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**The Importance of Communication Between Local, Academic, and Governmental
Organizations in Implementing Alternative Energies to Combat the Effects of Climate
Change**

The idea that the recent sharp rise in carbon dioxide levels internationally is a pressing issue is a widely agreed upon sentiment. Increased technological development in the past century continues to demand more and more energy as society's tools become more complicated and greater in scope. Naturally, we look towards alternative energy sources to dampen the energy sector's impact on climate change. However, despite widespread awareness of the danger of climate change, the American public lacks a clear understanding of their role in preventing climate change. Despite having a desire to reduce the effects of global warming, the public do not understand the role that they play in reducing global emissions levels. I contend that the primary reason for this disconnect is the lack of clear communication from sources of authority over the most effective alternative energy sources for reducing carbon dioxide levels. In addition, the United States government has not communicated the importance of decentralized renewable energy with the American public, despite many states supporting solar energy implementation in homes. In the absence of public understanding of the path to implement alternative energy technologies, the climate change crisis will continue to worsen and the energy sector in developed nations like the United States will continue to heavily contribute to the issue.

Climate change is an issue that is increasingly becoming more important as energy consumption increases. Climate change refers to net, long-term shifts in temperature and weather patterns that can be natural or human-driven (United Nations). Since the 1800s, humans have burned fossil fuels such as oil, coal, and natural gas to satisfy their increasing energy demands (United Nations). These fossil fuels emit greenhouse gasses that heavily contribute to rising global temperatures (United Nations). Common greenhouse gasses include methane, nitrous oxide, CFC-22, HCFC-22, but carbon dioxide is the greatest contributor to climate change with 76% of greenhouse gas emissions caused by the gas (Jin and Kim). Besides increasing temperatures, human-caused climate change contributes to rising sea levels, ecosystem extinction, increased flooding, and more extreme weather events (Stern). The main driver of increased carbon dioxide levels is from energy production and consumption, which produces $\frac{2}{3}$ of all greenhouse gas emissions (Jin and Kim). For this reason, searching for alternative energy sources to fossil-fuel-burning energies is of great interest to both academics and the public (Jin and Kim, Marlon et al., Stern).

Many citizens of the United States view climate change as a pressing issue that must be addressed both by individuals and governments. A 2021 Yale study reveals that 72% of Americans understand that global warming is occurring and 65% are worried about global warming (Marlon et al.). Americans are not only concerned about global warming but are also willing to act to help prevent it. A 2021 Pew Research Center survey found that 74% of U.S. adults are willing to make “a lot of/some” changes to how they live and work to help fight climate change (Pew). The changes that U.S. citizens would like to see also apply to the national level. 77% of those surveyed in the Yale study want the U.S. government to fund research into renewable energy sources which aligns with the fact that the energy sector is the heaviest

contributor to rising carbon dioxide emissions (Marlon et al.). Though most U.S. citizens believe that the U.S. government is doing a good job of combating climate change (47%), more citizens of other countries believe that the U.S. government is not doing a good job (36%) (Marlon et al.).

Citizens and government officials are both stakeholders in the movement to respond to climate change by adopting alternative energy sources. John M. Bryson of the Hubert H. Humphrey Institute of Public Affairs defines the term stakeholder as a management term that refers to all actors who influence and are affected by a subject matter or issue (Bryson). Stakeholders can be broken down into three categories: primary, secondary, and key stakeholders (University of Kansas). Primary stakeholders are people or groups who will be directly affected by the actions of an institution while secondary stakeholders are those who will be indirectly affected by actions of an institution (University of Kansas). Key stakeholders, who can be a part of either of the previously mentioned groups, have wield a great amount of influence on an effort and are involved in executing the action (University of Kansas). Stakeholders can become key stakeholders if their interest, how greatly they perceive they will be affected by the issue, changes. All humans are stakeholders in the issue of climate change because every person is affected, but not all humans are key stakeholders.

Despite the widespread belief that climate change is a large issue, global warming continues to exacerbate. In fact, the National Oceanic and Atmospheric Administration's 2021 Annual Climate Report states that the average rate of temperature increase since 1981 has been 0.32 °F (0.18 °C) per decade, twice as fast as the rate from 1880 to 1980 (National Oceanic and Atmospheric Administration). Even today, our international output of carbon dioxide is 11 billion metric tons, which exceeds the rate that natural processes can remove from the atmosphere (NOAA). Even with the public understanding that climate change is an issue, human

efforts to reduce carbon dioxide levels in the atmosphere have not been great enough to slow the increasingly rising global temperature rates.

Contrary to the American belief that the U.S. is performing relatively well compared to other countries, the reality is that the U.S. is not performing well in renewable energy production compared to other large contributors to climate change. The Pew survey found that 18% of Americans believe that China is doing a poor job of combating climate change (Pew). In reality, China is actually performing better than the United States with 14.95% of China's primary energy coming from renewable energy sources while only 10.66% of U.S. energy comes from renewable energy sources (Ritchie et al.). This discrepancy raises the question of why the U.S. has relatively low renewable energy production levels, especially for a developed country with the resources to invest in renewable technologies. The misconception of the U.S. performance in fighting climate change may reveal a larger disconnection between how citizens perceive their role in preventing climate change and how governments see the citizens' role in preventing the issue.

