.nt.ca/communities>
3. Diesel fuel combustion: <https://chembloggreen1.wordpress.com/>
4. Combustion of Wood: <http://chemistry.stackexchange.com/questions/1254/what-are-the-chemical-reactions-behind-fire>
5. Fuel oil combustion: <http://www.personal.utulsa.edu/~kenneth-weston/chapter3.pdf>

Extension:

1. There are many different ways to make changes to reduce greenhouse gas emissions (GHG). Brainstorm with your students a few ideas...if you need suggestions go to the publication "Steps for Climate Friendly living" at

<http://climatechangeconnection.org/resources/climatechangeconnectionpublications/>

2. Have students participate in NatureWatch to help contribute data to study the impacts of climate change: <https://www.naturewatch.ca/>

²Arctic Energy Alliance. 2009. NWT Community Wood Pellet Study. Online at:
<http://aea.nt.ca/research/research-2>