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The European Green Transition: Exploring the Sustainability of Wood Pellets as Biomass Energy in North Carolina, US

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“The climate crisis is not a science problem. It is a human problem. The ultimate power to change the world does not reside in technologies. It relies on reverence, respect, and compassion – for ourselves, for all people, and for all life.”

Paul Hawken¹

¹ 2021, p. 9, activist and author of *Regeneration: Ending the Climate Crisis in one Generation*

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Abbreviations

BECCS	Bioenergy with Carbon Capture and Storage
DA	Discourse Analysis
CDR	Carbon Dioxide Removal
CO ₂	Carbon Dioxide
DAQ	Department of Air Quality
EGD	European Green Deal
EJ	Environmental Justice
EM	Ecological Modernization
ESG	Environmental, Social, and Corporate Governance
GHG	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-Governmental Organization
PD	Post Development
RED	Renewable Energy Directive
SBP	Sustainable Biomass Program
SELC	Southern Environmental Law Center
UNCED	United Nations Conference on Environment and Development
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile Organic Compound

Abstract

The threat of worsening climate change has motivated governments to shape policies towards mitigating the worst impacts by aiming for sustainability. Europe is undergoing a green transition to such ends. Its current iteration of policies, the European Green Deal, require CO₂ reduction targets while incentivizing a green growth economy to lead the change. One outcome of such policies is the use of wood pellets as a form of biomass energy. The largest source of Europe's biomass energy comes from the southern United States.

The thesis explores the sustainability of such a process by asking, "What are the consequences of biomass energy as promoted by European green transition?" Interviews and thematic analysis from a case study in North Carolina, US reveal a chain of contested consequences emanating from policy discourse to local impacts. The community impacts suggest biomass energy is environmentally problematic, economically limited, and socially polarizing. The policy discourse reveals ecological modernization as a development model. This model relies on leadership from key institutions – governance, free markets, and technology and science – to achieve success. Those pathways to sustainability do not address the inherent power and politics within their approaches.

Relying on existing institutions within the ecological modernization discourse limits the transformation potential of the green transition. An additional pathway of citizen-led discourse could challenge the systemic conditions which not only caused climate change, but also address the inequities and injustices alongside it. In centering equity and justice, the transition could become a transformation, in which different discourses guide social relations and well-being. Though not a harmonious process, its importance is that it includes everyone in the realm of discussions, from diagnosing problems to co-creating new pathways.

1. Introduction

The increasing effects of climate change have sparked governmental action to prevent worst-case climate scenarios. For simplicity and coherency, the climate discourse has been focused on limiting greenhouse gases, specifically carbon dioxide (CO₂), to certain levels within a narrow timeframe (IPCC, 2022). The European green transition is the broader effort within Europe to achieve that goal by pursuing sustainability. The main attitude within this transition is to combine governmental policy with 'green' market incentives in order to reduce CO₂ emissions. One outcome of such thinking is the European Union's (EU) support for woody biomass energy as a replacement for fossil fuels. Due to the 2009 EU Renewable Energy Directive (RED), which mandated and incentivized EU Member States to increase renewable energy consumption, wood pellet biomass energy currently comprises 45% of the EU's renewable energy supply (Flach et al., 2020). The European Green Deal has essentially locked in biomass energy to meet its carbon reduction targets (European Commission, 2019). The majority of Europe's wood pellet biomass comes from the southeastern United States, mainly from one company, Enviva (Enviva, 2023a).

While hundreds of proposed climate solutions are gaining mainstream attention, most of them focus on technical fixes (Hawken, 2017). By restricting the sustainability pathways to markets, technology and policies, the systemic climate change discourse is concealed. One of the risks in concealing systemic drivers of climate change is that proposed solutions may actually worsen impacts on both humans and non-humans. For this reason, it is necessary to scrutinize how governmental policies frame the climate discourse and which sustainability pathways are deemed appropriate.

This thesis explores the impacts² of biomass energy as part of the European green transition. It does so on two levels; it conceptualizes the relationship between the European transition, biomass energy and their correlative development discourses; and it focuses on a case study of

² I use impacts and consequences synonymously in this thesis.

the biomass energy industry at the local level to illustrate how sustainability is framed and pursued. Through interviews and thematic analysis this thesis analyzes the social, environmental, and policy impacts of the biomass industry according to the attitudes and perceptions of interview participants. The findings from the analysis reveal discontinuity between the stated goals of biomass energy and the communities living in the center of this industry. The result is deep contestation that biomass energy itself is sustainable and will adequately mitigate climate change while uplifting issues of justice.

In response I highlight a framework of sustainability pathways which motivate various approaches. A citizen-led approach addresses the deeper causes of climate change and its proposed solutions. In centering this pathway, the dialogue expands beyond reliance on government policies, technology, and markets. By placing emphasis on the political dimensions of discourses, citizen-led pathways offer greater inclusion through prioritizing justice, equity and agency. In aligning these values with a sustainability pathway, the hope is that the systemic causes of climate change will be eliminated and the paths towards mitigation will be holistically navigated.

1.1 Research questions

This research follows a main research question, which is supported by 4 sub-questions:

What are the consequences of biomass energy as promoted by the European green transition?

The sub-questions are:

1. Under which line of development reasoning do European policy makers promote biomass energy and how are key definitions negotiated towards such policies?
2. Who are the major actors and networks involved in the biomass energy trade (and what implications does that have for sustainable energy solutions)?
3. How does the biomass energy industry affect local communities where wood is sourced (environmentally, economically, socially)?
4. Which type of transitional pathway does biomass energy represent?

The research investigates these questions by describing the methodology and tools used for the biomass energy case study (2). The analysis tools inform the choice of theories used to interpret the findings (3). A background gives context for conceptualizing the relationship between biomass energy, the green transition, and development discourses (4). The findings are then revealed through 5 main themes which highlight impacts of importance according to interview participants (5). A discussion examines discourses underpinning participants' views of biomass energy in specific and sustainability pathways in general, which then leads to answering the research questions (6). The conclusion summarizes this research and adds a suggestion for further exploration within this topic (7).

2. Methodology and Framework

This qualitative research explores the dynamics in using woody biomass as an energy source to mitigate climate change. The research goals are:

Theoretically, to explore the consequences of biomass energy; and to understand the role of biomass energy within sustainable development as part of the green transition.

Practically, to provide rich data from two local communities where wood pellet biomass is being sourced; and to put that data in conversation with the global conditions supporting biomass energy.

Personally, to listen to and learn from individuals whose voices may not be heard, yet who experience the reality of climate change transitions; and to further my own commitment to social justice and its engagement within climate change pathways.

The study design, tools, and analysis are explained further.

2.1 Design

As climate change mitigation is about both human and non-human considerations, it is important to qualify what these considerations are. This research explores policies and community impacts, both of which can be assessed through subjective experiences, attitudes, and relations among social groups. To explore these concepts with sensitivity, I rely on positions of knowledge and reality that differ from the natural sciences.

One of the strengths in qualitative research is its use of interpretivism. This approach recognizes that human experience is better understood through a model different from the scientific method (Bryman et al., 2021). Rather than assuming all knowledge is objective,

interpretivism validates alternative understandings of how knowledge is derived and reproduced. What is considered knowledge, or even acceptable knowledge, has deep implications for how a society understands dilemmas and paths forward. This also reveals how knowledge is not necessarily neutral but ultimately political.

A complementary qualitative position I employ is constructivism. It views social organizations, institutions, even cultures as continually made and remade from perceptions and actions of social actors (Bryman et al., 2021). This benefits my research in that I can delineate categories used in the social world as constructed through interaction and discourse. When looking at energy systems, societal transitions, and impacts on communities, this approach expands the conversation of analytical reflections.

Rather than starting with a fixed theory of what is happening, I use an inductive approach, which acknowledges theoretical influences yet responds to the data in an open way. That is, the stage between analyzing the data and applying theory to it will loop back multiple times to derive a coherent interpretation from which to answer the research questions. This iterative process is one of the hallmarks within qualitative research design meant as a way of sensitization to emergent themes, concepts, theories and analysis (Bryman et al., 2021; Maxwell, 2012).

The tools employed for this design include semi-structured interviews and observational site visits as a fieldwork component as well as a review of the literature.

2.2 Fieldwork

My research was designed with fieldwork in mind to access community perspectives firsthand. The decision to conduct fieldwork in the United States made sense for several reasons. The biomass (wood pellet) industry is situated primarily between Europe and the U.S., with the U.S. being the largest exporter (Sustainable Biomass Program, 2023c). This provided a chance to research both 'locally' and in the context of the largest scale of operations.

From a practical perspective, the integration into my chosen sites was quite manageable since I am from the U.S. One benefit was the familiarity of local governmental structures and relevant parties to contact. Furthermore, my cultural and linguistic fluency deepened my recognition of nuances as they pertained to my topic. However, the distances in this part of the states can be large and my sites were rurally located, which required me to rent a car and a place to live. Budget and time, therefore, became limiting factors.

The fieldwork was conducted between January 8 – 28, 2023 in North Carolina, U.S. The largest producer of wood pellets is Enviva, a public company, which has 10 production facilities across the US southeast (Enviva, 2023a). The state of North Carolina (NC) hosts 4 of those, more than any other state. Two facilities are in northeastern NC near the towns of Ahoskie (Hertford County) and Garysburg (Northampton County). For reference, the population of Ahoskie is 4,801 and Garysburg is 904 (U.S. Census Bureau, 2020).

I chose to focus on this region so I could compare data from two areas (70 km apart) with similar characteristics. More importantly, this seemed like a suitable site since I aim to understand community impacts of biomass production and these locations are among the epicenters of sourcing and producing wood pellets. They are also unique among pellet facilities because they heavily source from hardwood forests, rather than pines. For these reasons, it made sense to me to focus my research here.

My time was divided between driving significant distances (over 1,500 km – not including 3,400 km roundtrip to Missouri, my starting point) to look at clearcut forests, meeting with locals, observing wood processing facilities and the towns hosting them. I also conducted interviews remotely along with collecting secondary data online.

2.3 Method

2.3.1 Data collection

I favored a flexible, semi-structured interview approach in all but one case. As Bryman et al. (2021, p.425) note, qualitative interviews differ from quantitative in that there is greater interest in “the interviewee’s point of view”, “how the interviewee thinks and feels”, and the qualitative researcher wants “rich, detailed answers ... which can depart significantly from the interview guide.” The semi-structured interviews consisted of 7 questions designed to elicit participants’ experiences, attitudes, and knowledges relating to the biomass industry (see Appendix 1). This format allowed the participants to start within the topic and expand in directions deemed relevant to them. If time allowed, I followed new directions with an additional line of inquiry. As research progressed, the range of new participants required tailoring the interview guide. The data analysis afterwards could then uncover any hidden themes that were not explicitly part of the initial theoretical considerations, which is an advantage to using an iterative process.

The questions were designed to respect the participants’ privacy and interview duration. At the shortest, interviews were 15 minutes long (two interviews). At the longest, they stretched to 2 hours (three interviews). Most interviews landed between 45-75 minutes. Although my on-site fieldwork ended in January, I continued to conduct interviews through the end of February after returning to Norway. This process was via telephone, Zoom, and Microsoft Teams. I also collected secondary data through relevant documents (peer-reviewed journals, scholarly books, government and industry websites).

2.3.2 Data sources

The selection of interviewees led me down multiple paths. By narrowing my scope and keeping the research questions at the forefront, I restricted my sampling to almost exclusively participants based in North Carolina. Most of the participants interviewed either live in the

designated research sites or have a direct connection with them through land ownership, activism, working relationships, or knowledge of legal processes relating to Enviva's facilities. One exception is an NGO in Europe which was recommended through snowball sampling. Therefore, my sampling was not random, rather it was strategically selected for information-rich participants who had a direct reference to my research aims (Bryman et al., 2021).

Purposive sampling, as I employed it, is well-suited for this type of selection. The research questions offer guidance as to which categories of people and places could be information-rich and meaningful. I initiated contact using forms of purposive sampling that might be typical across populations (*city employees, forestry workers*) and those which seek variation (*academic, NGO, biomass producer*). My plan was to capture common features or themes which might exist across a wide variety of contexts and not skew towards deviant cases.

Snowball sampling allowed me to expand the chain of connections among interview groups by asking them for suggested contacts. This was useful in both getting deeper within a group (*residents*) and connecting to new groups (*department of air quality, doctor*). In some examples, I intended to use a purposive approach, but had difficulties accessing willing or available participants (*residents, workers within biomass facilities*). In this case, the snowball method was very helpful in moving the research along.

I initiated contact with most participants via phone call once on site. For some groups that involved a web search for appropriate departments and contact info (*forestry, academic, city employee*); for others, the name and number were provided to me from other participants (*forestry, department of air quality, resident, city employee, doctor, Enviva*); for some participants I initiated contact via email which then resulted in a phone call or video call (*academic, resident, NGO, journalist*); and lastly, I made in-person contact with (*resident, city employee, trucker*) through either a pre-arranged meeting or spontaneously.

Appropriate sample size is tricky to determine within qualitative research (Bryman et al., 2021). What matters to my study is rich, contextual significance provided via my methods. A narrow scope of research with rich participant data combined with a transparent analysis can yield a trustworthy study. Bryman et al (2021, p.386) does mention a range of 20-30 participants as a suggestion for publishable data. However, it is not a universal standard. My sample size, nonetheless, includes 21 interviews and 2 informal observations. Of those, I will analyze only the 20 interviews. One interview participant denied consent afterwards due to supervisor’s insistence. This did not have a noticeable impact on my research since I still conducted two interviews with other forestry workers.

Table 1 The results of my sampling criteria. Informant groups are separated by type of relationship to data relevant to the study. Number of Informants shows how many participants were selected based on each method of sampling. Informal observations and Site observations are not part of the data analysis explored below, yet they left impressions on my overall experience.

Informants by Group	Number of Informants		Gender
Forestry	3*	(2 purposive, 1 snowball)	3 male
Academic	2	(1 purposive, 1 snowball)	2 male
Department of air quality	2	(2 snowball)	1 male, 1 female
Resident	4	(4 snowball)	3 male, 1 female
City employee	4	(2 purposive, 2 snowball)	2 male, 2 female
Doctor	1	(1 snowball)	1 male
NGO	2	(1 purposive, 1 snowball)	1 male, 1 female
Journalist	1	(1 purposive)	1 male
Biomass producer (Enviva)	1	(1 purposive)	-
Trucker (pellets)	1	(1 snowball)	1 male
Informal Observations			
Resident	2	(2 purposive)	2 female
Logger	2**	(2 purposive)	2 male
Site Observations			
Facilities	2	(purposive)	
Forests (clearcuts, in-process clearcuts)	6***	(3 purposive, 3 snowball)	
Total	20	Formal Informants	14 Male, 5 Female, 1 Company

*One of those interviews will not directly appear in this thesis since I did not receive consent.

** Both loggers were active on a clearcut, but it was supposedly not supplying any wood to Enviva.

*** Three of the forest clearcuts were found by driving. I was intentionally searching, but without an exact location in mind.

2.4 Positionality and limitations

I practice reflexive positionality in this thesis. This attunes the reader to transparent methods and framing of the research. My deep interest in how humans navigate the human and non-human world motivates my curiosity in how climate change is understood and navigated. In grounding my study in reflexive awareness, I acknowledge I am part of the social world which I study and that I cannot avoid influencing it or being influenced by it (Maxwell, 2012).

Instead of claiming to be value-free, it is important to identify and recognize the impact of my social location, age, gender, sex, education, etc. on this research (Auerbach & Silverstein, 2003). These can exert influence on the research through formulation of questions, choice of methods, and areas of study. (Bryman et al., 2021). I acknowledge that my values of environmental sustainability, social justice, and equity likely influence all stages of this research. Furthermore, I view climate change as a phenomenon that impacts me both in subtle and obvious ways; and I actively explore how to apply myself towards mitigating climate change.

One risk of holding these values is entangling my stance as a researcher with various participants' perspectives, especially those deemed marginalized (Bryman et al., 2021; Maxwell, 2012). My task as a socially conscious researcher is to backstop against this risk by using transparency of research design and iteration of analysis. In foregrounding this awareness, I strengthen the reflexive positioning of this research. Where interference may occur, I take note and assess how the research should continue.

2.5 Consent

My project received approval from NSD (Norwegian Center for Data Research – now called Sikt) with the reference number 915616 on December 7, 2022. I have met and will adhere to the safety protocols concerning sensitive data and informed consent from each person I interviewed (see Appendix 2).

In each of my 20 interviews I have documented consent to use the information shared with me. Although I also have consent to publish the identities of 9 out of my 20 interviewees, I have chosen to keep all but one name anonymous for two reasons. One is consistency of presenting the data in a clear way that does not jump around from named individuals to those who are anonymous. The second reason is to hinder the possibility of favoring one source of information over another. This could happen either through me implicitly favoring text from a named source because of a perceived status of believability or also for the reader's bias of crediting/discrediting the source through familiarization. The only source I reveal is the publicly held company Enviva.

2.6 Data analysis

I primarily used a thematic analysis. This allowed me to focus on data after collection, rather than simultaneously iterating collection and analysis while in the field (Bryman et al., 2021). The flexibility within thematic analysis offers the researcher multiple paths for analytic criteria. In fact, I combine an intuitive approach with elements from grounded theory and discourse analysis. In doing so, I operationalize multiple elements which provide structure to my analysis. I started with a grounded theory framework for working with the data in 3 steps: managing the data, making sense of it, interpreting it (Auerbach & Silverstein, 2003; Bryman et al., 2021).

