Biomass, gas or cash: no one emits for free

The EU's flawed biomass emissions accounting system and its impacts on Bulgarian energy and society

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Abstract of the Thesis

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As action to mitigate climate change progresses, climate accounting has become more important, with accurate data allowing governments to accurately assess the situation of the environment and society and act appropriately. However, there are still debates about the best way to account for certain impacts of human activity and the environmental impacts from said activity. The European Union in its Renewable Energy Directive currently considers the combustion of biomass for heat and energy to be free of greenhouse gas emissions. This has been widely criticized for years, including by its own scientists. The downstream effects of this policy decision are not necessarily clear or well-understood, but within the European Union, emissions data related to the use of biomass for heat and energy is either lacking or flawed, based on an approximation rather than on reliable data. In the Republic of Bulgaria, where the rate of energy poverty is high and renewable energy development is still in its early stages, how emissions from biomass are counted can make a big difference in government policy. This study uses qualitative methods to examine the current state of play of biomass in both Europe and Bulgaria, while exploring possible downstream impacts of the zero-emission biomass policy in energy poverty and renewable energy development.

Author's Declaration

No portion of the work referred to in the thesis has been submitted in support of an application for another degree or qualification of this or any other university or other institute of learning.

Bryce Davis

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List of Abbreviations

CHP: Combined Heat and Power

DPSIR: Driver-Pressure-State-Impact-Response

EEA: European Environment Agency

ETS: Emissions Trading System

EU: European Union

EWD: Excessive Winter Death

GDP: Gross Domestic Product

GHG: Greenhouse gas

IPCC: Intergovernmental Panel on Climate Change

NOx: Nitrogen Oxide

OECD: Organization for Economically Developed Countries

PV: Photovoltaic, as in a solar photovoltaic power plant

RED II: the revised Renewable Energy Directive

RES: Renewable Energy System

SDG: Sustainable Development Goal(s)

SILC: Statistics on Income and Living Conditions

UN: United Nations

UNFCC: United Nations Framework Convention on Climate Change

WWF: World Wildlife Fund

1 Introduction

1.1 Problem Statement

As the world continues its efforts to monitor and mitigate climate change, accurate accounting of greenhouse gas (GHG) emissions and other environmental impacts of human activity is crucial to clearly understand and manage the problem. Currently, emissions accounting systems around the world vary widely in efficacy and scope. In the Republic of Bulgaria, the subject of this study, and the European Union (EU), of which Bulgaria is a member, the combustion of biomass (or the burning of organic matter) is considered to produce zero GHG emissions. Many low-income households in the EU, and particularly in Bulgaria, heat their homes by burning forest biomass, typically firewood or woody debris, in wood-fired stoves. This has produced negative downstream effects for renewable energy development and the reduction of energy poverty in Bulgaria, a vulnerable country that needs to make significant progress on climate solutions in a short period relative to wealthier and more developed countries. This approach to climate accounting could thwart the EU and its member countries in their ambitious climate and emissions-reduction targets. The European Parliament has made the block's two near-term climate targets legally binding: 55% reduction of GHG emissions by 2030 from 1990 levels, and carbon neutrality (emitting no more GHGs than carbon sinks can take in) by 2050 (European Parliament 2019).

1.2 Forest Biomass in Bulgaria: a Canary in the Coal Mine?

The Republic of Bulgaria is one of the newest members of the EU, and by gross domestic product (GDP), it is also one of the poorest countries in the Union (Eurostat 2022a) with the highest rate of energy poverty at 27.5% (Eurostat 2022b). Along with other member states of the EU, Bulgaria is in the early stages of transitioning to a greener economy in order to meet greenhouse gas (GHG) emissions reduction targets and renewable energy growth targets agreed upon in the Paris Climate Accords and the EU's climate targets.

Due to a combination of biogeographical, demographic, and economic factors, Bulgaria is particularly vulnerable to the effects of climate. The European Climate Adaptation Platform, Climate-ADAPT, states that Bulgaria "is situated in one of the regions that is particularly vulnerable to climate change (mainly through temperature increase and extreme precipitation) and to the increased frequency of climate change-related extreme events, such as droughts and floods," and this vulnerability threatens human life, the country's economy, and damage to key infrastructure (Climate-ADAPT 2021). Demographically, Bulgaria is an aging country. In 2017, 21% of its approximately 7 million people were aged 65 or older, and by 2050 this same demographic is expected to reach 30%. This large retirement-age population is likely to have lower economic productivity, likely leading to less tax funding for government projects, including climate-related ones. The level of poverty mentioned in the previous paragraph is a huge factor, providing less social and economic sustainability in the long-term, which will likely leave key economic sectors such as energy and agriculture more vulnerable to climate stressors: "climate change is expected to change the intensity, frequency, and distribution of extreme heat,

precipitation, and storms, exacerbating the vulnerability of energy infrastructure" (Climate-ADAPT 2021).

Putting aside a possibly bleak future, Bulgarians who are energy poor are already vulnerable to weather and climate events. An EU Statistics on Income and Living Conditions (SILC) survey found that in 2020 27.5% of Bulgarians answered the question "Can your household afford to keep its home adequately warm?" in the negative (Eurostat 2022b). A recent study of mortality among the elderly in Sofia, the capital city, found that almost 12% of elderly deaths between the years 2000 and 2017 were attributable to moderately to extremely cold temperatures (Petkova et al 2021). These numbers suggest that there is already more demand for household heating than is currently available, and as most Bulgarian households rely on forest biomass-based heating, the demand for wood is high, will likely rise in the future, and will put a strain on the country's forestry sector and GHG emissions limits.

Although Bulgaria is in a vulnerable position, it may find itself to be a leader in the region in terms of climate-related development. Bulgaria's location on the Black Sea, north of Anatolia, and to the east of several non-EU Balkan countries makes it an important crossroads and means that it has borders and close trade relations with several countries vying for EU membership. Its geographical, cultural, and socioeconomic position means that it may be seen as an example for Balkan EU candidate countries to follow. To add to that, Bulgaria may represent a 'canary in the coal mine' for the EU's future relationship with its forests due to its heavy reliance on forest biomass for heating, its large percentage of forest area – 38.2% of total land area (Stoeva 2020), and its extreme energy poverty relative to the rest of the block.

1.3 Why biomass?

Globally, the generation, transport, and consumption of energy in the forms of heat and electricity is one of the biggest sources of GHG emissions. Of biggest concern within the energy sector are fossil fuels,including coal, natural gas, and oil. These fuels are some of the heaviest GHG emitters and weening the world off of them is widely seen as one of the most effective and feasible ways to mitigate climate change (IPCC 2022).

Replacing these fossil fuels has involved the development and scaling up of both modern and older technologies, some of the most common replacements being wind, solar, and hydro-electric energy technologies. One of the most controversial energy sources in the fight against climate change is biomass. In the energy sector, biomass refers to most organic material, usually trees, woody debris, and agricultural crops.

Humans have been burning biomass for heat, fuel, cooking, and other purposes for a long time. Today many people still rely on this type of heating for survival in cold climates, and biomass is also burned in large power plants to generate heat and electricity (Srebotnjak 2011). As the world seeks to expand alternative energy sources, some consider the use of biomass to be an appropriate alternative to fossil fuels. However, there are many who criticize the continued combustion of biomass and point to the heavy GHG emissions and air pollution generated by it. Proponents argue that biomass is a renewable resource and the GHG emissions are balanced by the growth of new vegetation returning carbon dioxide to the Earth through photosynthesis. While this point may have some merit, critics point out that the combustion of biomass, especially trees, adds GHG emissions to the atmosphere that are not absorbed quickly enough by new vegetation to justify its use

(Camia et al 2021). Indeed, globally forest areas are in steady decline and have been for decades, damaging the ecosystem and decreasing the ability of forests to perform as carbon sinks (FAO 2022).

Countries with large percentages of their populations dependent on biomass for heat may find it difficult to efficiently install electricity-based or lower emission alternatives, and Bulgaria is no exception. Indeed, about 60% of Bulgaria's renewables, or 758 ktoe in 2016 was reported used by the household sector. Data appears to be unavailable on what percentage of that is firewood burned for heat, but it can be assumed to be a significant proportion. Out of 6.5 million people, the majority in small towns and rural areas, and a minority in urban centers, depend entirely or almost entirely on biomass combustion to heat their homes (Gantcheva 2018). This problem is further complicated by the fact that rural communities are often poorer and less likely to have access to alternatives, such as a natural gas pipeline connection, for example.

In climate change research and mitigation efforts, data is invaluable to understand the health of our climate today and in the future. Data on GHG emissions is especially critical, and governments and non-governmental organizations are constantly collecting and analyzing emissions data to strategize and take action. However, accounting for GHG emissions is not as straightforward as one might assume, and the way in which it is accounted for can make a huge difference. GHG emissions that are uncounted or counted inaccurately may mean that governments are not incentivized to act, or even may take actions that cause further damage.

