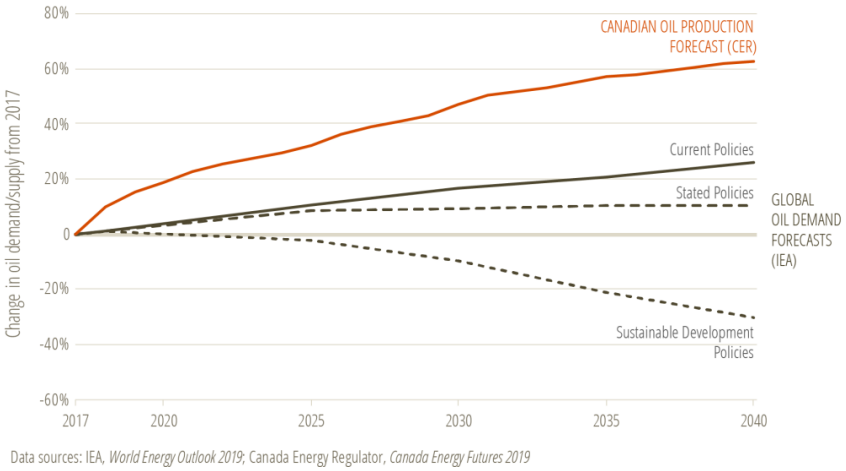
Trees - the Energy Saver

Abstract:

Trees are more than just your typical “woody, perennial plants” as suggested by the dictionary. In the world of science, they are highly regarded. In addition to supporting the lives of many organisms and providing consumers with a variety of products, trees play a significant role in reducing greenhouse gas emissions. Even though British Columbia has greatly evolved from its traditional reputation as a rural province- with the expansion of industrial and service economies in recent decades- we should not underestimate the value of its natural resources as they play an essential role in filtering water, purifying the air, and absorbing and storing carbon from the atmosphere. Planting trees in urban settings can combat the excessive release of CO_2 as more and more fossil fuels are burned. Hence, as the low-tech solution to energy overproduction, trees rectify the issue with a more sustainable approach. In this report, we will be learning about carbon fertilization and transpiration of trees, and how they can serve as the heroes to our changing climate.

Introduction:

It is named “Beautiful British Colombia” for a reason. The rich biodiversity of BC plays a significant role in representing the province’s distinct features. From the abundant woodlands to the crystalline, flowing rivers of the Canadian Rockies, the province’s geography and climate combine to create a range of unique ecosystems across the land. Dominating almost two-thirds of the province- with over 55 million hectares of trees; the forest of BC provides a greater collection of ecosystems than any other Canadian province or territory. [1] Over the history of Vancouver, the city has grown rapidly due to patterns of economic development. Accommodating the growing population, the need for transportation, industrial activities, infrastructure, and food production have resulted in the city using over 59 million gigajoules (GJ) of energy annually... That’s enough energy to travel to the moon and back 6,500 times! [2] In return, it emits 2.8 million tonnes of CO_2. As Canada's industrial structure, vast geography, and cold climate make it a highly energy-intensive country, Vancouver’s rapid urbanization is prone to emitting an excessive amount of CO_2 into the atmosphere.

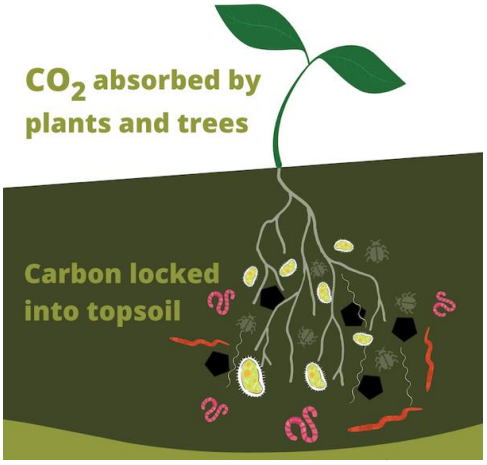


Data sources: IEA, *World Energy Outlook 2019*; Canada Energy Regulator, *Canada Energy Futures 2019*

*Red curve depicts the predicted increase in Canadian oil demand/supply from 2017 to 2040. The burning of fossil fuels, including oil, is one of the direct factors in the increase of CO_2 emissions.