Step 1 – After transcribing all the recorded interviews, I read through each one, including those interviews where I took typed (7 interviews) or handwritten (1 interview) notes. Then I posted my research questions above each transcript and read through again familiarizing myself with patterns or themes. Step 2 – I wrote down themes (repeating ideas) which intuitively made sense according to my topic and the type of interview group and questions posed (Maxwell, 2012). I then iterated steps 1 and 2 again.

After reviewing the initial themes, I decided to manually code the data in Excel using more specific codes to elicit additional detail. I worried that my initial themes were too broad and encompassed too much data. Moving from a theme such as *'environment'* in the initial round to codes of *'Forests/ logging/ sustainability/ sourcing/ clearcut/ habitat/ ecosystem/ plantations/*

emissions/ air pollution/ air quality/ health impacts/ water' brought out more richness in the data and greater potential for building themes and sub-themes.

At this point I derived 63 initial codes which were organized into 12 provisional themes. These were aggregated into 5 final themes: *Environmental dimensions of biomass* (4 sub-themes), *Economic dimensions of biomass* (1 sub-theme), *Social dimensions of biomass* (4 sub-themes), *Policy dimensions of biomass* (2 sub-themes), and *Attitudes towards biomass (Enviva)*.

Step 3 – Whereas the first 2 steps focused on explicit themes, I performed a final round of iteration focused on latent, or interpretive, themes using discourse analysis. In this case, I reviewed all the coded data again. I made note of which discourses were explicit and latent within the data, a benefit of combining these tools (Braun & Clarke, 2006). Specifically, my interest was in discourses surrounding the biomass energy industry in both localized and global contexts.

Discourse analysis (DA) is an analytic tool that traces how language can impose and maintain power within societies (Bryman et al., 2021). Discourses reveal the ways in which people view certain topics or their own behaviors as acting on these views. In short, this constructivist view of language, as expounded by Foucault, draws a connection between language and the material world, meaning language can create and enforce behaviors which then reinforce structural patterns until alternative framings are silenced, whether intentionally or not (Fairclough, 2003; Foucault et al., 2008; Hajer & Versteeg, 2005).

The dominance of a discourse, when it crowds out other framings within a cultural context, is referred to as a hegemonic discourse (Foucault et al., 2008). However, in place of hegemonic discourses, I use Benjaminsen and Svarstad's (2021, p. 66) leading discourse terminology that recognizes multiple prevalent discourses which do not singularly exercise hegemony.

Additionally, I draw on Scoones et al's (2015, P. 4) broader use of the term discourse in how they frame pathways toward sustainability. They use discourse to highlight the politics of knowledge and its material impacts within sustainability pathways and categorize 4 general

framings (explored further in the theory chapter), none of which are strictly independent from, nor dominant over, the others (Scoones et al., 2015).

The use of leading discourse and sustainability framings/discourses aligns quite well with interpreting my data. In this sense, I use a 'light' version of discourse analysis because my research focuses primarily on the impacts of biomass energy as experienced by community members, and secondarily on the framings of these impacts as they relate to sustainability pathways. My application of DA closely overlaps with thematic analysis, sometimes described as thematic discourse analysis (Braun & Clarke, 2006; Taylor & Ussher, 2001). Some forms of DA explore rhetorical devices, the action orientation of language, or the 3-dimensional framework of critical discourse analysis; however, thematic discourse analysis looks across the data, rather than within, for patterns of latent meanings from which assumptions and meanings are theorized as underpinning the data (Braun & Clarke, 2006). It is less complex and better suited for my study. I find this appropriate for applying participants' latent attitudes as well as overt comments within the sustainability discourses in order to better contextualize the impacts of biomass energy, both conceptually in the green transition and locally in perceived impacts.

The findings from the discourse analysis revealed shared and diverging discursive themes. The leading shared discourse is *sustainability is a universal goal (because of climate change)*. Contrasting discourses were *biomass energy is sustainable; biomass energy is not sustainable*. The supporting discourses emphasized alternative focal points within sustainability pathways: market-led, policy-led, technology-supported, science as objective truth, and community voices/ activism matters.

The data findings are presented in thematic groups. Given the variety of interview participants and differing sets of questions, the thematic groups are necessarily broad. I attempted to overcome this by combining my intuitive understanding of the data with thematic and discourse analyses. Rather than viewing this as a weakness, I see the rounds of iteration combined with inductive reasoning to align quite well. I found confirmation between the

intuitive themes, coded themes and DA. Lastly, the 5th theme of *attitudes* functions as both a separate and cross-cutting theme because the attitudes reflect sustainability discourses running through each theme.

The findings informed which theoretical approaches were more applicable. In the theory chapter I will discuss my use development theory and draw on elements from post development theory and transformations framework.

2.7 Trustworthiness

By providing transparency and reflexivity throughout this thesis, I hope to ground my study in authenticity and trustworthiness. I rely on iteration of analytical methods and triangulation to increase my ‘field of vision’, as Bryman (2021, p.364) puts it. Where appropriate, I seek confirmation from participants on quotes I use to make sure I correctly retain the meaning of their statements.

This thesis does not attempt to present an entire picture of the biomass energy industry between the U.S. and Europe. Rather, it presents this researcher’s thoughtful analysis contained within the limitations of time, budget, interview participants, available research, and individual subjectivities.



Figure 1 Author in front of an Enviva facility in Ahoskie, NC – January 2023.



Figure 2 Author with view of Enviva plant from town of Ahoskie, NC – January 2023.



Figure 3 Author near Enviva facility in Northampton, NC – January 2023

3. Theory

This chapter explains which theoretical concepts were used. These theories seemed appropriate for contextualizing the findings of the analysis and answering my research questions.

3.1 Ecological Modernization Theory

The theory of ecological modernization (EM) underpins much of the green transition discussions. As a theory, EM analyzes how industrialized societies deal with environmental crises (York et al., 2010). It is a school of thought that regards environmental protection as a marker of developed states and intertwined with healthy markets. The belief in successfully combining the economy with environmental protection has given rise to green growth movements.

Its origin stems from environmental sociology, which itself wrestles with the relationships between population and resource use and primarily critiques modern development processes, such as capitalism, industrialization, economic growth, etc. (Woodgate, 2010). The environmental crisis, of the 1960's and 1970's in the global north, was seen as fundamentally tied to the capitalist organization of the economy. However, during the 1990's, environmental sociology split into two camps: one which viewed the modernization project as anti-ecological at its core, thus not compatible with sustainability; the other deemed modernization, and its institutions, to be adaptable and capable of achieving sustainability (York et al., 2010). The latter camp evolved into ecological modernization advocates. EM proponents determined that the same system of capitalism, which created environmental crises, would now reflexively account for them through modernized institutional processes.

According to Mol (1996, p.305), one of the leading proponents of EM, the only “way *out* of ecological crisis” is by going “further *into* modernity” (italics in original). This argument claims ‘ecological rationality’ will permeate all layers of society as modernization processes continue,

eventually transforming from a dirty industrial caterpillar to an ecological butterfly (Gibbs, 2006; Mol, 2010). EM theorists assert that no other major, fundamental alternative to the present economic order has proven feasible according to economic, environmental, and social criteria; hence, solutions are best sought within institutions, not by replacing them (ibid.). Ecological rationality suggests modern institutions (those of the global north), such as multinational corporations and governments, will act in their own self-interests to place ecological concerns at center stage. This takes place due to tendencies attributed to 'late modernity' – rational self-examination driven by government, business, and scientific establishment along with social movements (York et al., 2010). Thus, environmental reforms will manifest naturally without requiring radical social, political, or economic change.

Three broad phases of EM can be outlined. From its inception in the 1980's by Huber and Jänicke, EM theory was rooted in technological solutions, skepticism of the state, and a belief in market forces for affecting change (Gibbs, 2006). The second phase lessened the emphasis on technological determinism and balanced the roles of state and market forces. The third phase added more emphasis on individual consumer choices, what might be seen as greening consumption (ibid.). Some theorists interpret EM through two forms, weak and strong. Weak EM adheres to techno-corporatist approaches through economizing nature and elitist-driven organizational structures (Gibbs, 2006). Strong EM emphasizes changes in production and consumption via greater democratization and social justice (ibid.).

While strong EM conceptually creates space for social justice, there is no developed theory of power relations from which to anchor the concept of justice. This implies discursive tendencies are situated within a traditional, or weak, modernization lens. As Wilson (2019, p. 94) notes, EM is a persuasive discourse because it reframes environmental protection and economic growth as complementary, even mutually reinforcing. The appeal of a such a discourse draws in traditional opposition groups; policy makers, business leaders and even the environmentally conscious public (Hajer & Versteeg, 2005; Wilson, 2019). Taken a step further, some contend such a discourse legitimates a policy-making culture which absolves private industry from its environmental responsibility, hence the widespread buy-in (York et al., 2010).

As both a theory and a pragmatic policy guide, EM is mainstream enough to be embodied throughout major institutions. The United Nations Environment Program (UNEP) advocates for a green economy initiative while European Green Deal established a goal of becoming climate neutral by 2050 in a manner that “contributes to the European economy, growth and jobs.” (European Commission, 2021; Wilson, 2019).

The biomass industry is another example. The EU Renewable Energy Directive from 2009 stimulated this industry by using policy and market mechanisms. As a means of transitioning energy systems from a fossilized carbon source to a renewable energy source, biomass energy makes sense only in so far as carbon (seen here as an environmental harm) can be counted, commodified, and regulated through policy and economic incentives. The discourses of biomass energy reinforce institutionalized ways of thinking, from the political to the economic.

In applying EM theory to my analysis, I intend to place the biomass industry within the EM framework. In doing so, it may provide insight on how my interview participants’ discourses surrounding the biomass industry fit within the precepts of this development model. However, I will also employ elements of post-development theory and transformation frameworks to expand both context and possible participant discourses.

3.2 Post Development Theory

At its most basic formulation, post development (PD) theory critiques the concept of development, that it cannot be reformed, and thus should be entirely rejected (Sengupta, 2019). PD originated in the 1980’s out of the post-structuralism school of thinking, of which Foucault was instrumental, and was further inspired by social resistance movements (Asher & Wainwright, 2019).

PD theorists distinguish the concept of development as beginning in 1949, when President Truman designated half of the world as ‘under-developed’ (Esteva, 2010; Sachs, 2019), while recognizing its roots trace back to European Enlightenment notions of evolutionism, capitalism and modernity (Escobar, 2007). Evolutionary thinking identified growth within plants and

animals as a fundamental process; the idea then was applied metaphorically to humans and societal institutions as a necessary, inevitable flow from 'what is' to 'what could be', from worse to better (Esteve, 2010). Capitalism took the premise of 'homo economicus', that humans are naturally inclined to further their own material interests (Agostino, 2007; Ziai, 2016). And modernity here is referred to the Eurocentric model which, among other beliefs, holds that science is the only reliable truth (Kothari et al., 2019).

The prevailing discourses influencing development (such as ecological modernization) are summarized as: the developed states of the global north are the ideal models for the rest of the world to follow; that progress is measured in economic growth and the direction is linear; that knowledge of progress is held among benevolent experts within political, scientific, technological, economic institutions; and that the process is apolitical (Ziai, 2016). While the traditional PD critique focused on how the global north discursively ordered and arranged the objects (global south) that it addressed, this critique equally applies to institutions within the global north as well. In this sense, global 'north and south' are metaphors, not geographical markers, whereby the south can refer to exploited minorities or women in developed countries (Kothari et al., 2019). It is also the case that while the global north may be seen as 'developed', it is simultaneously 'developing' and fully participates in development agendas, such as the UN Sustainable Development Goals.

According to some PD theorists, it is the discursive practice which sets the rules of the game: who can speak, from what points of view, with what authority, and to what criteria of expertise (Escobar, 1995). The relations between institutions, economic processes, knowledge, and technological factors define the conditions of the discourse. In other words, power is maintained and exercised through the reproduction of these discourses. Ecological modernization can be seen to embody two of the very discursive practices PD theorists critique: that only developed states can achieve environmental sustainability; and that there is a singular approach to sustainability and it is largely through top-down technocratic, economic methods. The power within EM theory lies within these discourses. Hence, to PD theorists, the concept of development and its practices (i.e., ecological modernization) are very political.

While PD theorists do not focus on prescriptive solutions; they do point to processes which may open alternative pathways to navigating our socially complex world. In no small feat, this includes the restructuring of current discourses, the so-called political economies of truth (Escobar, 1995). There is nothing less at stake than climate change and biodiversity loss (Gómez-Baggethun, 2019). They pose the following questions as starting points: what are the alternative ideals which could represent a desirable social change or a 'good society' (Ziai, 2007)? What new forms of social organization can arise out of new discourses? Can hospitality, conviviality, emancipation, or solidarity play a role? How else may sustainability be envisioned?

One movement that embodies PD's critique of capitalism and discursive power is the environmental justice movement (discussed further in the background chapter). In combining environmental sustainability with social justice, the concept 'just sustainability' reimagines what quality of life means; it places emphasis on equity; argues for living within ecological limits; and values present and future generations (Schlosberg & Collins, 2014). The conceptual thrust of the EJ movement challenges the constructions of injustice and treats the climate crisis as a symptom of these systemic injustices.

Additionally, environmental justice utilizes a pluralistic framework with 4 key elements to account for just relations. They are *distributive* justice – which refers to the distribution of burdens and benefits related to environmental interventions; justice as *recognition* – concerns who is given (denied) respect and whose interests, values and views are recognized and taken into account; *procedural* justice – is about who is involved and has influence in terms of decision-making; and *capabilities* theory focuses on the extent to which people are able to live the lives they consider to be valuable (Svarstad & Benjaminsen, 2020). These elements are meant to counter the inequity, misrecognition and exclusion which confront many disadvantaged people on the front lines of climate transitions. In essence, this is a form of resistance to the relations that contribute to the reproduction of unsustainable practices (Schlosberg, 2013).

In relation to my research question addressing the biomass energy industry and its impacts, post development theory offers insight into uncovering and critiquing the discursive practices which enable this industry. If there are harmful consequences of biomass energy, as it is promoted through a green transition discourse, then PD theory may offer a way to conceptualize why as well as to anchor suggestions in equitable terms.

As a final conceptual tool, I will briefly discuss some of the relevant topics within transformation studies. If ecological modernization theory locates where the biomass energy sits within a green transition model, and post development theory provides a conceptual critique with possible alternative pathways, then transformations framework may link the two theories and frame additional considerations.

3.3 Transformations framework

At the broadest level, many people agree that the world is on course for massive disruptions due to climate change. How to navigate these risks is the discussion of green transformations. The discourse of transformation does not rest on a well-developed theory, nor does it contain a widely accepted set of practices or strategies (Blythe et al., 2018; Schmitz, 2015). However, it is still useful to briefly explore some current framings for transformations, considering the biomass industry grew out of such framings.

While the terms green transition and green transformation are often used interchangeably, I will distinguish between transitions and transformations, as they pertain to the literature and my use in this thesis. Transitions are viewed as managed under orderly control through existing structures which tend to emphasize technology in reaching a known (presumptively shared) end (Scoones et al., 2015). More simply, a passage from one state to another with fixed points. Transformations involve a reordering of systems (institutions, relations of power, attitudes, and lifestyles) via diverse political alignments, social innovations, and struggles in pursuit of contending (possibly unknown) ends (Blythe et al., 2018; O'Brien & Sygna, 2018; Pelling et al., 2015; Stirling, 2015). Akin to a change in form or shape, much like a metamorphosis. Here, the

use of 'green' adds environmental dimensions of change, including social and environmental justice.

Although no perspective owns the notion of transformation, there is a normative premise across discourses that fundamental change (institutional, behavioral, technological) is essential to support desirable futures (Blythe et al., 2018; Pelling et al., 2015). What ultimately sets the two approaches apart is the focus on politics and discursive expressions of power. Regardless of the approach being discussed, it is worth asking whose 'green' counts; what is to be transformed; how is it to be transformed; under what time frame; etc. There is a great deal of discursive power involved in establishing the boundaries of the transformational terrain (Newell, 2015).

Scoones et al (2015) have outlined four broad pathways of green transformations. While there are similar typologies from other academics, this one seems most applicable to my research because of its attention to politics. Each pathway reveals a different framing of problem/solution and version of sustainability (Scoones et al., 2015). Each pathway reflects an approach or multiple approaches to green transformation, and thus a particular set of politics.

Technocentric focus – primarily focuses on top-down, technological solutions. *Marketized* focus – claims valuing natural resources, via a green economy, are necessary. *State-led* focus – recognizes states' roles in shaping markets, incentivizing technological innovations, and modifying institutions. *Citizen-led* focus – Change should come from below, not from powerful elites, through alternative, solidarity-based economies and redefining 'the good life'. Here, citizen-led pathways are viewed as the most progressive, and place civil society, social movements, and marginalized groups at the center. While the first 3 may be transitions to a green transformation, citizen-led pathways could themselves be transformative.

It should be noted these are not mutually exclusive categories, and pathways must be contextualized to scale. The important point is each approach suggests different frames,

different politics, different alliances between actors, and different routes for achieving green transformations (Scoones et al., 2015).

Since the biomass energy industry is an important tool within the European green transition, this framework can demarcate within which general pathway it resides. In doing so, we gain a conceptual perspective of the leading biomass discourse and its transition pathway implications.