1.4 Aims and Objectives

The aim of this thesis is to discover how the Republic of Bulgaria accounts for the environmental impacts, chiefly greenhouse gas emissions, of forest biomass combustion in households for providing heat, and why it has accounted for environmental impacts in that way. To that end, I explore national Bulgarian policies concerning energy poverty, household biomass combustion, and emissions accounting, and the real-world impacts of those policies.

Research questions:

1. How does Bulgaria account for and manage the environmental impacts, chiefly greenhouse gas emissions, of forest biomass combustion from household heating?
2. Why does Bulgaria handle these environmental impacts in that way?
3. How are the policies and practices on accounting for forest biomass combustion, particularly in household heating, perceived by different environmental stakeholders in Bulgaria?
4. What are the downstream effects of Bulgaria's environmental accounting of household biomass in renewable energy and energy poverty?

2 Literature Review

2.1 Climate Change, Energy and Forests

Climate change is putting increasing strain on the natural world, which in turn puts pressure on society as the resources we depend on become more limited. According to the 2022 report from the Intergovernmental Panel on Climate Change (IPCC), current nationally determined contributions (NDCs), or pledges from most of the world's national governments to limit emissions and fight climate change, mean that it's likely that global warming will exceed 1.5°C before the year 2100 (IPCC 2022, 15). Global warming above 1.5°C will result in the continued loss of entire species and will cause immense damage to human life and well-being by way of increased rate of natural disasters and strains on resources. However, we still have a good chance to keep global warming below 2°C, preventing even worse outcomes for the planet and human society. Achieving this will require "a rapid acceleration of mitigation efforts" (IPCC 2022, 15).

Among the sectors of society that contribute to climate change, 34% of human-generated GHGH emissions in 2019 came from the energy supply sector (IPCC 2022, 7). One of the quickest ways society can transition to a low-carbon economy is to replace fossil fuels, the heaviest GHG emitters of the energy supply, with renewable energy sources (IPCC 2022). Some experts and countries are advocating for bioenergy to be a sizeable part of this solution, while others say that this is a step backwards. Srebotnjak and Hardi point out that the modern renewed interest in bioenergy comes from the perception that it can be a powerful tool in the effort to "develop a sustainable renewable energy basis, and cut greenhouse gas emissions that contribute to climate change" (Srebotnjak 2011, 1009).

Bioenergy is a broad term that encompasses the central topic covered by this paper, energy from biomass combustion, and is worth defining. According to Lago, et al, “bioenergy is defined as a renewable energy produced from natural sources” (Lago et al 2019, 4). Bioenergy includes wood burned in a traditional stove for heat, energy crops grown to create products such as ethanol, crop or forest residues incinerated to create electricity, or even cutting-edge technology that produces energy from algae. In this paper, the focus is exclusively on traditional household biomass combustion for heat.

According to Srebotnjak and Hardi, biomass-derived energy “was the main source of heat and power [around the world] until the industrial revolution and still contributes a significant portion to energy consumption in the developing world” (Srebotnjak 2011, 1009). This practice is often referred to in the literature as ‘the traditional use of biomass’ and is defined by the UN in the document, Tracking Sustainable Development Goal (SDG) 7: The Energy Progress Report 2022, as “the use of local solid biofuels (wood, charcoal, agricultural residues, and animal dung), burned with basic techniques, such as traditional open cookstoves and fireplaces” (IEA et al 2022, 86).

There is some debate on the usefulness of biomass-derived energy for mitigating climate change, but traditional uses of biomass are widely cited as having quite negative effects on climate and the local environment. According to the IPCC, “the combustion of biomass generates gross GHG emissions roughly equivalent to the combustion of fossil fuels. If bioenergy production is to generate a net reduction in emissions, it must do so by offsetting those emissions through increased net carbon uptake of biota and soils” (Smith et al 2014, 877). Proponents of the wide use of biomass-derived energy often point to the fact that carbon emitted from the combustion of biomass is carbon that was initially

absorbed by plant matter from the atmosphere during the process of photosynthesis, a type of natural carbon sequestration. The European Environment Agency Scientific Committee in 2011 pushed back against this logic by stating:

> "It is widely assumed that biomass combustion would be inherently 'carbon neutral' because it only releases carbon taken from the atmosphere during plant growth. However, this assumption is not correct and results in a form of double-counting, as it ignores the fact that using land to produce plants for energy typically means that this land is not producing plants for other purposes, including carbon otherwise sequestered. To reduce carbon in the air without sacrificing other human needs, bioenergy production must increase the total amount of plant growth, making more plants available for energy use while preserving other benefits, or it must be derived from biomass wastes that would decompose and neither be used by people nor contribute to carbon sequestration." (EEA Scientific Committee 2011, 1)

Internationally, especially among scientists researching this topic, there seems to be growing consensus that the production of biomass-derived energy acts counter to climate change mitigation efforts when not managed alongside additional measures to balance out the negative impacts. However, as will be discussed in proceeding sections, influential organizations and government bodies such as the European Commission and the Bulgarian government continue to operate under the assumption that biomass combustion is inherently carbon neutral.

One of the biggest problems created by the overharvesting of biomass from forests is the loss of those trees and forests as carbon sinks, or entities that absorb carbon from the atmosphere, lowering atmospheric concentrations of GHGs. As the EU Biodiversity Strategy for 2030 puts it, "Forests are hugely important for biodiversity, climate and water regulation, the provision of food, medicines and materials, carbon sequestration and

storage, soil stabilisation and the purification of air and water" (European Commission 2020, 9).

2.2 Energy Poverty

The European Union has no official shared definition for energy poverty, but in its 2016 Energy Poverty Handbook, the European Parliament describes energy poverty as "when a person or household is not able to heat or fuel their home to an acceptable standard at an affordable cost" (European Parliament 2016, 21). Energy poverty can also be present when people cannot adequately cool their homes in hot climates or run necessary household appliances, but this study focuses on household heating. In financial terms, the Energy Poverty Handbook refers to the Scottish government's definition of energy poverty, which is when a household spends over 10% of its income on energy and heating costs (Fuel Poverty (Targets, Definition and Strategy) (Scotland) Act 2019). A European Commission website about energy poverty acknowledges that the EU and many of its individual member states lack an official definition of energy poverty but suggests that the EU can use answers from the EU-SILC survey question "Can your household afford to keep its home adequately warm?" as a primary metric for energy poverty (European Commission 2022). I will therefore use this metric as a stand-in for an official EU energy poverty rate in this study. The latest SILC figures available for both Bulgaria and the EU overall are from 2020 and will be used as the official numbers in this paper. Based on the 2020 survey, the EU's overall energy poverty rate was 7.5% of its population, while Bulgaria's was almost four times that at 27.5%, the highest in the Union (Eurostat 2022b).