The public disagrees on what energy technologies are the most effective, which clouds their perception of their ability to participate in implementing alternative energy. For instance, take nuclear energy, which produces 50% of America's clean energy (U.S. Department of Energy). Advocates for the energy source point towards nuclear's low carbon emissions, relative high energy output, and reliability for reasons why nuclear power plants should be produced more (Ho et al., U.S. Department of Energy). However, opponents to nuclear energy cite the environmental impact of radioactive waste, the higher cost compared to other renewables, and safety concerns as reasons for why this energy source should not be used (Jin and Kim). In addition, emotional factors such as a fear of nuclear energy because of nuclear weapons and

nuclear power disasters in the past contribute to the resentment against nuclear energy (Jin and Kim). Because Americans focus time trying to understand which alternative energy source is the most effective, U.S. citizens aren't focusing as much energy on determining how they can be involved in implementing these alternative energy solutions.

A primary reason for public confusion on the best alternative energy source to fight climate change is that there is a lack of consensus on the efficacy of renewable energy and nuclear energy at reducing carbon dioxide levels in the academic community. For instance, Kojo Menyah's 2010 study and Mohammad Jaforullah's 2015 study both addressed the question of whether each nuclear and renewable energy has an effect on carbon dioxide levels. However, Menyah concluded that there is a causal relationship between nuclear energy and carbon dioxide emissions but not between renewable energy and carbon dioxide emissions while Jaforullah et al. concluded the opposite (Menyah et al. Jaforullah et al.). While Jaforullah et al. do point out that Menyah et al. incorrectly used the standard log-linear functional form in their statistical analysis, the primary reason for the difference in conclusions that the effectiveness of alternative energy sources doesn't depend only on whether the energy source itself produces less carbon dioxide than fossil fuel burning energies. Instead, the issue lies in the lack of widespread implementation of renewable energy sources. Menyah et al. postulates that renewable energy hasn't yet reached its "threshold point" where the "renewable energy supply starts to mitigate CO₂ emissions" (Menyah et al.). Similarly, a study by Nicholas Apergis points towards the need to use fossil fuel burning backup energy sources because renewable energy is difficult to store as a reason why renewable energy may not reduce carbon dioxide levels (Apergis et al.).

Though scientific authorities disagree whether there is current evidence of renewable and nuclear energy reducing carbon emissions, researchers agree that their findings vary due the

difficulty of studying causality between energy technologies and emissions. The researchers above agree that factors such as GDP, national policy, and low rates of alternative energy implementation combined with the world's constantly increasing energy demand make it difficult to isolate renewable and nuclear energy on its own (Menyah et al. Jaforullah et al.).

Unfortunately, these nuances often are not conveyed in the abstracts of the studies; instead, the focus is on whether nuclear or renewable energy is having an impact on carbon dioxide emissions right now. The varying conclusions from reading these articles causes confusion among readers over which alternative energy sources are effective, further complicating the decision of whether to support certain alternative energies or not.

The difficulty of the public to understand that they will be greatly affected by climate change in the future reduces the public's interest in being involved in fighting climate change. According to the Community Tool Box, a resource created by the University of Kansas Center for Community Health and Development to "build healthier communities and bring about social change", the interest of key stakeholders is dependent on how greatly the stakeholder perceives they will be affected by it (University of Kansas). In the context of climate change, less than half of U.S. citizens believe that global warming will harm them personally and a similar 46% of Americans report that they have experienced the effects of global warming (Yale). Because many Americans believe that climate change will not and is currently not affecting them, they will be less interested in learning more about how they can positively contribute to the issue. The Community Tool Box defines interest as either meaning the stakeholder is directly affected by the issue or they are interested in the effort because of their moral values (University of Kansas). Because climate change is an issue that many Americans acknowledge but don't believe affects

them directly, focus must be put on changing the belief that climate change won't affect the individual.

When implementing alternative energy solutions, the public struggles to understand the significantly larger long-term economic devastation of climate change relative to its small short-term cost (Stern). This struggle is not unique to thinking of climate change consequences; struggling to relate to our future selves is a physiological issue. Philosopher Derek Parfit said that “we neglect our future selves because of some sort of failure of belief or imagination” (Parfit). It is difficult to emotionally connect with a version of ourselves—or our world—that we haven't ever interacted with. Paired with the belief that individuals won't be directly affected by climate change, Americans struggle to find reason to invest scarce resources such as time and money towards the climate change movement.

American citizens learning about how carbon dioxide levels are continuously worsening has the potential effect of reducing engagement in the individual addressing the issue. John Hopkins Political Science professor Adam Seth Levine found that issues that cause “material well-being” to worsen decrease political engagement (Levine). In Levine's study, people responded to an increased cost of healthcare by spending less money and less time on political activism (Levine). Climate change is such an issue that has the potential to affect “material well-being”, whether through increased rates of natural disasters, rising sea levels, or lower crop yields, so news of climate change worsening can reduce political engagement (Stern). When looking at climate change through the lens of stakeholders, stakeholders' interest in actively preventing climate change decreases as the issue worsens because their perceived sense of safety and security and economic stability may decrease. As these more pressing issues arise,

stakeholders will prioritize those issues over investing in or learning more about alternative energies.

