Shining Lights

Energy Literacy and Language in the NWT
Understanding your Energy Story

CIER

PEMBINA institute

ARCTIC ENERGY ALLIANCE

Chapter 2

Energy basics

What is energy?

Energy in remote communities

- *Where do we see energy in our every day lives?*
- *What does energy allow us to do in our communities and homes?*

Energy in Remote Communities

1. Energy heats and cools our home and protects us from harsh climates.

2. Energy powers our appliances – keeps our food cold, cooks our food, washing our dishes.

3. Energy powers our leisure devices – our television, our internet, our radios, music, cell phones. It connects us.

4. Energy lights our homes – on the inside and out.

5. Energy heats our water – for cooking, for showers and baths, laundry.

Energy in remote communities

6. Energy heats and powers our **community buildings.**

7. Energy powers the infrastructure in our community – our **water treatment plant, our waste water treatment plant, fork lifts, bulldozers.**

8. Energy moves our **cars, trucks and planes**. It allows us to come and go from our community.

9. Energy helps us **grow** and **moves us** – through the food we eat and the water we drink.

Energy in remote communities

With these examples, what does energy do?

Energy in remote communities

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Energy in remote communities

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Energy in remote communities

Energy **heats, cools, powers, lights**, **moves** and allows us to **grow**






Energy forms

Two main forms of energy

Energy can be **in action** or it can be stored.

Action energy = "**kinetic energy**"

<u>Examples of action energy in your community</u>

- Light from a desk light
- Steam escaping from a kettle
- A car driving down the road

Kinetic energy

Where do we see kinetic energy in our nature?

Kinetic energy

Where do we see kinetic energy in our nature?

- animals running, birds flying, fish swimming
- trees and plants growing
- rivers flowing
- winds blowing

Two main forms of energy

Energy can be in action or it can be **stored**.

Stored energy = "**potential energy**"

<u>Examples of stored energy in your community</u>

- Large diesel storage tanks
- Diesel fuel in your house storage tank
- Batteries in your smart phones, wall clock or TV remote control

Potential energy

Where do we see potential energy in our nature?

Potential energy

Where do we see potential energy in our nature?

- Animals – harvesting for food
- A rock on top of a hill ready to roll down
- Trees and cut wood for your fireplace

Energy types

There are two main types of energy

Non-renewable and **renewable energy**

- **Non-renewable sources** – energy sources that took millions and millions of years to produce and can't be replenished. Also called "fossil fuels"

- **Renewable sources** – energy sources that have been produced very recently and are easily replenished.

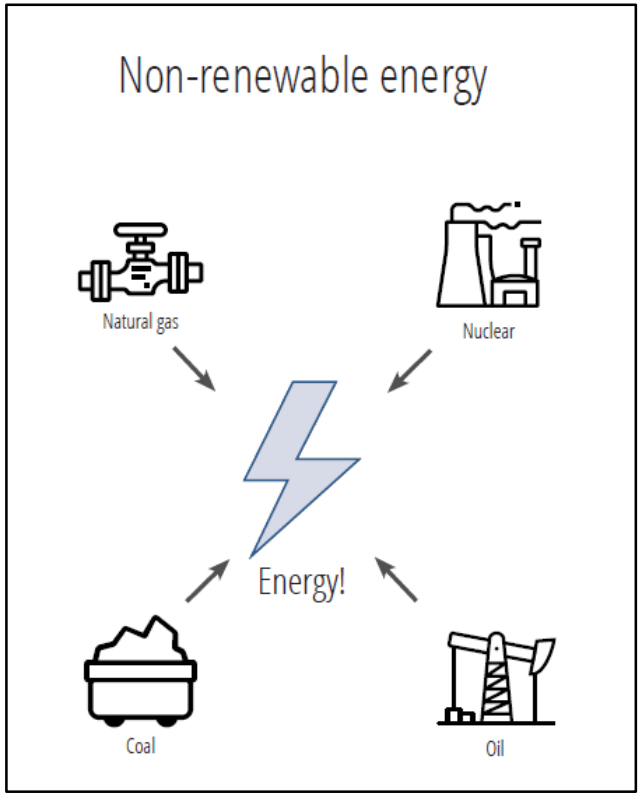
Non-renewable energy

What main sources of non-renewable (fossil) energy are mostly used today?

