



PEEL

People for Energy and
Environmental Literacy



Climate Change – Evidence and Causes

2018

Lesson 1 - Intermediate Level

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Forty years from now, children will live in a world shaped by our choices



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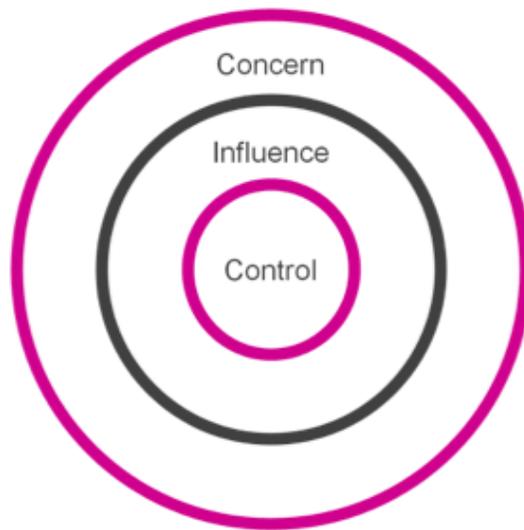
Ask students how old they will be in 40 years and what their children's lives will be like compared to their own. Speak about the ability to shape our lives by our choices.

Circle of concern, control and influence

Circle of concern - things we may not have direct control over.

Circle of influence - things that I can influence and others can do something.

Circle of control - things I can actually do



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It can be easy for kids to become overwhelmed by the issue of climate change. Using the circle of control, influence and concern helps students to discern what they can affect.

My Circle of Influence and Control

- Circle of Control:
 - Me, my actions, my thoughts
- Circle of Influence:
 - My family
 - My friends
 - My school
 - My community
 - My city
 - My province
 - My country



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Provide students some ideas of what is within their circle of control, and influence.

Terminology

- Greenhouse Effect
 - The greenhouse effect keeps the Earth warm by trapping heat in the atmosphere.
- Greenhouse Gas
 - Gases that trap heat in the atmosphere.
- Global Warming
 - The unusually rapid increase in Earth's average surface temperature over the past century due to rising levels of greenhouse gases released by people burning fossil fuels.
- Climate Change
 - A long-term change in the Earth's climate
 - Climate change is a long term shift in weather conditions
 - Change in wind, precipitation, length of seasons, strength and frequency of extreme weather events such as droughts and floods, wild fires.
 - Impacts will vary locally.



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Causes of Climate Change

Natural Factors

- Ocean currents
- Solar radiation
- Volcanic Activity

Human Factors

- Depleting ozone layer
- Increase in greenhouse gases from burning fossil fuels
- Using up forests and reducing the number of wetlands



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There are multiple causes of climate change,
Human factors are a key part of the issue
Humans through their actions have the ability to partially mitigate climate change.

Something is different....

- Kids your age in Alaska (Grade 3-8)
 - Three minute video – White Christmas Quinhagak, Alaska. Video was made by the fourth grade students.
- <https://www.youtube.com/watch?v=zVF6DQGh8lc>



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Review the videos.

Kids your age in Alaska – This is a great one for kids to be able to relate to students who are of similar age who are noticing a changing climate. Please point out to the kids where these students are located (Alaska) and discuss with them why these kids would be experiencing this change when they are so far north. How does it affect their lifestyle?

Overview of Climate Science

- Bill Nye The Science Guy. (Grades 9-12)
 - 5 minute video, Climate 101 with Bill Nye. Bill Nye narrates this short film on the basics of climate change.
- <https://www.youtube.com/watch?v=3v-w8Cyfoq8>



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Bill Nye –

This is a short presentation that provides the essence of climate change. It comes in a fact filled quick paced video that sometimes requires you to watch it a couple of times!

After watching the 5min video ask the students:

Bill Nye mentions that “We’re already seeing the temperature increases and we’re already seeing the consequences.” What have you experienced or heard about in the world today that may be evidence of the consequences of climate change brought up in the video?

Question's for students:

What experiences have you seen or experienced that could be attributed to changing climate?

The Greenhouse Effect

- The Greenhouse Effect
 - Video from US Environmental Protection Agency
 - Published April 3, 2015
 - Two minute video summary on the topic of the Greenhouse Effect
- <https://www.youtube.com/watch?v=VYMjSule0Bw>



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Questions for students.

Explain the greenhouse effect.

Give an example of a human activity that contributes to the greenhouse effect?