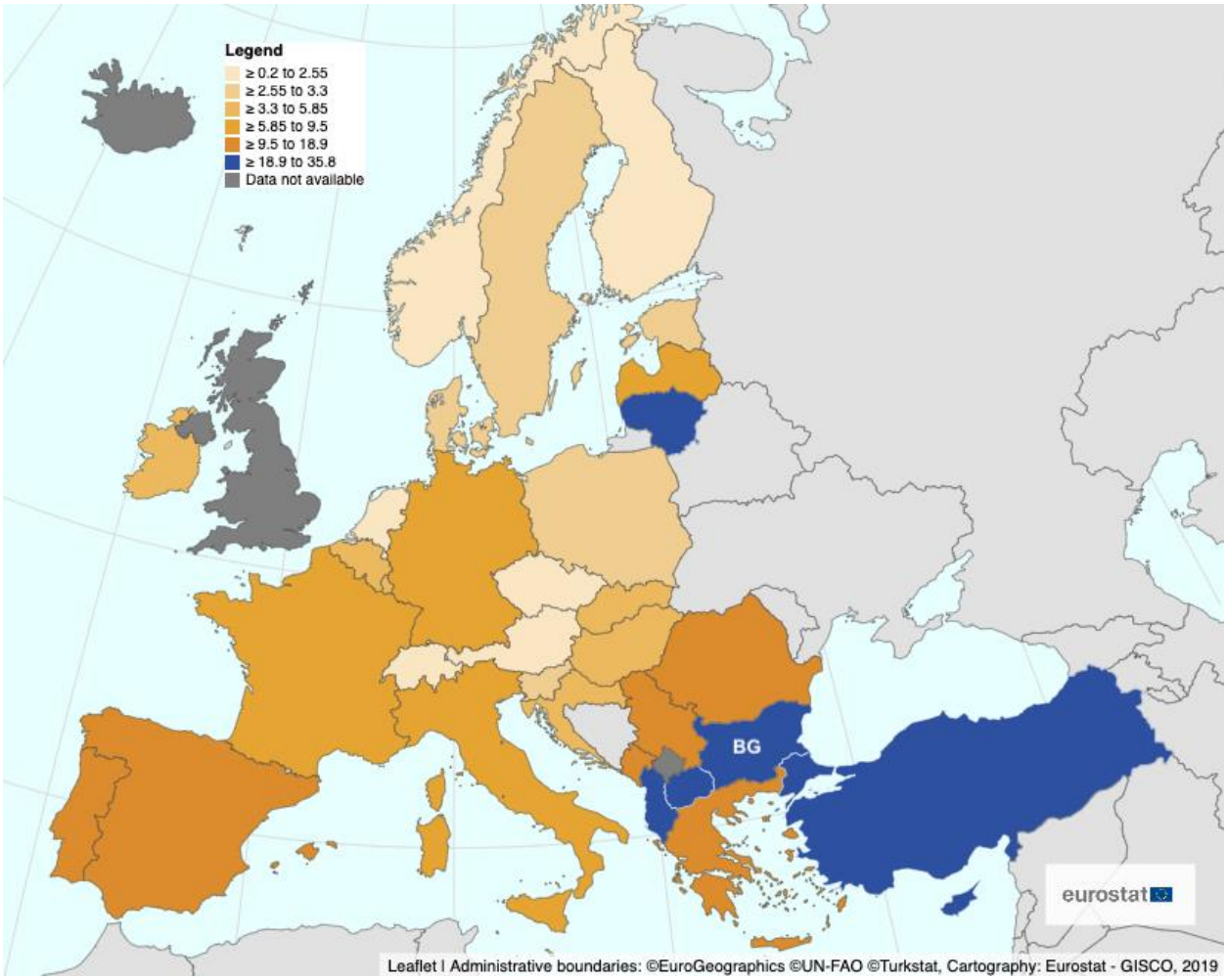

Figure 1: Energy poverty rate (% of population) by country in the EU, 2020; Bulgaria is labeled "BG" (Eurostat 2022b).

The Energy Poverty Handbook predicts increased worldwide energy poverty in the near term if governments do not increase social supports for the most vulnerable as trends in fuel and electricity prices have risen in the last two decades. One driver of the cost increases has been the installation of many new energy projects for the purpose of fighting climate change (European Parliament 2016). Prices will also rise due to increased climate change impacts, such as hotter temperatures and climate-related disruptions to energy grids and supply chains. In the near future, the ongoing war in Ukraine will likely

continue to strain the energy and fuel supply chains and make more people vulnerable to energy poverty, especially in Europe (Pfeiffer 2022).

Energy poverty, like general poverty, tends to have negative health and well-being impacts. The Energy Poverty Handbook reports that rates of death in winter months have a distinct link to the ability to adequately heat ones home (European Parliament 2016). Cold weather and humidity are both linked to what are often the immediate causes of death in these situations: respiratory and cardio-vascular diseases, which account for about 33% and 40% of Excessive Winter Deaths (EWDs) (Marmot Review Team 2011, 9). As hinted at in the introduction, energy poverty affects vulnerable people more than the general population, including older people, children, and those with chronic conditions (EPEE 2009). Sofia, Bulgaria saw 12% of its elderly population die of EWDs from 2000 – 2017 (Petkova et al 2021).

Energy poverty is a complicated issue that may be as much to blame on the lack of energy and heating infrastructure as it is on the lack of financial social support. In Europe the picture is complicated and varies country to country. A 2017 study of 32 European countries found significantly higher rates of energy poverty, poor health and poor well-being concentrated in Central and Eastern Europe. As may be expected, it also found that energy poor households have higher rates of poor health and poor well-being throughout the continent than wealthier households (Thomson et al 2017). Depending on the type of heating system used, air pollution can also be a big problem in energy poor communities, further worsening health outcomes. Heating systems using solid fuels such as wood and coal can contribute upwards of 75% of outdoor fine particulate matter (European Parliament 2016). Many low-income European households, especially in

Central and Eastern Europe, rely on such heating systems, usually in the form of old inefficient wood-fired stoves. Approximately 24% of EU households use solid primary biofuels, i.e. firewood and other organic fuels to heat their homes, while in Bulgaria it is much higher at 60% (Eurostat 2022c). According to Bulgaria's National Action Plan on Renewable Energy, "heating appliances - stoves and fireplaces - are predominantly old and inefficient and no less than 60-70% of heat is lost. Heating with high-efficiency boilers for local systems has not yet been developed" (Ministry of Economy, Energy and Tourism 2012, 176). With a lack of access to alternative energy infrastructure such as electric heat pumps, combined heat and power plants (CHPs), or connections to gas pipes, much of this population may need to rely on biomass combustion for heat for the foreseeable future.

2.3 Bulgaria's Energy Transition

Like the other member countries of the EU, Bulgaria is pursuing a green energy transition in which the goal is an economy that is based on more green renewable energy and less GHG emissions. In the Integrated Energy and Climate Plan (INECP) of the Republic of Bulgaria 2021-2030, Bulgaria's 2030 targets include 27.09% renewable energy in its gross final energy consumption, 42.30% renewable energy in heating and cooling, and that total GHG emissions do not surpass removals in the land use, land use change, and forestry (LULUCF) sector for the periods 2021-2026 and 2026-2030. Within this plan, the government projects that the household final consumption of energy from biomass will increase from 8.8 terawatt hours (TWh) in 2020 to 9.8 TWh in 2030, an 11% increase. The government projects a 37% increase in biomass quantities needed to meet demand in all energy sectors, which it claims will be sourced sustainably (Ministry of Energy 2020).

2.4 Forest Biomass and Climate Accounting in the European Union

The European Union has set itself two important legally binding climate related goals: 55% reduction of GHG emissions by 2030 from 1990 levels, and carbon neutrality (emitting no more GHGs than carbon sinks can take in) by 2050 (European Parliament 2019). In order to track progress towards these goals, the EU and its member countries collect various types of data; this paper will only discuss accounting of GHG emissions and LULUCF indicators. The collected data can help inform decisions by governments and organizations interested in acting to mitigate climate change by representing events on the ground in an understandable format. Under the Paris Climate Agreement, countries are currently allowed to use one of a variety of approaches to accounting for the net change of GHG emissions from harvested wood products (HWP). Different approaches are appropriate for different scales and situations, and the approach a country uses can significantly alter GHG emissions and removal numbers, sometimes even leading to double counting or non-counting of GHG emissions or removals (Sato 2019). However, the EU appears to use none of the standard approaches to accounting for GHG emissions from forest biomass combustion, and in its revised Renewable Energy Directive (RED II) explicitly promotes the adoption of biomass-derived energy as emissions-free (Booth 2020):

> "The RED II promotes use of forest biomass as a "zero emissions" fuel, even though burning biomass emits more CO2 per unit energy than coal, justifying this defiance of physical reality with the claim that if biomass is harvested "sustainably," so that harvesting levels do not exceed forest growth levels on the landscape, then there are no net emissions. In contradiction of this, multiple scientific studies show that far from being instantaneously carbon neutral, burning forest biomass has net CO2 emissions that require decades to centuries to offset with forest regrowth" (Booth 2020).

The EU's RED II is not unique internationally for counting biomass combustion as GHG emissions-free, but as several open letters from scientists around the world seem to indicate, this method of accounting is increasingly perceived as flawed (EEA Scientific Community 2011) (Beddington et al 2018). Beddington et al summarize the scientific rebuff of RED II's logic:

> "Even if forests are allowed to regrow, using wood deliberately harvested for burning will increase carbon in the atmosphere and warming for decades to centuries – as many studies have shown – even when wood replaces coal, oil or natural gas. The reasons are fundamental and occur regardless of whether forest management is "sustainable." Burning wood is inefficient and therefore emits far more carbon than burning fossil fuels for each kilowatt hour of electricity produced. Harvesting wood also properly leaves some biomass behind to protect soils, such as roots and small branches, which decompose and emit carbon. The result is a large "carbon debt." Re-growing trees and displacement of fossil fuels may eventually pay off this "carbon debt' but only over long periods. Overall, allowing the harvest and burning of wood under the directive will transform large reductions otherwise achieved through solar and wind into large increases in carbon in the atmosphere by 2050" (Beddington et al 2018).

Although this is clearly not a fully settled issue, it is important to point out that one of the most authoritative and influential organizations on climate change, the UN's Intergovernmental Panel on Climate Change (IPCC) has stated that forest biomass combustion produces significant GHG emissions. In fact, the EU's own Joint Research Centre (JRC), a body under the European Commission, concluded in its report *The use of woody biomass for energy production in the EU* that the combustion of most forest biomass is more GHG emissions-intensive than oil, gas, and even coal (Camia et al 2021).

