

Undergraduate Thesis Prospectus

Economy and Environment During COVID-19 Slowdown

(technical research project in Systems Engineering)

The Controversy over Forest Biomass as a Carbon Neutral Substitute
to Fossil Fuels

(sociotechnical research project)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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General Research Problem

What are the tradeoffs between economic and environmental interests?

Since the mid-nineteenth century, steady increases in temperatures have been observed across the Northern Hemisphere. The onset of this warming coincides with the industrial era and is widely accepted among scientists to be a result of human activity (Abram et al., 2016). The combustion of fossil fuels associated with industrialization and energy consumption releases greenhouse gases into the atmosphere, which limit solar radiation from reflecting back into space and traps heat. This process demonstrates a potential for irreversibility due to the longevity of carbon dioxide, which could prevent substantial temperature recovery for as long as 1,000 years once emissions are curtailed (Solomon et al., 2009). Anthropogenic emissions are also intertwined with the biosphere, demonstrating the potential to disrupt carbon-cycle feedback loops and accelerate climate change over the twenty-first century (Cox et al., 2000). As temperatures rise, vital carbon sinks are reduced, and biodiversity deteriorates, policymakers around the globe face mounting pressure to balance economic gains with environmental detriments.

Economy and Environment During COVID-19 Slowdown

How have COVID-19 restrictions stifled different sectors of the global economy and their contributions to emissions?

The COVID-19 pandemic has provoked longstanding and competing interests of economy and environment. In the first half of 2020, safety measures intended to reduce the risk of transmission, such as increased sanitation, physical distancing guidelines, and facial coverings, became commonplace. Failure of basic precautions to contain the virus led to more drastic interventions, such as travel restrictions, business and workplace closures, and stay-at-home orders, which impeded economic activity to a more significant degree (Balmford & Annan, 2020). As the global economy slowed, so did polluting activities and their contributions to emissions. Observations from publicly available satellite sensors have shown that concentrations of various atmospheric pollutants, nitrogen dioxide especially, decreased during this time period in China (Adams & Johnson, 2020; McMahon, 2020).

Policy responses have varied among governments across the globe. In Australia, COVID-19 restrictions have been more mild than China and neighboring New Zealand and evolved more gradually (Hale et al., 2020). Non-pharmaceutical interventions (NPIs) to slow the spread of the virus tended to be viewed favorably by Australians, according to an analysis of Twitter data across six English-speaking countries. Restrictive NPIs -- gathering restrictions, lockdowns, travel restrictions, and workplace closures -- elicited more controversy than less restrictive NPIs, such as personal protection, social distancing, and testing and tracing (Doogan et al., 2020).

Restrictive NPIs appear to be the primary inhibitors of productivity across the globe, but travel restrictions have been of particular concern for Australia's robust mining industry. On January 29, 2020, state, territory, and national resources ministers classified mining as essential after Queensland declared a public health emergency, recognizing the industry's importance in Queensland and potential to aid national economic recovery. Travel restrictions, however, would still complicate availability of fly-in, fly-out (FIFO) mine workers, many of whom are indigenous peoples and are at a higher risk of complications from COVID-19 (Cholteeva, 2020).

Pressure to prop up the mining industry coupled with increased demand for metallurgical coal by China helps explain the Australian dollar's rally from March (-20%) to July (-0.6%). Currencies in other key mining countries, such as Russia (-12.5%), South Africa (-16.2%), and Brazil (-25.8%), have not fared as well (Azevedo et al., 2020). Disruption to Australian mining is difficult to track with granularity, but satellite observations of light pollution may offer insight into aggregate activity. In Texas, significant reductions in light pollution from oil fields were observed by NOAA Satellites from January to April, coinciding with the drop in oil prices (Barentine, 2020).

While mining and other polluting economic activities may have stalled in the early stages of the pandemic, air pollution persisted in certain regions. From March to April, Melbourne saw a 40% increase in nitrogen dioxide concentrations, the greenhouse gas most associated with power plants and vehicle combustion engines (Sánchez-García et al., 2020). However, Apple mobility trends reported stark declines in transit (-85%) and driving (-60%) activity relative to baseline levels during the same period (Apple,

2020). Further investigation is required to better understand the impact of COVID-19 policies on individual sectors and their contributions to air pollution.

