The Melt Will Be Felt!

Welcome to the 2020 United Nations Climate Change Summit!

The United Nations is hosting an annual summit inviting scientists and political leaders to discuss global climate concerns and possible solutions for the upcoming year **(United Nations, 2019)**. This year the topic of discussion is the rapid thawing of Arctic permafrost and the subsequent release of methane (a potent greenhouse gas) into the atmosphere.

It has been explained that cold temperatures in the Arctic have led to the formation of perennially frozen soils called permafrost. These soils have constantly accumulated decayed plant and animal matter over thousands of years and as a result contain large reservoirs of carbon **(Schaedel, 2016)**. As global surface temperatures increase, arctic permafrost will begin to melt, inducing microbial activity which takes up organic carbon and subsequently releases methane into the atmosphere **(Schaedel, 2016)**. While there is unified agreement among scientists regarding the causes and hazards of melting permafrost, skeptics continue to believe that anthropogenic climate change is not a real problem, even as the negative impacts are being clearly felt and recorded worldwide. Your job as a UN committee member is to work with your team of chemists and environmental scientists to prove to skeptical politicians that although the melting of the permafrost and release of methane may seem gradual, it is very much a current environmental issue. The melting of the permafrost is happening extremely rapidly and if it continues at this rate it will continue to contribute to the devastating consequences of climate change.

Guidelines, Topics to Address, and Objections

Below are guidelines for topics which you need to address, and possible objections that you suspect might be posed by political skeptics regarding the chemical and environmental aspects of melting permafrost and release of methane. Within your research team, work through the problem and create a PowerPoint presentation of no more than 15 minutes. Remember that as a committee member, you need to document these processes and highlight the negative consequences of methane emissions from the thawing of arctic permafrost. You will present your findings to the whole committee (your classmates and teacher).

1. **1. The Greenhouse Effect**

Carbon dioxide is a primary contributor to the greenhouse effect and by far the most well-known greenhouse gas to the general public. Because of the prevalence of CO_2 in media coverage, other greenhouse gases are often disregarded, despite their potential to cause serious repercussions if

emission rates are not controlled. To introduce methane as a greenhouse gas to the audience and establish its difference from carbon dioxide, show the 3-dimensional structures of both molecules, and illustrate the types of bonds present. Additionally, compare these two with other gases in the atmosphere such as oxygen and nitrogen which are not considered to be greenhouse gases. Why are these not considered to be greenhouse gases even though they account for more than 99% of atmospheric gas composition? ***Hint:*** *Look into what Infrared active gases are compared to non-Infrared active gases.*

2. **2. Sources of methane release**

List some of the major sources from which methane is released into the atmosphere to make it evident that those sources need to be addressed. ***Note:*** *Represent this in the form of a pie chart or a bar graph.*

3. **3. Global Warming Potential (GWP)**

Compare the GWP of methane to that of carbon dioxide to illustrate the effects that methane has on global warming. **Hint:** *Look into factors such as the greenhouse potential of methane compared to carbon dioxide, the lifetime of each in the atmosphere.*

4. **4. Possible objection from a skeptical politician**

"Even if methane is released into the atmosphere it will get degraded in the upper atmosphere just like most other molecules and will eventually become harmless." **Hint:** *Address this statement pre-emptively by investigating what methane breaks down into after undergoing several processes in the atmosphere and why it still might be a problem.*

5. **5. Possible objection from a skeptical politician**

"Methane in general, and the melting of permafrost, are part of several positive feedback loops in the climate system. What is a positive feedback loop, and why are they potentially problematic for global climatic change?" **Hint:** *Consider the effects of a positive feedback loop in relation to an increase in temperature with methane.*

6. **6. Conclusions**

Finally, wrap up your presentation and give concluding remarks on why methane emissions are a problem and need to be addressed. ***Note:*** *Additionally, if there are any other topics or interesting points that you might want to add to the presentation, feel free to do so. Also, you may dedicate multiple slides to each address each point. They need to be restricted to one slide each.*

References

1. Can plants help to prevent permafrost thaw? *https://www.ed.ac.uk/sustainability/what-we-do/climate-change/case-studies/climate-research/can-plants-prevent-permafrost-thaw* (accessed Feb 2020).
2. Heubl, B. Arctic methane levels reach new heights. *https://eandt.theiet.org/content/articles/2019/09/arctic-methane-levels-reach-new-heights-data-shows/* (accessed Feb 2020).
3. National Snow and Ice Data Center. *https://nsidc.org/cryosphere/frozenground/methane.html* (accessed Feb 2020).
4. Schaedel, C. Guest post: What the latest science says about thawing permafrost. *https://www.carbonbrief.org/guest-post-what-the-latest-science-says-about-thawing-permafrost* (accessed Feb 2020).
5. UNITED NATIONS Climate Change - Summit 2019. *https://www.un.org/en/climatechange/un-climate-summit-2019.shtml* (accessed Feb 2020).
6. Main sources of methane emissions. *https://whatsyourimpact.org/greenhouse-gases/methane-emissions* (accessed Feb 2020).
7. Thiessen, M. Methane, explained. *https://www.nationalgeographic.com/environment/global-warming/methane/* (accessed Feb 2020).
8. Housecroft, C. E.; Sharpe, A. G. *Inorganic Chemistry*; Prentice Hall: Harlow, 2007.