Overall, the EU's RED II appears to conflict with a growing scientific consensus on GHG emissions from biomass combustion, and this erroneous accounting method may lead to some serious outcomes. For one, as Booth, Beddington et al, the IPCC, and the EU's JRC have pointed out, the GHG emissions from biomass combustion are actually higher than that of fossil fuels. Emissions are possibly highest in traditional uses of biomass, i.e. non industrial biomass combustion: "traditional uses of biomass tend to have very low conversion efficiency (5–15 percent) which can cause local demand to exceed sustainable supply and lead to deforestation and other negative environmental effects" (IEA et al 2022, 86). The potential for deforestation and other environmental impacts has increased significantly in recent decades, as the "use [of biomass-derived energy] in the EU has tripled since 1990, and the most intensive form of forest biomass harvesting, for wood pellets, is accelerating" (Booth 2020, 4). To put the problem in more concerning terms, from 2011 to 2015, biomass loss increased by 49%, and in the proceeding three years it increased by 69% (Booth 2020, 4). By one global estimation, bioenergy produces 405 million tonnes of CO_2 emissions each year, about as much as total yearly emissions as Italy (Chamberlain 2022).

The EU has become heavily reliant on bioenergy as its renewable energy of choice. Today total generation of bioenergy in the EU supplies 60% of the block's renewable energy and a subset of that, forest biomass combustion for heat and power, supplied 35% of EU renewable energy. The total generation of bioenergy in the EU today is three times as much as it was in 1990, and in just five years from 2013 to 2018, wood pellet consumption increased by 50% (Booth 2020).

The idea that burning forest biomass produces no net GHG emissions has trickled down from the EU into the policies of national governments and private companies. Many industrial wood processors in the EU have willingly or ignorantly taken on this policy, including a pellet plant in Bulgaria, quoted in the report *Future on Fire*: “Carbon emissions from combustion do not change the content of carbon dioxide (CO2) in the atmosphere. They are environmentally friendly fuel, neutral in terms of CO2, as they are extracted from renewable sources” (Chamberlain 2022, 10). In Bulgaria’s National Action Plan for Forest Biomass Energy 2018 – 2027, energy from forest biomass is referred to as “carbon neutral,” and the document critiques current EU policies and potential future revisions to those policies on forest biomass, claiming that there is “serious pressure at the European level to reduce/stop the use of wood for energy production through the adoption of regulatory restrictions,” (Consortium ‘Focus Systems’ 2018, 159). The document also asserts that one of the current weaknesses of European policies in this area is the “relative peripheral importance of the opportunities and role of forest-wood biomass and its use for energy purposes” (Consortium ‘Focus Systems’ 2018, 158). These criticisms of supposedly overly restrictive policy, in light of what is presented in this section about RED II, indicate a strong attachment to the use of forest biomass in Bulgaria.

2.5 Theoretical framework: DPSIR

Driver-Pressure-State-Impact-Response (DPSIR) is a causal model that has been used since the 1990s to evaluate the relationship between human society and the environment (Eurostat and European Commission 1999, 5). Many non-governmental organizations interested in studying this relationship for work on climate change or ecological issues, including the European Environment Agency (EEA), the United Nations (UN), and the

Organization for Economically Developed Countries (OECD), use DPSIR to model the complexities of societal-environmental interaction.

The DPSIR model identifies five distinct but connected components of society and ecology. Drivers, or driving forces, (D) represent broad trends in various sectors of human activity, which can come out of basic human needs or economic forces, such as the need for shelter or an industry's expansion. The pressures (P) are the actions of society that directly affect one or more elements of the environment. For example, if people need shelter and heat to survive (D), they may cut down and burn trees (P). The new resulting status of the environment is represented by the component state (S), which reflects the changes brought about by human activity, such as a forest with fewer trees or an atmosphere with more greenhouse gases. Resulting from the change in state of the environment is the impact (I), and this can be any effect of that change. For example, a forest that has been over-harvested will lead to several impacts, including the forest having less capability to support biodiversity, less wood for future human use, fewer trees to absorb carbon dioxide from the air, etc. Finally, responses (R) are any action taken by humans in an attempt to solve or manage the impacts. Usually this is in the form of an organized action, such as government policy. An example of a response might be satellite monitoring of forests and legal action taken against illegal loggers. Responses can be directed at the drivers, pressures, state, impact, or a combination as seen below in Figure 2.

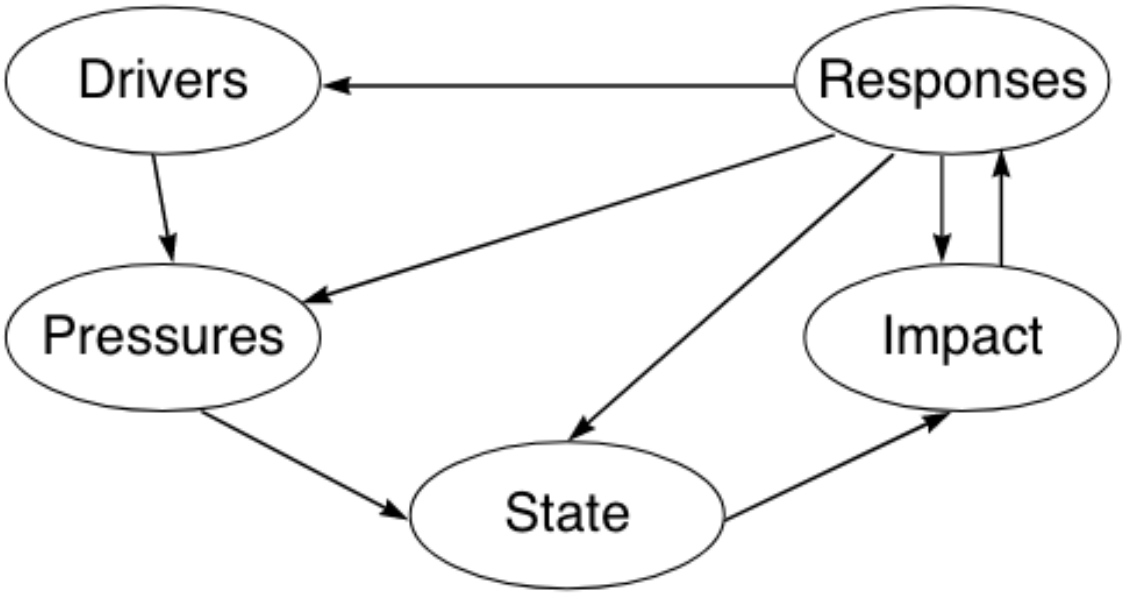

Figure 2: A simplified Driver-Pressure-State-Impact-Response model (Smeets 1999, 6).

DPSIR was chosen for this study for its combination of broad interpretability, adaptability, and clear individual but connected components that can be used to analyze almost any human-environment interaction. It has been used in various recent studies from a study analyzing degradation of agricultural land (Khemiri 2022) to one analyzing the impacts of face masks polluting the environment (Tesfaldet 2022). The model is given further credence by its use in multiple international organizations that use it to conduct environmental research and analysis.

In this study DPSIR is used to understand and navigate the complicated web of interactions among various actors and actions as Bulgaria seeks to lower GHG emissions and improve the lives of its citizens. It is used to analyze qualitative data towards answering the research question of this study because the way in which environmental impacts are accounted for can directly or indirectly influence the responses of governments and other societal actors.

3 Methodology

3.1 Qualitative Research

In order to understand the outcomes of government policies on household biomass heating, I conducted qualitative research based on semi-structured interviews and field observations in the capital city, Sofia, including attending an event on green energy. Six of the interviews were in-person in Sofia and Vienna and four were held virtually, with a variety of experts on biomass and renewable energy in Bulgaria, from the employees of government ministries to workers in civil society organizations, such as the World Wildlife Foundation (WWF). My interview participants are listed in Table 1 below. Five of my ten participants either opted for anonymity or did not return the research consent form, meaning they were granted automatic anonymity. For the anonymous participants, I attempted to provide enough detail about their expertise without giving personally identifiable information.

Table 1: Interviewee expertise

Name	Position / Expertise
Meglena Antonova	Campaign Program Lead, Greenpeace Bulgaria
Apostol Dyankov	Climate and Energy Program Manager, World Wildlife Fund
Radostina Slavkova	Energy and Climate Coordinator, Friends of the Earth Bulgaria
A.K.	Energy systems expert
Ivaylo Aleksiev	Executive Director, Sustainable Energy Development Agency

T.K.	RES expert
L.S.	LULUCF expert
T.M.	State expert, Ministry of Energy
Detelina Petrova	State expert, Climate Change Policy Directorate at Ministry of Environment and Water
T.G.	Energy security and energy transition expert

To identify, locate and contact my interviewees, I utilized a combination of purposive and snowball sampling techniques. I began with purposive sampling, reaching out to experts I knew of or whose organizations I was familiar with. I sought out experts who could speak on forest biomass, renewable energy development, energy poverty, or climate accounting in Bulgaria. My methods of searching for participants included researching Bulgarian civil society organizations and government agencies that work on the issues I was interested in asking about. I was also assisted by some professors and colleagues who had contacts in Sofia working on closely related issues. Once I began speaking with initial contacts, I turned to the snowball sampling technique and asked my initial contacts to help me get in touch with people they thought could contribute to my project.