The theoretical lenses described in this chapter were informed by the data analysis. The predominant lens of ecological modernization theory situates the biomass industry within development practices. Post development theory critiques the discursive underpinning of EM, therefore the biomass industry, and points toward alternative discourses. The conceptual transformation framework locates where the biomass industry fits within a pathway toward green transformation and illuminates possible alignments and incongruities with discursive framings.

These approaches do not attempt to provide a complete picture of how to view biomass energy or the green transition, however, in combination they offer a powerful perspective for engaging in such pressing matters.

4. Background

The background sets the stage for the research question asking about the nature of biomass energy impacts and how the European green transition enables such impacts. It attempts to create scale – from the local to the international – and perspective for the framing of this research topic. The case study is on Enviva, the largest producer of wood pellets for biomass energy. This locates impacts at the community level in North Carolina, US. Biomass energy is promoted as sustainable energy and thus is part of sustainable development. Sustainable development sits within the broader European green transition. The green transition is the concept for how Europe can mitigate climate change impacts. The green transition scales the impacts of biomass energy to an international level due to policies. Nested within the local and international levels are the leading discourses of sustainability. Leading discourses, when widely accepted, exert immense power in shaping how societies perceive problems, solutions, and everyday life. Hence, impacts of sustainability discourse manifest from the discursive to the physical levels.

This chapter highlights the arc of development and its discursive framings: 1) the origins of modern development processes, 2) to the origin of sustainable development, 3) then to an example of sustainable development (biomass energy) and 4) how it ties in to the green transition, which 5) introduces politics as a core tension within the guiding premise: that development can simply be made sustainable and that equity and justice can be achieved along the way.

4.1 Development and climate change

The Intergovernmental Panel on Climate Change (IPCC) has made clear that the world is on track for irreversible climate change if humanity does not limit global temperature rise to 1.5 degrees C (IPCC, 2022). Limiting temperatures requires reducing global greenhouse gases (GHG) to 50% of 2019 levels by 2030 and reaching net-zero carbon dioxide (CO₂) by mid-century if the worst impacts are to be avoided (ibid.).

The challenges in reducing CO₂ quickly are manifold. The most apparent challenge is the complete reliance of our energy systems, and thereby modern existence, on hydrocarbons (Knox-Hayes, 2016). There is a direct connection between the Industrial Revolution of Europe starting in the mid-1700's to the abundance of carbon emissions in the atmosphere presently (Heidrich, 2021; IPCC, 2022). It is with fossil fuels, and the Industrial Revolution, after all, to which we owe the predominant systems of modernity (Ziai, 2016).

The implementation of the first steam engines in Great Britain, by way of coal, ushered along other mechanized, technical processes which effectively changed the nature of commerce (Heidrich, 2021). The advantages of mechanized power also sped up production, encouraged expanded networks via railways and steamers, and required a constant supply of material inputs to meet growing operations (Newell, 2015). Increasing production necessarily meant an increase in consumption.

The great shift from biological energy sources to fossilized energy, employed within a developing system of capitalist modes of production, also represented a social shift toward capitalist social relations (Newell, 2015). The abundance and cheapness of coal allowed business owners to keep wages low (*ibid*). However, cheap energy and mass production made products more widely affordable. The effects of Fordism provided individuals with a growing supply of material wants and needs, including, for example the automobile (Newell, 2015). Hence, capitalism combined with mass production and consumption urged modernity into material prosperity.

The alignment by national governments to embed capitalism within social, cultural, and political institutions is referred to as the 'great transformation' (Mazzucato, 2015; Polanyi, 2001). The balance of social forces led to a profound impact on the organization of societies and their worldviews. This point also highlights the discursive connection between the Industrial

Revolution and development processes today. Progress was an assumed state, science confirmed it, material growth proved it, and comparison to the rest of the world justified it.

The material benefits of the Industrial Revolution were largely localized to the Global North (Western Europe and North America). Many of the resources needed to sustain these processes were imported from the Global South (Allina, 2021). European expansion abroad for increased materials and markets, also known as colonialism, provided another foothold for modernization (ibid.). The pursuits abroad exported European ideas and values, reaching ever further into the global network (Shanin, 1997).

The leading worldviews arising from the Industrial Revolution period are consequential to today's climate crisis. The worldviews guide the discourses which, when rooted in cultural acceptance, crowd out other ways of thinking and behaving (Leichenko et al., 2019). Some current worldviews witnessed in today's climate discourses are: the claim that humans are individualists pursuing our own material interests; that we view 'ourselves' separate from nature, which can be ordered and subdued; that we are rational beings; and that we can accurately divide subject from object, which puts science in a field of high truth (Ziai, 2016). On a theoretical level, these ideas suggest societies can evolve, or develop, towards something better towards which everyone should strive. However, that example of progress is generally focused on the Global North and measured in economic performance. The pursuit of such economic progress may create necessary yet 'acceptable' harmful consequences (Ziai, 2016).

4.2 Sustainable development

The negative consequences of economic progress and growth became a rallying cry for sustainability. The modern environmental movement of the 1960s and 1970s configured the themes of population growth, capitalism and resource limits into a publicly convincing conversation (Woodgate, 2010). Influential publications such as Carson's *Silent Spring*, Ehrlich's *Population Bomb*, and the Club of Rome's 1972 report, *The Limits to Growth*, set the stage for moving environmental concerns to the policy discourse (Sachs, 2010).

The UN Conference on Human Environment (Stockholm) in 1972 foreshadowed the climate change discussions to come (Woodgate, 2010). The Club of Rome's report increased its impact by using scientific evidence to claim business as usual was unsustainable (Millstone, 2015). By 1987 governments had a solution. The World Commission on Environment and Development, also known as the Brundtland Commission, determined to merge growth and environment by simply managing natural resources more efficiently. This would be known as sustainable development (Sachs, 2010).

Brundtland's definition was "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland, 1987). The Commission sidestepped a deep analysis of fundamental problems with growth, instead saying resource limits were not fixed, rather they are malleable to technology and social organization (Rist, 2008). In affirming its growth mandate, the Commission (1987, p.14) stated, "we have in the past been concerned about the impacts of economic growth upon the environment. We are now forced to concern ourselves with the impacts of ecological stress upon our economic prospects."

Though growth and environment were clearly the themes of the report, it affirmed the importance of equity for all citizens. The 'new era of economic growth' should reach everyone and also provide 'effective citizen participation in decision making,' including at the international level (Brundtland, 1987). While the report did not offer specific solutions, it made some acknowledgements and suggestions which proved impactful.

One recommendation by the Brundtland Commission was to initiate follow-up conferences to further discuss sustainable development issues. The 1992 'Earth Summit' in Rio de Janeiro, officially the United Nations Conference on Environment and Development (UNCED), resulted in passing several notable documents: *Agenda 21* – a sustainable development primer for governments to consult; the *Convention on Biodiversity* – its aim to preserve biological diversity

and encourage its sustainable use; and the *Convention on Climate Change* – which dealt with greenhouse gases, including reducing CO₂ to 1990 levels (Rist, 2008). The decisions of the Brundtland Commission have continued to have consequences for the pathways of development.

4.3 Biomass energy development

In 1990, the newly created IPCC needed to measure CO₂ systematically and cautiously. To avoid counting GHG emissions twice, the scientists put emissions in one of two categories, either energy use or land-use change (Wisner et al., 2019). That meant burning trees for energy only counted as land-use emissions, not energy use (ibid.). For example, if a hectare of forest is cleared and the wood used for biomass energy (or bioenergy³), the carbon lost from the forest is counted as land-use emissions while the same carbon released out of smokestacks from burning the wood (energy use) is completely ignored (EEA Scientific Committee, 2011). This accounting detail has had important ramifications, including setting the stage for claiming biomass energy is carbon neutral.

The ensuing conventions reinforced and broadened what could be called the carbon loophole. The 1992 UN Framework Convention on Climate Change (UNFCCC) reinforced the IPCC emissions criteria and required countries to report their emissions accordingly (EEA Scientific Committee, 2011). However, the 1997 Kyoto Protocol made changes which continue to influence current carbon accounting policy. The Protocol set emissions caps in the energy sector but not for land-use, while at the same allowing certain ‘forest management’ practices to zero-out land-use emissions for bioenergy (Searchinger et al., 2009; UNFCCC, 1998). The net result created the appearance of a carbon neutral process whereby all bioenergy was treated equally, regardless of the source of biomass (EEA Scientific Committee, 2011). To illustrate this further, a one-hectare forest could have all the trees cut, then burned for energy, replanted with trees, and legally there would be no carbon emissions from either land-use or energy use.

³ Bioenergy includes bioliquids, biofuels, and biogas, all of which are produced from biomass. In this thesis I use bioenergy to refer to primary woody biomass, unless otherwise stated.

The historical precedence of Kyoto's legislation was reiterated in the 2009 EU Renewable Energy Directive (RED). The EU RED, providing financial incentives, required EU Member States to adopt national action plans to achieve 20% renewable energy use by 2020 (European Union, 2009). It was arguably this financial boost for Member States which initiated the transition to biomass energy at scale. Since 2009, EU RED has undergone several revisions, the most recent of which is subsumed under the European Green Deal (European Commission, 2019). The impact of RED has been significant.

EU RED defines biomass as the biodegradable fraction of products, waste, and residues from agriculture, forestry, and municipal waste (European Union, 2009). Woody⁴ biomass refers to forestry residues, whether directly or from secondary industries such as construction scraps or sawmill residues (*ibid.*). Europe represents roughly 50% of the global wood pellet demand, with most of it going to industrial heat and power facilities (Flach et al., 2020). The uptake has been significant enough that the EU generates 60% of its total renewable energy from bioenergy, of which 75% is biomass (*ibid.*).

Many European consumers of biomass energy source from within Europe. However, the UK, Belgium and the Netherlands primarily import from North America (Stashwick, 2019). Since leaving the EU, the UK continued with its renewables targets, maintaining its status as leading global consumer of biomass (Camia et al., 2021; UK Parliament, 2021). Within the UK, biomass energy accounts for the second largest source of renewable energy, nearly 13% of total electricity supply in 2021 (Booth & Wentworth, 2023). Europe overall remains a net importer of wood pellets, the most of which come from one company, Enviva.

Enviva, the world's largest supplier of wood pellets, is headquartered in the U.S., sources all its material from the US Southeast, and ships most of it to Europe (Enviva, 2023a). Since its

⁴ Primary woody biomass refers to roundwood, treetops, branches, stumps, etc. removed directly for energy production (Camia et al., 2021). In this thesis I use the general term 'biomass energy' to refer to specifically to primary woody biomass, unless otherwise stated.

founding in 2004, its business has boomed in response to the climate-focused policies of Europe. The growth in business, however, has also been met with strong opposition. There is intense ongoing debate among activists, academics, policy makers, and business leaders about Enviva's business model, and whether biomass production is truly sustainable.

4.4 Biomass energy debate

The terms of the biomass debate center on definitions of renewable, carbon neutral, and sustainable. Most of the assertions made invoke science. Renewable biomass suggests that the process of harvesting trees for energy can be naturally replenished. Carbon neutral biomass production suggests the carbon released from harvesting and burning trees will be reabsorbed by new trees (Wisner et al., 2019). Sustainable biomass implies the process is renewable, carbon neutral and creates minimal harm environmentally – and in some views socially (ibid.).

There have been many scientific articles from both sides discussing these issues. One of the earliest articles to start the debate was in 2009, the same year the 2009 RED was enacted. Scientists published a highly regarded article addressing the 'carbon loophole' of biomass and a suggestion for closing it – to simply count carbon emitted from smokestacks and tailpipes (Searchinger et al., 2009). Since then, two sides of the debate have evolved, the pro- and anti-biomass camps.

Supporters of biomass energy claim burning pellets is better than coal and promotes healthier forests (Enviva, n.d.). Studies show forests can be 'sustainably' managed for the protection of nature and benefit of humans (Miner et al., 2014). Other studies highlight the loss of carbon from older, unproductive trees; the increasing carbon uptake from newer, better bred species; the importance of income to local economies; its scalability; and the dispatchable energy security being complementary to wind and solar (Aguilar et al., 2020; Aguilar et al., 2022; Chudy et al., 2021; IEA Bioenergy, 2018; Wear & Bartuska, 2020).

Critics of biomass energy claim it is not carbon neutral and it harms biodiversity (Dogwood Alliance, 2020). In contrast to the supporters, studies show older forests absorb more carbon as they age, not less, while also acting as carbon sinks (Stephenson et al., 2014). Furthermore, while some studies may show biomass production to be sustainable, others claim scale matters. Many studies rely on econometric models to predict how land-use changes outside of the immediate harvesting ranges, presumably due to positive harvesting influences (Ter-Mikaelian et al., 2014). Some say these models conflate entire regions with what actually happens within the sourcing areas (Booth & Mitchell, 2020). Critics also note that biomass is actually worse than coal in terms of CO₂ emissions per unit of energy; that biodiversity is harmed by the scale of harvests and monoculture plantations; carbon sequestration takes too long to meet climate targets; and that it is reliant on subsidies which impedes better sources of renewable energy (Booth, 2018; Buchholz et al., 2021; Searchinger et al., 2018; Sterman et al., 2018).

As a case of possible foreshadowing, the wood pellet energy debate has paralleled the palm oil energy debate. The 2009 EU RED also promoted renewables in the transport sector, which drastically increased Europe's use of palm oil as biodiesel (Sihvonen, 2019). In 2018, 53% of imported palm oil was used in diesel and 12% used to generate electricity and heating (ibid.). The majority of palm imports come from Indonesia and Malaysia, two countries where the ballooning industry has drastically increased deforestation, biodiversity loss, displaced many villagers, and arguably increased CO₂ emissions (Russell, 2020). In a policy turnaround, the EU has recognized the controversial consequences of palm oil energy and opted to phase out, albeit with exceptions, its required use by 2030 (Sihvonen, 2019). The wood pellet energy debate, however, continues.

Where the two sides of biomass energy not only converge, but also appeal, is the authority of the IPCC. Biomass supporters note the most recent IPCC report suggests all pathways to net-zero carbon by 2050 involve using bioenergy, specifically in the form of carbon dioxide removal (CDR) (IPCC, 2022). The emissions from burning biomass at the smokestack can theoretically be captured and stored, a form of CDR, known as bioenergy with carbon capture and storage

(BECCS). However, critics of biomass also point to the IPCC as proof that carbon neutrality and biodiversity protection are urgent matters, which biomass energy worsens (The scientific community, 2021). They highlight the IPCC's view of pursuing pathways which address equity, justice, and sustainable development (IPCC, 2022). The IPCC raises key tensions, the need to transition urgently along sustainable development pathways, and that of equity and justice for all citizens during the transition.

4.5 Green transitional development + environmental justice

The green transition is an umbrella term. It refers to a societal transition to sustainable practices. Some of the concepts include green energy, green mobility, and green consumption (Leichenko et al., 2019). Though the strategies for sustainability can emphasize technology, policy, markets, and/or citizens as preferred pathways of change (Scoones et al., 2015), many governments favor techno-managerial strategies which can implement and evaluate targets and goals, such as the Paris Agreement (Leichenko et al., 2019). In this sense, the language of green transitions speaks to policy makers, innovators, and the business community, because of its discursive reliance on markets, policies, and science (ibid.).

The European Green Deal (EGD) is the most recent and comprehensive plan put forth under Europe's green transition (European Commission, 2019). The EGD is the EU's "new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use" (2019, p.1). It also promises to be just and inclusive and protect citizens from environmental harms while keeping well-being at the center of economic policy (Fetting, 2020). The sustainability strategies favored in the EGD seem to rely on policies, technology, and markets to meet climate goals, while acknowledging inclusivity as a concern rather than a transition strategy.

The tensions within the IPCC are mirrored in the green transition taking place in Europe. Put another way, the tension between sustainable development and equity and justice is political.

4.5.1 Politics of justice

The inclusion proclaimed by the EGD is a recognition that all people deserve equity and justice. However, this version of inclusion also immediately defines the context of what it means to be included, who decides, who should deliver it, and how it should be assessed. These questions concern strategies of accountability and participation. The historical processes of development, by way of economic growth, have had countless negative consequences for people and the environment. Social movements have been a response to those injustices.

Environmental Justice (EJ), as a social movement, is born from ‘ecological distribution conflicts’ (Martinez-Alier, 2019). The EJ movement took off in 1982 in Warren County⁵, North Carolina after protests against industrial dumping of toxic waste in poor black communities (Bullard, 1993). The affected communities were chosen based on perceived powerlessness of the locals, not because of environmentally sound conditions (ibid.). The movement sought to forge ties with other groups of disadvantaged peoples, using EJ as a lens to make sense of their struggles over negative community impacts. The struggles were over conditions of livelihood, access to natural resources, and the distribution of pollution (Martinez-Alier, 2019).

EJ has become a global movement made of groups intersecting between environmental protection and civil, social, and cultural rights (Wapner, 2021). Its diverse collaboration has added another ethical dimension to environmentalism, foregrounding the indignities that accompany environmental degradation (ibid.). One such indignity is the ‘politics of unsustainability,’ where political power engages in performative action by dislocating the harm elsewhere (Brand & Lang, 2019; Wapner, 2021). The EJ movement has attempted to disrupt the politics of unsustainability.

⁵ Warren County neighbors Northampton County, which is where one of Enviva’s facilities is located and featured in this research.

Placed in context with a green transition, EJ characteristics invoke a just transition. Just transitions address equity issues arising from 'going green', such as increased inequality or spatial displacement of polluting industries to other poorer locations (Leichenko et al., 2019). Just transitions reject transferring harm downstream to disadvantaged communities or future generations. Combining EJ's critical analysis of environmental harm with social justice organizations, just transitions center equity and justice, not growth.