Non-renewable energy

What main sources of non-renewable (fossil) energy are mostly used today?

- Coal
- Oil (and everything made from that)
- Natural gas
- Nuclear



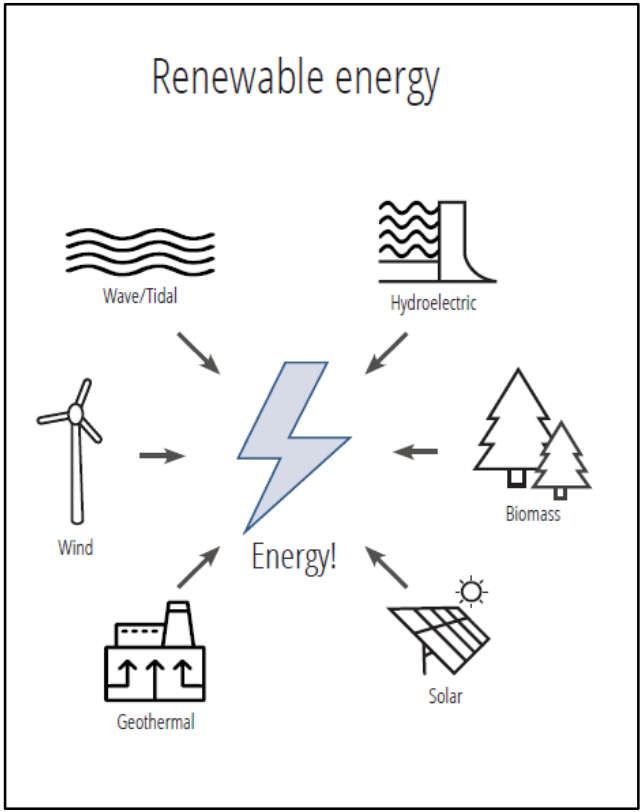
Renewable energy

What main sources of renewable energy are mostly used today?

Renewable energy

What main sources of renewable energy are mostly used today?

- **Biomass**
- **Solar**
- **Water**
- **Wind**
- **Geo-exchange (shallow)**
- **Geo-thermal (deep)** (but very little in Canada)
- Wave and tidal (still in research and development phase)



Energy units

Power and Energy

Technical terms:

Power is ***the ability to do work***
Energy is the ***total amount of work done over an amount of time***

ENERGY = POWER multiplied by TIME (POWER x TIME)

- Most common unit of POWER is the **Watt (W)** – it describes how fast energy is used.
- The most common unit of ENERGY is the **kilowatt-hour (kWh)** – it describes the amount of energy used over time.
- 1 kWh of energy = 1 kW POWER device used for one hour, or a 2 kW POWER device used for 30 minutes.

Remember, when talking about ENERGY use, it is always in reference to an amount of time

Kilos, Megas and Gigas

- Based on the International System of Units (SI)

Power	Energy
1,000 Watts = 1 kilo Watt	1,000 Watt-hour = 1 kiloWatt-hour
1,000 kilo Watts = 1 Mega Watt	1,000 kiloWatt-hour = 1 MegaWatt-hour
1,000 Mega Watt = 1 Giga Watt	1,000 MegaWatt-hour = 1 GigaWatt-hour

Power	Energy
1,000 W = 1 kW	1,000 Wh = 1 kWh
1,000 kW = 1 MW	1,000 kWh = 1 MWh
1,000 MW = 1 GW	1,000 MWh = 1 GWh