The semi-structured nature of the interviews allowed me to ask questions pertinent to the focus of my research, while providing room for my interviewees to spontaneously bring up relevant and interesting points. As my research is focused on policy, the qualitative approach made the most sense. In this case, I found that using a quantitative approach

would have been difficult due to a lack of data, especially in areas relevant to my research in which data is not being adequately collected or disseminated.

I did not have the same conversation with each participant due to the variety of their expertise and simply because each new conversation took different directions. However, I had question topics I asked most participants about as long as the question topic was relevant to their work. Table 2 gives a thematic overview of the questions asked of the participants in this study.

Table 2: Themes of interview questions

Theme	Description
Climate and energy transition targets	Asked for opinions of Bulgaria's progress towards its climate and renewable energy development targets.
Climate accounting in bioenergy sector	Asked about participant's awareness of discrepancy, what could be behind it, and what the downstream impacts are.
Impacts of 'green' policies	Asked about green policies used in national and municipal governance in the country and their effectiveness.
Impacts of EU membership	Asked whether EU membership has positively or negatively impacted country's energy transition, climate targets, green policies, etc.

While I was in Sofia, I attended a policy workshop and networking event on green energy titled "Миссия: Зелена България," or "Mission: Green Bulgaria." This event brought together civil society experts and advocates as well as government ministers and experts in focus groups on a variety of issues related to sustainability. At this event I was able to take advantage of the snowball sampling method by asking my interview participants to

introduce me to relevant experts at the event. This helped me to meet new people who work on my research topic and yielded two additional interviews.

Despite the event being held in Bulgarian, a language I have limited understanding of, I was able to learn a lot about how the organizations working on the green energy transition collaborate. One of the employees of WWF assisted me occasionally by interpreting when he thought the content was important to my research. The event was attended by experts and advocates from a variety of organizations like WWF, Greenpeace, and Friends of the Earth, and included several government employees from the Ministry of Energy and the Ministry of Environment and Water. Though I did not participate in much of the group discussions due to the language barrier, I was able to observe interesting collaborations and discussions among the participants of the event. The workshop sessions divided the participants into six groups that focused on the themes of green innovations, energy independence, bioeconomy, smart cities, nature-based solutions, and sustainable finance.

During my time in Sofia I sought out observational data when I could. I observed stark divides in energy poverty between ethnic Roma communities and ethnic Bulgarian communities; I experienced days that were unbearably hot and chilly rainy days; I visited several offices for organizations and government ministries and observed that the buildings were often barebones and sometimes in disrepair. I was even able to witness a significant political event in the 10 days I spent in Sofia: the government coalition that was seen as one of the greenest governments Bulgaria had ever had, fell apart. This provided invaluable observational data for me in the form of reactions from my participants and other residents of Sofia.

3.2 Analysis

In order to analyze my interview data, I coded my conversations with a combination of descriptive and structural coding. Structural coding is based on research questions and themes, while descriptive coding is based on common topics in the interview itself. I started out by listing preliminary ideas of themes based on my research questions and skimmed my interviews to assign the themes to important talking points. After a round of that, I employed descriptive coding by looking for new themes that came up in my conversations but were not necessarily planned for ahead of time. This combination of coding methods allowed me to approach my data with intention based on where I thought the data would take my research and then identify additional relevant themes that I did not initially consider. Once I had a condensed and interesting set of topical and sentiment-based themes, I organized my participants and their talking points by theme. Using these coding methods, I was able to identify novel ideas and issues, similarities and differences between participants, and a variety of sentiments related to my research topics.

3.3 Ethics

I took all CEU ethical research guidelines into consideration when conducting my research. In each interview, I asked for consent to use the participants' names, positions, and answers to my questions in my research. I informed all of my participants of the academic nature of my research and that the research was contributing to my master's thesis. All participants were told that they could request anonymity in the research if they so desired. Although most of my interviews were done via phone call, I created a simple but thorough consent form and asked my participants to sign it and return it to me. I

received most of the signed forms back, and I granted automatic anonymity to those who did not return the signed form.

3.4 Limitations

My research ended up having a few limitations that affected the final analysis and results. First, I was limited by living outside of Bulgaria and only having about ten days in the capital, Sofia, to conduct in-person interviews and make other observations. Although I contacted many people ahead of my trip to Bulgaria requesting interviews, just four were available for in-person interviews while I was in Sofia. By not being in Bulgaria for the rest of the time I was conducting my research, I missed out on a higher quality of interview that comes from being face-to-face with someone. My phone conversations yielded good quality conversations, but I missed out on nonverbal communication and the intrapersonal connection that could have created a better rapport with my interviewees and granted me more insight into their attitudes and feelings about the conversation topics. I found that the phone conversations tended to be shorter overall, with shorter participant answers, and the conversations tended to stick more to the specific subjects I brought up, rather than leading into related and perhaps interesting topics.

Additionally, I suspect I could have acquired a higher number of total interviews had I been in Bulgaria for the entire time of research. Two of my interviews happened because I initially met the participant in Sofia, or because someone I met in Sofia recommended I reach out to them.

I would have liked to expand my research beyond the policy level. I limited myself to experts in my research topics because they were easier to reach, likely to speak English,

and because research time overall was limited. However, a more complete and interesting picture of the situation may have emerged if I were able to speak with people facing issues of energy poverty, workers in forestry, or recipients of specific social programs from the government. My pool of participants was limited to people whose contact information I could find online or who were recommended to me by someone else, via the snowball sampling method.

4 Results

This section is dedicated to the results of my interviews, the event I attended, and additional field observations in Sofia. In coding my interviews, I identified several important themes that helped to shed light on the situation in Bulgaria. The first theme I will discuss is energy poverty in Bulgaria. The second theme is the combination of national factors participants cited as holding Bulgaria back from setting and achieving more ambitious and robust climate goals. Participants pointed to three main factors: budget restrictions, societal mindset, and geographic limitations. The third theme is environmental governance and corruption, two entangled challenges that may impede current efforts to decarbonize Bulgaria. Finally, the fourth theme captures the differences in attitudes held by stakeholders I spoke to and interacted with towards government policies and the overall effectiveness of the national government.

4.1 Energy Poverty

In this section I report my findings that intersect with the issue of energy poverty. Energy poverty can be difficult for a national government to manage, especially in Bulgaria, one of the most energy-poor countries in the EU. T.G. reported that their organization's analysis determined that energy poverty is "one of the biggest problems in Bulgaria." Indeed, as stated in section 2.2, 27.5% of households in Bulgaria are estimated to be energy-poor. Ironically, T.G. and Dyankov both mentioned that Bulgaria has no official definition of energy poverty, though there have been efforts by organizations including WWF to estimate the prevalence of the problem through surveys and other studies.

Policies designed to alleviate energy poverty frequently overlap with environmental governance. I decided to separate out this section to focus on Bulgaria's massive energy poverty problem, which is a key reason why so many Bulgarian households depend on forest biomass for heating and energy in the first place.

My participants were quite critical of some government policies designed to help the environment by replacing wood-fired stoves with pellet stoves, more efficient stoves, or even community-based solutions such as combined heat and power (CHP) plants, as these policies have done little to alleviate energy poverty, and in some cases have possibly entrenched the problem further. Some are short-term fixes that do not make a significant difference in either the emissions from household heating or in the economic lives of the recipients of the policies. For example, a policy described by Dyankov and T.G. offers monthly subsidies for households with low incomes, strictly for purchasing wood, coal, or electricity. Pellets are not included in the subsidy, a significant oversight that harms households that are trying to do right by themselves and the environment. According to T.G., some recipients of this policy simply resell the wood and coal they purchased with the subsidies on the black market for higher prices. On the other hand, pellets are expensive. T.G. told me that they can be 30 to 40% more expensive than wood bought on the legitimate market.

To add onto the problems with this subsidy program, it is implemented not by the Ministry of Energy, which handles the implementation of most other energy policies in the country, but by the Ministry of Social Affairs. For T.G., the Ministry of Energy would be a better administrator of such policies, as it already handles similar policies and has the institutional understanding of the wider landscape of energy policy and energy poverty.

T.G. and other policy experts suggested years ago that purview of the policy be moved to the Ministry of Energy while maintaining the same public funding, but it was never moved, and problems persist. T.G. was quite doubtful of the Ministry of Social Affair's ability to responsibly handle the policy – he did not seem to think that there was much critical thinking about the policy, and that the Ministry was simply doing the bare minimum that the policy required and making no effort to improve it.

Other policies end up making things worse, even entrenching a household's energy poverty by locking them into a new technology with similar or higher costs to their old wood-fired stoves. One such policy in some municipalities is designed to replace wood-fired stoves with pellet stoves. While in theory this is positive as pellets are more efficient and create less emissions and pollution than traditional wood, T.G. pointed out that pellets can be 30-40% more expensive than legally purchased traditional wood. That one factor means that many people may see pellet stoves as not an upgrade, but a liability.