What is a Tonne of Carbon Dioxide?

- We cannot see it, or hear it, or taste it!
- What if we could see it?
 - This three-minute video of New York City 2010 Greenhouse Gas Emissions are visualized as one-ton spheres of carbon dioxide gas.
 - Video is designed by Carbon Visuals and Environmental Defense Fund. Emissions are at the rate of approximately 1.72 tons per second.
 - City of New York is on track to reduce emissions by 30% by 2017 compared to 2010.
- <https://www.youtube.com/watch?v=DtqSlpIGXOA>



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Evidence of Climate Change

Increased average global temperature

- Global warming

More extreme weather

- Flood, droughts, fire, higher snow fall
- More major storms

Melting ice sheets

- Greenland and Antarctica Ice Sheets

Rising sea level

- Caused from melting ice sheets

Ocean Acidification

- Oceans are becoming more acidic



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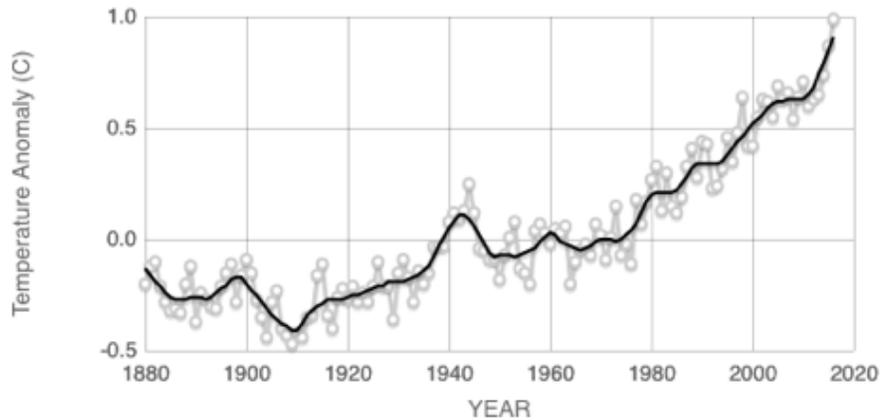
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Other evidence includes:

- Declining arctic sea ice
- Reduction of permafrost
- Decreased snow cover
- Glacier retreat
- Warming oceans

The Earth's average temperature is increasing

- The chart shows the Earth's land-ocean temperature since 1880, compared to the 1951-1980 average temperatures.
- Most of the warming has occurred since the 1960s.
- The 10 warmest years have been in the past 12 years.



Source: climate.nasa.gov



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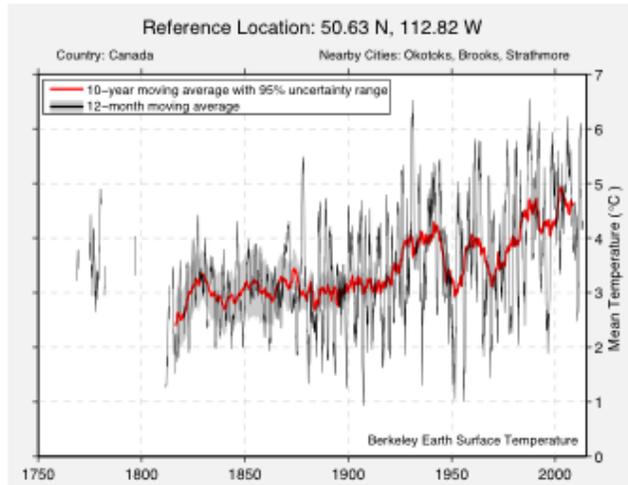
Reference:

Climate.nasa.gov

Most of the rise has happened since about 1970 in the annual land-surface temperature..

This graph illustrates the change in global surface temperature relative to 1951-1980 average temperatures. Sixteen of the 17 warmest years in the 136-year record all have occurred since 2001, with the exception of 1998. The year 2016 ranks as the warmest on record.

What about Calgary's temperatures?



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Reference:

<http://berkeleyearth.org>

The information shown provides wide swings in temperature. Is Calgary on the same warming trend as the rest of the earth? What do you expect to happen in the temperature swings?

