Final Geography Project

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Geography

June 4th, 2022

Task 1

Core

Figures

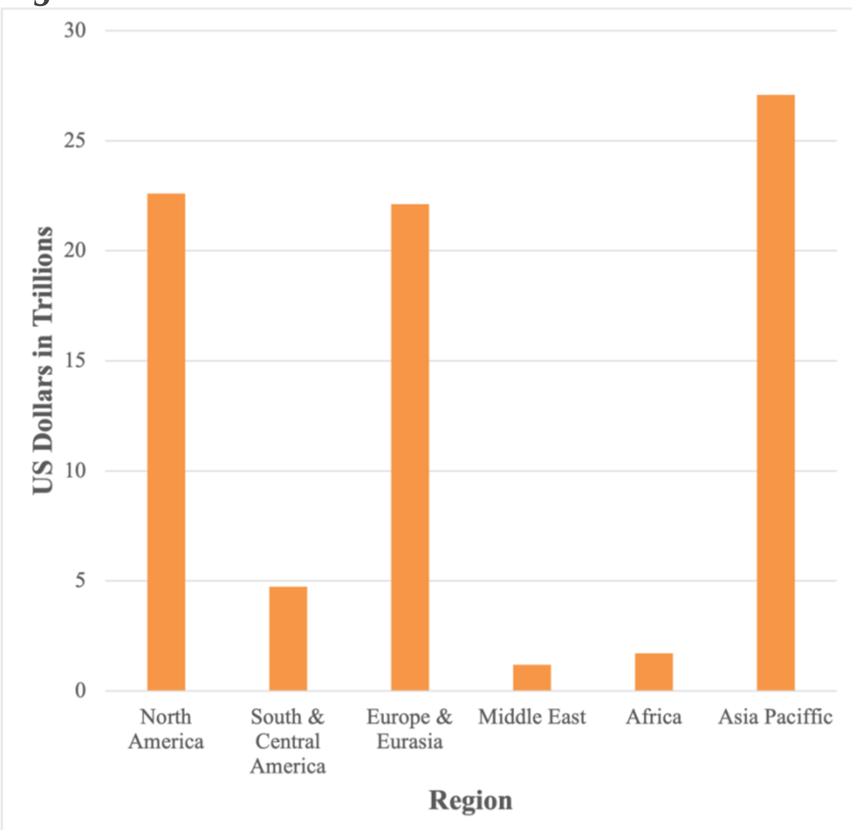


Figure 1 Bar Chart: *GDP of Different Regions (USD)*

Data modified from: (*GDP (Current US$)* | *Data*, n.d.)

