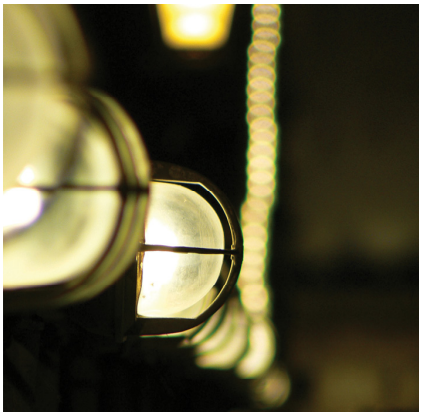
University of Saskatchewan

Smart Purchases Big Impact

Sustainable Purchasing Guide

Fuels

Sustainability... your university, your world



University of Saskatchewan

Fuels

Introduction

This section provides information on currently available options for ***fuels*** that can help to move the University of Saskatchewan toward its sustainability goals. Living within the boundaries of our sustainability goals requires us to apply two main strategies:

Dematerialization requires that we reduce the amount of materials as much as possible; and that we continually move toward the use of 100% recycled content.

Substitution requires that we find less harmful materials to replace those that currently damage and are not recyclable.

Sustainable purchasing is about including social, environmental, financial and performance factors in a systematic way. It involves thinking about the reasons for using the product (the service) and assessing how these services could be best met. If a product is needed, sustainable purchasing involves considering how products are made, what they are made of, where they come from and how they will be used and disposed.

Finally, remember that this is an evolving document – it will change with new information as our understanding of sustainability impacts and potential solutions improves.

Purchasing Services

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Smart Purchases Big Impact

Wherever possible **CHOOSE** products that employ a combination of characteristics listed in the left hand column, and **AVOID** products that demonstrate characteristic in the right-hand column.

CHOOSE	AVOID
• Fuel efficiency • Low in sulfur and/or additives • Low in carbon content (such as natural gas or propane) • Mixtures with renewable products (biodiesel or ethanol)	• High in carbon content (such as gasoline or diesel)

Option: Use Fuel Efficiently

Strategy: Dematerialization (SO 1, 2, 3, 4)

Fuel efficiency can be influenced in three primary ways: (1) through vehicle choice, (2) the way in which the vehicle is driven; (3) how the vehicle is maintained. Look for the EnerGuide label on vehicles that provides information on a vehicle's fuel efficiency. The purchase of a hybrid gas-electric or other fuel-efficient vehicle will reduce, although not eliminate, many emissions associated with the combustion of fuels.

Personal driving habits also have a large impact on fuel consumption. Driving less, and in a more efficient manner can control the costs of operating a vehicle by minimizing emissions. Keeping vehicles well-maintained also improves their operating efficiency.

Option: Consider Natural Gas

Strategy: Substitution (mainly SO 1)

Natural gas burns cleaner, more efficiently and more completely than gasoline or diesel fuel. This means that it produces fewer toxic pollutants and greenhouse gas emissions.

Many manufacturers offer vehicles that run on natural gas. However, the storage of natural gas in vehicles and the refueling infrastructure are technical challenges, and on average vehicle costs are 30-50% higher than gasoline consuming vehicles. Conventional gasoline vehicles can be converted to natural gas and the lower price of natural gas compared with gasoline will help to offset much of the initial cost difference.

A key consideration in converting to natural gas is the proximity of fueling stations. If they are too far away, efficiencies gained through a better fuel may be lost through longer travel distances.

Although it is a cleaner fuel than gasoline or diesel, natural gas is nevertheless extracted from the earth's crust and has many of the same sustainability impacts associated with gasoline and diesel. For instance, exploration and production processes can systematically encroach into natural areas and chemical compounds are often released through spills and leaking storage facilities in addition to regular emissions.

Option: Consider Propane

Strategy: Substitution (mainly SO 1)

Propane is produced as a by-product of natural gas processing and oil refining. Propane burns cleaner, more efficiently and completely than gasoline or diesel fuel and produces far fewer toxic pollutants and greenhouse gas emissions. The use of propane as an alternative fuel reduces greenhouse gas emissions and is generally less expensive than gasoline.