For all of the discussion around these policies, they have so far been limited to urban communities, and have ignored the largest population using wood-fired stoves – the rural population. According to T.G., 90% of rural Bulgarians rely on wood-fired stoves for heating, while only 60% of the total population of the country relies on stoves. 60% is no small figure, but if these policies are not reaching rural communities at all, then that leaves almost all rural Bulgarians in a vulnerable and uncertain status quo.

For several of my participants, the government's enforcement of wood heating regulations have been severely lacking. There are allegedly thriving black and 'grey' markets dealing in wood for stoves that some households rely on, and these markets generate harmful,

inefficient, and costly wood products. While government regulations require wood to be stored and dried one year, according to T.G. and Slavkova, dealers in these illegal and quasilegal markets often sell people wet wood that may have been stored and dried for only a few months, if at all. T.G. explained that the combustion of wet wood produces more pollutants and is less efficient than that of properly dried wood. Participants Dyankov, Slavkova, Antonova, and T.G. were highly critical of the lack of enforcement of these policies because of their harmful impacts.

Both T.G. and Dyankov had a lot to say about the Roma communities in Bulgaria and their struggles with energy poverty. The Roma people are a collection of often-marginalized ethnic groups found throughout Europe, and Bulgaria has one of the largest populations. The relationship between the Roma and other ethnic groups – namely the majority Slavic Bulgarian ethnic group – is heavily stratified; Dyankov even labeled it 'segregation'. I had the opportunity to personally visit Fakulteta, the largest Roma neighborhood in Sofia, and the wealth disparity between it and other parts of Sofia was stark. It felt like walking into a different country. The homes were much smaller, the roads, sidewalks and other infrastructure were in disrepair, and stray dogs and garbage littered the streets and green spaces.

Some policies meant to improve heating systems in the country target Roma and other minority communities in urban municipalities because they tend to need the most assistance. Like much of the rest of the poor population Roma communities are more likely to burn wet, inefficient wood, and even textiles and old tires to heat their homes, according to Dyankov. The combustion of such materials produces significantly more

GHG emissions and air pollution than properly dried wood or wood pellets, directly damaging the health of these communities.

Additionally, due to centuries of social stratification and discrimination, the Roma communities tend to be distrustful of government policies and initiatives, even if they appear from the outside to be intended to help. T.G. talked about how many Roma families declined offers from the government to replace their heating stoves free of charge because they are worried that they would then be monitored more closely by the government if they accepted. Whether imagined or real, monitoring of Roma communities by the Bulgarian government could in theory result in actual legal trouble for members of those communities, whose homes are often classified officially as illegal dwellings, according to Slavkova. She also pointed out that due to these homes being illegal, other government initiatives like energy efficiency renovations and bigger heating systems cannot be installed.

4.2 Playing Catch-Up: Perceptions of Bulgaria Compared to Neighboring EU Countries

Bulgaria's starting position in the race to mitigate climate change and transition its economy to green energy is arguably significantly behind that of many of its fellow European Union member states. Several of my interviewees made a point to emphasize this as I spoke with them about their country's efforts. The main factors that the participants saw as holding the country back can be sorted into the categories of budget restrictions, societal mindset, and geographic limitations.

Being one of the poorest members of the EU (Eurostat August 13, 2022), Bulgaria must rely on the Union for a lot of funding of its climate change mitigation efforts, according to Dyankov and Petrova. Petrova, an expert for the national government, blamed a lot of the country's inability to make quick progress on climate on its national budget, from fully taking advantage of best practices promoted by the EU to not being able to quickly replace old technologies like the outdated wood-fired stoves that most of the population uses for heating. However, she emphasized that this does not mean that Bulgaria will not try to reach its climate goals, rather it means that Bulgaria will need to put in more effort than other countries to do so.

Although the task at hand appears daunting given the situation she described, she seemed to have a defiant optimism that these achievements are possible. She made it clear that Bulgaria is in a time crunch to catch up with the rest of the Union on climate when she told me that Bulgaria has already used all of the funding it received from the EU to implement innovative renewable energy and household heating technologies. Unfortunately, the conversation shifted then and I did not get to ask which program the funding was coming from and specifically which innovative technologies Bulgaria was purchasing with the funds. From my research on the topic and from other interviews, I concluded that the funding likely came from the Fit for 55 package, and the innovative technologies likely include solar photovoltaic (PV) installations and pellet stoves.

Two participants pointed to the mindset of society at large as a factor that holds Bulgaria back from achieving more in climate. Dyankov explained his outlook on Bulgarian society by describing it as a "patronage system," in which workers are heavily reliant on their employers for a variety of basic needs outside of income, even comparing the system to

feudalism. This indicated a negative bias toward Bulgarian society, at least in the context of labor relations. He explained that in many cases workers for large energy companies in Bulgaria exist in ecosystems controlled to some degree by their employers, in which the workers might buy necessities from their employer's shops and live in their employer's housing. He described one case in which the boss of a patronage-based energy company ran for public office and successfully encouraged his employees to support and vote for him. Dyankov, Slavkova and Antonova all described the bosses of these large energy companies as oligarchs, and Antonova referred to a particular oligarch's energy company holdings as his "little coal empire."

Such a patronage system can become a problem for climate progress when the biggest beneficiaries of the system – the heads of energy companies – direct their power towards climate and energy politics. In one example explained by Antonova, Slavkova and Dyankov, the government lead by former Prime Minister Kiril Petkov slowly began to increase enforcement of environmental permitting laws for power plants. According to Antonova, when the government forced one small power plant, a relatively small part of the national energy system, to stop operations until it fulfilled its permit requirements, the government faced quick backlash primarily from the plant's workers. Protests that appeared to be organized by their employers according to these three participants, were planned in Sofia and the Director of the Regional Authority (in whose district the plant was located) received many phone calls demanding she withdraw the decision to temporarily close the plant.

In the case of energy poverty, discussed more in-depth in the previous section, the societal mindset of Bulgaria can be hard to disentangle from economic issues. It is hard

for people in difficult economic situations to care much about things beyond their immediate needs. When speaking to me about the challenges facing Bulgaria's climate efforts, Petrova stated:

> "The problem is that in our society, these topics are not very popular, because the people mostly want to live better, [rather] than to think about the environment and climate change… We first have to improve the understanding of our society that [these efforts are] needed"

When discussing various programs that have attempted to replace peoples' wood-fired stoves, Dyankov told me that Bulgarians are "very emotionally attached" to firewood. Given that Bulgaria is about 30% forest (National Statistical Institute 2022), he was implying that the traditional use of firewood is ingrained in Bulgarian society as much as a survival necessity as cultural heritage.

This emotional attachment to firewood presents a challenge that may be slow to overcome. Dyankov's organization WWF Bulgaria ran a campaign on social media last year to promote "very modest" best practices for using firewood in homes, such as checking the origin of the firewood, how to properly store it and burn it more efficiently, and encouraging people to buy more energy efficient stoves. He told me they received a lot of negativity and push-back:

> "We got huge angry responses like, 'you will teach us how to burn firewood? We've been doing it for generations'… We now have to restart this [campaign]."

The third national challenge facing Bulgaria in this area is the country's geography. Three different participants – Dyankov, Petrova, and T.G. – emphasized that about 35% of

Bulgaria's territory is designated under Natura 2000 as protected natural areas, meaning little to no energy projects can be constructed on this land.

Protected land is not the only type of land on which it is difficult to construct renewable energy projects. Dyankov told me that just like firewood, agriculture is a sensitive and culturally significant topic for Bulgarians, and this has allowed an opening for anti-renewable lobbies to make and spread claims that renewable energy projects will inevitably ruin otherwise fertile land. A large and successful anti-renewables campaign by these lobbies claimed that the construction of solar PV parks strips the soil underneath, rendering it unusable in the long term. The truth, according to Dyankov, is that companies operating solar PV parks spray pesticides under the solar panels to kill weeds, rather than removing them manually, thus polluting and potentially damaging the soil. In his eyes, the arguments put forward by the anti-renewable lobbies were dishonest and in bad faith, because the actual damage being done to the soil is easily preventable, shorter-term, and likely repairable. Dyankov told me that ultimately the campaign was successful, and it hampered efforts to install new renewable energy projects for years.

Discussing Bulgaria's limitations in pursuing a green energy transition, Petrova mentioned that issues like budget and land use often intersect, so the country must be creative in finding solutions:

> "We accept [that we must] reach the [climate] targets, but we try to minimize the price that we should pay for that…using different kinds of national specific situations. For example, if we have more area that we can put the solar parks, we will use it. If we have the area that we have much more wind, we will use it."

That said, Alexiev told me that while Bulgaria still has potential to install more wind turbines, it is small due to the best locations for wind energy projects already having been developed, leaving solar and hydroelectric energy as the more likely candidates for future renewables development.