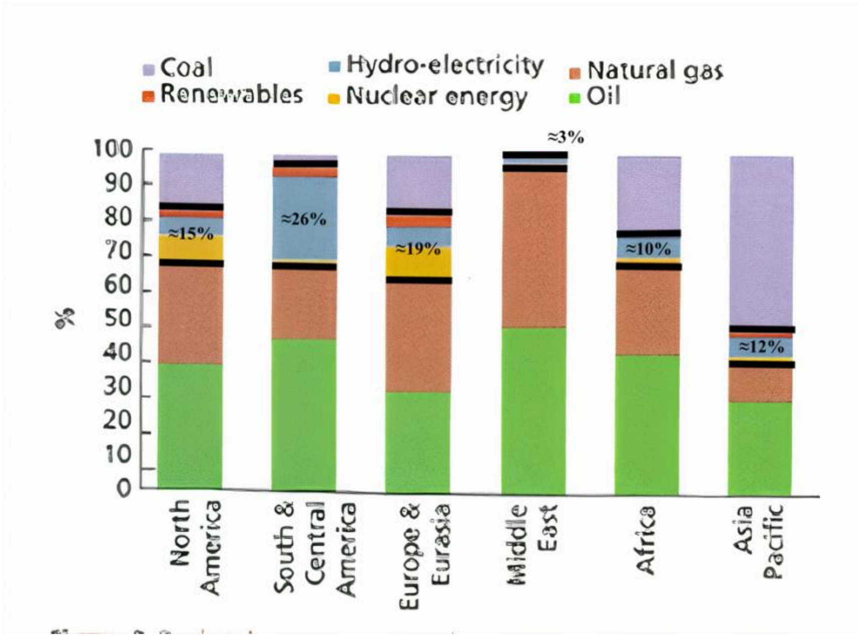


Figure 2A Compound Bar Chart: *Energy Distribution per Region*

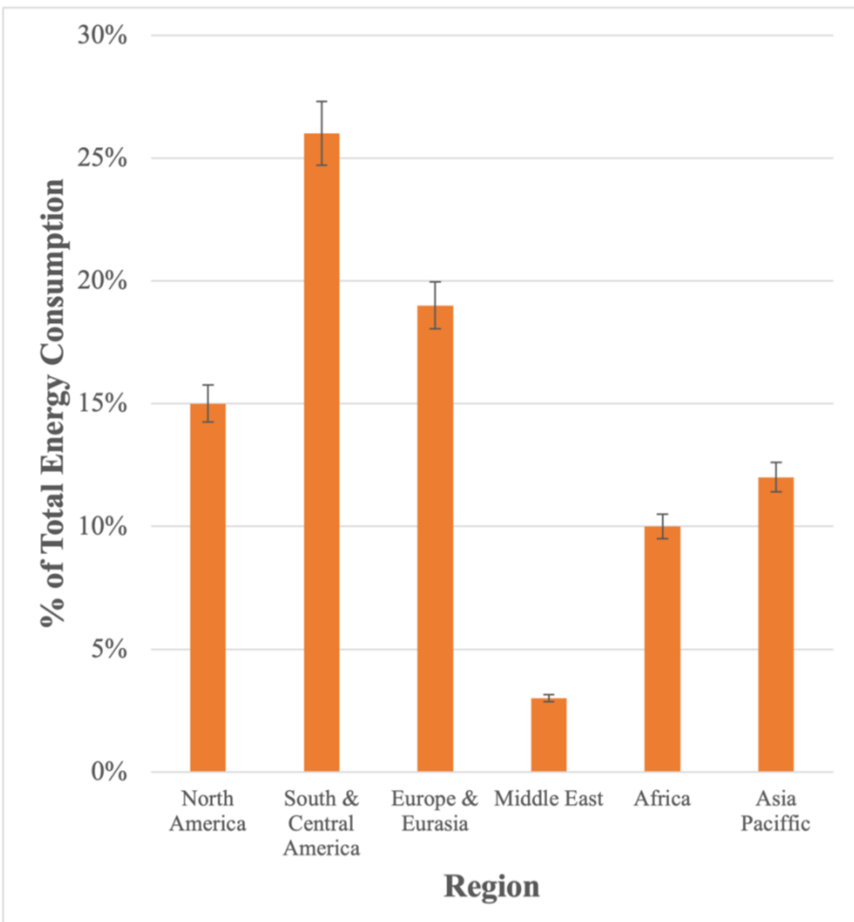


Figure 2B Bar Graph: *Renewable Energy Distribution*

Written Response

Part A

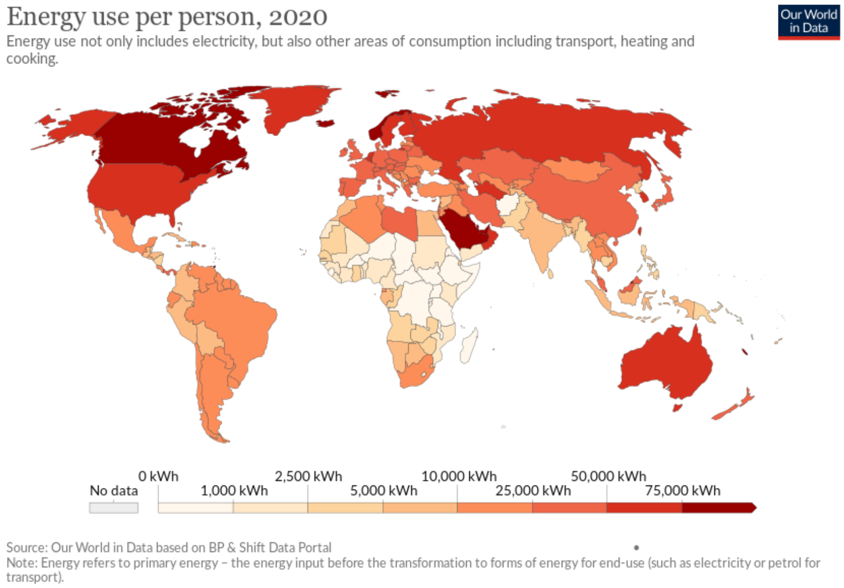
Sustainability, by definition, is the avoidance of the depletion of natural resources in order to maintain an ecological balance within the present and on a long-term basis. A more sustainable region would use an energy source that is much less harmful on a regional and global basis (i.e., hydroelectricity, nuclear energy, etc.). Regarding specifics, I think that the sustainability of a country is heavily dependent on its Gross Domestic Product (GDP). For example, North America and Europe both source 15-20% of their energy from renewables and have a GDP of 22 trillion dollars (Figure 1 and Figure 2B). This makes logical sense, considering that renewables are a new market, and their cost margins have to increase, thus catering to a higher market. However, some countries deviate from this pattern, for instance, South and Central America, which use a margin of 30% renewables (27% coming from hydroelectricity), yet their GDP is just five trillion.

Part B

Sustainability refers to not only energy consumption (environmental) but also the social and economic impacts. On the basis of environmental factors, I think this does not present a sustainable future. Rooting back to the definition of sustainability, it has to "maintain ecological balance," If countries are extracting their energy from 80% fossil fuel, it poses a dramatic threat to the environment. Figure 2B shows that even big players in global progression (North America, Europe, and Asia Pacific) are still only, on average, obtaining 15% of their energy from renewable sources. Socially and economically, the future looks grim as well because the warming of the planet leads to a domino effect, causing a multitude of different natural disasters. These destroy communities and thriving businesses, thus hindering our ability to converse and trade economically. In a nutshell, the graphs showing such a minimal usage of renewables (average globally: 14%) leads to hundreds of new natural disasters which prevent social and economic growth.

Stretch

Figures



Schematic 1: Energy consumption per person

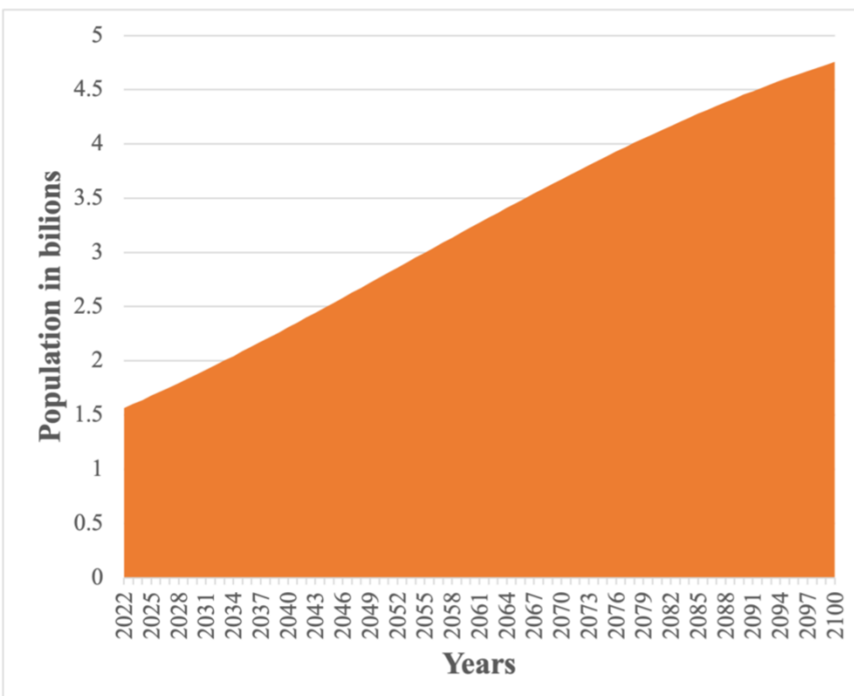


Figure 3 Filled Line: *Africa Projected Population (2100)*

Data modified from: (Ritchie, 2019)

Written Response

The biggest challenge I foresee regarding Schematic 1 is the uneven distribution of energy per person regarding a lack of governmental change. It is not ethically fair to have countries like Saudi Arabia and Canada use up 80,000-90,000 kWh of energy, whereas Chad uses less than 1,000 kWh. Nevertheless, the energy consumption is also dictated by the population, considering that more people will generically use more energy. In developing nations, the population will continue to grow exponentially, and places in Africa will start using more energy to sustain their population. Coalitions like the UN and NATO should provide energy infrastructure to equip their population better. Africa's population is already going to triple in the next century (Figure 3), and with this comes three more billion people who need energy, which is not being provided. Developing nations will not be able to support their population without an adequate quantity of energy, which is the most significant challenge I foresee regarding energy usage across the world.