Power – units

- The standard unit of power is the **Watt (W)**
- Another common measurement of power is **Horsepower (HP)**
- One horsepower (HP) is equal to 745.7 Watts (W)
- Cars have a HP of between 70 HP and 200 HP. Pickup trucks have a HP of up to 500 HP
- A Ford F150 has a 395 HP engine, or around 300 kW

Energy - units

- A **kWh** is one of the most common ways to express the amount of ENERGY that is used
- A gigajoule **(GJ)** is also an expression of ENERGY that is used

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- **kWh** and **GJ** are like two apples
- The are both apples, but slightly different
- 1 GJ = 278 kWh

- **kWh** is often the unit to express electricity consumption
- **GJ** is often the unit to express the amount of energy in natural gas or diesel fuel (barrels or tanks of diesel stored)

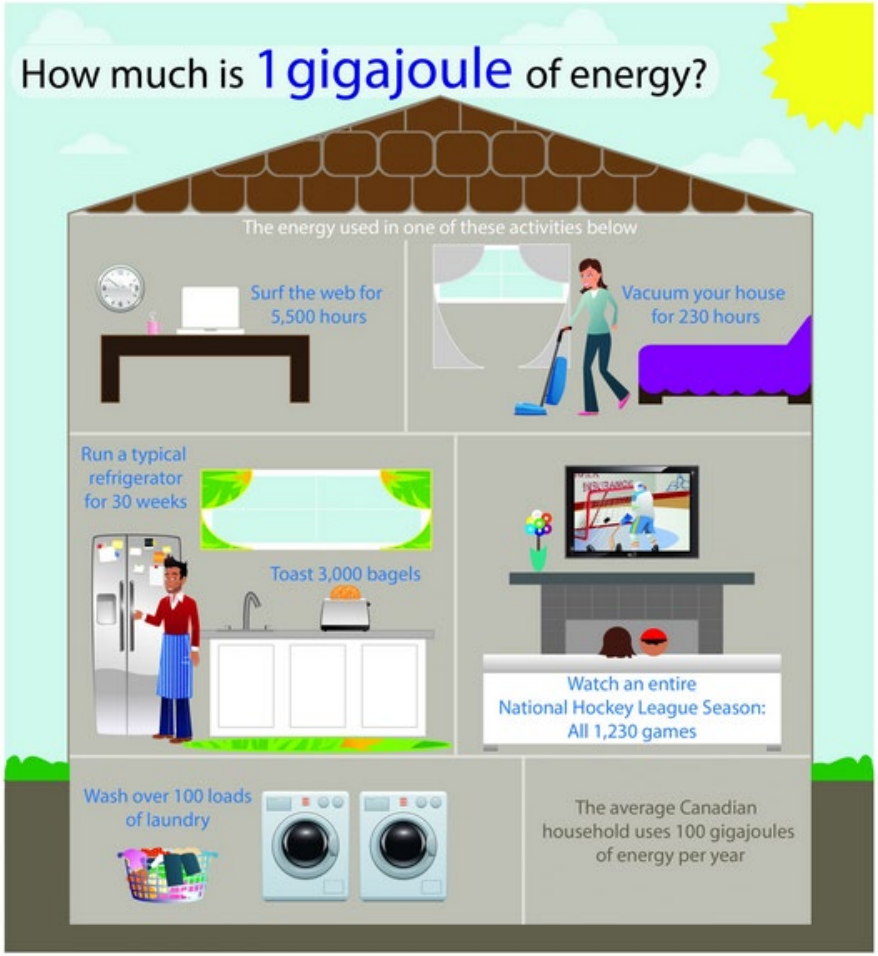
The water bucket example

- We are going to fill two buckets with water at different rates for the same amount of time.
- The first one slow which represents low power.
- The first one fast which represents high power.
- Guess which one will have consumed more ‘energy’ by the end?

What is a GJ ?

- Using a computer for 5,500 hours (almost 7 months straight)
- Toasting 3,000 bagels
- Washing over 100 loads of laundry
- Vacuuming your house for 230 hours (almost 10 days straight)

The average Canadian household uses 100 GJ of energy per year.