Environmental justice points out the politics in sustainable development processes. This is necessary if the inherent tension within the green transition is to be resolved with minimal harm to humans and the environment. This may be a valuable framework for which to navigate the 'wicked problem' of climate change, whereby contested theories of its origin – and therefore solutions – do not hinder the dignified treatment of people or the environment (Rayner, 2012).

Biomass energy is a result of several historical processes. Industrialization based on fossil fuels set the climate crisis in motion while entrenching global economics based on growth. The environmental movement in the North of the 1960s and 1970s challenged the economic model. Sustainable development was presented as a middle path to preserve both growth and the environment. Biomass energy has been elevated as a middle path because of its environmental profile. Vigorous debate ensues whether biomass is carbon neutral and sustainable. This debate is held within the green transition which pursues sustainable development while acknowledging a need for justice and equity for everyone. The leading discourses of growth and top-down governance ignore the political implications of the green transition. Activist movements, such as environmental justice, challenge the leading discourse of growth and commodifying nature. They put politics directly in the middle and suggest a just transition is necessary, where human values are centered.

The terms of the biomass debate are deeply intertwined with its purpose – to achieve a sustainable future and mitigate climate change. The contested nature of biomass energy

illustrates the various reference points each person has for understanding the debate. Everyone, from policy makers to scientists, operates with values, worldviews and ethical perceptions of natural resources and their management (Camia et al., 2021). By addressing the politics in the debate, pathways to sustainable practices become more transparent.

5. Findings

This chapter presents the findings of the thematic analysis along with the discursive elements. There are five themes: *Environmental dimensions of biomass* (4 sub-themes), *Economic dimensions of biomass* (1 sub-theme), *Social dimensions of biomass* (4 sub-themes), *Policy dimensions of biomass* (2 sub-themes), and *Attitudes towards biomass (Enviva)*. The order of themes begins with the physical and moves towards the conceptual. The broad themes are revealed as distinguishing focal points within the discussions of biomass. There is necessary overlap between the themes.

The theme *attitudes* also works as a cross-cutting theme throughout the findings. Most interviewees take a stance towards biomass energy or Enviva. How they qualify that stance is revealed as a discursive tendency aligning within Scoones et al's (2015) sustainability pathways. The discourses framing their positions are sometimes semantic, and other times latent. The emphasis on problems and solutions hint towards which general discourse is favored. The leading discourse centers on sustainability as a goal with various pathways⁶ of how to approach it, such as market-led, policy-led, technocentric-led, or citizen-informed.

The interviewees, while kept anonymous, are referred to according to their group names. The group names are determined based on their respective connection to the biomass energy industry. For example, the interviewees in group *forestry* are referred to as: Forestry 1, Forestry 2; and so on for each group; Academic 1, City 1, etc. The two non-governmental organizations (NGOs) will be referred to by name, but not the actual interviewee within the NGO. The NGOs are Fern and Southern Environmental Law Center (SELC). Lastly, Enviva will be referred to as simply Enviva.

⁶ Following Scoones et al (2015), I refer to pathways and discourses interchangeably, as they are the guiding frame of thinking within the leading discourse of 'sustainability as a universal goal'. This broad use of discourse allows me to apply it generally, yet usefully, to my participants as it relates to the research questions.

To quickly set the stage, here is the basic process of biomass production. Trees (or leftover parts of trees) are harvested from forests within a prescribed radius (120 km) of a pellet facility. These trees are then trucked to the facility where they undergo processing into pellet form. Once prepared, they are trucked to a port where they are shipped to Europe, predominantly the UK. Upon arrival, they are transported to a power plant where they are burned for heat and energy production.

The following themes will present the interviewees' experiences and attitudes related to the biomass industry. These should not be taken as participants' comprehensive or definitive views.

5.1 Theme: Environmental dimensions of biomass

This theme addresses the research question exploring impacts of the biomass energy industry at the local, environmental level. Each participant's perspective ties into the environmental dimensions of biomass. The leading discourse of *sustainability as universal goal* runs throughout the theme. The sub-themes pick up on alternative framings of the sustainability discourse. The framings identified are those which emphasize markets, science, and technology.

At the heart of these discussions around biomass, the respondents' focus is usually on the environmental aspects, specifically whether forest conditions are sustainable. Given the entire premise of using wood for energy is based on its sustainability, it is the qualifications of this term which animates the discussions throughout all the sub-themes. Respondents appeal to sustainability by referencing types of forests harvested, scale of harvests, data on forest conditions, productivity, or biodiversity.

This theme is separated into 4 sub-themes which identify specific characteristics of importance to the respondents. The sub-themes converge on impacts of biomass at the local level. They serve to accentuate the environmental dimensions within conversations, rather than act as strict boundaries. Therefore, there is frequent overlap between them.

5.1.1 Forests

An important starting point for understanding forest impacts is looking at trends. The US Southeast (SE) is where Enviva's entire biomass source material originates. A common point iterated among forestry officials, academics, and Enviva is that forest volume has increased in the US SE for decades. As Forestry 2 states:

We are growing much, much more timber than we are removing from harvest, natural mortality or land use, in terms of volume. In terms of acres, it's been stable for 20 years, maybe adjusts 100,000 acres up and down, but [it's] been at the mid 18 million for last 20 years. That's encouraging. That's been one measure of overall forest sustainability. Our forest base has been stable, and our tonnage has been increasing.

Enviva echoes a similar assessment, noting its own impacts on forest volume:

Enviva has been a positive impact on healthy growing forests and forest inventory across North Carolina. As it pertains to Enviva's primary sourcing counties [,] forest inventory has increased by over 20% between 2011 and 2021.

The forest service data show a decrease of 44,000 hectares in forest land across North Carolina from 2016-2021, yet an increase of 3.77 billion cubic feet (volume) of live trees (USDA Forest Service, 2022). This statistic speaks to fact that foresters replant faster growing pine trees whenever possible, illustrating how area can remain stagnant while volume increases. The historical context is also an important marker for forest growth in the US SE. Academic 2 acknowledged, "the inventory is growing. It almost had to grow after the turn of the century, because we clear cut the whole country. From that baseline, having trees at all is an improvement. [However], we've got this growing inventory and these growing removals."

While the trend in overall forest volume is less contentious, the types of forest harvested draws varied perspectives. These conditions relate to biodiversity and sustainability impacts, including

how carbon emissions from harvesting these forests are modelled. The pellet mills in the communities of Ahoskie and Garysburg (and those in Virginia) are somewhat unique in that they source from both hardwood and softwood forests, whereas the rest of Enviva's mills source primarily softwood (Williams, 2021).

According to participants, harvesting hardwood forests has additional environmental impacts. In general, hardwoods take longer to grow, which means the age of the hardwood forest being harvested is typically older. For example, Academic 2 explains, "if you look at hardwoods... across the South, the average age they're harvested is like 50 plus [years]. No one's doing intensive... biomass with young hardwoods. That didn't work out. So, if you just look at the hardwood forests, I'd say over half of the volume will be over 50 years old." Forestry 2 puts the average hardwood harvest age at "60-80 years" old, compared to pine plantations with a "final harvest" after 20-30 years. This implies a further developed ecosystem among the older hardwood forests.

In NC, valued hardwoods are found in either upland or lowland areas. Lowlands are commonly referred to as swamplands, bottomlands or wetlands. Many of these bottomland forests have special considerations because of their biodiversity significance. As Forestry 1 explains, "people are against swamp logging," if not done mindfully, because of their ecosystem importance. That said, Forestry 1 acknowledged, "Enviva looks for sustainable swamp tracts to log... in compliance with forest practice guidelines." Sustainable in this sense means, "cut[ing] junk hardwood from swamps because it doesn't have grade value" (Forestry 1). Grade value means merchantable saw-timber quality. It might be considered junk if it, "is anything that's not worthy of being sawn... [such as] a crooked tree... a tree with rot in the middle... or of a species that that no one uses" (Academic 2).

However, some respondents note the value of hardwoods is not their financial potential. Rather, sustainability should value the stored forest carbon. The carbon implications of harvesting hardwoods are arguably greater than with pine trees due to the hardwoods' carbon

equilibrium being higher, thus capturing more CO₂ and for longer (Sterman et al., 2018). SELC highlights:

We commissioned experts to do a carbon life cycle analysis... using these clearcut bottomland hardwood forests and that came back and showed basically a very large carbon debt. When you're using clearcuts of hardwood forests, [it creates] anywhere from 60-80 to 100 years of carbon debt, [which is] the period of time after harvest before you get to the point of... carbon parity, where the regrowing forests reabsorb some of that carbon where you get back to point zero. So, basically, you have excess carbon emissions in the atmosphere for near to a century if not longer.”

This sub-theme highlighted one of the environmental dimensions of impacts. It is one reference point for understanding how biomass energy is viewed locally. Sustainability was framed within a financial focus among Forestry and Academic participants. This hints at ecological modernization, using existing institutions to achieve sustainability.

5.1.2 Harvest methods

The biomass harvesting methods drew a range of responses from participants. Some focused on frequency and scale of clearcuts, some on types of forests, and others on replanting after harvests. It is the regrowing of trees after harvesting which makes biomass renewable, and theoretically carbon neutral.

It is common within the forestry industry to preference clearcutting over selective logging. The Forest Service recommends it because otherwise high value trees are selected while weak or dead trees are left behind, thus weakening the new forest. According to the forest service, selective harvesting leaves behind trees which can impede the speed and quality of growth for the new forest due to ‘volunteer’ seeds competing with planted varieties for space, water and sunlight (NC Forest Service, n.d.). Enviva states, “‘Clear cutting’ and ‘thinning’ are common and preferred methods by which tracts in the working forest landscape of the U.S. Southeast are

harvested.” It is understood here that ‘weak’ forests and ‘working’ forests refer to quality of trees in terms of merchantability.

Elaborating further, Forestry 2 outlines the considerations for forest stewardship. “Forest management, ecosystem management, restoration, whatever your objectives are, [whether] for timber, wildlife, species, etc., if you’re doing management, usually those prescriptions involve some kind of manipulation of the forest.” In this case, the Forest Service promotes clearcutting as a productivity prescription, where forest health is equated with financial outcomes. As Forestry 2 goes on to explain, describing Enviva’s use of unmerchantable material, “that’s another benefit of having markets like that, it ties into sustainability.” The logic is that by Enviva harvesting poor quality wood, it creates more opportunity for newer, healthier trees to grow. Sustainability in this sense means merchantability and forest volume both increase.

When participants comment on Enviva clearcutting or not replanting forests, they imply it was Enviva’s operations which created these conditions. According to one observer, “I could not figure out what industry this was that was clearcutting land and then not replanting... I had never seen a paper company clearcut a hardwood [forest of] hundreds of acres or 80 acres or 50 acres, which is what I was witnessing. I drove up and down for a number of years and they weren’t being replanted” (Resident 1). A similar comment was made by Journalist, “I don't know how many hundreds of acres they're [Enviva] harvesting every week in their 50-mile radius zones. That's not being replenished somewhere else and they're [Enviva] certainly not planting trees.”

It is important to note that Enviva does not actually harvest or replant forests. They purchase the woody biomass from suppliers who bid on selected forest tracts. Furthermore, Enviva maintains its operations are sustainable through requiring suppliers to sign a Master Wood Purchase Agreement. In this agreement, one of the “binding sustainability requirements” states, “that SELLER shall agree to not deliver fiber [woody material] from conversion harvests

to any Enviva facility.” Conversion harvests refers to land-use change, meaning all harvests that Enviva buys from must go back into forest production.

Resident 2 added, “When you see a predominantly clearcut hardwood area, there’s overwhelming odds that the demand to feed Enviva was instrumental in that site being clearcut, whether that’s 30% or 70%, or something, but this logging of hardwood forests didn’t occur in that area before Enviva came to Ahoskie.”

Enviva stated the same percentage range in its purchases, while adding they “buy the fiber that no one else wants.”

We source wood sustainably from regions where forest inventories are growing, never⁷ source from a tract where land use change will occur, and take special care to avoid areas with high conservation value. Enviva sources from working forests within a 75 miles radius of our plants. Enviva augments the productivity of these working forests by purchasing the parts of the harvested wood that are generally not utilized in other higher-value markets (Enviva).

Some observers claim that Enviva’s business case, and hence amount of wood required, has shifted from filling a niche market fed from leftover materials (secondary woody biomass) to one that needs whole trees (primary woody biomass) in ever greater quantities.

What Enviva had been telling the public was that they were going to use waste and residues and specifically, at that time, they were even more explicit that they were using things like twigs and branches and the leftover materials. We very quickly started finding out that these facilities, Enviva in particular, [were] not using twigs and branches, that they were using trees from clearcuts and from clearcuts of bottomland hardwood forests. And some wetland forests specifically in eastern North Carolina (SELC).

⁷ During my field work I visited a clearcut from which Enviva bought wood (according to two sources) but was never replanted and is now being developed into commercial lots. Pictures are in the appendices.

Also skeptical of Enviva’s initial public messaging, Academic 2 explains, “one knew that you could not build an industry, a large industry, off of scraps from picking up [leftovers], you'd have to cover hundreds of miles of land to find enough wood to do that.”

Even one of the critics, Resident 1, notes how some people were happy with the original story of collecting waste wood. “A lot of times when the forest was cut down, a lot of waste was left [prior to Enviva’s operations]. And it was nice to see it being utilized for something productive [used for biomass].” However, that changed once residents “realized... what that really meant,” referring to one example of Enviva “cutting all the way down to the shoreline and cutting these really old Cypress trees. Cypress trees are hollow. So, in Enviva’s mind, that’s waste wood... You can’t use it for anything productive. It doesn’t have any real value” (Resident 1).

Pushing back on criticism of Enviva’s practices, one respondent defended the biomass industry by appealing to Forest Service data. As Forestry 2 clarifies, “I’m pointing this out [the increases in forest volume] because there have been claims to the contrary, because of Enviva’s presence, that our forests are being converted from natural hardwood to pine. The data don’t say that. There are data⁸ and sources that I think are reliable and credible and scientifically based.”

According to one study using a time-series analysis of satellite data up to 2019, Enviva’s sourcing area for the Ahoskie and Northampton facilities saw an overall decline in forests since the facilities opened, including a decrease in hardwood forests – with 41-47% of wood pellets coming from hardwoods (Williams, 2021).

The growth in forest volume is generally attributed to better breeds of pine trees. After harvesting, if forests are planted back, it is usually into a monocrop. In most forest sites, except for bottomland hardwoods, the general strategy is to plant “back into plantations” of pine

⁸ The NC Forest Service has 5,713 sample plots across the state, of which 3,634 are currently forested. Each year 10-20% of those plots are visited and measured by field crews (USDA Forest Service, 2022).

trees, usually loblolly pine⁹ (Academic 1). “As a whole, southern pellets use 80% pine. And really the region you're talking about [northern NC] is the only region that uses dominant hardwoods. Everyone else is feeding off pine plantations... That goes for the whole industry” (Academic 2).

Even though this tree species is endemic to the region, the scale of harvests and conversion of forests into plantations has impacts on biodiversity. As Academic 2 concludes, “pines are genetically homogeneous. Thankfully for our habitat, biodiversity perspective, hardwoods are nothing like that.”

5.1.3 Biodiversity

Biodiversity is another dimension of environmental impacts from biomass production. Respondents generally referred to biodiversity in varying ways, referencing either water quality, wildlife, biodiversity loss, or qualifying the scales of biodiversity.

Academic 1 views water quality as “the biggest concern” in terms of forestry practices related to biomass production. With many forests occupying wetlands, swamps, and other lowlands, the water quality directly impacts the flora and fauna in these ecosystems. In North Carolina, landowners have “no requirement to get a permit to harvest trees,” but they are required to follow state water quality standards (Forestry 2). However, for forestry-related activities, contractors and landowners can opt out of the state’s sedimentation and erosion control plan if they agree to follow the Forest Practice Guidelines (NC Forest Service, 2018). Though this includes dubious self-reporting of any non-compliance circumstances, Forestry 1 stated, “there is a lot of compliance with Forest Practice Guidelines.”

Resident 1 noted some of the water quality standards may be ineffective. “A lot of them [loggers] don’t understand ecology or the effects of cutting right up to the shoreline and the silt runoff and the unintentional consequences of cyanobacteria and some of those things

⁹ Scientific name: *Pinus taeda*.

happening, which is a real problem in a lot of the rivers around here, particularly in the summers because we're in a big drought, too.'

Academic 2 discussed biodiversity within plantations, flatly stating, "wall to wall pine plantations would not be a good biodiversity story." However, Academic 2 reframed the perspective, asking, "at what scale does the biodiversity issue become less of a problem?" Pointing out scales is an important aspect when assessing on-the-ground impacts to biodiversity and sustainability. Acknowledging one's perspective is also important. Academic 2 clearly states, "I think there's a biodiversity trade off in the US South. I'm an economist. So, every question is a trade-off question."

North Carolina sits squarely within the North American Coastal Plain, identified by Conservation International in 2016 as one of 36 global biodiversity hotspots because of its species richness, biodiversity uniqueness, and less than 30% of its native vegetation remains (Carter Jr & Hillaker, 2021). High rates of deforestation and industrial pesticide use in plantation forests threaten habitats for many species of birds, reptiles, and plants (ibid.).