Looking for Evidence: Greenland's Ice Sheets

- NASA's Earth Minute: Greenland Ice Sheets
 - A two minute video about Greenland Ice Sheets.
 - Greenland is warming almost twice as fast as Antarctica, which is causing the ice to melt and raise global sea levels. NASA is monitoring this.
- <https://www.youtube.com/watch?v=yLm7PSsvW8g>



Elephant Foot Glacier, Greenland

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Image reference:

https://28oa9i1t08037ue3m1l0i861-wpengine.netdna-ssl.com/wp-content/uploads/2014/09/4874_1dd7.jpeg

Evidence: The oceans are getting more acidic

- The oceans absorb carbon dioxide (CO₂) from the air. (About 25% of the CO₂ from the air)
- Problem:
 - This changes the chemistry of the sea water making it more acidic.
 - This impacts corals, and shellfish as they cannot make their shells as a result.
- This is called ocean acidification.
- A shell placed in sea water that is more acidic dissolves in 45 days.



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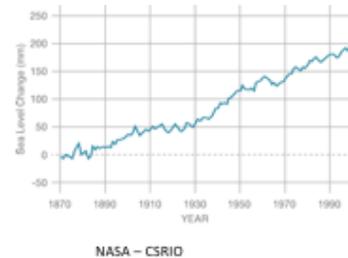
<http://oceanacidification.noaa.gov/>

Evidence: Sea Level rise

- Sea level is rising at an increasing rate.
 - Global sea levels have been rising over the past century
 - Rate has increased in the recent decades.
 - In 2014, global sea level was 6.6 centimeters (2.6 inches) above the 1993 average.
 - Sea level continues to rise at a rate of about 0.3 cm (1/8") per year.
- Two causes
 - Expansion of sea water as the oceans warm from increasing global temperature
 - Melting ice sheets over land which adds water to the ocean.



Risk is to people who live on or within 100 kilometers of a seashore. (39% of the world's population) (That's about 2.8 billion people)



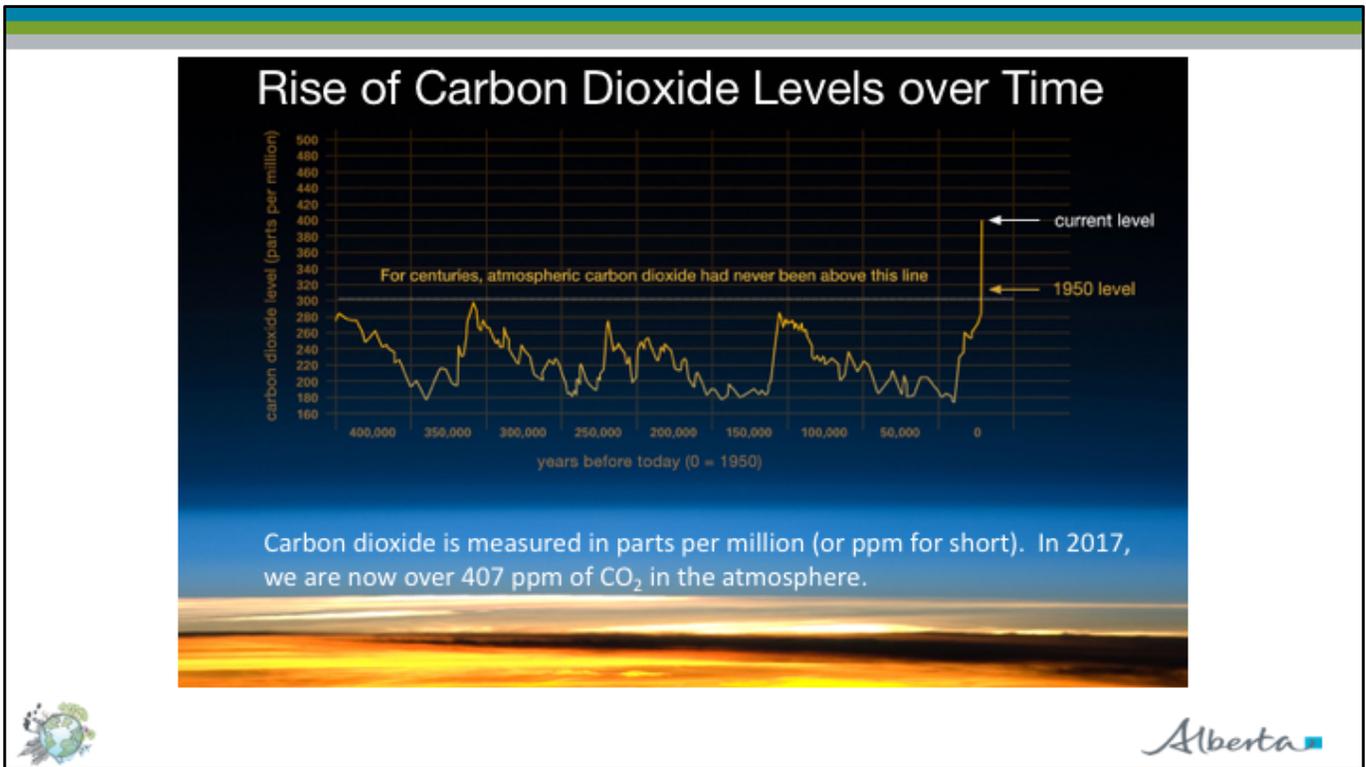
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Reference:

<https://oceanservice.noaa.gov/facts/sealevel.html>

National Ocean Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce.
Accessed 30 August 2017.

<https://sos.noaa.gov/datasets/sea-level-rise-impact-of-6-meter-red/>
Sea Level rise: Impact of 6 meter (red)



https://climate.nasa.gov/climate_resources/24/

https://climate.nasa.gov/system/resources/detail_files/24_co2-graph-021116-768px.jpg

“Ancient air bubbles trapped in ice enable us to step back in time and see what Earth's atmosphere, and climate, were like in the distant past. They tell us that levels of carbon dioxide (CO₂) in the atmosphere are higher than they have been at any time in the past 400,000 years. During ice ages, CO₂ levels were around 200 parts per million (ppm), and during the warmer interglacial periods, they hovered around 280 ppm (see fluctuations in the graph). In 2013, CO₂ levels [surpassed 400 ppm](#) for the first time in recorded history. This [recent relentless rise](#) in CO₂ shows a remarkably constant relationship with fossil-fuel burning, and can be well accounted for based on the simple premise that about 60 percent of fossil-fuel emissions stay in the air.”

Questions.

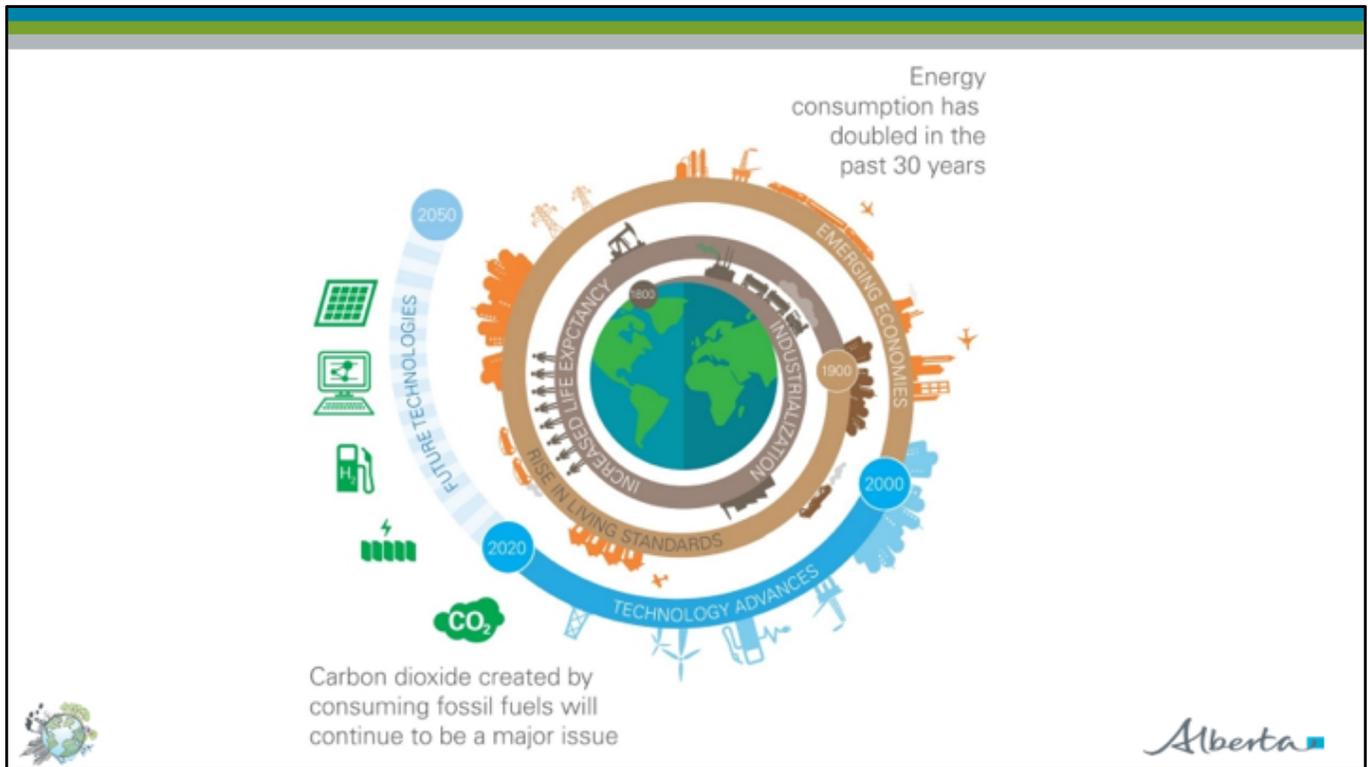
How is the carbon dioxide levels measured?