Source: Natural Resources Canada, https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/efficiency/housing/Gig%20Infographic%20Landscape%20-%20english.jpg

What is a GJ ??

One GJ of natural gas is the same as:

- 27 m^3 of natural gas
- 26 litres of fuel oil
- 39 litres of liquid propane
- 278 kWh of electricity
- 4% of a cord of seasoned wood

These all contain 1 GJ of energy

- A 20 lb propane tank contains ½ GJ of energy

A one cubic meter container (m^3).

About 27 of these filled with natural gas is about one GJ of energy.

But remember natural gas is a gas and oil is a liquid. Liquids tend to have much higher energy densities.

What is a kilowatt-hour (kWh) ??

- One device that has a 2,000 watts (W) power rating is left on for 10 hours consumes 20 kWh of energy:

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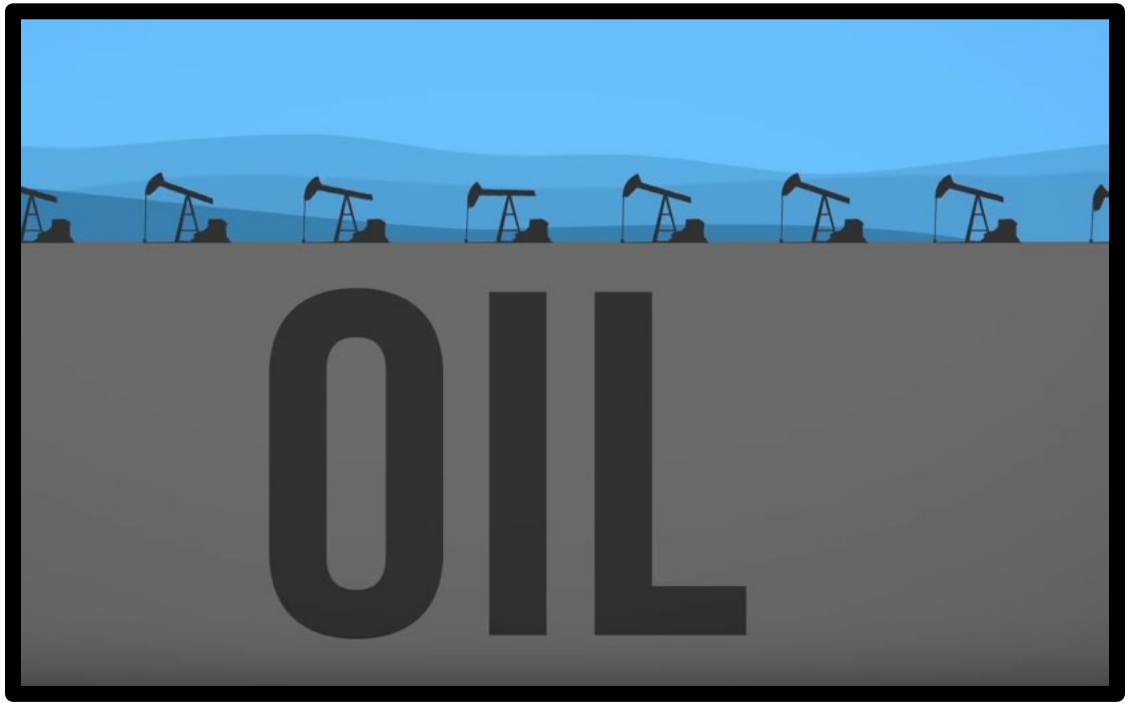
Power X Time = Energy Consumption

