The Responsibility of Engineers in Guiding Climate Change Initiatives

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The effects of climate change are becoming more apparent as time passes. Intuitively, there is a feeling of higher intensity storms, whether a hurricane or high amounts of rainfall, that have been cropping up in the past few years. Beyond just this feeling, there has been a rise in attribution studies tying the increase of climate change to weather events. The World Weather Attribution has been analyzing extreme weather events since 2015, measuring the effects climate change had on the severity or the frequency of the events that occur. From these sorts of studies, the WWA can predict such things as the likelihood of certain storms, claiming of the Typhoon Hagibis that landed in Japan in 2019 that it was "made about 67% more likely by human-caused climate change" (EPA). While the effects of climate change become clearer, the solutions pushed in media have become more misguided. According to the EPA, the single largest sector that contributes to climate change is the transportation sector, at 27%. From that perspective, the priorities going into EVs seems appropriate. However, looking at the remaining emissions paints a different picture, showing that the burning of fuels for power, for industry, and for commercial/residential heating takes up nearly 62% of the emissions, and even more so when looking at a global perspective. While a reduction in emissions in the transportation sector would be significant, it should not be the priority over changing the underlying infrastructure that relies on fossil fuels to operate. Clean energy sources, mainly for use in industry and electricity, is essential to making the most significant reduction in our emissions. With both the growing predictability of climate change's affects and an understanding of its sources in mind, the responsibility of engineers in addressing climate change is clear. Engineers must work to create technology that mitigates the damage extreme weather (through climate change) can cause different regions in the world, while also working to prioritize changes to the most important infrastructure to reduce our emissions, regardless of what is the 'flashiest' thing to work on. Through the creation of technology such as storm surge barriers and advanced irrigation, the effects of climate change on people can be mitigated, and through the promotion of clean energy sources and technologies such as carbon recapture, the effects of climate change on our planet can be slowed or even reversed.

One of the main responsibilities of engineers in regards to climate change is to work on technology that helps to protect people from the effects of extreme weather that results from climate change. While not all effects of climate change will be preventable, intelligently designed systems for cities are essential to minimizing these effects. Climate change has led to a couple major damaging events, for opposing reasons – the increase of global water temperature leads to more water in the atmosphere, increasing the intensity of rainfall and other storms which increases flooding. To protect individuals and cities from flooding, engineers could work to continue the development of technology

such as storm surge barriers. Traditional storm surge barriers are “fixed installations that allow water to pass in normal conditions and have gates or bulkheads that can be closed against storm surges or high tide to prevent flooding” (Climate-Adapt). In major regions, such as coastal areas or around commonly flooding rivers, the creation of additional or greater sized storm surge barriers can help to protect people from the damages of flooding that major storms often bring. This technology can be paired with the growing technology of Flood Mapping, which “use remote sensors to determine which areas are most at risk of flooding based on elevation, proximity to bodies of water, and other topological data” (Dames). While we may not have the resources to protect every city or every home from flood damages, we can be efficient about protecting as many people as possible by using the data from Flood Maps to find what regions are most prone to flooding, and then creating barriers around the regions where flooding is both most common and could cause the most damage. On the other end of the spectrum, the increase in temperatures evaporates more water that is normally in the ground, which in some regions can cause significant drought. While there is little that can be done to add more water to an area under drought, we can use technology to better maintain the water supplies of every region. Through the use of automation and sensors, the water we use for irrigation can be most optimally applied. An example of this technology has been developed in December of 2017, which works as follows: “as the irrigation system moves across a field, the sensors determine a crop’s water needs triggering the release of water based on a signal produced when the crop is water stressed. Using an algorithm tied to the water needs of specific crops in specific regions, the system determines when, where and how much to irrigate” (O’Brien). Another technology to reduce the amount of water we use is called ‘micro-irrigation’ or ‘drip irrigation,’ in which instead of water being sprayed far above plants, the water is delivered directly to the roots of the plants. While this technology is more expensive, it is predicted to “use about 20 to 50% less water than conventional sprinkler systems” (Guven). If both intelligent, automated sensor systems could be paired with drip irrigation, the amount of water that we use for creating our food could be optimized, which could keep a lot more water available to mitigate the effects of drought. While such technologies may at this point be costly and impractical to always use, that is exactly where the responsibility of engineers comes in, to reduce the complexity and cost of such systems and ensure through that that they can be accessible to all areas that are needed.

While the mitigation of current effects of climate change is a high priority, engineers are also obligated to work to help address the root causes contributing to climate change through technology. The primary focus, as mentioned earlier, should be the changing of our power infrastructure from carbon-based fuels to renewable energy resources. According to the International Energy Agency, 72% of

our energy usage comes from non-renewable resources, and of the renewable resources, 17% of our total energy comes from hydropower. The ability to expand our hydropower infrastructure through dams is limited geographically, but a more underutilized areas are with wind and solar power. Currently, the most underutilized energy source is solar, which only accounts for 3% of our total energy contribution. According to the Department of Energy, "solar energy is the most abundant energy on earth", and if the ability of solar panels to harness it was increased, and we put time into building infrastructure in the most optimal regions (such as the solar farm in the Mojave Desert), we would be able to begin to cut back on a lot of our carbon emissions in a safe manner. Alternatively, the new progress into an energy producing nuclear fusion reaction could lead the way to clean and safe nuclear energy that could replace the previous carbon power plants. Through a combination and promotion of these two technologies, engineers should work to greatly reduce our future carbon emissions. Even if that were to be achieved, however, the carbon emissions that have accumulated to this point will not reduce on their own. That is where another, clean-up technology comes into play: carbon recapture. Carbon recapture, mainly through direct air capture, "is a process that separates CO2 from ambient air. The separated CO2 is then permanently stored deep underground or converted for use in long-life products like concrete that prevent its release back into the atmosphere" (Department of Energy, 2022). Recently, the Biden administration has launched a "$3.5 billion program to capture and store carbon dioxide," promoting new jobs and development into this industry. With the funding from the government and the necessity to try and mitigate the accumulation of carbon emissions we have generated at this point, it is the responsibility of engineers to capitalize on the interest to create effective technology that can meet our needs in this regard.

Ultimately, engineers will need to be the ones leading the technological innovations that will result in overcoming climate change. It may require a prioritization of human needs over what is the most profitable, and in that regard, the advocation and support of legislation in government to fund these initiatives will be essential. Engineers should be looking to both protect people from the current effects of climate change, by protecting flood prone regions and increasing our water efficiency to mitigate drought, and then look forward to reducing are carbon emissions significantly while recapturing what carbon we have used to bring our climate back to a stable level. Making these changes will need to be a global initiative with all people on board, so perhaps the greatest responsibility of the engineer is to communicate the importance of all these things in a way that is persuasive and to lead others into contributing resources to the mitigation and reversal of climate change.

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