Task 2

Core

Figures

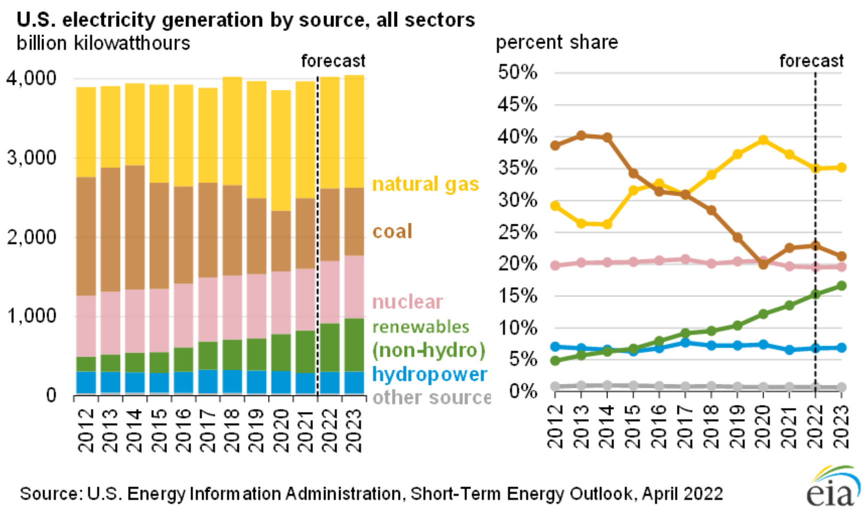


Figure 4A: *US electricity generation by source*

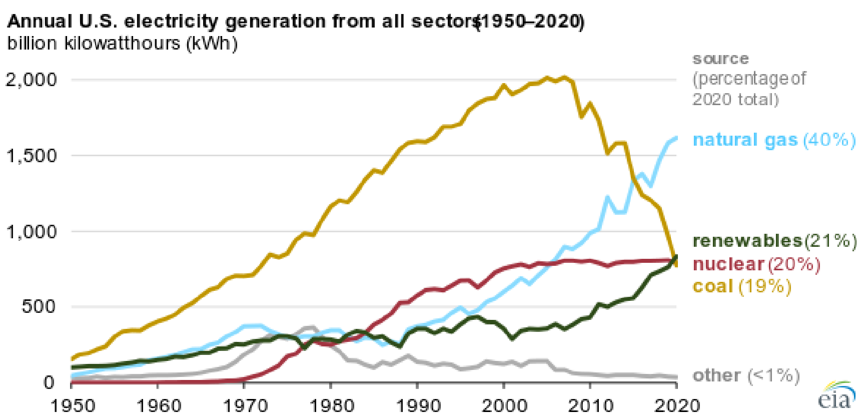


Figure 4B: Annual U.S. electricity generation

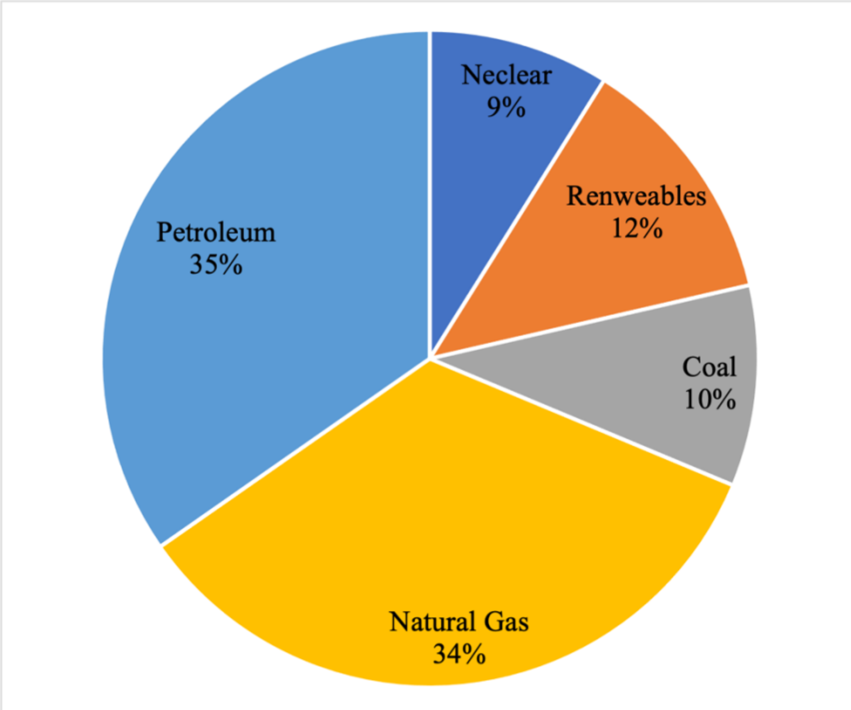


Figure 4C: *U.S. energy source distribution (2020)*

Data modified from: (*U.S. Energy System Factsheet | Center for Sustainable Systems*, n.d.)

Written Response

Part A

There is not much of a drastic difference in the US' energy profile from 2012 to the projected usage in 2023. As most climate scientists projected, harmful sources of energy (i.e., coal) would decrease, resulting in a 20% reduction in coal from 2012 to 2023 and a 10% increase in renewables from 2012 to 2023. However, sources like natural gas have risen 5% from 2012 to 2023 because as coal manufacturing decreases (roughly 500 billion kilowatt-hours), humanity would need to find another energy source that is consistent and reliable, which is natural gas.

Part B

In the last decade, the US has been shifting its energy sources, but there is definitely some more improvement that can be made regarding sustainability. Sustainability is the avoidance of depleting any natural resources in order to maintain ecological balance in the short term **and long term**. Considering the short- and long-term basis, Figure 4B, states that the US was sourcing 40% of its energy from natural gas. Natural gas is more efficient than coal, but on the contrary, it produces methane which is around 25 times more potent than carbon dioxide (*Importance of Methane*, n.d.). This, coupled with the lack of initiative being given to renewables, results in a decline in sustainability.