2 kW X 10 Hours = 20 kWh

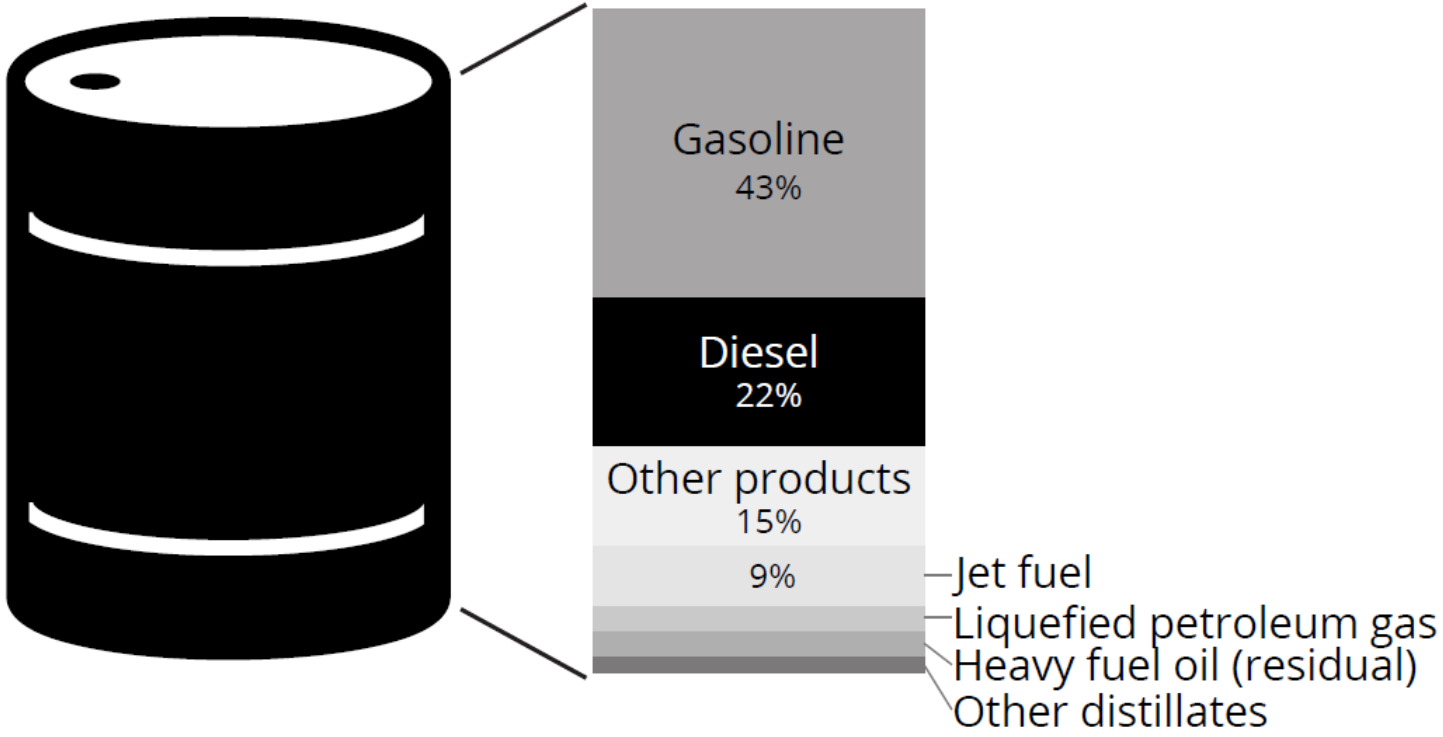
One 80 watt (W) lightbulb left on for one full day (24 hours) uses approximately how much energy?

a) 10 GJ
b) 200 kWh
c) 1,000 kw
d) 2 kWh

Oil


OIL

Products from a barrel of oil



Barrel of Oil Equivalent (BOE)

A Barrel of Oil

- a barrel of oil contains 160 litres of oil
- The amount of available energy in a barrel of oil is called the **Barrel of Oil Equivalent (BOE)**

5.8 GJ of available energy

A Barrel of Oil Equivalent (BOE)

- 1 **Barrel of Oil Equivalent (BOE)** is approximately 5.8 GJ

(Available energy, or primary energy is the total available amount of energy released from burning oil. But more on that later)