Carbon absorption

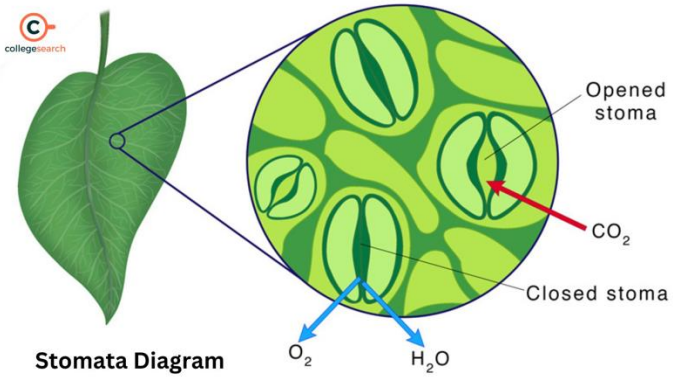
[3] Following the increase in CO_2 emissions, researchers have noticed that trees are growing thicker and thicker. Let us picture a tree as a giant enlarging cylinder. We can compare the added volume of that cylinder to the addition of an extra tree ring that stores energy. This stored energy is known as the **biomass**. In addition, the **carbon fertilization effect** describes the increase in photosynthesis of a plant as a result of rising CO_2 levels. As emissions increase, trees pull in more CO_2 during photosynthesis. The absorbed CO_2 is then deposited in the trees' trunks, branches, roots, leaves, and soil, making it possible for them to grow and release more oxygen into our environment. [4] While the growth may not be noticeable if we walk outside immediately, studies have shown that our modern vegetation is about 20-30% larger compared to trees 30 years ago. This is helpful because larger trees absorb more carbon. [5] In the United States, out of the billions of tons of CO_2 pumped into the atmosphere over the last 20 years, trees have removed about 10-11% of gross emissions. Through these statistics, we can discern the value of these plants, and if we apply this idea carefully to tackle excessive CO_2 emissions, **carbon sequestration**- the practice of removing and storing CO_2- can be achieved.



Transpiration

Have you ever walked into a forest and experienced an immediate decrease in temperature? No, it's not your false perceptions. Trees and plants "sweat" in a way similar to humans. Through a process called **transpiration**, trees, and other plants can cool themselves and the surrounding air. During this process, plants lose water to their environment through **evaporation**- when the liquid is turned into a gas. As part of photosynthesis, the water and nutrients are then taken up by the roots from the soil and delivered to the stem and leaves. Trees can therefore cool their surroundings by releasing water vapour into the air through their leaves. Some of the water that is drawn up the roots exits the plant through the pores on its leaves, known as the **stomata**. As this "sweat" evaporates, heat is removed from the air, providing a cooling effect. Transpiration's ability to lower temperatures can potentially reduce the impact of urban heat islands by providing shade and cooling the surrounding area. [6] However, if there is insufficient water or high temperature, the stomata will close during the day,

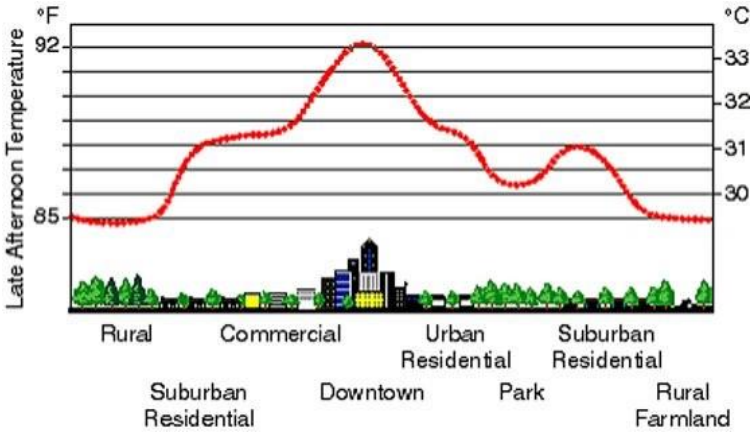
causing a low supply of carbon dioxide which in turn reduces the rate of photosynthesis. As a result, in order for transpiration to be effective and mitigate overheating areas, such as cities, trees must be nourished properly and periodically.



Stomata Diagram

Heat management

Cities are **heat islands**. As vegetation is replaced by asphalt and concrete for roads and buildings necessary to accommodate the growing population, more surfaces get inevitably created. These surfaces are prone to absorbing sunlight, and as a result, they raise the overall temperature of the area. **Microclimates** are commonly created within a city as the temperature is several degrees warmer than in its surrounding rural area. [7] However, research shows that trees can reduce the average temperature of cities by 16.17°C compared to one without effective urban forest planning.



The urban forest of Vancouver is composed of every tree within the city. With 160,000 street trees, thousands of park trees, and 713 hectares of forest, urban trees have the collective ability to influence the city's climate. They can improve the surrounding environment by providing shade and wind protection, as well as absorbing carbon dioxide and transpiring water. Trees become most practical when they are strategically planted around buildings or beside pavements of parking lots and streets. [8] [8] For example, researchers have found that planting deciduous trees or vines to the west is typically the most effective way to cool a building- especially if the plants can shade the windows and part of the building's roof. For residents, appropriate landscaping and plantation of trees can reduce the demands

for air conditioners in unpleasantly hot summers, protect them from the force of winter winds, and ultimately save money to live comfortably in the fluctuating, harsh climates of BC. In addition, urban forest planners focus on planting trees in areas with the lowest canopy covers, such as the Downtown Eastside, where the most significant heatwaves are experienced. This combats the serious problem for the unhoused where they struggle to avoid the excruciating summer heat as they have little to no access to proper shading- let alone indoor cooling.

Conclusion:

Our city is predicted to experience even hotter, drier summers and more frequent rainfall following climate change and rising sea levels. As a result, urban forests will play an increasingly important role as we experience these negative effects moving forward. The role trees play in saving energy has yet to be discovered by the majority, but if consensus is achieved for this strategy of energy conservation, a major step can be taken towards saving money for individual home and business owners. We must recognize, however, that it is only through proper planning, design, and maintenance that we will be able to fully harness the plant's potential to conserve energy in our communities.

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