A key consideration in converting to propane is the proximity of fueling opportunities. If they are too far away, efficiencies gained through a better fuel may be lost through longer travel distances.

Although propane burns cleaner, it is nevertheless is derived from oil or natural gas, so sustainability impacts are not entirely eliminated.

Option: Consider Biodiesel

Strategy: Substitution (mainly SO 1)

Biodiesel is an alternative to diesel fuel that is made from vegetable oils, waste oils or animal fats. Compared to conventional diesel, biodiesel combusts more completely and produces fewer greenhouse gas emissions. In addition, organic waste used to produce biodiesel may have otherwise been dumped into landfill or discarded into the environment, possibly releasing methane.

Option: Use Eco-Logo Certified Ethanol

Strategy: Substitution (mainly SO 1)

Ethanol is a liquid alcohol made of oxygen, hydrogen and carbon. It is obtained from the fermentation of sugar or converted starch contained in grains and other agricultural feedstocks. Ethanol can be processed into industrial ethanol or fuel-grade ethanol. In Canada, ethanol is made principally from corn and wheat, using a milling process. Canadian farmers, notably in Saskatchewan, are becoming increasingly aware of ethanol's economic benefits. Fuel ethanol is used in Canada as an additive to gasoline in concentrations of 10% ethanol (E-10) or in much higher proportions. E-10 can be used in all gasoline vehicles made since the 1970s. Flexible fuel vehicles can use either gasoline or gasoline-ethanol blends with concentrations of up to 85% ethanol (E-85).

Option: Consider Hydrogen

Strategy: Substitution (mainly SO 1, 2, 3, 4)

Hydrogen can be combined with oxygen in fuel cells to power vehicles, and depending on the source of the hydrogen, with zero or very low emissions.

Most automobile manufacturers are now working on prototypes for hydrogen fuel cell vehicles. Due to the variety of potential fuels available for conversion to hydrogen, fuel cells may be a viable energy technology that offers significant environmental, energy efficiency, supply and economic benefits. Currently, there are still many barriers to their use in vehicles, including the lack of a hydrogen distribution infrastructure, high capital costs for fuel cells and hydrogen production technologies and challenges related to hydrogen storage. Still, efficient hydrogen powered vehicles may be the best long-term fuel solution.

Arriving
at the currently preferred options

1. Identify the service

Fuels are used to power vehicles that provide transportation services for both people and materials.

2. Assess the need

Meeting the needs of campus operations requires the movement of people and materials. In many cases, this function is fulfilled through motorized transportation that requires fuel.

3. Identify the contents

ThThe two most common fuels for light duty vehicles (cars, van, pick-up trucks) are gasoline and diesel, as well as B5 and B20 biodiesel in heavy duty vehicles.

Gasoline is a complex manufactured mixture that does not exist naturally in the environment. Gasoline is a colorless, pale brown, or pink flammable liquid; that is produced from ***crude oil***, and typically contains more than ***150 chemicals***. The method by which gasoline is made determines the chemicals that are present in the gasoline mixture, and the actual composition of gasoline varies somewhat depending on the source of the crude oil and the manufacturer.

Diesel fuel is a complex liquid mixture of hydrocarbons with a higher number of carbon atoms than gasoline. It is also produced from the refining of crude oil. Diesel contains approximately 18% more energy per unit of volume than gasoline, which along with the greater efficiency of diesel engines contributes to greater fuel economy than gasoline. In addition, diesel requires less refining, generally resulting in lower costs. However, diesel also results in higher emissions of a variety of contaminants (discussed below).

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4. Identify sustainability impacts

i. ....systematically increasing concentrations of substances from the earth's crust?

- The entire of lifecycle of both gasoline and diesel, including extraction, production, transportation, refining of crude oil and use in consumer vehicles, is energy intensive, relying on the ***combustion of fossil fuels***. The combustion of fossil fuels leads to an increase in concentration of substances from the earth crust in nature, in the form of carbon dioxide (CO2), carbon monoxide (CO), methane (CH4) and sulfur oxides (SOX). Increasing concentrations of these substances in nature can contribute to a number of negative effects such as climate change, and acid rain, as well as negative human health impacts.

ii. ...systematically increasing concentrations of substances produced by society?