Fern also recognizes the importance of scale and context, stating:

It's methodologically quite complex actually to determine the climate and biodiversity impact of one particular piece of wood being sourced from the forest. It really depends. It's always a local evaluation. What's the forestry model? What's the forestry management? What's the logging method? Is it a clearcut? Is it selective logging? Is the stump being removed or not? Have you cut the tree to burn it entirely, in which case the climate impact is terrible, or are you just burning the sawdust from cutting it? In which case the counterfactual is totally different.

One participant discussed another aspect of biodiversity. Resident 4 illustrated the wildlife changes in and around the communities. While showing me a picture of a man holding a mountain lion, Resident 4 explains:

This is one of the things that they put out to help control the deer population. Because so many trees are being cut, they [animals] kind of fight, fight for space. They got to stay concealed. There's a habitat issue where we tend to see we've always had a lot of deer. People have made the decision to put out coyote to help control the deer population. The coyote has got[ten] out of hand, so they just started to put cougars out to help control the coyote population. We have bears around. We have a lot of different things that are just popping up that we've never had to deal with [before Enviva]. You know, somebody's [wildlife] got to go somewhere.

Residents 1 and 2 addressed biodiversity impacts in personalized ways. Resident 1 shared, “I was impacted because... we’re losing hardwood forests all around us. And so, the environmental aspect and the loss of biodiversity was something that was really in tune with me.” Resident 2, who owns and has planted hardwoods on about 45 acres of woodland, marvels at hardwoods, saying, “the reason they’re so precious is because they’re slow growing and that’s what they do.”

Lastly, SELC acknowledged that NC does not have true old growth forests anymore. Adding, even though there is a lot of forest land in the state, the types of forests are “still problematic on a carbon side, let alone problematic on a wildlife and biodiversity side of things.”

This sub-theme of biodiversity adds another component to the research of environmental impacts of biomass production. While respondents referenced various, or even vague, aspects of biodiversity, many recognized that it is important for overall sustainability. Yet, for some respondents, biodiversity is less important than productive, marketable forests.

5.1.4 Soil (carbon)

It is the carbon story which is the most divisive within biomass discussions. The carbon accounting of biomass is deeply intertwined with economics and policy. The carbon topic, therefore, will be addressed across several themes, as it fits. Yet, there is one aspect of carbon that I will briefly mention here.

Most of the carbon conversations, whether in policy or among scientists, are about carbon within trees and in the atmosphere. Soil carbon, in the US SE forests, is less commonly discussed. However, Academic 2 did express concern for levels of soil carbon being uncounted, noting “deep organic soils... this is where the most sensitive carbon story is.” The pine plantations in the US SE follow a harvest practice which clearcuts entire tracts, pushing around soil during the harvesting and site preparations before replanting. “I think we're going to need some of that technology to figure out how to have a soft imprint on the land and just be grabbing trees and not grabbing soil,” Academic 2 suggested.

When elaborating further on the carbon payback period within pine plantations, Academic 2 admitted, “I don't think [after] one cycle it would come back. But... what we're talking about is if there was a loss in soil carbon... are you also replenishing that? I don't know.” In other words, planting one tree for every tree harvested may not be sufficiently carbon neutral because of additional soil carbon loss. One study from Europe showed a net soil carbon loss in all layers of soil over a 30 year period only when forests were intensively harvested (Achat et al., 2015). But there is another way of counting carbon, as discussed in the next theme.

This theme, *environmental dimensions of biomass*, presented participants' views and experiences of the biomass energy industry as it relates to environmental conditions. The impacts addressed are experienced both locally and physically to these communities. These dimensions include the scale and type of forest harvested, the methods of harvesting, the biodiversity impacts, and the soil carbon disturbance. The participants' responses ranged from complete support of biomass energy to condemnation, in light of the environmental impacts.

This theme addresses the research by exploring some of the impacts of biomass energy. Furthermore, participants' comments revealed a leading discourse of sustainability as a universal goal. The differences within this discourse point to preferences for how to achieve sustainability. Some participants view sustainability through a financial lens, a view which aligns with ecological modernization. Other participants noted an inherent value in nature which supersedes the financial aspects. A view which challenges the primacy of economics. Respondents also invoked elements which align with the discursive pathways to sustainability, suggesting either economics, technology, or science are reliable to achieve sustainability.

5.2 Theme: Economic dimensions of biomass

This theme addresses research exploring impacts at the local, economic level. The economics of biomass are important at both the local level and policy level. At the local level, it is the economics of private land ownership which incentivizes landowners to plant trees, according to some respondents. At the policy level, it is government subsidies which allow the biomass industry to exist, according to others. Both assessments are contested. This theme will look at the analysis of economics from the local level. The policy level economics are addressed in the policy theme. There is one sub-theme, *modeling*, which addresses respondents' views on how economics are justified locally.

As mentioned earlier, a common assertion among some respondents is that forest volume is increasing in the US SE. The reason for this is supposedly due to private property rights. "We have a long history of increasing forest carbon in US South and we did it in a market-oriented privately-owned space" (Academic 2). To give perspective, the forestry industry in the US SE is composed almost entirely of private land, with 82% of forested land in NC privately held (USDA Forest Service, 2022). Whereas the US average is around 56% (Butler, 2014).

"Something like 80-85% of North Carolina forests [are] in private ownership. Somewhere in the 90%, almost 100%, of the wood products comes off of private land" (Forestry 2). The economic

logic is that landowners are incentivized to follow the market when making decisions with their land. If the forestry economy is strong, the amount of forestland increases. “I point to the literature that says the higher return landowners get, the more forestland we have... and that's documented in a lot of empirical studies.” Academic 2 further explains, “in the South, if you raise prices (of wood), you get more timberland. Now, it's likely to be pine plantations, but it's still better than ag (agriculture) land in terms of a carbon perspective.”

In terms of biomass, it is often claimed that Enviva has created a new market, that of waste wood. Forestry 2 explains the “stuff Enviva takes was previously seen as liability,” meaning landowners would have to pay to clean it up or just leave the waste wood on their land. “What happens if you don't have a market for the stuff Enviva's taking? It stays in the forest” (Forestry 2). The precise influence of Enviva on local market conditions is unclear. Instead, proponents highlight the overall market effect of adding another revenue stream to landowners:

Land is privately held here [NC], and landowners need an incentive to keep their forests. It can go to different land uses – agriculture, house development, solar farms, etc. Enviva drives some of the incentive to keep forests as forests... One of the claims that isn't true – landowners don't make decisions to harvest largely based on Enviva's price. They make decisions to harvest based on economic reasons, the higher value wood is driving that decision... But the really smart PhD scientists say the more you harvest, the more forest land acres and volume of wood you have. People don't understand that, but it's a market incentive to keep land in forests. It's a market incentive to manage forests, which makes them more productive. If we cut a forest today and replant in a month, the new forest will be more productive in terms of volume (Forestry 2).

The idea that the US SE is unique for forestry and biomass is reiterated. “I'm not sure this story applies anywhere except in the US South. It certainly would not apply in Pacific Northwest (US). It certainly would not apply in Canada, and that certainly would not apply in Brazil,” because “it's privately owned, largely unregulated [land]. So maybe 20% of those landowners are large,

very large landowners, but a lot of them are small landowners and so they have smaller plots” (Academic 2).

Another respondent suggested a slightly different economic calculus. Noting that job prospects in parts of NC were low, some landowners moved away, yet retained family land. According to Resident 1, “if you grow up in eastern NC, your only goal is to get out of eastern NC. There’s nothing to do here [job prospects]. So, a lot of these kids have... inheritance of land, but they live [outside of NC]. A lot of these are absentee owners. And they don’t know what happens to the wood. They don’t care what happens to the wood.” A similar sentiment from another respondent put it in stark economic terms, “a lot of these small towns have taken a hit and are dying” (Forestry 1), suggesting any economic boost, such as waste wood for biomass energy, is driving support for increased forestry.

5.2.1 Modeling

The conclusion among some respondents is that economic conditions are an overall net positive for forests. Although, due to market demand, “it’s more positive for pine plantations than it is for other trees” (Academic 2). The way economists determine the industry impacts on forests is largely through modelling. This is an important aspect because many decision makers rely on economists’ projections based on these models. Modelers are making projections on how the economic conditions and forest volume interact, which is how they assess overall sustainability of biomass production. As the biomass industry is set to drastically expand, these models become even more important, as well as contested:

When I run our model for the whole south and see where the model finds more wood, it’s moving from the east to Louisiana, Arkansas, [and] Mississippi. And that’s mainly driven by the fact that plantations have leveled off in the east, and they’re still increasing in south. Florida’s lost 2 million acres of plantation. So, Florida’s already sort of... going down. Georgia’s levelled off. North Carolina, Virginia levelled off. So, the thing about my

modeling is the next 25 years is pretty much known to me, because those trees are already planted (Academic 2).

However, the scales and reference points of models can be misleading as well:

The point I'm making here is that the evaluation of the climate impact of wood sourcing is completely local and it's very difficult to generalize even though there are scientific evidence which that show that you can make this generalization. It's very much a modeling discussion. And the problem with models is that they rely on assumptions, and depending on the assumptions you're using, you can totally change the outcome. Their (modelers) reference point is all the regions where they're (Enviva) sourcing, which is a super large reference point of course. Whereas if you use as a reference point the very specific areas being logged, then the picture changes completely of course (Fern).

Academic 2 acknowledges challenges with modelling forests to determine the economic and carbon interactions¹⁰:

Hardwoods are very interesting, but they are harder to model. It's easy to model a homogeneous resource (pine plantation) going through an age class distribution and [where] each age represents a product. But you can actually look at growth and removals and harvest in the Forest Service data. And that's what I used to model stuff with. People are data driven on the decisions in this space because they're making a commitment for 25 years at least. I don't think modelling provides the answers. I run a dozen scenarios just to see what matters not to see which one is the future.”

¹⁰ Academic 2 shared a PowerPoint with me before our meeting, but the details were not mentioned in our conversation. On slide 26, titled “The Carbon Score of Wood for Energy Looks Worse When You Assume”, the first two points are when you assume: “small areas (plots) rather than landscapes” = no market effects; and “short time frames (20 years vs. >100 years).” Both are noted as “affected by modeling assumptions.”

The models certainly remain contested among respondents. For example, some respondents claim forest loss is worse within Enviva's harvest range, not better. While Enviva may be replacing the local market demand from a closed down lumber mill, it apparently has surpassed that demand. "What the SELC study shows is that they've filled that demand and exceeded it. So, they've increased deforestation in their harvest areas by 6% a year" (Journalist). Forestry 2 agrees tepidly on this detail; "everything is local, so yes, in wood procurement areas near the mills, there will be more wood consumption." However, Enviva referenced Forest Service data which suggest "an increase in forest inventory in Enviva's specific primary sourcing counties by over 20% between 2011—2021."¹¹

The discussions of data and models within the biomass energy debate are summed up by Fern, stating, "people are throwing science at each other." Rather than getting bogged down in the science debate, this thesis tries to point out how participants frame and use science and which assumptions are explicit and implicit within the debate.

The findings in this theme, *dimensions of biomass economics*, illustrate how participants view local markets impacting forests. The leading discourse employed by supporters of biomass energy is that markets, due to private ownership, drive sustainability. This is a reiteration of the ecological modernization approach. However, the findings also show mixed perspectives on the reliability of models, in terms of forest volume and economic drivers. This suggests that other factors matter for assessing sustainability, not just financial considerations. Which other factors matter, in terms of exploring community level impacts, will be addressed in the next theme.

5.3 Theme: Social dimensions of biomass

This theme aids the research by exploring the impacts of biomass energy at the local, social level. It presents the physical, emotional, and psychological impacts for the community members in and around the two Enviva facilities represented in this thesis. The views vary

¹¹ The link provided to me by Enviva was invalid and they did not state the parameters used in the rather tedious forest service database.

widely among participants, depending on their relationships to Enviva and the communities. Their views qualify the ways in which communities and health are valued and treated.

There are 4 sub-themes: environmental justice (EJ), air quality, other health concerns, and jobs. Each sub-theme reflects an important social impact, as discussed by participants. While there is overlap between the sub-themes, these distinctions were revealed to be the most engaging for participants.

5.3.1 Environmental Justice

The human health aspects of biomass production are most pronounced nearest Enviva's pellet facilities. The cumulative health impacts fall under environmental justice considerations. EJ seeks the fair treatment and involvement of all people affected by industrial hazards and regulations in their communities. This subtheme will share the findings of EJ concerns and permitting processes as this directly relates to the impacts of biomass energy explored in this thesis.

The EJ movement started in the 1980s very close to the Enviva's current facilities of Ahoskie and Northampton. It grew from communities who experienced environmental marginalization based on socio-economic status, that of being poor and usually a minority. Today, all four of Enviva's pellet facilities are located in EJ communities¹² (Koester & Davis, 2018). The counties of focus for this thesis, Hertford and Northampton, have poverty rates at 22% and 21% respectively, where the state average is 15% (Harris & Umbarger, 2021). The Latinx, Asian, and American Indian demographics are the most extreme from the state average, with 72% of American Indians in Northampton County being in poverty, compared to the 25% state average (ibid.). The non-white population in Hertford County is 67%, in Northampton County is 61%, and in North Carolina the average is 37% (DataUSA, 2020).

¹² The criteria used in that study follow the same used by the state of Massachusetts, which requires poverty rates for all ages to be above state average and for a non-white population greater than 25% to be considered an EJ community. North Carolina does not yet have an official guideline for determining an EJ community.

For an Enviva facility to operate in North Carolina it must satisfy specific permitting procedures. The only environmental permits required by the state are air quality permits. The North Carolina Department of Air Quality (DAQ) is the agency responsible for these permits. This agency is a branch within the NC Department of Environmental Quality (DEQ). DEQ oversees the newly created Environmental Justice Program. The EJ Program is a response to public outcry over environmental regulations.

The main avenue for citizens to contest Enviva's facilities is through DAQ. Anytime Enviva renews a facility permit, or submits a proposal for an expansion, "public notices are triggered" by DAQ to that facility's corresponding community, as explained by DAQ 1. Public notices become public forums if DAQ determines EJ criteria to be met. If met, the forum provides an opportunity for citizens to voice their concerns, in line with the justice of recognition component of EJ. In some circumstances, depending on the feedback, DAQ will review and "modify the permit, if necessary" (DAQ 2). The public comment forum has become a tool for concerned citizens to push back against Enviva.

The public forums are a function of the EJ Program. The program identifies vulnerable groups using an EJ tool to collect census data within a facility's 1-mile radius to assess specific conditions. According to DAQ 2, particularly sensitive sites "can be high schools, day cares, nursing homes, etc." In addition, "the board looks for specific demographic cutoffs that can be an identifier for an EJ condition," such as income, race, etc. (DAQ 2). If any thresholds are crossed, then the EJ board issues a report to "suggest enhanced outreach" to that population, which then creates a public forum (DAQ 2).

However, the outreach is simply to notify vulnerable groups "on the frontend of applications instead of the backend" (DAQ 1). This is important, as DAQ 2 notes, because "public interest in Enviva has been large." DAQ claims they want the public involved in these matters. DAQ 1 notes, "no comment is beneath stating. We want to hear from everyone. Each comment goes

into public record.” However, DAQ cannot promise any changes based on those comments. This suggests that the other components of EJ, especially procedural justice are not seriously considered. Nevertheless, “if 100 people show up and oppose a facility going in, even if a draft permit can’t be modified, DAQ wants to hear [from the public]” (DAQ 1).

The responses heard at the public forums range from health concerns and worries about deforestation, to being supportive of Enviva and its job creation. One observer, who was present at the most recent forum in the fall of 2022, remarked:

A large contingent [of people] have spoken in favor of Enviva. I’ve talked to DAQ and hearing officers. They admit, most of the stuff people comment on is not related to air quality permit. It’s more like ‘we don’t like Enviva because they’re cutting down the forests. Where are all the animals going to live?’ Foresters [were] saying it’s great for my business. Little old ladies with oxygen tanks [were] saying I’m fearful of emissions being produced. You get the whole gamut. It’s really interesting (Forestry 2).

A respondent from DAQ acknowledged the challenge between welcoming all voices and then being limited in addressing those voices:

A lot of comments we get are about communities, the impact of facilities and multiple facilities on a community and the siting of a facility. And that is something beyond my control. In my personal opinion... because they’re [the comments] out of my purview, it may come across as if we don’t care, or their concerns don’t mean anything, but we just can’t do anything [about it] (DAQ 2).

The actual impact of the EJ reports seems to be limited, according to several respondents. DAQ is limited in how it can use the EJ reports. They essentially function as a notification mechanism for vulnerable groups who may be impacted by the facility’s operations. However, there is nothing beyond this notification protocol. As DAQ 2 states:

There are no teeth within these EJ reports¹³. They are merely recommendations for enhanced outreach opportunities. These are at the end of each report. Largely these are informational to the public on where they can find information about the facility in question which is seeking a permit. It's a mechanism that gives a voice to the community to respond to this process.

SELC agrees that “the environmental justice aspect... does not seem to have resulted in any meaningful change to how these facilities operate or to issuance of these permits.”

Furthermore, SELC notes the overlap between EJ communities and pellet facilities. In this case, that includes Enviva's and those of competitor Drax:

Every community I've worked in with a pellet mill, which is a dozen... is what I would consider an environmental justice community. There's research showing that pellet mills in the southern United States are 50% more likely to be located in what is considered an EJ community, and that's definitely what I have seen on the ground working with these communities.

The importance between EJ and the biomass industry is highlighted further. “The environmental justice impact bleeds into all of this. It's most directly related to the community harm... but it's part of the climate story as well because as climate change gets worse, you've got the climate related environmental injustices and things like that” (SELC). Here, SELC seems to imply the full range of EJ framework should be considered, not just the recognition component, but also the distributive, procedural and sense of justice, especially given the worsening impacts of climate change.