Decentralized photovoltaic installations, small-scale solar panels, are an integral in the implementation of alternative energy resources. Traditional fossil fuel-burning systems require large, industrial power plants to function (Klitkou et. al.). However, renewable energy sources like solar power and hydropower offer the option to produce energy at a small scale in remote areas that are far from large power plants (Diaz, et. al.). Decentralized production is preferable to centralized power for these communities because transmission and distribution losses from transporting the energy are much lower (Thapar, et. al.). Solar energy is difficult to convert into a solution, which is required for transportation (Thapar). In addition, centralized power plants favor urban areas over rural areas, so decentralized power fulfills the needs of smaller communities (Thapar). Other benefits of decentralized power plants include creating more jobs compared to centralized projects, increasing revenue for the local community, and increasing gender equity (Thapar).

Though there is policy support for decentralized solar production in the U.S., state policies to facilitate solar implementation don't guarantee that citizens install solar panels. According to the North Carolina State University Database of State Incentives for Renewables & Efficiency, every U.S. state has policies and incentives in place to support homeowners to use solar panels (North Carolina Clean Energy Center (NCCEC)). 29 U.S. states offer credits that either expire or don't expire for monthly net excess energy generation from home solar panels at the retail rate and 41 U.S. states offer at least some credit for excess energy generation at or below the retail rate (NCCEC). In addition to credits for excess energy to support homeowners with solar panels, 40 U.S. states either do allow or have no policy preventing 3rd Party Solar PV

Power Purchase Agreements (PPA), which is when a third party company operates solar panels on a homeowner's property and then sells the energy to the homeowner at a low price (NCCEC, EPA). PPAs give an incentive for homeowners to purchase solar (EPA). However the existence of these policies doesn't imply that the citizens will take advantage of them. For example, take Colorado, one of 9 states that credits excess solar energy production where the credits do not expire and allows PPAs (NCCEC). Despite Colorado having these supportive policies and receiving one of the highest normal solar irradiance levels, a metric that corresponds to higher solar energy production, Colorado only has the 22nd highest photovoltaic energy production levels per capita in the country (U.S. Energy Information Administration). By comparison, states in this high solar irradiance region in the south-western U.S. mostly have the highest solar photovoltaic energy production per capita levels. California is in this region and has the highest photovoltaic energy production level in the country.

A reason for the policy and implementation misalignment for decentralized solar production in the U.S. is that the government hasn't adequately communicated the importance of decentralized solar production to the public. The installation and operation of decentralized photovoltaic power cells requires a shift in how citizens view the energy production and consumption process. In an energy economy dominated by fossil fuels, energy is produced far from the consumer (Klitkou et. al.). The consumer of centralized power is physically removed from the source of the power and only sees the consumer end of the energy's life. However, decentralized energy systems demand that the consumer is involved in the production of the energy, a complete shift in how the consumer interacts with their energy. While many states have current policies that support home-owners who choose to transition to solar energy, state

governments are not focusing enough on convincing the public that installing solar panels is a necessary component of the countries' plan to reduce carbon emissions.

Alignment of policy and public goals is not guaranteed just because the issue is widely seen as one that needs to be addressed; only with clear, bidirectional communication between public and governments can the climate goals of developed nations be met. The Stern Review on the Economics of Climate Change contends that agreement of climate action is necessary on an international governmental level, but without local support, these policies will fall short (Stern). The concept of agreement of goals on both small and large scales can be applied to other political issues that have international effect, like the regulation of nuclear power and nuclear energy plants. Clearly, international safety regulations and protocols are necessary for nuclear weaponry because of the devastating potential the technologies could have. In addition, on the local level, understanding of safety measures for nuclear energy is equally important. With clearer agreement between international and local bodies, devastating nuclear disasters like Chernobyl and Hiroshima could have been avoided.

Communication between local communities, national governments and academics is a necessary step for implementing alternative energy sources to combat rising carbon dioxide levels. A misalignment of goals between these three groups has the potential to create a stalemate where solutions proposed by one body are not implemented by the others. With climate change continuing to exacerbate, the need to promote communication between these groups is becoming more urgent. Future research could explore more specific policies in the U.S. on a state by state basis to identify where governments have created policies intended to increase decentralized energy production but there hasn't been a strong reaction to implement these technologies among local communities. In addition, there is a lack of survey data on the views

that Americans have on purchasing solar panels for their homes. Survey data from the Pew Research Center and Yale University focus on views of the issue of climate change, but data on the tangible actions that Americans are willing to take to implement alternative energy is needed to better understand current American sentiment. By continuing to research the importance of communication among different levels of government, the process of implementing alternative energy will be more smooth and effective, supporting its original goal of reducing the impact of global warming.

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