Stretch

Figures

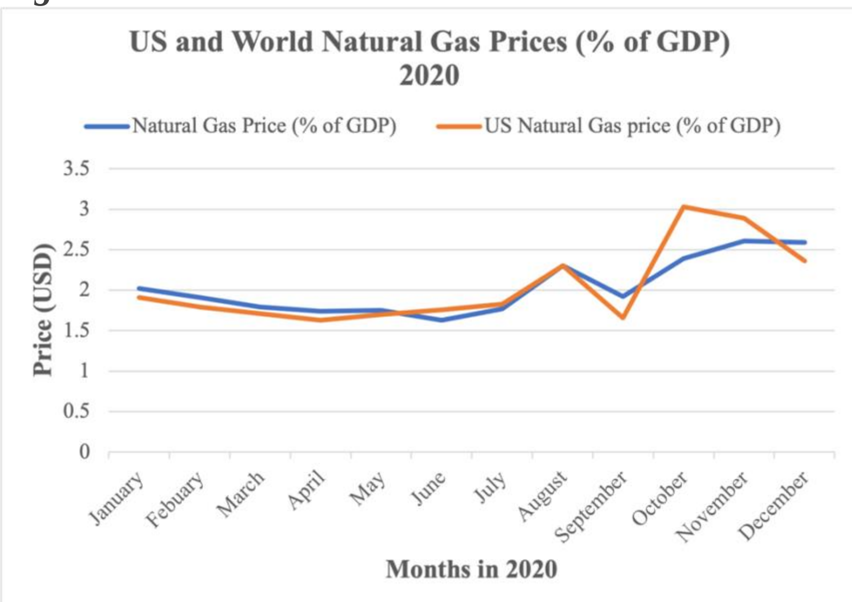


Figure 5 Line Graph: *U.S. and World Natural Gas Prices (% of GDP)*

Data modified from: (*Natural Gas Rents (% of GDP) | Data*, n.d.)

Energy Produced by the US in 2020	Energy Consumed by the US in 2020
4,116 billion kilowatt-hours	**3,675 kilowatt-hours**

Table 1: *U.S. Energy Consumption and Production*

Data modified from: (*What Is U.S. Electricity Generation by Energy Source?*, n.d.) and (Staff, 2020)

Written Response

Part C

These factors encompass most of the energy security, as they are primarily dependent on the adequacy, reliability, and affordability of the energy, as well as accessibility and acceptability. If a country has a variety of renewable energy potentials, they have the infrastructure to utilize it. However, if the distribution of this energy is disproportional, then there is no point. In this example, according to the definition provided above, the country would be "energy secure," but in reality, it is not. The distribution of energy is arguably more important than the process of obtaining it. Acceptability ties to adequate supply, but currently, the notion of natural pollution and fossil fuels is becoming more *unacceptable*. In contrast, renewables are becoming *more* acceptable, resulting in a change in energy sourcing.

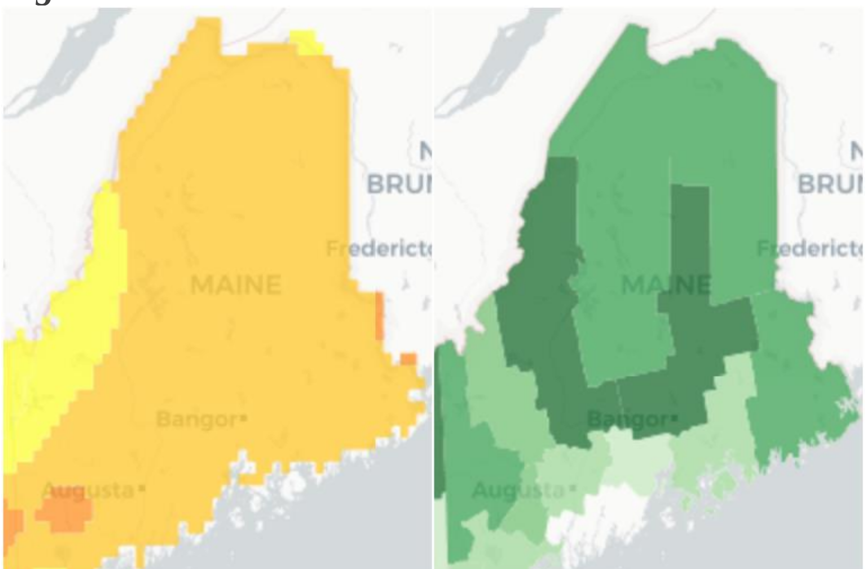
Part D

According to the Figures above, the US is mostly energy secure. Regarding affordability, the predominant energy source in the US is natural gas (shown in Figures 4B and 4C). Thus, the cost of natural gas will determine part of the US energy security. Figure 4C shows that natural gas is mostly affordable, following the global trend. Also, adequacy and accessibility are shown in table 1, as the energy that is being produced by the US is still slightly higher than that consumed by the population as well. Nevertheless, as shown in Figures 4A and 4C, reliability and acceptability prevent the growth of their energy security. The US is primarily using fossil fuels as their energy source, which allows them to be prone to political instability, and a shortage. The main thing the US has to overcome to become more energy secure is to use more renewable sources in their energy profile.

Task 3

Core

Figures



Schematic 2**:** *Geothermal vs. Biomass residue in Maine*

Data modified from: (RE Atlas, n.d.)

Biomass Residue	**Geothermal**
76	1.5

Table 2: Necessary Land (hectares) for Geothermal and Biomass Energy

Data modified from: (Geothermal Power Plants — Minimizing Land Use and Impact, n.d.; The Freeing Energy Project, 2020)

	Biomass Residue	**Geothermal**
Cost of power plant	$4000	$2500
Cost of maintenance (per kilowatt hour)	$0.15	$0.06

Table 3: Cost of Biomass and Geothermal Power Plant

Data modified from:(Biomass for Electricity Generation | WBDG - Whole Building Design Guide, 2016; Geothermal FAQs, n.d.)

Written Response

Based on preliminary research, Biomass residue and Geothermal energy were best suited for Maine, as they were most abundant and suitable for the climate. I would base the biomass power plants near Princeton and Lewiston. Biomass residue involves the burning and processing of dead matter, but mainly trees as a source of energy. This might have its advantages, as it can easily be infused in oil and gas, but when the wildlife is cut down for energy, the process in which the trees grow is much slower than the rate of them cutting it down. Maine has the greatest number of trees in the US, and thus would not affect them as much, but still cause problems in terms of habitat destruction, especially considering that most of their natural wildlife is dependent on trees. Not only this, but biomass would promote monoculture (the cultivation of a singular crop species) in terms of agriculture for convenience. This offers the problem that when their crops are exposed to a disease, most crops will die. This potential hazard, coupled with 14.7% of Maines residents being food insecure, allows for a potential catastrophe regarding food distribution. Also, a Biomass plant costs $4000, which puts strain on Maine (see Figure 7). Maine suffered the most from the pandemic, becoming the eighth-worst economy in the US, targeting business the hardest. Finally, the land is crucial to homeowners in a place like Maine. 61% of their population lives rurally (the highest in the US), and thus, biomass takes up a lot of space (see Figure 6). This would infringe on private territory and cause a nuisance for the landowner.