¹³ During this conversation Enviva (Ahoskie) was awaiting a permit from DAQ. The delayed permit was noteworthy, according to DAQ2 because “the EJ board has gotten involved.” The permitted was granted a few weeks after this January 26 interview.

For Enviva, the air permitting process is how they address EJ concerns. In addition, any pushback to the permitting process is perceived as harm to the very communities Enviva claims to protect:

As Enviva is growing and seeking to expand certain facilities and construct new ones, we require new environmental permits, and this permitting process – which typically includes opportunities for communities to weigh in – has given a small but vocal set of activist critics an opportunity to get press attention. Ironically, as activists use the air permitting process to protest the forest products sector, they are often delaying installation of air emission control equipment at our plants designed to minimize emissions from the wood-pellet manufacturing process and provide cleaner air for our communities.

In a further explanation, when asked about EJ concerns around its facilities, Enviva detailed how it views itself in the community:

[It] includes more than providing well-paid jobs and creating a positive economic impact. It entails being an integral part of the communities we call home and demonstrating environmental leadership, including in the way we operate our facilities and engage with our communities. For instance, we have a dedicated community relations team that engages with the local residents and neighbors to answer questions, address concerns, and provide support as needed.

SELC claims DAQ has fallen short in its EJ assessments by limiting permitting criteria to only the facility in question, rather than the cumulative context in that facility's location. SELC asserts federal law supersedes state law and informs state agencies on how to proceed. The federal law in question is known as Title 6 of the Civil Rights Act, which requires a regulating body to consider the cumulative impacts of industry within a given area. SELC notes, "they [DAQ] have to comply with Title 6, which basically says you cannot cause a disproportionate impact to protected classes. In our opinion, [it is] very clear that state agencies are supposed to consider

cumulative impacts in their permitting decisions, in their environmental justice assessments, all of these things.”

This sub-theme highlighted the respondents’ views on environmental justice concerns of Enviva’s operations. Some participants criticized the use of public forums to protest Enviva. Others noted the EJ tools created by DEQ do not affect any change. Participants seemed generally aligned that some notion of environmental justice matters, they differ in how they qualify it. One view suggests regulations meet safety protocols; therefore, health is met. This seems to align with ecological modernization in that developed countries have advanced institutions which satisfy environmental protections. Another view shows mistrust for institutional and business-led safety standards, further highlighting how development processes can harm vulnerable communities. This view employs a more critical stance of institutions and focuses on equity as a development requirement.

5.3.2 Air quality

The topic of air quality was the most discussed health concern. This sub-theme looks at differing accounts of Enviva’s air quality and associated health issues. Among respondents, there is disagreement about the standards used in determining Enviva’s air quality. As Enviva states:

For all the accusations activists throw at us, the reality is that all we’re doing is getting the moisture out of wood and condensing it into a form that is efficient and safe for transport. All of Enviva’s manufacturing plants are designed and built to meet or exceed the applicable air quality regulatory requirements. Like safety, this is an area where we will never compromise. All of our facilities operate with legal and valid air permits. We use state-of-the-art industry-proven air emission control technology to reduce emissions from our manufacturing process, and in many cases, we have voluntarily installed more equipment and controls than are required by law. If a neighbor ever raises any concerns

about our activities, we thoroughly investigate, find a solution to fix the problem if needed, and report on the results to the highest levels of the company.

As another respondent noted, “possession of legal and valid air permits does not guarantee absence of air quality violations” (SELC). In a simplified version of the permitting process, pellet facilities use assumptions about their emissions based on various factors. It is these projections of emissions that qualify a facility for its permit. The Clean Air Act stipulates a facility is “supposed to assume a worst-case emissions scenario” for their application, according to SELC. However, SELC claims, “state agencies take the company’s word for it and assume perhaps lower levels of emissions and then they permit them in massive times [of pollution].” Due to advocacy from SELC and others, facilities must now perform stack testing within six months of a permit approval and periodically every few years afterwards. Regardless, some respondents think this is not enough to truly monitor emissions.

In one example of Enviva not meeting adequate air quality standards, SELC and another organization sued DEQ in violation of the Clean Air Act for permitting Enviva’s Hamlet facility, also in North Carolina. The case was settled by all parties, resulting in Enviva installing additional “control technology... to reduce VOCs [volatile organic compounds] by 95%” (SELC). Since this case, Enviva now voluntarily installs control technology as part of each permitting renewal process.

Regardless of the air quality permits obtained, respondents iterated an important distinction between the Clean Water Act and the Clean Air Act. SELC noted the Clean Water Act seeks to “eliminate pollution,” whereas the Clean Air Act “allows pollution.” Explaining the Clean Air Act further, SELC pointed out, “it’s got this kind of dual role between industrial growth and controlling air pollution.” Another respondent echoed that point. “They are not no harm permits. So... a lot of people say, ‘Enviva got an air permit. So, they’re not causing any harm to the community’ and that’s wrong. It’s a permit that is based on economic considerations for the company” (Doctor). The US Environmental Protection Agency touts the benefits of combining

clean air with a free market approach, claiming it gives industries flexibility to choose how they meet regulations while keeping protection costs down (EPA, 2023).

The emissions from Enviva's pellet facilities include "VOCs, carbon monoxide, greenhouse gases, organic hazardous air pollutants, [and] particulate matter" (Doctor). The problem with measuring these emissions is that internal testing occurs infrequently, and external testing is pretty much non-existent. According to one respondent, "the state has air quality monitors, but most of those monitors are located 30-40-50 miles away [from Ahoskie]. DAQ was forced to put in a local monitor, but it just measures nitrous oxide" (Doctor). In expressing the point of placing monitors close to facilities, Doctor said, "people don't breathe regional air quality, they breathe hyperlocal air quality."

Furthermore, the 1-mile radius from each facility is not a clear demarcation of a safe distance from a facility. In many instances, the VOCs, nitrous oxides, and particulate matter are forced into "ground level ozone [in] the presence of heat and light" (Doctor). This expands the range of human impact outside of the 1-mile radius. "There's significant medical literature that... all of those are harmful to human health" (Doctor). In fact, according to a survey of the medical literature, air pollution¹⁴ is considered the largest environmental health risk with no known safe levels of particulate matter (Hamanaka & Mutlu, 2018).

The complications linked to poor air quality include, "heart disease, diabetes, obesity, depression, low birth weight, premature birth, birth defects, miscarriage, asthma, anxiety, dementia, longevity, etc." (Doctor). Put in the context of an EJ community, where disadvantages already exist, poor air quality complicates matters. In terms of health outcomes, Hertford and Northampton Counties rank among the lowest in the state, 84th and 86th out of 100 counties (UW Population Health Institute, 2023). In practical terms, "there are going to be medical consequences from that and those are not tracked" (Doctor). Elaborating further:

¹⁴ Defined in the study as: gaseous components (nitrogen dioxide NO₂, nitric oxide SO, sulfur dioxide SO₂, ozone O₃, and carbon monoxide CO) and particulate matter (carbonaceous particles with chemicals and metals, such as nitrates, sulfates, endotoxins, etc).

[If] you don't have insurance... [either] you have this long-term medical debt you're never going to pay, [or] people are not going to get medical care... Who pays for that? Individuals pay for that. The county pays for that. The insurance company pays for that. So, all of those medical consequences, just on economics alone, are not considered.

Ahoskie and Garysburg have uninsurance rates of 12% and 14%, respectively, with a state average of 10.7% (DataUSA, 2020). Enviva expressed how they “work closely with environmental regulators to ensure continued compliance with the Clean Air Act.” Adding, “we invest heavily in our plants, making them the most environmentally controlled facilities in the industry, with best-in-class emission control technology to minimize impact from our operations on neighbors and communities.”

This sub-theme raised points about air quality regulations, the permitting methods, and the harms of poor air quality. Respondents all agree on the importance of clean air, however, some differed on what clean air means and how communities may be affected. Furthermore, some respondents assume the air quality is harmless if regulations are met, while others point out the flaws in the regulations. The air quality protections of the EPA, which affect Enviva's facilities, are driven by a dual role of balancing health with economics.

5.3.3 Other health impacts

Some of the more observable impacts reported by some community members include noise and dust. Resident 3, who lives near the Enviva facility in Northampton, complained of the constant noise. Specifically, the “debarker makes a loud ‘boom boom’ noise,” which travels far and occurs 24 hours a day, 7 days a week. The sound is worse in the winters when nearby trees provide less noise dampening. As a result, “people aren't sleeping well at night” (Resident 3). Another frustration mentioned by Resident 3 is, “dust shows up on cars every two days or so from plants,” which adds time and expense to cleaning the car and house.

City 2 and Resident 4 agree that people who live closer to the facilities experience the negative aspects. As City 2 shared, “I guess depending on where you live in the community... then you might not have a good view of Enviva.” Elaborating slightly, City 2 noted “they’ve had some issues... up there [near the facility in Garysburg] with the noise, the trucks, and things of that nature.”

Resident 4 shared a similar view that proximity to a facility increases the awareness of it. In somewhat of a lament, “unfortunately, most people don't live near here [the facility near Garysburg]. They're not that rightly affected by it. It doesn't bother [them] one way or another. There's no concern of theirs because it's not an issue of theirs.” One of the issues mentioned by Resident 4 is increase in logging trucks, which adds noise, exhaust, and safety concerns.

This sub-theme addressed other health impacts to communities living near Enviva’s facilities.

5.3.4 Jobs

A common feature for businesses to promote themselves is acknowledging their economic impacts on a community. This subtheme will address the jobs aspect of Enviva’s facilities as a social impact. The respondents had mixed opinions regarding Enviva’s actual local economic impacts. A common theme among some respondents is Enviva’s community relations, rather than its job creation.

Enviva employs 1,300 people across 10 facilities, 6 shipping terminals, and 5 corporate offices in 4 countries (Enviva, 2023b). When siting a facility, Enviva relies on “a combination of business factors, primarily driven by proximity to wood baskets, accessible workforce, transportation logistics, and supportive communities” (Enviva).

All City respondents noted Enviva’s engagement with the community in specific ways. City 1 explained that in Ahoskie, “Enviva has working relationships with farmers and the city. They sponsor a turkey giveaway, recreational teams, [and] movie nights.” Furthermore, City 1 says

“most people support Enviva” and that they provide jobs while contributing to an “economic growth spurt.”

City 2, in Garysburg, agrees Enviva’s jobs provide salaries “probably more than what the average citizen... in Northampton County make[s].” As for the economic impact on the town of Garysburg, “I don’t think it has really made one.” However, Enviva did donate “almost 200 turkeys” to the town for Thanksgiving. The median household income in 2020 for Garysburg, which is 98% black with a poverty rate of 23% and the town nearest Enviva’s facility in Northampton County, was \$29,835, while Northampton County average was \$39,000, and in NC was \$56,600 (DataUSA, 2020).

In echoing similar comments, City 3, of Ahoskie, believed Enviva is “good for employment,” and the community has a good perspective of them. “Enviva has paid for [the] fire department’s... new equipment... donated AEDs [automated external defibrillators] to local buildings... [and] sponsored a turkey giveaway.”

City 4, of Ahoskie, was less emphatic, flatly stating, “[I] can’t tell if they’ve made a big impact. They were probably welcomed by Ahoskie because there isn’t much industry in the town or many jobs,” of which “they provide a few.” Ahoskie, with a demographic of 64% black and poverty level of 23%, also has a median income well below the state average, at \$36,000 (DataUSA, 2020).

One other respondent was positive towards Enviva’s presence. Trucker, at the Garysburg facility, said all the trucks are equipped with safety and emissions controls, that the trucks are essentially ‘green.’ In addition, Enviva’s facility brought in “new water lines, ditches, new pavement, cable and hundreds of jobs.” In that regard, there were “no issues or concerns with Enviva.”

Lastly, Resident 3, while critical of Enviva, is not opposed to economic development. However, Resident 3 “can’t see how they’ve (the community) benefited from Enviva being there. It has cost us because property tax has gone up 6% after giving tax breaks to [the] industry.” This puts the tax rate among the highest 3 counties in the state. While agreeing that Enviva does donate turkeys during Christmas, somewhat cynically Resident 3 says, “it’s a tax write-off for them [Enviva]. They don’t care. It’s just for show.”

The findings in this theme *social impacts of biomass* reveal the diverse ways respondents feel impacted by Enviva’s facilities at the community level. Some issues mentioned were frustrations with environmental regulations, permitting weaknesses, air quality concerns, noise, dust, increased taxes, and limited job growth. Some benefits highlighted were Enviva’s jobs creation, donations to various causes, and meeting permitting criteria. The environmental justice concerns were the most prominent talking point among proponents and critics of biomass energy. The EJ concerns, however, did not translate into a full account of the EJ framework either from DEQ or from Enviva.

The three themes so far have explored the community level impacts of the biomass industry, revealing environmental, economic and social consequences, which is a focus of this research. They have also revealed a discourse of sustainability as a goal. There is contestation, however, in how best to pursue sustainability and which pathways should be given importance (economic, policy, technology, or citizens). The next theme aids the research questions by looking at how policy is negotiated, who the main actors are, and which approaches to sustainability are favored.

5.4 Theme: Policy dimensions of biomass

The findings of this theme address the research exploring policy impacts on the biomass energy industry. In doing so, this theme moves the chain of impacts from the local, community level up and out to the international level. The respondents’ views on the policy discussions generally

were pessimistic. They addressed various aspects of the policy debate, circling on subthemes of criteria and subsidies.

A short introduction to this theme will be helpful. The idea of biomass energy as carbon neutral is crucial to this policy and, therefore, continues to be debated within policy circles. At the time of these interviews, Europe was in tripartite discussions, known as the Trilogues, taking place between the three main European governing bodies: The European Parliament, The European Commission, and The Council of the EU. Among the topics negotiated was the Renewable Energy Directive (RED) 3, the primary piece of legislation which, in 2009, incentivized the use of biomass energy as a method to transition Europe away from fossil fuels. Among the RED topics is whether to renegotiate any criteria, such as environmental protections, definitions, or subsidies.

5.4.1 Policy criteria

Fern gave context for decision-making within RED discussions in Europe. “The Commission issued a legislative proposal [for RED], [and] they have a monopoly over legislative initiatives.” Though the initiatives start with the Commission, the Council is where they get decided. According to Fern, “the Council of the EU is essentially the body where everything gets done as the last resort in the EU.” That is important to know, “since the Parliament is the only directly democratically elected body in the EU.” However, as a legislative process, by going through the Council, “it's meeting and deciding behind closed doors... [and] that's the way EU Member States are very much using the EU as a tool to do their dirty work because there's no media, there's no citizens allowed within the Council. So, they can do pretty much what they want without being accountable for it.”

While many respondents shared a general critique that biomass energy is not sustainable, Fern gave one example of how RED policy provides loopholes for sustainability:

One change in RED 2 was the introduction of sustainability criteria for forest biomass. But if you read... article 29 paragraph 6 sub-paragraph A... then you will see that it's a legality test... Essentially, it says that the biomass... [is] deemed sustainable... when in the country where the biomass is sourced there is national legislation aiming for a certain number of objectives.

In this case, getting a certification from the Sustainable Biomass Program (SBP) means compliance with the RED 2 sustainability criteria. SBP currently has 6 standards to qualify for certification, which are ultimately delegated to other 'certification bodies' to assess individual producers (Sustainable Biomass Program, 2023a). However, the certification process seems positioned between environmental and industry interests. A look at the board of SBP shows 10 members – 3 biomass producers (including Enviva), 3 biomass energy users, 3 green-growth civil society members, and 1 chair (Sustainable Biomass Program, 2023b).

When asked about the implications of RED discussions, Enviva responded, “[our] production is certified by the Sustainable Biomass Program, annually audited, and has always complied with its sustainability criteria.”

However, the practicalities of how SBP certifies sustainably harvested wood remains unclear to some. According to another respondent who witnessed a clearcut and followed the trucks to an Enviva facility in Ahoskie:

There weren't any certifiers on the site that day I was there. There were sixty trucks that showed up at Ahoskie that day, at the least. There was nobody certifying what was in those trucks, or where it came from, or whether it harmed biodiversity, whether [it] contributed to deforestation. The answer to all that is yes. But they're [Enviva] still getting approved. (Journalist)

SELC also noted weakness in the sustainability criteria. Though their efforts to change it did not work, they did work with partners to get an amendment added which allowed EU “Member States to be more restrictive in their sustainability criteria than the EU.”

Some of the respondents pointed to various reasons why Europe was not going to remove woody biomass from the renewables list. The main reason is because this industry has taken root. Fern claims it would “totally ruin the credibility of their renewables targets.” Adding to that, Fern sees biomass energy as a “fait accompli,” a done deal that is too far along to be contested. Too many Member States already rely on biomass to “meet their legal requirements” of reducing emissions (Journalist). SELC pointed out the strength of lobbying, “So, the lobbying and the interest in many of the Member States is very strong to keep biomass as a renewable energy form.” The lack of political will was addressed by Journalist as well. “There has been no political will to take something off the table that they know... is horrible.”

Enviva sees it differently, stating, “Enviva is glad to see Member States holding firm against counterproductive proposals, and are confident negotiators will find a compromise that allows woody biomass to continue its vital role in supporting Europe’s path to net-zero.”

Another component of sustainability within RED discussions is accounting for carbon. While companies which currently burn woody biomass do not have to claim any emissions from the exhaust released through smokestacks (known as 0-emissions rating), the industry is lobbying governments for a negative emissions rating, through new technology.

