Climate Change Impact on Fuel and Energy

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Climate Change poses a key challenge for modern day engineers. As technology continues to develop, increasing greenhouse gas emissions are overburdening the environment's homeostatic balance, resulting in increasing global temperatures. The consensus among climate scientists is that human activities have a direct correlation with shifting climate patterns toward warming temperatures in a shorter time frame when compared to available data on natural climate shift patterns. The United States (US) Environmental Protection Agency (EPA) estimates that between 1990 and 2020, greenhouse gas emissions from transportation showed the greatest increase across all sectors, with an estimated 27% of total US greenhouse gas emissions coming from this sector alone ("Carbon Pollution from Transportation", 2022, para. 1). Figure 1 shows the carbon dioxide emissions from different transportation types. Transportation that does not rely on fossil fuels, such as walking and biking, produces no carbon dioxide, while driving alone in an average car run on petrol produces 153 g/person.Km (Karyono, 2015, p. 3). EPA regulations which aim to regulate greenhouse gas emissions from transportation are projected to reduce lifetime greenhouse gas emissions from vehicles built in 2015 to 2025 as high as 270 million metric tons ("Carbon Pollution from Transportation", 2022, para. 5).

Figure 1

Carbon Emissions by Transport Types

Mode	Detail	Occupancy	CO_2 (g/Km)	CO_2 (g/person.Km)
Walk			0	0
Cycle			0	0
Motorcycle	**4-Stroke <250cc**	Driver only	73	73
Motorcycle	4-Stroke <250cc	Driver plus pillion	73	36.5
Bus	Diesel (1996-2001): Urban use	100%	892	25.5
Bus	Diesel (1996-2001): Urban use	75%	892	34
Bus	Diesel (1996-2001): Urban use	50%	892	51
Taxi	Minicab passenger car: Petrol	1 passenger	216	216
Taxi	Minicab passenger car: Petrol	2 passengers	216	108
Taxi	Minicab passenger car: Petrol	3 passengers	216	72
Train	Network Turbo: diesel (regional network)	100% occupancy (all seats full)	3637	21,1
Airplane	Domestic UK (B737-400)	100% occupancy (all seats full)	32107	219,9
Airplane	Long-haul International (B747-400)	100% occupancy (all seats full)	93102	223
Car	Average city-car petrol	Driver only	153,3	153,3
	Average city-car natural gas	Driver only	118	118
	Average city-car petrol hybrid	Driver only	107,3	107,3
	Average large family petrol	Driver only	244	244
	Average large family petrol	Driver plus 4 passengers	244	48,8

Note: Figure taken from "Architecture and Technology: The impact of modern technology on global warming" by Tri Harso Karyono.

Climate Change as a result of greenhouse gas emissions will further necessitate in changes in US energy consumption, with as much as a 1.8℉ increase in national temperatures leading to increased use of air conditioning, with an estimated 5-20% increase in energy consumption, and a 3-15% decrease in energy consumption used for heating ("Climate Impacts on Energy", 2017, para. 3). Temperature increases also lead to changes in the water cycle, producing disruptions in energy production. Higher temperatures lead to increased rates of the evaporation of liquid water to steam, while less water condenses in the atmosphere, leading to a decrease in precipitation rates. These conditions produce droughts, which hinders the ability for power plants to get enough water to cool their systems. This poses a problem because to produce a single kilowatt-hour of electricity power plants require an average of 25 gallons of water ("Climate Impacts on Energy", 2017, para. 7). The need to cool power plants competes with other water needs, such as having enough clean drinking water for the population, as available water reserves decrease. Alternatives to fossil fuels, such as biofuel energy, require their own unique water needs which must be considered in the overall analysis of environmental impacts of various energy sources.

Facilities located in coastal regions which import coal, gas, and oil face a different facet of changes in the water cycle. Large stores of solid water, such as the polar ice caps, have begun melting in response to Climate Change. The excess liquid water has led to rising sea levels. One example of where the impact can be seen on our energy and fuel supply are the 100 platforms and 558 pipelines that were damaged as a result of the Hurricanes Katrina and Rita ("Climate Impacts on Energy", 2017, para. 14). Disruptions in imports lead to scarcity which raises prices for the consumer, such as gas prices. The US Federal Highway Administration (FHWA) analyzed the gas prices per month in 2007 and 2008 and compared that with total national vehicle miles traveled (VMT). They discovered that when gas prices began to increase in 2008, the VMT decreased by as much as 5.6% (Brand, n.d, para. 2). Referring back to Figure 1 above, cars produce a significant amount of carbon dioxide emissions, so less time spent driving can result in lower carbon dioxide emissions; however, supply chains would become impacted by the rise in gas prices, which gets added to the costs of products purchased by consumers. As of June 6, 2022 the national price per gallon of gas is $4.876 ("Gasoline and Diesel Fuel Update", 2022), leading to political debate on the reliance of foreign oil.

Engineering students must develop a multi-disciplinary mindset to understand and respond to Climate Change. Comprehension of the causes of Climate Change requires a grasp of ecological processes, understanding the economic impact leads to better investment decisions, and creating designs which maximize benefit to humanity while minimizing harm can be rooted in engagement with societal issues. Engineers who do not analyze the impacts of Climate Change could create designs which accelerate the larger problem and reduce access to resources necessary for beneficial engineering

solutions. Earth's resources aren't infinite, so a more sustainable approach results in longevity of designs. As a society, there is still work to be done to make alternative energy solutions more affordable to developing nations and for those with a lower economic status. In addition, alternative energy solutions must still be researched to determine areas where environmental impact is a concern. Learning about Climate Change at an undergraduate level prepares students with resources to begin tackling these challenges so that the world is left in a better condition for future generations.

References

Brand, Dan. (n.d). Impacts of Higher Fuel Costs. Federal Highway Administration. Retrieved June 10, 2022 from https://www.fhwa.dot.gov/policy/otps/innovation/issue1/impacts.cfm

Carbon Pollution from Transportation. (2022). Environmental Protection Agency. Retrieved June 10, 2022, from https://www.epa.gov/transportation-air-pollution-and-climate-change/carbon-pollution-transportation

Climate Impacts on Energy. (2017). Environmental Protection Agency. Retrieved June 10, 2022, from https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-energy_.html

Gasoline and Diesel Fuel Update. (2022). US Energy Information Administration. Retrieved June 10, 2022 from https://www.eia.gov/petroleum/gasdiesel/

Karyono, Tri. (2015). Architecture and Technology: The impact of modern technology on global warming.