Geothermal energy is also a possibility in Maine. Geothermal energy is the extraction of the heat within the earth to generate energy. I would base the geothermal power plants near Bangor and Orono. Maine has the enormous potential for Geothermal energy in the US (due to its proximity to the Eurasian plate), and importantly, it has almost no effect on the environment. Maine mainly uses Flash Steam and Binary Cycle Geothermal plants, which require some fluid. This fluid is predominantly water, which is easily sourced in Maine. Around 39 rivers run through Maine, which could easily facilitate the use of geothermal energy. Not only this, but the Appalachian

Mountains run directly through Maine, which allows for a more significant generation of geothermal energy. When mountains are formed, it is due to a converging tectonic plate. Thus, there is the ability to extract more energy. Especially in central Maine, geothermal has a huge potential. Regarding economics, a geothermal power plant would be half as less expensive, putting less burden on the people. Not only this, but it takes up minimal land, which puts less of a constraint on homeowners.

Regarding energy security, Maine using renewables as their primary energy source (geothermal energy) would reduce energy costs, thus making it more affordable and accessible. Geothermal energy is also very reliable, as the earth consistently emits heat that can be used to generate energy. Finally, regarding acceptability, this is a very modern and efficient energy source, which might appeal to consumers and innovations in geothermal energy.

Stretch

Figures

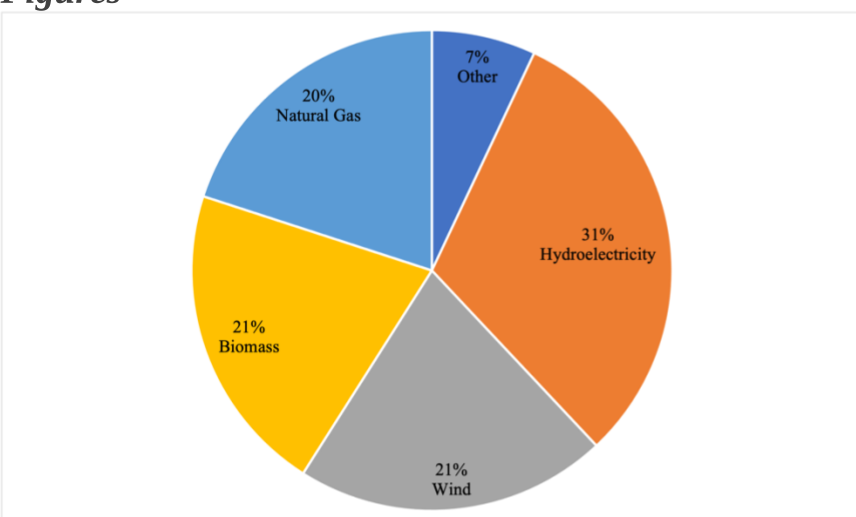


Figure 8 Pie Chart: *Maines energy distribution by source*
Data modified from: (*Chart: Maine's Power Mix*, n.d.)

Written Response

I proposed that Maine should use geothermal energy as their primary renewable energy source, but in reality, Maine's primary energy is sourced from hydroelectricity. There were a lot of small rivers running through Maine, and by taking advantage of this, 31% of their net energy production is from hydroelectricity (see Figure 6). One limitation is the damage it causes to marine ecosystems and its proneness to flood. However, 20% of their energy still comes from natural gas, releasing harmful gases (methane and carbon dioxide) into the atmosphere.

Task 4

Core

Figures

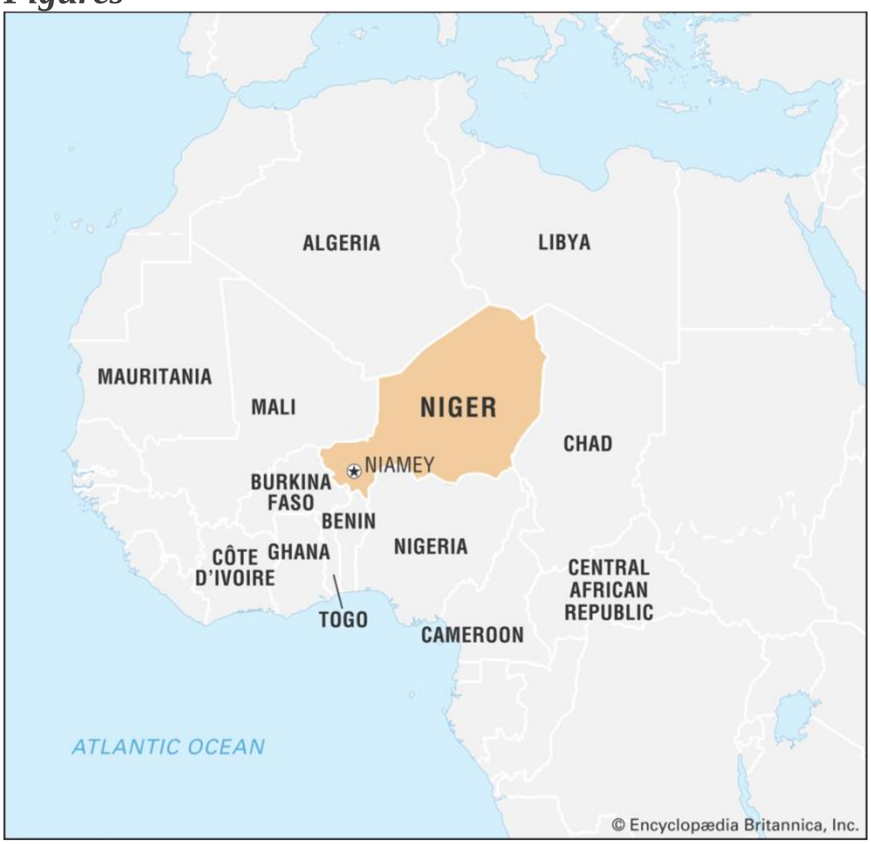


Figure 7: *Map of Niger*

Data modified from: (Dresh, n.d.)

