Our team, in order to push our idea's forward, wrote a report directed to congress and the president sharing our findings. Our report outlined the effects of different regulation on the current global climate.

Report:

It is to be understood that with our current technologies, greenhouse gas emission is vital for progress. Given the push for less regulation to speed production, we want to understand what happens to global temperature in three cases. Those three cases include, increased regulation, decreased regulation, and unchanged regulation. In relation to our model, that would follow as k-values greater than zero, less than zero, and equal to zero.

Evaluating our model for a k-value of zero leaves us with a cubic function with three zeros. Our model is a rate of change function in terms of temperature, so the zeros would represent temperatures that result in no change over time.

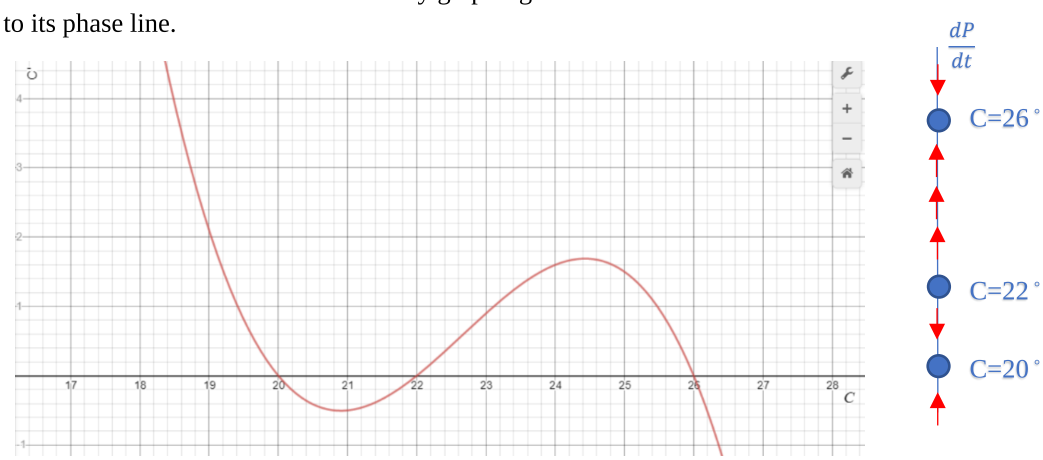
$$\frac{dC}{dt} = \frac{1}{10}(C - 20)(22 - C)(C - 26) - (0)$$

$$C = 20, 22, 26$$

The zeros occur at C-values of 20, 22, and 26. Considering that the current equatorial temperature is 20˚C, which is one of our zeros, we can determine that the temperature will remain unchanged as long as regulation remains unchanged. If the current temperature were to be a different, the resulting temperature over time may have been completely different.

By plugging in values around our zeros, we can understand how the temperature may have changed in time. Plugging in a temperature less than 20˚C into our model results in an overall positive answer, which would mean a positive increase in temperature. It is important to also note as the temperature would not be able to exceed 20˚C as it is one of our zeros and does not allow change, therefore the temperature would rather just approach 20˚C slowly overtime. For a temperature greater than 20˚C but less than 22˚C, the model would give out a negative answer, meaning a decreasing temperature. Again, the temperature would not be able to decrease less than 20˚C and would instead slowly approach it. The same pattern continues for values between 22˚C and 26˚C, where the result is a positive growth that approaches a temperature of 26˚C. Finally, if the temperature had been above 26˚C, the result would have been a negative answer ergo a decreasing result approaching 26˚C.

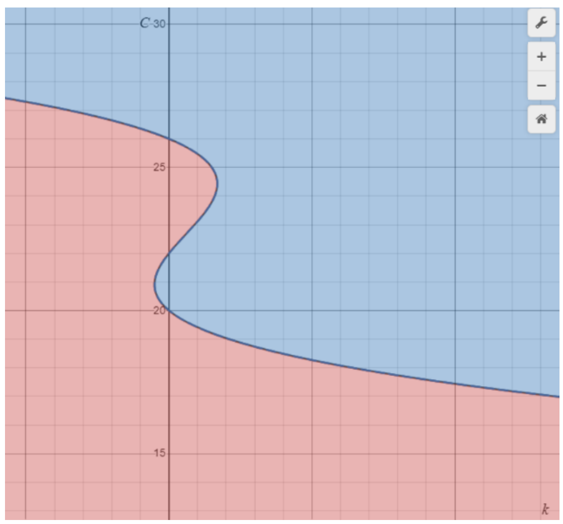
The previous behaviors described are easier visualized by graphing our model with a k-value of zero and comparing it to its phase line.



Climate Rate of Change v. Climate (Desmos.com)

In the graph, values above the x-axis, or t-axis in this case, represent growth where values below the t-axis represent decreasing temperatures. For different amounts of regulation, where regulation in our model is simply a constant, the graph is shifted up or down in the plane. For decreased regulation, the function is shifted up, which results in the 20˚C and 22˚C equilibrium temperatures to approach each other and the 26˚C equilibrium temperature to increase slowly. With enough regulation, there would only be one equilibrium temperature at some value greater than 26. For increased regulation, the behavior is similar as the function is shifted downward. Instead of the 20˚C and 22˚C equilibrium temperatures approaching one-another, the 22˚C and 26˚C equilibrium temperatures do, and the 20˚C temperature decreases slowly. Eventually, only the one equilibrium temperature remains at some temperature less than 20˚C.

Repeating this process for all values of k would allow us to visualize what would happen to the climate for any given amount of regulation. Again, since our model equation is a rate of change function, setting it equal to zero allows us to see the points at which the climate will not change. Doing this without subbing any values for our regulation variable, k, generates a function that uses k as a dependent variable. This function combined with the behavior discovered before allows us to create a bifurcation diagram. This diagram shows us the behavior of the climate for any given amount of regulation at any initial condition for climate. To show if a condition around the function tends to decrease, we will color it blue. To show if a condition around the function tends to increase, we will color it red.



Climate v. Regulation (desmos.com)