The Biomass Energy with Carbon Capture and Storage (BECCS) process is a speculative technology meant to capture the release of CO₂ from power plants and store it underground. The current CO₂ released from burning biomass is assumed to be offset by future tree growth. Hence, if the smokestack CO₂ is collected, that equates to negative emissions, on paper.

Drax, a UK energy company supplied by Enviva, which burns more woody biomass than any other entity in Europe, has lobbied the UK government for subsidies based on BECCS. Drax is also the world's second largest biomass producer and competes in the US southeast with Enviva. It recorded its highest profit ever in 2022 at \$890 million while generating 11% of the UK's total renewable energy from burning 7.7 million tons of wood pellets (Drax Group, 2023).

BECCS would provide a "third stream of revenue" for the industry (Fern). The first stream is subsidies for Member States who use biomass energy. Drax, with the aid of \$653 million in subsidies for 2022, will offer its shareholders the largest payout yet (Drax Group, 2023). The second is revenue from claiming 0-emissions ratings, which matters for some Environmental, Social, and Corporate Governance (ESG) funds. As Fern explained, "BECCS is seen by the biomass industry as their lifeline" because the climate neutral argument is no longer credible. He sees the justification for using biomass shifting to hone "in on energy security, availability, [and] dispatchability, which are all priorities... for the EU these days."

SELC agreed with the tenor that Drax is using BECCS as "a mechanism to allow them to continue on as they are right now, even though their existing subsidies are set to sunset in 2027. Basically, they're trying to find a way to keep this going past that 2027 time period, even though I don't think anyone reasonably believes they're going to have large scale BECCS by 2027." However, if it does materialize, SELC cautioned, "BECCS is a big concern because it could be a massive expansion of the industry."

This sub-theme looked at European policy effects on the biomass industry. The respondents were generally critical and pessimistic of any significant policy changes coming from the Trilogues. A discourse revealed in this sub-theme shows industry-supportive policies to achieve sustainability, which aligns with ecological modernization. While sustainability for policy makers means getting off coal and reducing CO₂, critics noted that the current biomass energy policies are ineffective because they are too focused on the economic solutions.

5.4.2 Subsidies

Participants viewed biomass energy subsidies similarly, except for Enviva. While Fern sees subsidies as less vital, other respondents believed they still are vital to this industry.

SELC asserts, “subsidies are 100% important to this industry. I do not think this industry would exist without the subsidies. It definitely never would have gotten started without the subsidies. That that is very clear and I do not think it could exist now without the subsidies. Biomass is [a] much more expensive form of energy than wind and solar.” SELC, therefore, has focused on international policy in the UK and EU, given the importance of subsidies in driving the industry in North Carolina. Furthermore, SELC is working to “prevent any subsidies or incentivization of biomass” either federally or at the state level, to limit further growth locally.

Similarly, Journalist agrees subsidies are vital to the industry because it is not a sustainable model. For example, “we're the world's single largest producer of wood pellets, North Carolina. And... the governor has said ‘we'll never burn wood pellets for energy, because they're not carbon neutral, they're not sustainable, they're not renewable’” (Journalist). Adding to this point, Resident 4 pointed out the state’s Clean Energy Fund does not include Enviva or the biomass industry. Connecting subsidies to local jobs, Resident 2 suggested, “they’re [Enviva’s employees] just making wood pellets and so they live and die by that, which means they live and die by subsidy, because it is not a high btu fuel... and the only reason this thing works is the subsidy being paid.”

Referring to sustainability criteria, Journalist highlighted Australia as a positive example. In recent months, Australia changed its biomass “definition to not a renewable energy source.” The biomass industry will likely not develop there if no subsidies or carbon credits are available. As a couple respondents noted, biomass subsidies are not at the expense of fossil fuels, “they're at the expense of genuine renewables” (SELC).

When asked directly about subsidies impacting their business, Enviva responded their “business model is not contingent on subsidies.” Enviva produced roughly 6 million tons of wood pellets in 2022, the bulk of which went to Drax, itself supported by subsidies and Enviva’s largest customer (Drax Group, 2023; Enviva, 2023a). It seems highly likely that European subsidies impact Enviva’s business model.

The findings in this theme, *policy dimensions of biomass*, show many participants are closely aligned in their critiques of European biomass policies. Specifically, the critics of biomass energy find fault in the definitions used, the non-democratic decision making, the certifiers who uphold the standards, and subsidies. Enviva maintains biomass puts Europe on a carbon neutral path. This theme illustrates the chain of effects from European policy makers down to European Member States and on down to the businesses operating at the local level, such as Enviva. Policy makers and Enviva approach sustainability through markets and industry-favorable policies. However, critics of biomass energy also support policies to achieve sustainability, just not the current biomass energy policies. This shows a possible convergence in a sustainability pathway led by policies, yet a divergence in the spirit of such policies. The divergence hints at critiques of a pure green growth, ecological modernization agenda. This theme also pointed to the research question exploring the main actors in this industry, which include European policy makers, third-party certifiers, Member States, and energy producers.

5.5 Theme: Attitudes towards biomass (Enviva)

The findings in this theme explore attitudes and perceptions of biomass energy impacts. This theme illustrates respondents’ attitudes towards the biomass industry in general, Enviva specifically, or even an attitude about how to affect change to the industry. This theme also functions as a cross-cutting theme in that the respondents’ attitudes relate to each of the themes. Some comments also highlight a light discourse of sustainability pathways, which may not have been revealed in other themes. In general, respondents were equally divided in their attitudes.

The Forestry group had no issues with the biomass energy industry in North Carolina or the way Enviva conducts its operations. Forestry 2 acknowledged that opinions about Enviva's business model and practices varied across the community. However, Forestry 2 chose not to directly weigh in on the sustainability debate, offering this instead:

The sustainability and renewability claims of this whole business model, [of] growing trees and cutting trees in NC and shipping them over [to Europe]. Is this a net carbon benefit? I don't know, I don't play those games. But there are smart people who've looked at this in Europe and say it works. If you look at Dogwood Alliance, Southern Poverty Law Center, NRDC [Natural Resources Defense Council], they have opposition to this industry. Whether their opposition is valid is for someone else to say... I don't trust their data sources... [but] I look at a lot of data I do trust. Is it good for the climate, good for the earth, I don't know.

In general, the Academic group also aligned on biomass being a net positive for North Carolina, if not the US SE as a whole. Academic 1 simply stated, "when [the] market improves, landowners follow... It's baring out in markets around facilities." Meaning a functioning market influences landowners to grow trees. That said, Academic 1 did mention being aware of general complaints around the industry, such as water quality, over-harvesting forests, "impacts on wildlife," "EJ impacts," etc.

Academic 2 sees biomass energy as a product of well-functioning markets in the regional context of the US SE. "As long as people are coming to the US South to try to do what they're doing (biomass production), I think the world is a better place, both from a carbon perspective and from a land perspective. I can only say what pellets do, in my mind, in the US South and I think we're lucky how that story comes out. I don't think it's exportable."

However, the caveat, "as long as being better than coal is relevant... I'm confident that this (biomass) is an improvement. I'm also hopeful that substituting for coal isn't our long term..."

strategic goal. It's just... we're building infrastructure now to address this transition phase into an economy that's not going to depend on woody biomass to be better than coal.”

The City group generally thought their towns of Ahoskie and Garysburg were supportive of Enviva. When asked about Enviva’s purpose of mitigating climate change by using biomass energy, most were skeptical. City 1 positively responded, saying “they are a successful part of renewable energy and constantly try to make it better.” The other three responded with “I really can’t answer that” (City 2), “no roles towards climate change” (City 3), and one with a chuckle saying, “I don’t see it affecting it [climate change] at all” (City 4).

The Resident group were aligned in their criticism of the biomass industry and Enviva. Resident 1 recognizes that Enviva is not breaking any laws but feels adamantly biomass is “just a crime against nature.” As a retired citizen, Resident 1 also laments younger people not being motivated to act. The public outcry needs to be broader to change anything. “We’re only going to get any movement on this if we get 22-25% of people aware of it. Anything less than that and you’re just spinning your wheels.” Therefore, Resident 1 suggests the industry either has to be “litigated or legislated for anything to happen.” And by happen, Resident 1 means seeing Enviva’s operations “eliminated.” Some research backs up Resident 1, showing that depending on the context, social transformations may only require 10-25% of a group to share a strong belief (Leichenko et al., 2019).

Resident 2 is equally convinced about the industry. Biomass energy is “absolutely the wrong thing to be doing for climate.” Resident 2 is worried about the ecosystem impacts in North Carolina. “[It] is pretty gross in terms of destruction of diversified habitat, the logging, the corporate smashing up of all kinds of things... It's essentially making the wood pellet industry an extractive industry.” The contempt was also levied at Europe. “I think they [EU politicians] probably wouldn’t admit to looking at North Carolina as a third world country. That’s what they’re treating us like.” Resident 2, also retired, is involved in shareholder activism opposing Drax. As Drax is the largest purchaser of Enviva’s pellets, Resident 2 hopes to cut off the source

of money by appealing to pension funds which are sensitive about ESG criteria. Resident 2 claims not to be fooled by “that mumbo jumbo greenwash happy talk.”

Resident 3 decided to be “a voice in the community since there aren’t many voices and it’s important.” According to Resident 3, “the people who live in and around [Enviva’s facility] feel like they’ve been invaded.” As a local voice in the community, Resident 3 hopes to get more citizens involved in speaking out.

Resident 4 is also a voice in the community near the Northampton facility. Part of Resident 4’s effort is to “build the base of our local people. We’re trying to get them more involved in what’s going on.” Resident 4 noted “a lot of them have fear to speak publicly about things, to address things.” As a result, it might seem like fewer people are affected than is the case. “If there are 10 people that have an issue and I speak about all ten of those issues, everyone takes it as if only one person [is] speaking.” The goal is to get elected officials to listen to their concerns. If that does not work, then Resident 4 hopes the “polling sites” will make their voices heard.

Fern’s position on biomass energy is similar to other critics, yet also nuanced. Fern would accept a biomass industry that exists only off secondary woody biomass that has followed the cascading principle. The principle states the wood should be used in higher value-added products first, then reused, recycled and finally burned (Olsson et al., 2016). Fern sees the lever for changing biomass in the subsidies. “My hope is that the discontinuation of subsidies, if it happens, sends the right message to investors that the time of warranted profits is over and that the risk of investing into such facilities is higher... Investors need to hear that signal loud and clear.” In recognizing the importance of the green transition, Fern also is aware of the risks. “The green transition has really a lot of authority as a political impetus and you can do all sort of things with this power, but you can also do all sorts of things that are very wrong. And biomass, I think, is a really, really good example of this.”

SELC is clear in its critique of Enviva and biomass energy. SELC points out the discrepancy between carbon emissions accounted on paper versus in the atmosphere. “Often what we hear is, ‘without biomass we can't meet our... carbon reduction targets.’ Well, you're not really meeting them anyway. You're meeting them on paper, but you're not meeting them in reality.” SELC continued, “I would say that Enviva is contributing to excess carbon emissions in a time when we need to be drastically reducing emissions. So, they are exacerbating climate change by their business model.”

Journalist also agrees with the other critics, with a deference towards urgency. “Biomass is carbon neutral. It's just not carbon neutral in the time frame that we need in this particular climate crisis. And 30 years is too long. It clearly is not an environmental policy that can be defended.” Echoing a similar avenue of challenging the industry, Journalist agreed, “the more likely place for actual pushback against the industry is if investors start bailing... If they got into it because they thought this was an environmentally friendly way to invest their money, then they're being fooled.”

Doctor also agreed with the criticisms of biomass energy. What Doctor wrestles with is how to affect change. “The question is how do you get these groups of like-minded people together and how do you get this critical mass which works hours and hours, weekends, nights, [and] holidays to solve a problem?” The “critical mass of people... is the best part about doing this because whenever an issue comes up, there are certain segments of the population that latches on to that and they can't put it down. And generally it has to do with some sort of injustice. So, injustice drives people, it drives people politically, scientifically, it gives energy.”

When asked about Enviva and biomass energy altering the atmospheric carbon budget: “From a climate change thing... it makes absolutely no sense to remove the best natural technology we have to prevent climate change and make it worse.”

Trucker was brief, yet favorable, of Enviva and its impacts on the community as well as the effort towards mitigating climate change. “They’re just doing what they can.” Trucker also owns 20 acres of white pine which is harvested for income.

Enviva’s response to the climate crisis was emphatic. “The world cannot afford to delay taking decisive climate action. The Intergovernmental Panel on Climate Change has mapped out numerous pathways toward a sustainable future, and they all rely on wood bioenergy.” Enviva also views itself as an environmental steward. “Environmental stewardship can mean a lot of things. To us it means displacing coal, fighting climate change, growing more trees, protecting sensitive ecosystems, contributing to cleaner air, reducing waste, and always being a good neighbor.”

This theme explored participants’ explicit attitudes of biomass energy and Enviva. Some respondents centered their focus on how biomass energy is unsustainable and therefore worsens climate change. Some noted the personal impacts from feeling marginalized in their own communities and the emotional and psychological stress it creates. Others voiced motivation and frustration with generating activism to fight the industry. A few thought the best strategy to affect change is through shareholder engagement. Some proponents of Enviva, however, noted the positive will its community relations generates in Ahoskie and Garysburg. They see Enviva as another example of positive change for the climate. A few other respondents expressed a more neutral stance about its climate impacts, stating neither anything negative nor positive. Most respondents, however, continue to imply or even state that sustainability is universal goal. The contention lies in the pathways to get there.

5.6 Summary of findings

This research explores the impacts of the biomass energy industry, its key actors, and the development logic of the green transition. The findings from the thematic analyses revealed 5 predominant themes among respondents which help reveal how impacts can be interpreted. The themes explored the impacts at the local level, in North Carolina, through environmental,

economic, and social dimensions. The policy theme looked at how European green transition policies influence the biomass energy industry. The attitudes theme added stronger reflections on the perceptions of biomass energy and sustainability.

The leading discourse revealed across the themes was: sustainability is a universal goal because of climate change. The contention of biomass energy lies in whether it is truly sustainable or not, and how sustainability is defined and negotiated. The supporters of biomass energy emphasized the importance of markets, technology, and policies as pathways to sustainability.

The critics of biomass energy and Enviva generally addressed changing the industry through shareholder activism (markets), removing subsidies (policy), and voting/activism (governance). While there may be support for a citizen-led pathway, it remains unclear to what extent. However, in advocating for environmental justice, critics do align with centering equity and justice in their sustainability approaches, which is fundamental to a citizen-led pathway.

Enviva's responses showed support for the sustainability discourse. They revealed an inclination to respect market outcomes, encourage policies supportive of biomass, and utilize technology (air quality controls) to minimize harmful consequences.

6. Discussion

This chapter discusses the findings and interprets them within the theoretical contexts of ecological modernization, post development, and transformation pathways. The chapter is organized into the 4 sub-questions which lead to the main research question. I conclude with a perspective on implications and limitations.

The research explores the consequences of biomass energy as promoted by the European green transition. A summary of the findings shows 5 main themes as dimensions of impact. The themes address local and global impacts. At the local level, they span environment, economics, and social impacts. At the global level, they cover policy and climate change. Respondents' attitudes of biomass energy were mixed, from supportive to critical. The leading discourse aligns with sustainability as a universal goal. Contrasting views posit whether the industry is sustainable or not. Pathways¹⁵ towards sustainability generally emphasized various focal points of importance: economic, policy, technology, environment, and community.

6.1 Answering the research questions

[Under which line of development reasoning do European policy makers promote wood pellet biomass and how are key definitions negotiated towards such policies?](#)

The research shows a lineage of development thinking that traces back to the European industrial revolution. Presently, Europe's attempt to mitigate climate change – caused by the same world view and inherent systems of the 1800s – is known as the green transition. Specifically, the European Green Deal is the most succinct iteration of Europe's transition process. The policies of the EGD are primarily centered on economic growth with sustainability as a goal (European Commission, 2019). Biomass energy policies, created prior to the EGD, have been subsumed and further promoted within it as a viable renewable energy (ibid.). This

¹⁵ As a reminder, this research follows Scoones et al's (2015, p. 10) 4 pathways toward sustainability – state/policy led, technocentric, marketized, and citizen-led – which are broad framings of emphasis that relate to different understandings of problems and solutions.

incarnation of development aligns with ecological modernization theory. Under this reasoning, the best approach to achieve sustainability is through existing modern institutions of governance, economics, and techno-scientific (York et al., 2010). It could be said the major environmental agendas of the past 3 decades, such as the Kyoto Protocol, the Paris Agreement, the European Green Deal, etc. are a testament to the institutional recognition for modifying growth parameters. However, ecological modernization can be contested on multiple grounds.

Post development theory opens an avenue of critique by challenging the dominant discourse expressed through Europe's green transition. The growth imperative of capitalism, albeit 'greener', still requires increased material inputs, whether sourced locally or globally. While the EGD hopes to decouple the economy from the resource base, there is no empirical evidence which shows green growth achieving that at any significant scale (Gómez-Baggethun, 2020). The comparison equally applies to energy use as it continually increases despite efficiency gains (York et al., 2010). Hence, the volume of forests required for biomass energy today will necessarily expand due to the development model of ecological modernization.