Where are the CO₂ levels measured?

What is Canada's role in measuring CO₂ levels over time?

Given the trends, should CO₂ levels be reducing or increasing?

Where is CO₂ levels measured today?



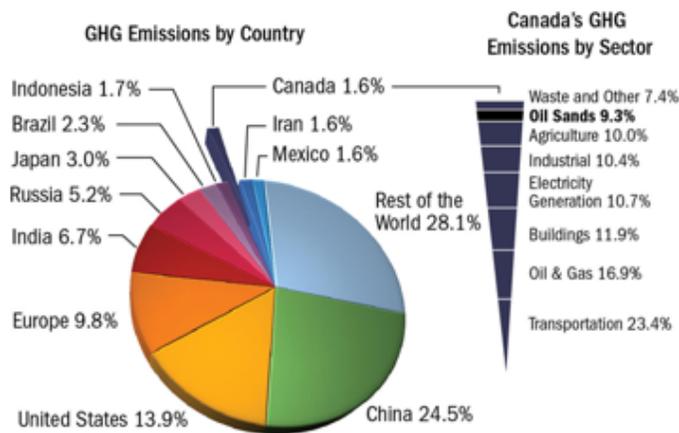
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Energy consumption has grown significantly since the 1800's with industrialization, increased life expectancy, rise in living standards, emerging economies. In the past 30 years the world's energy consumption has doubled. The resulting issue of carbon dioxide created by consumption fossil fuels will continue to be a major issue.

It is interesting that this infographic is from BP (British Petroleum) in that even the oil and gas companies of the world acknowledge the increased issues associated with increased consumption of fossil fuels. This infographic does give hope in the rise of technology advances both in the oil and gas and electricity generation, and the rise of future technologies including energy storage, solar, and hydrogen fuels.

Where are all these global greenhouse gas emissions coming from?

Global GHG Emissions



Sources: World Resources Institute 2014, CAIT Climate Data Explorer and Environment Canada, *National Inventory Report 1990-2014 Greenhouse Gas Sources and Sinks in Canada*



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http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/energy/images/publications/facts_greenhouse_gas_emissions_e.jpg

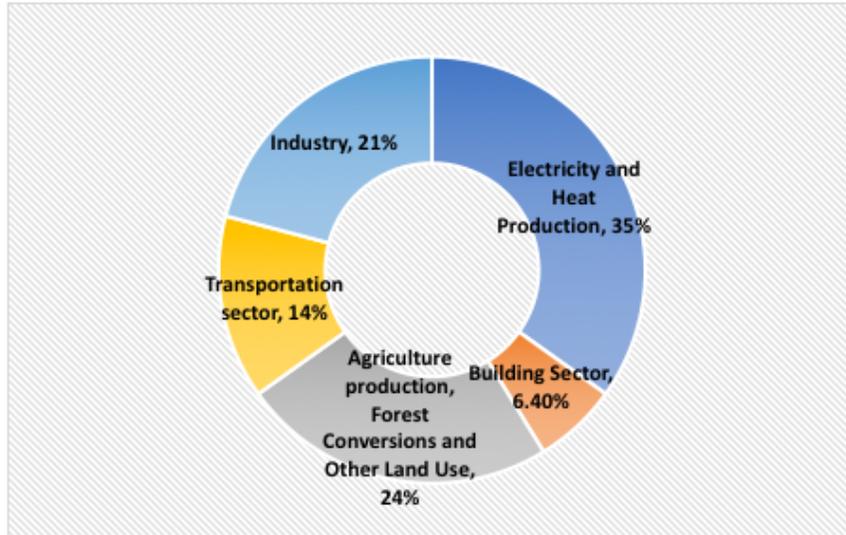
Largest sources include 1) China, 2) USA, 3) Europe

Canada ranks as the 9th highest absolute emissions in 2014, but our population is not the 9th highest?