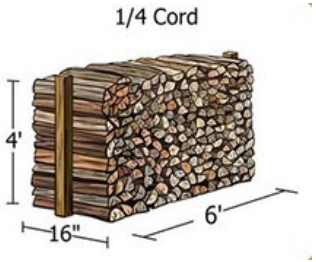
Comparable energy content as a BOE (5.8 GJ)

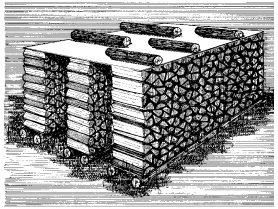
some examples …

- 156 m^3 of natural gas

X 156

- ¼ of a seasoned cord of wood



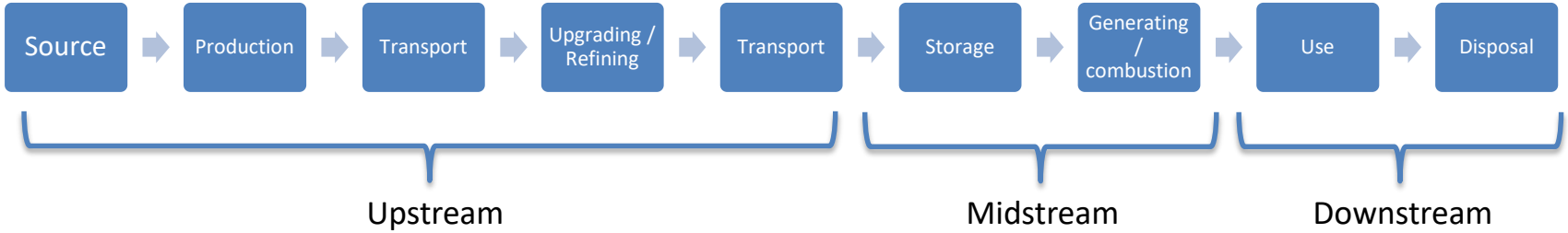


Comparative – this is <u>one</u> cord of wood

- 12 x 20 lb liquid propane tanks

Upstream and downstream impacts of a barrel of oil

- Extracting, upgrading, refining and transporting oil are **upstream activities**
- Storing, combusting are **midstream activities**
- Disposal are **downstream activities**
- Together these activities are called the lifecycle of oil and gas production
- All of these activities have various negative upstream impacts. Some are more significant than others



Afternoon Break

Impacts from transporting, storing and burning diesel in your community

We have developed a *mind-map* of some of the main impacts diesel has on a community.

Let’s discuss some of these impacts and brainstorm what’s missing in the diagram.

Key Terms to Remember

Non-renewable energy

Energy sources that took millions and millions of years to produce and can’t be easily replenished

Renewable energy

Energy sources that have been produced very recently and are easily replenished

Power

The ability to do work

Energy

The total amount of work done over an amount of time

Negative upstream impacts

The various impacts (environmental, economic, social, health) caused from upstream activities

Oil

A viscous liquid derived from petroleum, especially for use as a fuel or lubricant

Barrel of Oil Equivalent

The equivalent amount of primary energy contained in a barrel of oil. Equal to 5.8 GJ of energy

Upstream impacts of oil

The environmental, social, economic and health impacts from producing oil

Upgrading

a process by which bitumen (heavy oil from oilsands) is transformed into light oil by fractionation and chemical treatment, removing virtually all traces of sulphur and heavy metals

Refining

a process where crude oil is transformed and refined into more useful products such as gasoline, diesel fuel, asphalt base, heating oil, kerosene, liquefied petroleum gas, jet fuel and fuel oils

Primary energy

Amount of energy contained in a fuel

End-use energy

The usable amount of end-use energy through a conversion process

Other terms?

Are there other important terms we missed?

What is oil and where does it come from?