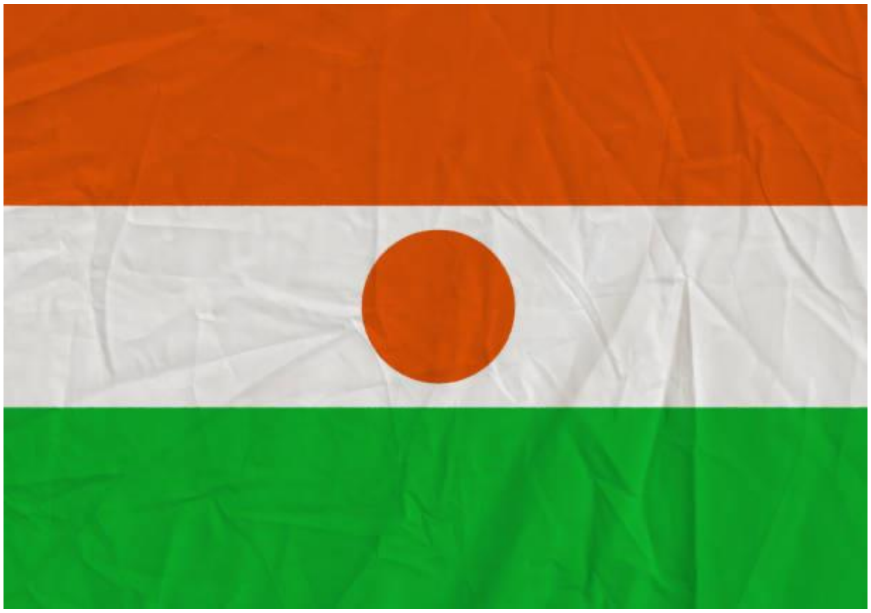


Figure 7: *Flag of Niger*

(Vector Flag of Niger, n.d.)

I chose Algeria as a comparison due it being one of the most successful countries in terms of sustainable development (encompassing social, economic, and political). This would allow a clear comparison of what Niger could be achieving as it has an HDI of 0.784, whereas Niger has an HDI of 0.394, a significant difference. Not only this, but both have roughly the same environmental properties.

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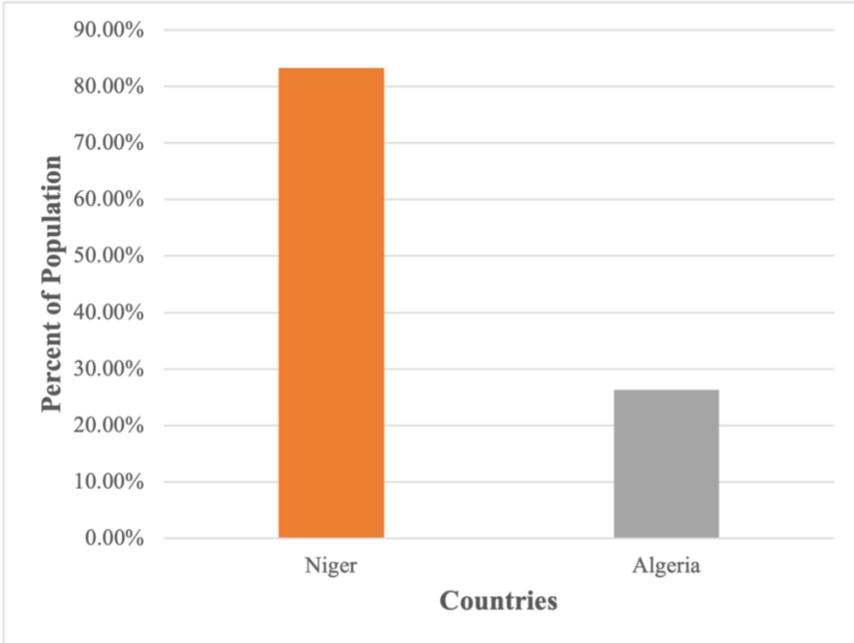

Figure 6: Rural Population of Niger and Algeria
Data modified from: (Niger Rural Population 1960–2022, n.d.)
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<tr><td>Niger</td><td>83.30</td></tr>
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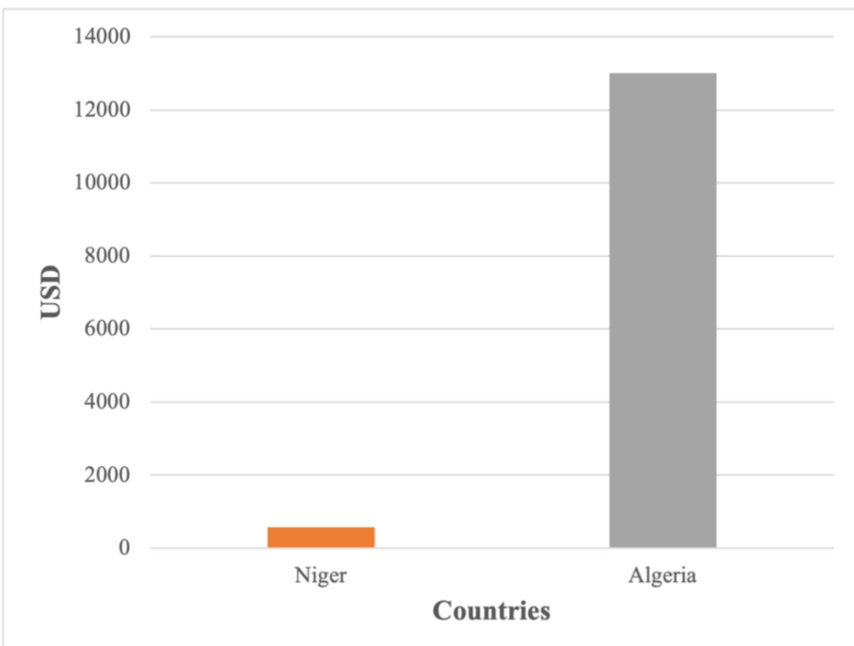