Canada's largest source of emissions include A) Transportation, B) Oil and Gas production, C) Heating buildings, D) Electricity Production. What is Canada's role in reducing emissions?

Sources of Global Emissions

Energy production remains the primary driver of GHG emissions



Source: IPCC – 2010 GHG Emissions

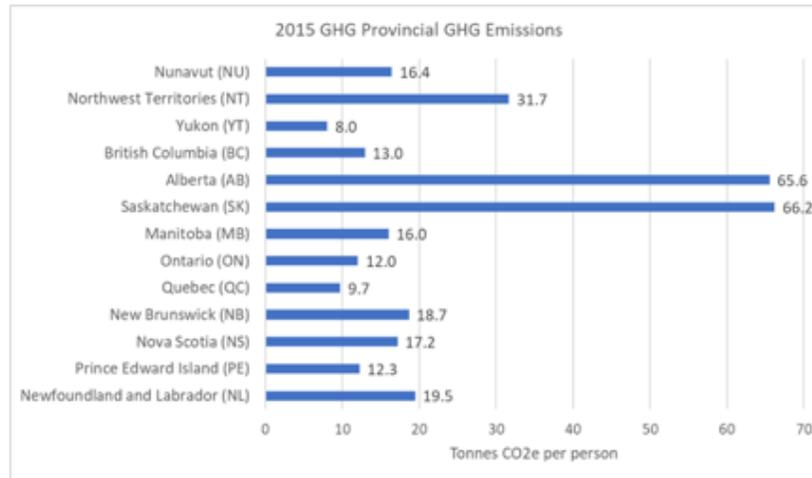


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https://www.ipcc.ch/pdf/assessment-report/ar5/wg3/WGIIIAR5_SPM_TS_Volume.pdf

The majority of the world wide emissions are coming from Energy – Electricity and Heat Production (35%) and the Transportation sector (14%) for a total of 49%. Using renewable energy for electricity, heat and transportation, could dramatically lower the amount of greenhouse gas emissions.

Canada's Emissions per Person Per Year



Canada's emissions are 21 tonnes per person in 2015.



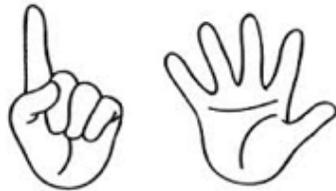
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Review the chart as a class. Reflect on Alberta's emissions and Saskatchewan's. Look at other provinces. Why is Alberta so high?

Ask students how they think the per capita emissions differ from the rest of the world? Are we higher or lower than other countries? How do we compare with the world average?

What do you think are some of the reasons for such vastly different Greenhouse Gas Emissions across the provinces?

World Average Greenhouse Gas Emissions per Person



6 Tonnes CO₂
equivalent Per
Person Per Year

Reference: 2013 data

Population in 2013 – 7.1 billion



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Reference:

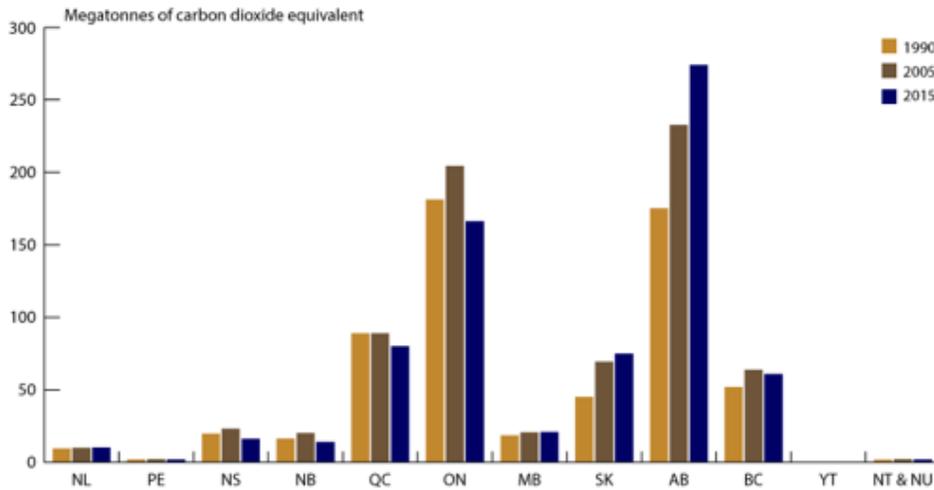
Source: CAIT Climate Data Explorer, World Resource Institute.