4.3 Environmental Governance and Corruption

My participants who work in civil society outside of government had a lot of critiques to offer on how environmental laws and regulations are handled within the Bulgarian government. This section will discuss a variety of challenges in environmental governance, including issues in EU regulations, enforcement and loopholes in Bulgarian law, and corruption.

The European Union is a supernational organization that passes laws as a block that its member states must follow. This dynamic is important when it comes to environmental regulations. The EU has collective legally binding climate targets that all member states must plan for and contribute to.

As explained in section 2.4, the European Union considers biomass combustion to be emissions-free. As a member of the block, Bulgaria has explicitly adopted this standard, and many of my participants were critical of this practice, arguing that it has a real and significant impact on Bulgarian environmental policy. For one, T.G. told me that the national government currently has no real way to collect accurate data on GHG emissions from household biomass combustion. The best data available for GHG emissions at a national level, according to T.G., are estimates put out by the National Statistical Institute. There is no effort to collect accurate emissions measurements at a national level, and so

the estimates must be extrapolated from market data and from local measurements of specific airborne pollutants, such as nitrogen oxides (NOx). This means that more than likely the national estimates for emissions are inaccurate. Both T.G. and Antonova cited recent studies that found that pollution from household heating came close to the levels of pollution from transportation in Sofia, the capital city.

Unfortunately the problem goes beyond a lack of data. T.G. informed me that as the national government was putting together the document, the Integrated Energy and Climate Plan of the Republic of Bulgaria 2021-2030, the government initially wanted the country's biomass use to increase by 27% by 2030, simply by increasing the amount of forest biomass used in household heating. T.G. spoke about how this number became a big debate among the experts involved, and after a year of deliberation the number was lowered. The final version of the document projects only an 11% increase in biomass use by 2030. For T.G., this moment demonstrated the way in which policymakers think – focused on easy, short-term solutions and with the goal to simply check off EU-level policy requirements, rather than pursuing solutions with long-term benefits. T.G. suggested that rather than simply increasing the amount of biomass burned in households to match EU goals, the government should focus on improving energy efficiency and lowering pollution with solutions like better enforcement of forest biomass regulations, replacing inefficient stoves, and offering pollution filtration systems.

The problems that come from counting biomass combustion as having zero GHG emissions does not stop at households. According to Antonova, in some cases companies that operate combustion plants, most of which are former coal-fired plants, will claim that they are incinerating waste materials containing biomass over a certain

regulatory threshold, thus saving them in emissions allowances, allowing them to pollute more. This apparent deception ultimately saves the companies money that would otherwise be included in the EU's ETS or paid to the government in the form of fines for exceeding their allowed emissions limits.

Antonova described her laborious efforts with Greenpeace to bring these plants into compliance with regulations:

> "Several of the big coal power plants decided that they're going to be switching to other fuels, but without major retrofits, they were just saying that there is no need to do any changes to the installation…which [would] require, for example, an environmental impact assessment. We have demanded that they are participating in the public consultation, [and] we have challenged the permits of some of these plans. We have managed to convince [some power plants] at least publicly to say, 'we're not going to burn waste when it comes to municipal mixed waste.'…[These plants] need to go through a formal permit process, which takes at least half a year. And when we get involved, this process becomes even longer because we sue them, we ask for more information. Some of these plants have been reporting in their annual reports that they're burning different fuel, because for them, it's important even though they're getting the fines for not complying with their permit. Apparently, it's more economical for them to pay the fine or to postpone paying the fine because they also sue, they challenge [permit requirements] in court."

Some energy companies have gone much further, operating in ways that makes it difficult to tease out the distinction between poor environmental governance and corruption. The energy oligarch mentioned several times by Antonova, Slavkova and Dyankov has according to them created his own emissions-verification agency, on paper unconnected to his energy companies. They explained that this agency is essentially a shell company with little more than a post box in the United Kingdom as proof of its existence. Antonova emphasized what a big problem this is, as it allows this oligarch to easily validate the

emissions data claimed by the oligarch's energy companies, even if the data is inaccurate. Eventually this practice was discovered by an investigative journalist, and a case was brought to the state agency for the regulation of competition, which simply found that the verification agency and the oligarch were not connected in official government records, so it determined that there was no conflict of interest. Slavkova described the situation in stark terms:

> "Many of these CHPs and coal power plants are owned by a particular energy oligarch, and we have many reasons not to trust him. And in this scheme with the manipulations of the co2 emission quotas, they used a very young firm that is again connected to this person, and which has almost no experience in verification of emissions. But suddenly, it started to verify the emissions of all of his power plants."

Slavkova informed me that she and her organization are still fighting companies on this front. Za Zemiata commissioned a report on this practice of hiding GHG emissions and at the time of this interview, they had already commissioned a report and were preparing to publish it and share it with the authorities.

When asked about whether being in the EU has had any positive or negative impacts for the biomass and forestry sectors in Bulgaria, Dyankov told me that there have been positive developments for these sectors from being a part of the block. However, he stated that the positive changes do not come from the EU institutions themselves, but rather from EU-based non-governmental institutions and investigative journalists that being a part of the block gives Bulgaria access to that it might not have otherwise. Four of my participants mentioned helpful research done by investigative journalists on environmental governance, energy poverty, and forestry.

4.4 Inside and Out: Perceptions of Government Effectiveness

It did not take long while coding my data to see a notable divide in attitude towards government policy and the functioning of government in general. In this section I present my findings on how sentiments differed between the participants who work outside state institutions (NGO and policy institute representatives), and those who work within the state when it came to how they spoke about the effectiveness of Bulgaria's environmental governance. While I laid out specific criticisms my participants levied in previous sections, in this section I present more general observations. There was a clear divide in sentiment between government and non-government workers, though it was not perfectly split. Two government employees, Petrova and A.K., shared some level of critique of government policies and practices, while the remaining three government workers offered none and seemed to represent the government line. All participants working outside of the government offered up at least some level of critique of the government's policies.

While open critiques of government policy, expressed by seven of the ten participants, were indicators of some degree of skepticism, several participants expressed cynicism quite openly, with six participants – Antonova, Dyankov, Slavkova, L.S., T.G., and A.K. joking about the actions of government ministers and energy oligarchs, and the general situation. The jokes came across as a possible coping mechanism, as the people making them clearly cared about the energy poverty and environmental problems in the country and are investing time and effort into improving them. As they saw it, their efforts were being stymied by forces much more powerful than them, and perhaps laughter was their way to console each other and themselves. These cynical jokes about apparent

government incompetence were expressed in the form of sarcastic statements, occasional quips, and anecdotes, such as this one told to me by T.G.:

> "I remember a funny situation in 2019, when, during internal discussion between representatives of different ministries and agencies, the representative of Ministry of Energy said that we still don't have strategy for development of Bulgarian forestry. And the deputy director of the State Agency of Forestry, said, 'but we do have this strategy. And it is since six months already sent to your ministry for review.'"

Participants expressed varying levels of frustration about Bulgaria's environmental problems. Participant A.K. expressed real anger in our interview when describing the collapse of the fragile government ruling coalition that happened the day before our interview. There was no way to plan for such an event, but the collapse of the ruling coalition, after just six months in power, provided invaluable observational data for me in the way of the reactions of my interviewees and other environmental advocates that I interacted with on my research trip to Sofia. The coalition, lead by prime minister Kiril Petkov, was made up of four centrist to left-leaning parties and was described to me as "the greenest government coalition ever" by Dyankov and A.K. I observed an entire spectrum of reactions to the event. Some expressed frustration and outrage, while others expressed disappointment, and still others rolled their eyes, made jokes, or projected a cynical lack of surprise. Although some participants attempted to hide their disappointment in this turn of events, I observed a palpable change in mood of both my participants and other people I interacted with in Sofia from one day to the next over the period in which the government coalition fell apart.

When discussing Bulgaria's progress towards climate, energy poverty, and renewable goals to participants Ivaylo, T.K., T.M., and at times Petrova, I noticed a clear tone of

optimism and faith in the actions of the government. When I asked questions, for example about biomass combustion and its designation as emissions-free in national policy, that opened space for criticism of government policy, these four participants either pointed to successes in government policy or cast doubt on the potential flaw in policy.

5 Discussion

Taken together, the research and findings of this study present a complicated picture that we can attempt to better understand and interpret using the DPSIR framework. This chapter uses the DPSIR framework along with the literature review to discuss the results of the study. As an attempt to allay confusion and increase clarity, the individual terms *driver, pressure, state, impact*, and *response* will be used in this section only to refer to components of the DPSIR model.