Figure 7: GDP per Capita of Niger and Algeria
Data modified from: (GDP per Capita (Current US$) - Niger | Data, n.d.)
</td><td>
<table>
<tr><td>Niger</td><td>567</td></tr>
<tr><td>Algeria</td><td>13,002</td></tr>
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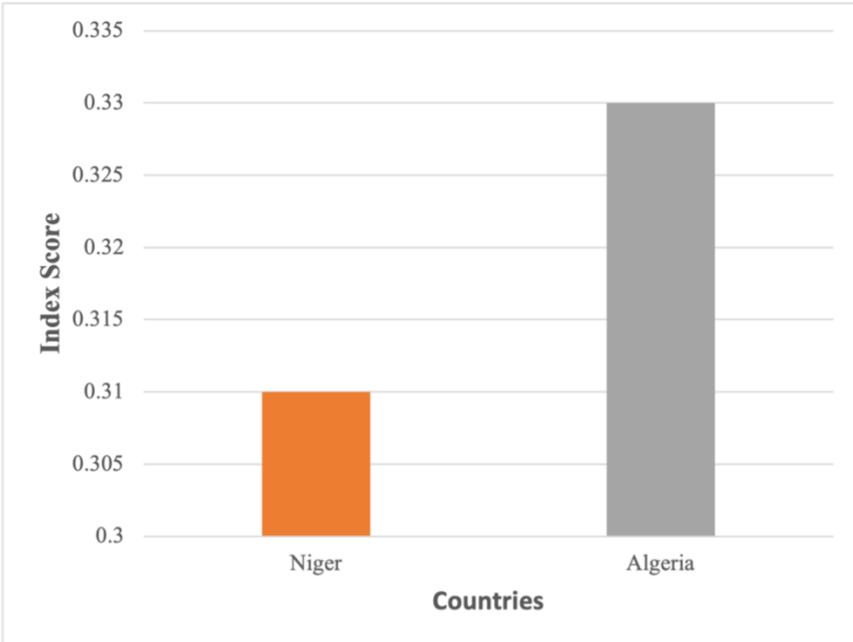


Figure 8: *Corruption Perceptions Index of Niger and Algeria*

Data modified from: (Transparency International, 2019)

Niger	0.31
Algeria	0.33

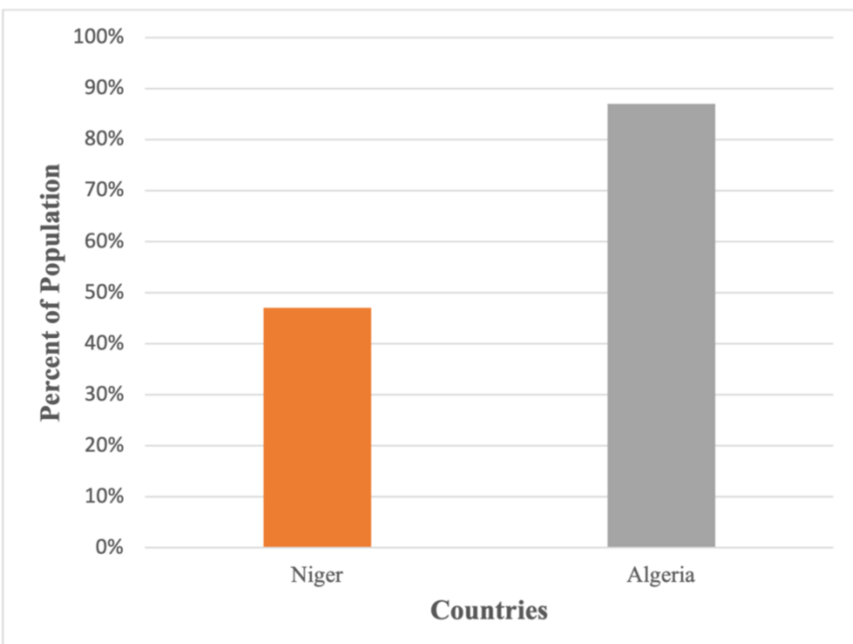


Figure 9: *Clean Water of Niger and Algeria*

Data modified from: (People Using Safely Managed Drinking Water Services (% of Population) | Data, n.d.)

Niger	47%
Algeria	87%

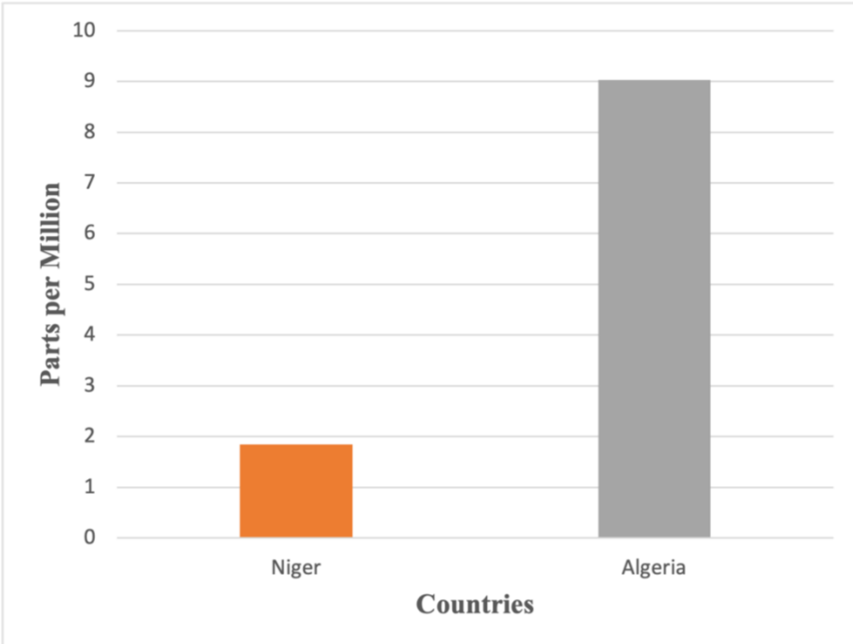
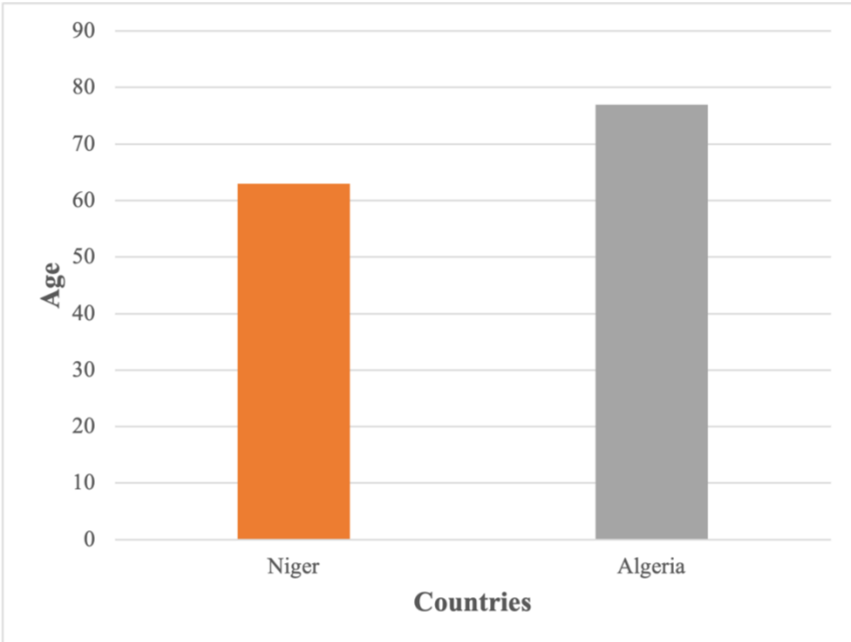


Figure 10: *High Technology Exports of Niger and Algeria*

Data modified from: (High-Technology Exports (Current US$) - Niger | Data, n.d.)