But hey, if the world average is 6 tonnes per person, then how is Alberta at 65.6 tonnes per person?

Population in 2017 estimate – 7.6 billion people – www.worldometers.info

Teachers can reference back to the mountain of CO₂ shown in the New York video.

Canada's Greenhouse Gas Emissions



This bar graph illustrates the total emissions by each province and territory for the years 1990, 2005 and 2015 in megatonnes of carbon dioxide equivalent (Mt CO₂ eq). Alberta was the highest contributor in 2015, followed by Ontario, Quebec, Saskatchewan and British Columbia; the total from all other provinces and territories contributed less than 70 Mt. Ontario started off as the highest-emitting province in 1990, but was surpassed by Alberta in 2005 and 2015.

Ref: Environment and Climate Change Canada, Greenhouse Gas Emissions by Province and Territory

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https://www.ec.gc.ca/indicateurs-indicators/18F3BB9C-43A1-491E-9835-76C8DB9DDFA3/GreenhouseGasEmissions_Prov_EN.png

What do you think are some of the reasons for such vastly different Greenhouse Gas Emissions across the provinces?

Congress of the Parties 21 – Paris (COP 21)

- In December 2015 a commitment called the **Paris Agreement** was presented at the United Nations Climate Change Conference.
- The Paris Agreement recognized the **urgency for all countries to do their best** to mitigate climate change.
- **Canada agreed** to sign on to this obligation.
- Today 145 countries in the world have signed this agreement, with the exception of USA.



Lets stay well below 2 degrees C change

And try to limit the increase 1.5 degrees C change

UNFCC COP 21
PARIS AGREEMENT

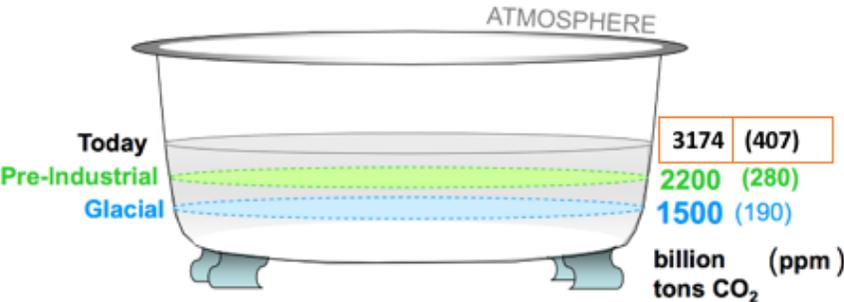


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Why would all 145 countries agree to sign?

What was the rationale for the USA to join the Paris Agreement?

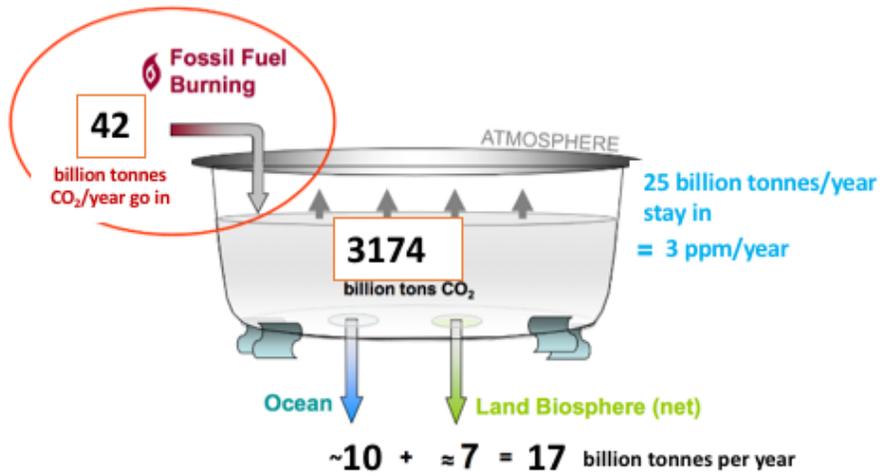
Our atmosphere is like a bathtub



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Source: co2.earth, July Atmospheric CO₂ as recorded at Mauna Loa