The goal of this project is to determine how government policies implemented during the COVID-19 pandemic have slowed economic growth in various sectors and, in turn, impacted air and water quality. The connections drawn between COVID-19 policies, economic activity, and environment can help inform future decisions were another pandemic or similar global crisis to arise.

The Controversy over Forest Biomass as a Carbon Neutral Substitute to Fossil Fuels

Since 2015, how have interest groups and advocacies in the U.S. divided over the suitability of biomass as a sustainable substitute for fossil fuels?

Since the introduction of the Paris Agreement in 2015, parties to the agreement have considered new ways to meet reduced emissions targets. As carbon pricing makes fossil fuels less practical for industry, renewable and low-carbon substitutes occupy an increasing share of global energy mix (Best & Burke, 2020). Bioenergy (including wood pellets) is one alternative, which is classified as carbon neutral under the Kyoto Protocol of 1997. Across Europe, coal-fired power plants are being converted to burn pellets. States thereby reap the benefits of its carbon neutral status while minimizing operational disruption (Berndes et al., 2016). Under the European Union's revised Renewable Energy Directive (RED II) of 2018, member states must adapt their energy infrastructure, and biofuels such as wood pellets can serve the purpose (European Union, 2019).

U.S. wood pellets support the transition; exports grew by a factor of 6.5 from 2008 to 2016, largely due to rising demand in the European Union. This trend is expected to continue as southeast Europe, Japan, and South Korea import more wood pellets to supplement energy production (Thrän et al., 2019). As pellet companies have scaled their production, however, the future of biofuels has become controversial. Burning biomass releases carbon previously absorbed from the atmosphere, yet the consequences of these emissions are complex and unsettled. In the U.S., the world's largest producer of wood pellets, the rising global demand has implications for forestry, agriculture, and transportation (Wang et al., 2015).

Biofuels are considered carbon neutral under current international carbon frameworks, but the classification's validity is disputed. McKechnie et al. (2011) showed that only over a long term (16-38 years) can power from pellets emit less greenhouse gas than power from coal. Booth (2018) argues that harvesting biomass also depletes vital carbon sinks, which standard carbon accounting ignores. When it comes to land use, Searchinger and Heimlich (2015) point out that bioenergy competes with crops and is relatively inefficient; present-day photovoltaic systems can generate 100 times the usable energy per hectare, less the carbon emissions. Sterman et al. (2017) warns that climate policies that ignore the payback period of carbon debt from burning biomass may fail. The success of future policies will hinge on proper assessments of long-term effects.

The climate implications are contentious. On March 4, 2019, environmentalists from five European countries and the U.S. sued the European Union to stop RED II, citing bioenergy's contributions to emissions. The directive, which sets a target of 32% energy consumption from renewable sources by 2030, encourages member states to "exploit the full potential of biomass" (European Union, 2018). The plaintiffs argued that "RED II will accelerate widespread forest devastation and significantly increase greenhouse gas emissions by not counting CO₂ emissions from burning wood fuels" (Hajjar & Olden, 2019). The suit was dismissed on account of insufficient standing.

The World Bioenergy Association, which represents the interests of pellet consumers, maintains that biomass fuels are carbon neutral (WBA, 2012). The United Kingdom accounted for one quarter of global pellet demand in 2015 (Thrän et al., 2019); the U.S. supplies two-thirds of its pellets. Nearly all go to the Drax Power Station in northern England. Drax CEO Andy Koss denies that biomass enterprises are responsible for clearcutting; instead, they scavenge land that others clear-cut for lumber. He claims "most foresters will tell you" that such biomass collection "is the best way to get regrowth to come back, and that it's good for biodiversity across a managed landscape" (Elbein, 2019). Both the WBA and Drax refer to biomass collection as "harvest," which invokes notions of a recurring and replenishable cycle.

The U.S. Industrial Pellet Association, whose members sell to Europe, argues that the pellet market provides use for wood that would otherwise go to waste (Elbein, 2019). Maryland-based Enviva, the world's largest pellet supplier, frames pelleting as a fossil

fuels exit strategy and complement to wind and solar (Enviva, 2020). In 2015, the Partnership for Policy Integrity (PPI) and Environmental Advocates of New York petitioned the EPA and states to “include in any biomass policy a detailed system for verifying that feedstock being burned is actually coming from a sustainable source.” The petition failed (LaRoss, 2015). As the U.S. pellet industry grows, such regulatory demands will grow too (Bruggers, 2020; EPA, 2020).

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