Niger	1.84
Algeria	9.03



Niger	63
Algeria	77

Figure 11: *Life Expectancy of Niger and Algeria*

Data modified from: (Niger Rural Population 1960–2022, n.d.)

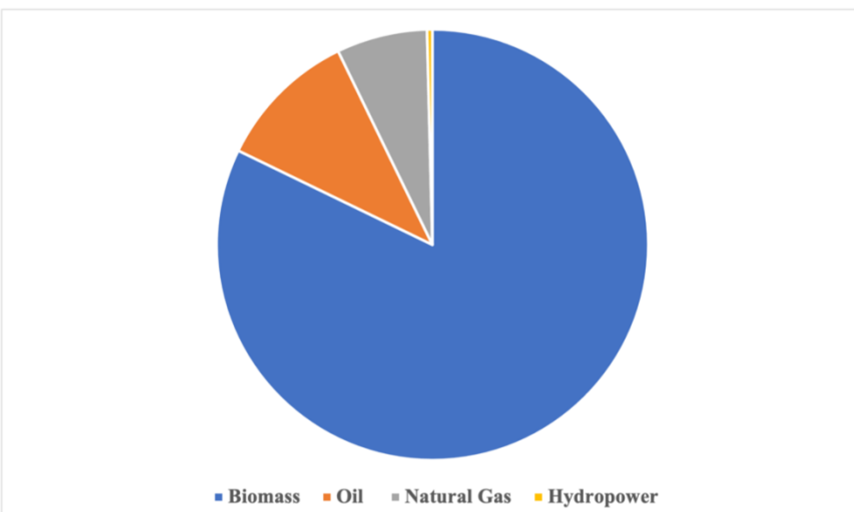


Figure 12: *Niger energy distribution by source*

Data modified from: (Niger Energy Situation - Energypedia, n.d.)

Written Response

Part A

Niger struggles to give energy to its citizens. Less than 20% of its population has access to modern electricity. This lack of distribution was mainly attributed to their lack of extensive infrastructure. In Niger, more than 80% of the population lives in rural areas (see Figure 9). This results in a more spread-out country and strains the electrical grid system. This, coupled with the limited GDP per capita, which was potentially caused by the high levels of corruption, prevented the growth of their infrastructure (Figures 10 and 11). I believe the lack of infrastructure resulted in the struggle to deliver electricity to their population. Niger frequently endures droughts and floods as well. In these types of disasters, the delivery of electricity is essential to the population, which further stresses the necessity for a centralized infrastructure is a necessity. This is shown by the lack of clean drinking water present in the area, as well as the prevented growth of technological advancements (see Figures 12 and 13). Considering the dis-proportional energy distribution and the downgraded infrastructure, this resulted in the exceptionally low life expectancy in Niger.

Part B

The lack of a centralized infrastructure is causing a burden on their electrical system and the citizens in Niger. I believe that integrating an international system, such as the United Nations (UN), would hold politicians accountable and streamline the income to maximize the public benefit. This would not only give the communities trust in their governmental system, but it would increase the efficiency of certain private-sector partnerships and thus increase the revenue they generate. The UN would also spotlight this problem to other global leaders to step up. However, this might cause Niger to be reliant on the UN for such goods, and thus would actually mitigate internal growth. and This would be a more short-term solver to corruption. Also, if the citizens are given more relevant tools to participate in governmental policies, it would lower the corruption rates– this would be a more long-term solver. Not only this, but if the government promoted infrastructural projects such as building roads/bridges, this would thus lower the corruption rates within that area, as more of the public is benefiting. Building roads/bridges would also allow Niger to become a more connected country and consequently relieve the stress on the electrical grid system. Specifically, regarding their sustainability, I feel that Niger has the potential to switch its energy sourcing. More than 75% of Niger's energy comes from biomass. This might seem like a positive trend, but in reality, the cutting down of trees is much faster than they grow, and in this process, Niger is destroying their environment (almost 65% of their land is desert, and their soil's quality is depleting as well). Instead, I would recommend Niger to spend more of their focus on developing solar energy and taking advantage of their desserts (which were created by the blunder of biomass residue)—specifically developing the solar photovoltaic to function with the rain (almost half of the year in Niger is rainy). A sustainable future will always aid the future of a country, as its energy is coming from a more reliable and sufficient source. The use of solar energy, or any other renewable, will also allow the greater distribution of energy in Niger.

Task 5

Core

Written Response

China's energy use has exponentially increased and officially surpassed the United States in 2009. The human factors contributing to the rise in China's energy use can be divided into economic, political, and social reasons. Firstly, China was experiencing an economic boom in the 1980s and 1990s, which allowed them to develop their energy sources, explicitly targeting coal. This gave China the money to start importing and exporting oil and coal. This not only made coal affordable, but it also improved its public notion as the development of coal consequently improved its environmental impacts. Coal pollutes the air and releases sulfuric acid, which contributes to acid rain and destroys ecosystems. Politically, this gave China more power over *western* nations. However, their switch to renewables would further change their course, allowing less reliance on countries such as the Middle East for high trading oil prices. Socially, China had set up several oil reserves to prevent fluctuations in prices, appealing to the consumer further. This attracted consumers and allowed the government to control the distribution of energy. Not only this, but the recent capacity increase in renewables would shift its public appearance and become net zero by 2060. Finally, China takes advantage of the

Yangtze River by a 2-kilometer dam to generate 22,500 megawatts of energy. This supplies Shanghai and Chongqing with energy that can easily be changed to the demand.

Stretch

Written Response

I had touched on this, but coal would not allow the sustainable development of China. Sustainability means avoiding the depletion of natural resources to maintain an ecological balance within the present and on a long-term basis. Fossil fuels would contribute to climate change, which threatens the future. China is starting to shift its energy sourcing (having one second-largest wind power plants in the world) to benefit the future and increase its energy capacity as renewables tend to be more efficient with their energy generation.

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