Sources and sinks of Carbon Dioxide



POPCORN ACTIVITY

- How many years does it take to reach a 2 degree Celsius change (490 ppm)
- Activity, discussion, and debrief



World Emissions Per Capita per Year

Country/Region	Amount of CO ₂ 2013 Billion Tonnes per year	"Popcorn amount"	Tonnes per person per year
China	8.6	1/3 cup	9
USA	6.3	¼ cup	20
Europe	4.2	1/8 cup	8
India	2.9	4 tsp	2
Russia	2.2	4 tsp	15
Japan	1.4	2 tsp	11
Brazil	1.0	2 tsp	5
Indonesia	0.7	1 tsp	3
Canada	0.7	1 tsp	21
Rest of the World	14.1	½ cup	5
		World Average	6
		<i>Alberta</i>	66



Source: CAIT Climate Data Explorer, World Resource Institute.

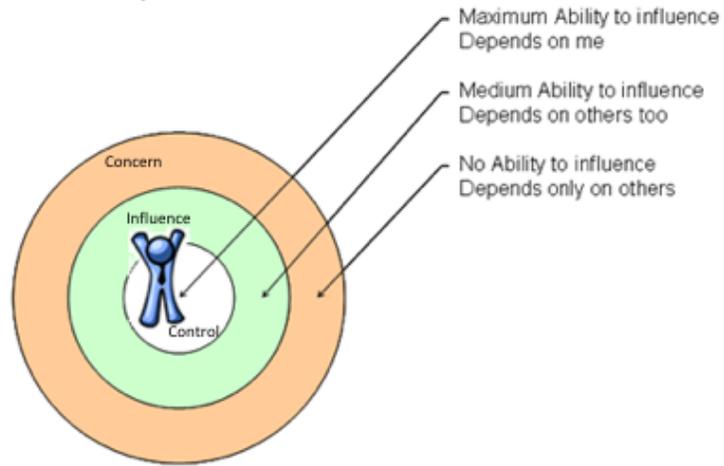


Let's Talk About You!



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Circle of concern, control and influence



Circle of concern represents external factors such as the things we may not have direct control over.

Circle of influence represents the things that I can influence and others can do something.

Circle of control represents things I can actually do



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My Circle of Influence and Control

- Circle of Control:
 - Me, my actions, my thoughts
- Circle of Influence:
 - My family
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How Do We Use Energy?



Heating

- Heat my home, my food



Transportation

- Travel to school, activities, travel on holiday



Electricity

- For my cooking/eating, entertainment, lighting, appliances, computers



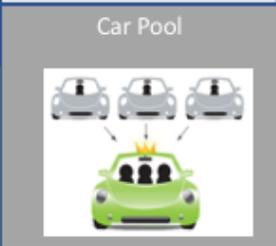
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Talk with the students about the ways that you use energy. There are three primary ways we use energy, heating, transportation, and electricity. Discuss how you could reduce the amount of energy use.



Discuss with students what they will doing to make 1 change. What will you do?

TRANSPORTATION CHOICES



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What do you think is some choices you could use to reduce your greenhouse gas emissions?

HEATING CHOICES

Wear a sweater and slippers at home



Turn down the thermostat

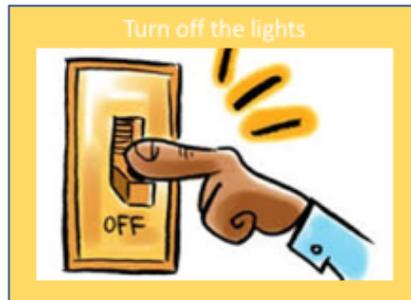


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What do you think is some choices you could use to reduce your greenhouse gas emissions?

ELECTRICITY CHOICES



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What do you think is some choices you could use to reduce your greenhouse gas emissions?

WASTE CHOICES

Don't
Waste Water



Don't
Waste
Food

RECYCLE



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What do you think is some choices you could use to reduce your greenhouse gas emissions?



THANK YOU!

PEEL is supported by the Community Environment Action Program. This project is offered in partnership with GreenLearning Canada Foundation, provider of free online education programs about energy, climate change and green economy.



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