5.1 Good Intentions, Bad Results: Forest Biomass Accounting

In Bulgaria the basic need for an adequately warm home and increasing electricity demands are the drivers putting pressures, i.e. cutting down and burning trees, on ecosystems, especially forests. The resulting state of the environment is one with fewer trees and smaller forests, which in turn puts pressure on energy poor Bulgarians. This appears to be a cycle in which the line between the impact component and the pressure component of DPSIR is blurred. At times they may be the same thing. To make matters worse, Bulgarian government support of biomass-derived energy as its best renewable energy option to meet EU obligations only adds fuel to the fire. This response is really a subset of the response of the EU at large to the impacts of climate change, but unfortunately appears to be one in which the response worsens the state of the environment. Poorly regulated biomass extraction is shrinking one of the EU's biggest carbon sinks, its forests.

To have a successful bioenergy sector that actually does what the EU and Bulgaria want it to do – reduce GHG emissions without putting additional strain on human needs –

"bioenergy production must increase the total amount of plant growth" (EEA Scientific Committee 2011, 1). This is not happening in Bulgaria, where the policies and regulations on forest biomass are sometimes vague and rarely enforced, allowing a significant amount of illegal logging, with no significant efforts to protect and rapidly scale up forests.

This study has made it increasingly clear that the combustion of forest biomass puts real pressure on the environment, including GHG emissions added to the atmosphere. What is still unclear is why the European Union has maintained the policy of counting biomass combustion as emissions free, when several of its institutions and many of its scientists have concluded that the policy makes no scientific or policy sense if the goal is to promote clean energy (Camia et al 2021) (EEA Scientific Committee 2011) (WWF 2022).

> "The Commission is shirking its responsibility. It basically admits in this [JRC] report that EU bioenergy policies are accelerating climate change then lobs the ball into the court of Member [Countries] to fix the problem. We urgently need biomass rules to be tightened in the EU Renewable Energy Directive before any more damage is done." - Alex Mason, Senior Policy Officer, WWF European Policy Office (WWF 2022)

The lack of action given such clear evidence is confounding, but really puts into perspective T.G.'s view that policymakers are simply looking to check off boxes and are less concerned with the actual effect of their actions. Bulgaria's INECP document, while flawed, puts forward some laudable objectives. According to the INECP, Bulgaria aims to "promot[e] low-carbon economic development," while "ensuring that energy is available at affordable prices to all consumers" (Ministry of Energy 2020). However, the facts and arguments presented in this paper make these two objectives seem quite incompatible. On the one hand, low-carbon economic development is of course possible with the right

types of energy, such as solar, wind, hydroelectric, and nuclear. On the other hand, the high-carbon fuel source of forest biomass is still one of the most affordable ways for energy-poor Bulgarians to heat their homes to an adequate level. Unless Bulgaria is willing to make a 180-degree turn on biomass accounting, it may need to choose one of these objectives, because it appears that it cannot achieve both.

In the same document it sets out a few national energy priorities, two of which are "diversifying the supply of energy resources" and "consumer protection by ensuring fair, transparent and non-discriminatory conditions for the use of energy services." Once again, its policies on forest biomass appear to run counter to these objectives. For one, Bulgaria wants to use 42.30% renewable energy in heating and cooling by 2030 (Ministry of Energy 2020), most of which would be made up of biomass combustion as it is today, because most homes still do not have the infrastructure to access renewable-based heating and cooling by any other means. The INECP also claims that increase in biomass use will have a neutral effect on the LULUCF sector "because no significant increase in the land allocated to energy crop cultivation is projected" (Ministry of Energy 2020). This seems unlikely to be true and possibly based on the false premise that either biomass production will somehow not affect forests or that Bulgaria will rapidly switch to more advanced biofuels by 2030, both of which seem unlikely.

5.2 Linking Data and Actions

Some of my participants pointed out that Bulgaria has no official definition of energy poverty, although organizations working on the problem have requested one. I discovered in my research that the EU also has no official definition of energy poverty (European

Commission 2022). It is beyond the scope of this paper to figure out if the lack of a definition of energy poverty by both Bulgaria and the EU is like the biomass accounting issue, i.e. if one is essentially the cause of the other, but it is not unreasonable to assume that many EU policies work that way. In many ways, the EU is the authoritative body to its national member governments. Despite being a quasi-democratic body in which the member states get to veto EU laws if they do not like them, the EU still holds considerable sway over the policies of its member countries simply by nature of the hierarchical national-supernational relationship. An official definition of energy poverty would likely go a long way in making Bulgarian efforts to fight it more effective, which is likely why four of my participants mentioned the problem. As expressed in the introduction, having accurate data is vital to having accurate policy responses, which is why the current designation of bioenergy as carbon neutral is so harmful – it essentially allows for a gap in data, which makes responding to the problem more difficult. Similarly, when there is no official definition of a driver like energy poverty, it makes the response more difficult. Organizations and governments might operate with different concepts of what energy poverty as a driver of environmental pressures is and how it can be managed, which can lead to a large variety of financial and policy tools as responses. Worse than simply being ineffective, some responses to these impacts and drivers are actively harmful, such as the policy to promote wood pellet stoves or the energy subsidy program. Both responses appear to actually entrench energy poverty, even if there are some short term benefits.

To revisit biomass extraction, the lack of data on emissions from biomass-derived energy has lead to negative impacts far beyond Bulgaria's energy poor. Throughout European countries, forests are being torn down for the industrial logging of wood products. In some

cases, large amounts of green trees are being felled and processed to create ‘sustainable’ wood pellets for stoves. The report Forests on Fire posits that the loss of forests through “industrial logging also poses high risks for biodiversity, ecosystem function and the ability of forests to regenerate, making use of stemwood and coarse woody debris a “lose-lose” scenario for both forests and the climate” (Chamberlain 2022, 2). Due in part to the policy claiming that biomass-derived energy is carbon neutral, many of the industrial plants cited in this report are being allegedly dishonest about the sources of their biomass. Sometimes they claim it is simply forest ‘residue’, i.e. leftover twigs and other biomass litter. Were biomass considered by the EU to produce GHG emissions, there would likely be more enforcement of data collection and reporting, and possibly less incentive for these plants to tear down forests if they knew they could be investigated for suspicious emissions reporting.

As said in the results section, being a member of the EU has somewhat improved the emissions and ecological situation in the biomass and forestry sectors in Bulgaria due to access to investigative journalists and NGOs. One of the block’s biggest tools to influence events in its member countries is its laws that must be reflected in member country national laws. However, in Bulgaria many of these climate and energy laws are not well-enforced or even ignored, making them essentially pointless. This is a prime example of an ineffective government response to environmental impacts.

5.3 Downstream Effects of Flawed Climate Accounting

Ultimately this study does not go as far as to prove a clear link between the climate accounting of forest biomass combustion with the issues of renewable energy

development and energy poverty. However, the results do at least suggest that, with the metaphorical renewable energy box being checked thanks to use of forest biomass, the government has less incentive to make bold moves in renewable energy development. Why would it? Its renewable energy targets have been handily met in the past due to this type of accounting: in 2020, Bulgaria surpassed its renewable energy target by over 5% thanks to its large biomass usage (European Parliament 2021). When there is a lack of policy and data on a subject, the impact component of the DPSIR model may appear less urgent than other issues to politicians and government workers.

With such a huge reliance on biomass for EU obligations, it seems clear that there is not only no incentive to respond with rapid deployment of other types of renewables, but that there is an incentive to continue to increase the amount of biomass used. So, when a large portion of the population relies on biomass anyways for home heating, a government response that reduces the amount of biomass for heating would seem counter to the government's priorities, even if it fulfills a different (if undefined) goal of reducing energy poverty.

6 Conclusion

With climate change looming larger each year as the world struggles to act rapidly enough to prevent the worst outcomes, climate accounting is a vital method of evaluating our current situation and taking action for the future. While the exact correct method of accounting for GHG emissions has been subject to debate for as long as people have been able to measure and calculate them, there is a growing international consensus on best practices. While energy derived from biomass combustion is recognized by prominent international organizations like the IPCC as producing roughly the same or more GHG emissions as fossil fuels (IPCC 2022), the EU and Bulgaria are among those choosing to ignore these emissions on the flawed logic that because biomass comes mostly from plants, the carbon levels equal out since those same plants absorbed carbon as they were growing.

This policy has been disastrous for European forests. In Bulgaria, where the energy poor rely heavily on forest biomass to heat their homes in the winter and renewable energy development is slow, biomass is being championed as a climate-friendly renewable energy source. Because it counts at the EU level as emissions-free, Bulgaria has been able to beef up its climate numbers in emissions and renewable energy targets.

This leaves advocates and other stakeholders in Bulgaria's energy transition feeling frustrated, and for many of them likely represents a broader ineptitude in the Bulgarian government, which has struggled to satisfy environmental activists in its climate policies.

The theoretical framework used in this study, the driver-pressure-state-impact-response model, was used throughout to link the relationship more clearly between human society

and the environment on the topics of environmental governance, energy poverty, biomass energy, and climate accounting. The takeaways of this study are that climate accounting is vital to proper mitigation of climate change, and a flawed accounting system can change incentive structures within governments, organizations, and individuals on how they act on environmental issues.

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