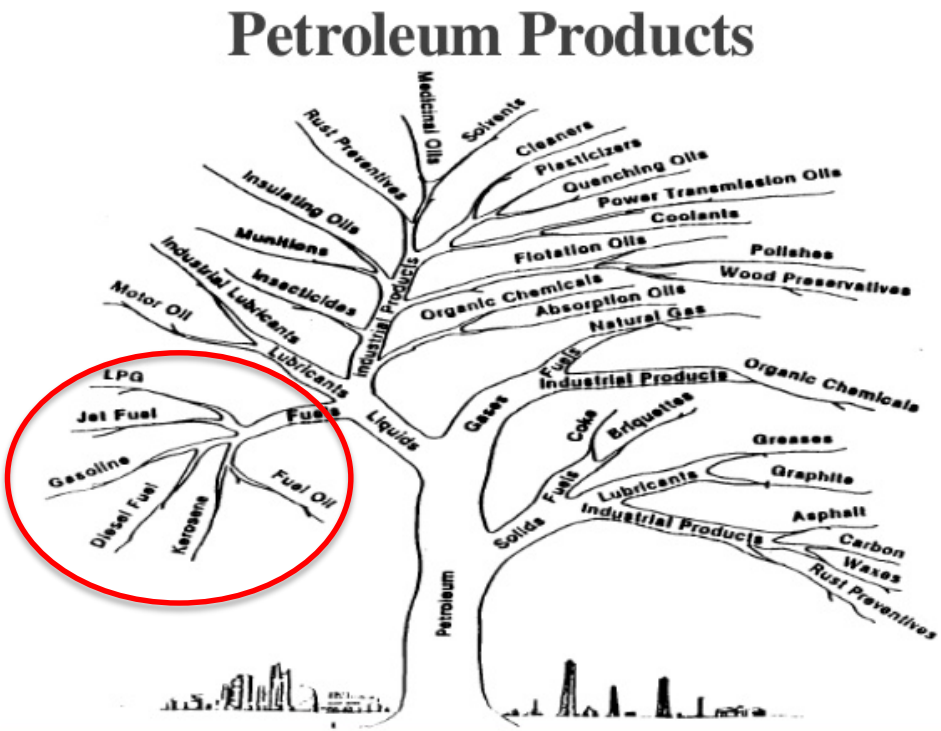
- Oil - a viscous liquid derived from petroleum, especially for use as a fuel or lubricant.
- There is **conventional oil** and **unconventional oil.**

Conventional oil – oil that is drawn directly from the ground (usually through drilling a well and pumping) and requires little upgrading. Sometimes referred to as crude oil.

Unconventional oil – oil produced or extracted using techniques other than the conventional (oil well) method. The Athabasca Oilsands are a source of unconventional oil.

What can you get from a barrel of oil?

- **Most common products** - diesel, gasoline, jet fuel, motor fuel, heating fuels



https://www.slideshare.net/hels92/chapter-1-70741876

Upgrading

- Through the complicated processes of upgrading and refining, all of these different oil products can be created.
- **Upgrading** - a process by which bitumen (heavy oil from oilsands) is transformed into light oil by fractionation and chemical treatment, removing virtually all traces of sulphur and heavy metals.

Strathcona refinery, Edmonton Alberta

Refining

- **Refining** – a process where crude oil is transformed and refined into more useful products such as gasoline, diesel fuel, asphalt base, heating oil, kerosene, liquefied petroleum gas, jet fuel and fuel oils.

Strathcona refinery, Edmonton Alberta

Process automation – Athabasca oilsands project

Quiz question #1 – What source of energy is a non-renewable form

a) solar
b) wave
c) geothermal
d) natural gas

Quiz question #2 – What does a Watt (W) usually refer to?

a) The amount of energy used
b) The amount of power something has
c) The ratio of power to energy
d) The equivalent kilowatt-hour value

Quiz question #3 – What product is <u>not</u> derived from a barrel of oil

a) Gasoline
b) Jet fuel
c) Natural gas
d) Diesel fuel