- Gasoline and diesel are liquid mixtures of several hundred types of complex hydrocarbons. Emissions resulting from the combustion of fossil fuels include known or probable human carcinogens such as ***benzene, formaldehyde, acetaldehyde*** and ***butadiene***. With diesel this list can be extended to include ***polyaromatic hydrocarbons*** (PAHs) and ***nitro-polycyclic aromatic hydrocarbons*** (N-PAHs). Natural gas contains much fewer complex hydrocarbons, but results in the formation of formaldehyde when combusted.
- ***Additives are also used in gasoline*** to improve performance. For example, MTBE (***methyl tertiary-butyl ether***), which replaced lead additives, allows gasoline to combust more completely. MTBE and other chemical compounds may enter ecosystems through leaks in underground storage tanks and poor handling practices. Low levels of MTBE can make potable water supplies undrinkable due to its offensive taste and odour.
- Other complex compounds are also released into the ecosystem from production, transport and storage of fossil fuels. Examples include ***ethylbenzene*** and ***xylene*** from glycol dehydrator systems at well site facilities.
- The ***combustion of fossil fuels*** produces a number of chemical compounds, including ***nitrogen oxides*** (NOX) and ***ammonia*** (NH3) that build up in the atmosphere. Nitrogen oxides are precursors to the formation of acid rain. Ammonia also facilitates the formation of smaller particles that negatively affect human health.
- Combustion of fossil fuels results in an increase in ***volatile organic compounds*** (VOCs). Both nitrogen oxides and volatile organic compounds are procurers to the formation ground level ozone, a major constituent of smog.

iii. ...systematically degrading nature by physical means?

- The activities associated with the ***exploration and extraction of fossil fuels*** may systematically degrade nature, particularly in cases where land is disturbed and not reclaimed or restored.
- ***Fossil fuel infrastructure***, such as pipelines or refineries, can disturb existing natural areas by fragmenting habitats, limiting overall land area available to wildlife, impacting biodiversity and negatively affecting the overall health and resilience of ecosystems.

iv. . . .systematically undermining people's ability to meet their basic human needs?

- Particulate matter (PM) produced by the combustion of fossil fuels, and associated construction and mining activities have a negative effect on ***human health***. Some PM has been linked to cancer including carcinogenic fuel combustion products found in some forms of diesel exhaust.
- SOX, NOX, and CO emitted by the combustion of fossil fuel may result in a number of ***negative human health*** effects such as breathing discomfort, respiratory illness and cardiovascular disease.
- During the production of natural gas, hydrogen sulphide (H2S) released from "sour" gas is a significant ***public safety hazard***. H2S is acutely toxic to humans even at very low levels -- death can occur within a few minutes at levels of 1,000 ppm or greater.

5. Envision sustainable fuels

In principle, energy needs for transportation in the future would be provided in a way where:

- No substances are derived from the earth's crust (e.g. petrochemicals and metals), unless those ingredients are 100% captured and reused in technical cycles.
- No ***substances*** are persistent in nature, unless those substances are 100% captured and reused.
- In addition, the production process would:
    - Not contribute to the increased concentrations of substances from the earth's crust or the buildup of persistent compounds in nature,
    - Use only sustainable renewable energy or energy produced in a carbon-neutral manner;
    - Not rely on practices that systematically physically degrade land and ecosystems; and
    - Not rely on practices that undermine people's capacity to meet their basic needs.

continued on page 4 . . .

6. Identify and prioritize alternatives

Identify the product or service that offers the best pathway toward meeting all four of our Sustainability Objectives by using the following three criteria:

1. Does the product or service move us in the right direction with regards to our four Sustainability Objectives?
2. Does the product or service create a flexible platform for the next step toward sustainability?
3. Is the decision financially viable?

Resources
and Additional Information

1. Natural Resources Canada: Alternative Fuels
   http://oee.nrcan.gc.ca/transportation/alternative-fuels/780

WHISTLER

This guide was made possible through the generosity of the Whistler 2012 project, which shared its template and much of its research.