Post development theory especially shines a light on the politics of development. The politics of development address the power of who shapes policies and who is impacted by those policies. Biomass energy politics are illustrated in the secretive nature of decision making within the Trilogues. Here, the definitions of sustainable, renewable, and carbon neutral are negotiated. In fact, the lack of transparency within the Trilogues is a known issue which threatens democratic accountability between the public and policy makers (Brandsma, 2019; Rosén & Stie, 2022). The governing bodies defend the closed-door meetings as more efficient for negotiations (Brandsma, 2019). Ultimately, the results of such meetings benefit the biomass energy industry while still making claims of enhanced environmental protection. To this point, a press release by Enviva praises the recently concluded RED 3 negotiations¹⁶ in the Trilogues which allow primary woody biomass its continued status of 100 percent renewable while protecting existing

¹⁶ The full details are not yet publicly available as of this writing.

subsidies for plants burning pellets (Enviva, 2023c). Without public input, the foundational institution of democratic governance is significantly challenged.

Another risk to democratic policy participation comes from messaging. The sense of urgency instilled by the IPCC carbon deadline gives deference to green policies. Urgency can motivate people to act and it can freeze participation. Individual engagement in climate solutions tends to be less available at extreme levels of urgency, due to psychological withdrawal; the result is to relegate complete decision making to those in leadership (Wilson & Orlove, 2021). The risks of ‘managing urgency’ could coopt democratic principles, depending on how leaders present it.

Regardless of urgency, the green growth sustainability pathways are institutionalized (within policies, markets, and technology) and framed within a familiar top-down discourse. As such, the sphere for alternatives shrinks and the contestation of said policies remains narrowly outlined, contesting targets and dates rather than injustice and inequity. Increasing the sense of urgency could further hinder the public’s perceived abilities to challenge biomass energy. In the sense of how biomass energy is framed, justified, and enacted, the policies are quite political.

In summary, the research shows European policy makers follow an ecological modernization approach to biomass energy development. They rely on existing institutions, such as European governing bodies and free markets to reduce carbon dioxide emissions and mitigate climate change. The governing bodies, with input from industry stakeholders, qualify key definitions in such a way that existing infrastructure and industry are not hindered. Furthermore, this process is largely finalized in meetings obscured from transparency norms. As a result, primary woody biomass is considered ‘sustainable’ and ‘renewable’ and thus promoted within European green transition legislation. The entire biomass energy industry is largely legislated, conducted, and promoted from a hierarchy of power nested within the discursive logic of ecological modernization.

Who are the major actors and networks involved in the biomass energy trade (and what implications does that have for sustainable energy solutions)?

The major actors in the wood pellet energy industry, as explored within the findings and literature, are the EU and its leading governing institutions; publicly traded companies Enviva and Drax; third-party 'sustainability' certifiers, such as the Sustainable Biomass Program (SBP); and the private landowners in North Carolina who sell their timber.

In applying a post development critical lens, the chain of actors suggests a few things. One, since European policy support for biomass energy is large and the main producers are limited, companies such as Enviva (the largest producer of biomass globally) enjoy considerable power. This power impacts how renewable energy legislation is negotiated as well as limits the influence from suppliers, who are thousands of small landowners. Given the circumstances of privately-owned, small-holder forests in North Carolina and Enviva's purchasing percentages of 30-70% per plot (Enviva, 2023b), it is unlikely for concerned landowners to either individually demand changes to Enviva's practices or to unionize for collective power. At the same time, it is unclear if landowners in the sourcing area relevant to this thesis have grievances with Enviva. It is likely they fully support the industry because it provides additional revenue for them. Regardless of landowner attitudes, the power implications remain the same. Whether in favor of Enviva or not, the disaggregated constellation of landowners reduces the democratic potential within the biomass energy network that could theoretically alter its structure.

Two, since this network is driven by top-down authority, with minimal new infrastructure necessary, it could invite other forested countries to cash in. A few countries in Europe already produce biomass energy for their own consumption. Finland, Sweden, and Estonia produce enough energy from local woody biomass to support 15-35% of their total energy supplies (IEA Bioenergy, 2021). However, the potential expansion of the biomass model could severely impact social and physical environments where there are fewer protections than in those countries or that of North Carolina. Furthermore, the economic growth impetus requires a

wider scaling out at the bottom to supply biomass demand, while retaining the narrow top structure, thus further consolidating power relations.

Finally, the chain of actors implies Europe's path forward in pursuing renewable energy pathways is best handled within existing hierarchies and institutions, an ecological modernization approach. Although these institutions are necessary for part of the green transition, they likely foreclose myriad opportunities for energy sufficiency rooted in local solutions (IPCC, 2022). Additionally, shipping wood pellets from North America to Europe (and beyond) perpetuates a capitalist phenomenon of commodity fetishism, where the consumers of energy are disconnected from its production and related consequences (Benjaminsen & Svarstad, 2021). Such consequences, which are meant to be safeguarded against by the third-party certifiers, are likely to continue when the network of actors – producers, policy makers, and certifiers – all advocate for the continuation of biomass energy.

How does the biomass industry affect local communities where wood is sourced (environmentally, economically, socially)?

The depth and scale of impacts on local communities from biomass production are varied and contested.

Environmentally

The findings show the following contested consequences on the local environment: increased deforestation; increased forest volume; decrease in hardwood trees; increase in pines; decrease in biodiversity; increase in wildlife challenges; increase in soil runoff; increase in forest carbon sequestration; decrease in forest carbon sequestration.

Using trees for energy production has direct consequences on the forests being harvested. That is obvious and intended. However, the nature of intended consequences is not agreed upon by everyone. This contestation highlights the power and politics inherent in biomass energy. However, the theory of ecological modernization does little to account for power

relations. It trusts that properly functioning institutions, with input from civil society, will rectify necessary (environmental) wrongs as a matter of course (Mol, 2010).

The Enviva facilities of Ahoskie and Northampton are located where many hardwood forests still retain biodiversity (Carter Jr & Hillaker, 2021). The growth imperative of the industry pushes Enviva into these biodiverse forests. State laws, meant to support private land ownership (itself a divisive tradition born of the Industrial Revolution) have minimum guidelines for harvesting private forestland, focusing mostly on water protection (Angelis, 2019; NC Forest Service, 2018).

The clearcutting harvest methods preferred by the Forest Service and Enviva emphasize forest health and productivity. However, productivity is acknowledged in economic terms, as merchantable wood. Productivity is also applied to how much carbon a new forest will sequester, compared to its harvested predecessor. However, carbon sequestration seems like a secondary argument. Enviva is, after all, beholden to its shareholders. The logic of productive forests also encourages the planting of monocrop plantations.

The scale of clearcutting and plantation forests reduce the biodiversity within a given area. While biodiversity within the findings is referred to generally, it has been applied to wildlife, water quality, and ecosystems. Given the twin crises facing the planet, climate change and biodiversity loss (IPCC, 2022), it is biodiversity which often gets ignored. As noted by one of the participants, there are 'trade-offs' when modeling economics, and biodiversity is the tradeoff for forest productivity.

Within the findings, the leading discourse is that sustainability is a universal goal, which justifies the environmental impacts. However, participants disagree on whether biomass energy can support that goal. Supporters of the industry view environmental impacts in a positive light, referencing policies, markets, and technology as justification that biomass energy is necessary and effective. Opponents to the industry view environmental impacts negatively. They also

invoke the same institutions; however, they insist there are flaws within those processes which should be corrected. Once corrected, then biomass energy would no longer be justifiable.

Rather than just correcting institutional flaws, PD theory illustrates how alternative discourses are available. A discursive view of forests as mere objects does little to mitigate the consequences of harvesting biodiverse forests at scale and replanting into plantations. However, by aligning humans and forests within shared ecosystems (a common practice among many peoples globally), other management practices arise. In validating such a discourse, biomass energy may take a different context. Or possibly not fit in this context. More importantly, alternative discourses which situate justice and equity at the center of climate change transformations may not require biomass energy at all, thus further mitigating its contested environmental impacts.

Economically

The findings highlight the following economic impacts of Enviva on two local communities: jobs creation for facility workers and truck drivers; increase in county taxes (Northampton).

Enviva, and its supporters, claim the facilities in Garysburg (Northampton County) and Ahoskie (Hertford County) provide an economic boost to the area. The plants provide roughly 90 jobs in Northampton County and 50 jobs in Hertford County (NC Dept. of Commerce, 2010; NC Dept. of Commerce, 2011). However, it was noted that local governments helped lure in Enviva with financial incentives in order to generate income for tier 1 – most distressed – communities in the state (ibid.). While the average salaries were promoted as higher than county average, paying \$38,000 instead of \$27,000, there was also a noticeable increase in property taxes in Northampton County meant to recoup its incentives (Kamp, 2021). Hence, while some citizens gained better paying jobs, all homeowners within Northampton gained increased taxes.

The local economic impacts of jobs and taxes exists, according to supporters, because biomass energy incentivizes nearby landowners to grow more trees. This is the discourse of ecological

modernization. According to some proponents, biomass energy is a successful story because of private property rights and market incentives. If not for the market, forestland would be converted into marginal agriculture or development, thus worsening climate change.

However, it remains questionable how well the free-market approach works for biomass energy. Enviva still supports (if not relies on) government subsidies. Enviva stated¹⁷ its “business model does not rely on subsidies;” however, in its press release after the Trilogues outcome, Enviva praised the “assurances that electricity-only plants already receiving subsidies will continue to do so, meaning Enviva’s existing off-take contracts are not expected to be impacted” (Enviva, 2023c). Clearly Enviva is referring the European subsidies provided to incentivize burning biomass energy.

Regardless of subsidies, the logic of forestry economics rests on models, of which many assumptions must be made. The principal assumption is that people always act in their own self-interest and in material ways, meaning the value of a forest is always financial. Without this assumption, economic modelers lose a principal component to their analyses. Another assumption is that harvesting forests is carbon neutral. This may be the case, but it is based on a timeframe of 100+ years (Sterman et al., 2018). These assumptions illustrate the implicit biases within the discourse that guides biomass energy economics at the local level. Such economic models underpin the application of ecological modernization.

Although, it must be noted that participants did not contest the reliance on free markets as a pathway to sustainability. Rather, disagreements ranged on the economic realities within communities. This could be because of the discursive power of capitalism. When a discourse tends forecloses alternative ways of thinking and being, it moves from leading to hegemonic (Benjaminsen & Svarstad, 2021). While ‘sustainability as a universal’ goal may be a leading discourse among participants, the use of free markets to achieve it may be hegemonic.

¹⁷ This quote is mentioned earlier in the Findings chapter. It comes from Enviva’s emailed response to my questions.

Socially

The findings show diverse social impacts from Enviva: positive community relations (via donations, sponsorships); increased air pollution; noise pollution; dust pollution; increased truck traffic; all of which are increased environmental justice concerns.

The social consequences of biomass production at the community level are broad. The perspectives are mixed depending on the participant's connection to the community. Some consequences are planned and expected. Jobs creation and tax revenue are the foremost. Other consequences may be expected, though not preferred. Air quality issues is one example. Although permits are required, the regulation allows for polluted air in managed (if monitored) quantities. Other consequences such as noise pollution, dust pollution, and increased traffic hazards have not drawn a response from Enviva. This may suggest a way to minimize the perceived harm as insignificant. The collection of negative consequences may be summed up as environmental justice concerns within the community.

A critical condition of EJ is the powerlessness of the impacted communities. In this case, prevailing development discourses have deemed it acceptable to site polluting industries in proximity to disadvantaged people. Lax regulations at the state level do not account for multiple industries' cumulative effects on the community. Without state protections and proper safeguards on industry, EJ communities are left to defend themselves.

EJ is a critical resistance movement that aligns with post development thinking. The residents of Ahoskie and Northampton are not alone in their struggles against the biomass energy industry. Though the movement formally emerged from the same vicinity, the struggles for equity and justice are global (Temper et al., 2020). Resistance to renewable energy projects is as conflictive as those against fossil fuel projects (ibid.). The injustices from resource extraction or pollution disposal occur in both instances. The EJ Atlas database documents community led mobilizations against economic activities where environmental impacts are a key grievance (Temper et al.,

2015). Though not comprehensive, there are 3,873 global cases documented, with 209 in the US, the second highest amount (ibid.). One of those is a case against biomass energy, but with a facility in a different part of North Carolina.

As a discourse, ecological modernization prioritizes institutional responses to environmental conditions. While democracy is considered important for the evolution of ecological modernization, there is a lack of focus on power and politics. If institutions prioritize economic growth, then that discursive power subdues the ability for proper justice and equity. In this case, that would align with the EJ's dimensions of justice, namely distributive, recognition, participation, and sense of justice. If equity and justice in Ahoskie and Northampton were realized, it is possible that Enviva's operations would not be permitted or required to impose such tight standards that it would be financially unfeasible. This could be a result of a pathway to sustainability involving citizen-led movements.

In summary, the community level impacts of biomass energy are diverse and contested. While the industry exists as an energy solution to climate change, it creates additional consequences locally. The positive consequences are viewed by some participants as jobs, positive community relations, and providing a renewable energy source. The negative consequences expressed by participants include worsened EJ conditions (air, noise, and dust pollution, and lack of power to affect change), and worsened ecosystems through the loss of biodiversity and destruction of diverse forests. Ultimately, wood pellets at the local level are not sustainable and do not reduce CO₂ in the timeframe required by the IPCC.

While participants align with the leading discourse of 'sustainability as a universal goal', they emphasize different pathways. Supporters of biomass energy rely on the ecological modernization approach of policies, economics, and technology pathways. While the critics also invoke the same pathways, they tend to do so from a grounding in justice and equity. The local resistance to the industry could be seen as a citizen-led pathway to sustainability. Such a pathway challenges power and politics while agitating for equitable relations.

Which type of transitional pathway does biomass energy represent?

Participants' attitudes help illuminate the leading discourse of 'sustainability as a universal goal,' specifically, how they frame biomass energy. Views were divided whether biomass energy should be part of that goal and how so. Participants generally relied on the same pathways in support of sustainability. However, the difference is in how well-functioning those pathways were perceived.

Proponents of biomass using market-led approaches thought markets justified the energy source. Opponents, on the other hand, thought markets were not accurately represented due to government subsidies and shareholder ignorance. Opponents wanted subsidies removed and shareholders made aware of the industry's harmful effects. None of the participants challenged the institution of free markets.

Proponents of biomass energy using state-led approaches thought policies were effective and necessary to reduce global carbon levels. Opponents, also using state-led approaches, wanted crucial terminology redefined in order to drastically curb or halt the industry. At the local level, opponents of biomass energy faulted weak regulations which allow multiple polluting facilities in a community. They supported stricter regulations. A few opponents were critical of institutional misgovernance. Those comments were directed toward business influences. Most of the participants, however, did not challenge the institutions of governance and environmental regulation.

Proponents of biomass energy using a technocentric supported views were limited. Primarily the technology discussions were supportive of innovations to reduce soil disturbance and to capture carbon via BECCS. In this case, pellets themselves are not considered technology. Opponents using a technology lens were critical of the effectiveness of BECCS for two reasons. One, because it remains unproven at scale (Fajardy & Pour, 2022). Two, because it would justify the continuation of biomass energy. The opponents, and to some degree proponents, were

supportive of technology for other renewable energy sources. No participants challenged the institution of technology and development.

Proponents of biomass did not engage in a citizen-led approaches toward sustainability. A few proponents acknowledged social justice issues and community relations, but not as a form of self-representation to decision-making. Opponents of biomass energy invoked issues of justice and equity. Furthermore, some opponents participated in journalism, activism, and legislative efforts to reduce biomass energy harm on the environment and vulnerable community members. Some methods of activism promoted political avenues, such as voting for politicians who respected voices of vulnerable community members. Other forms of activism promoted economic changes by encouraging shareholders to withdraw funds from Enviva. None of the participants seemed to fully engage in a citizen-led pathway, whereby citizens are capable, intelligent, cooperative decision-makers who can help co-create pathways to sustainability. However, this does not diminish the values held among the activists, which center on equity and well-being for everyone. It speaks more to the discursive framing inherent in hierarchical systems of power, which restrict the realm of possibilities (Eriksen et al., 2015).

Science was regularly invoked by many participants. Either through studies on carbon sequestration, carbon emissions, forest growth, data on air quality, or local economic models. Some proponents of biomass energy referred to their sources of science, which they deemed more credible and authoritative. Some opponents did the same. A couple participants acknowledged the assumptions needed for modeling forests and economic impacts. However, there was a general acceptance that science is objective and neutral. The contestation of one another's science was rooted in explicit deception of the scientific methods, rather than the inherent assumptions by scientists themselves. In other words, if a forest economist acknowledges a 100-year timeframe while modeling carbon emissions, that is explicit. The implicit bias in formulating scientific research and analyzing the results, researchers' positionality, was not generally questioned.

Post development theory is useful to challenge the green growth discourse and its use of data and science as objective truths. This is not to castigate all science as uncredible, rather to add another context with which to interpret how scientific knowledge is presented and by whom and with what intentions. In this context, one could interpret the opponents' use of science driven by a sense of community, connection to the environment, and justice. The goal is to achieve sustainability peacefully, without further harm. Whereas participants who used science to support the biomass energy could be seen to trust key metrics, individual components versus whole systems, and trade-offs. The goal may also be sustainability, but with a different vision of what matters in getting there.

In summary, the current implementation of biomass energy aligns within ecological modernization. As a pathway to sustainability, biomass energy relies on state-led, market-led, and technocentric institutions. However, these pathways largely follow existing development discourse, which tends to shut out alternative framings of sustainability. These pathways may offer transitional processes en route to sustainability, but it is a path of contestation due to the political and power implications. Citizen-led pathways, as encouraged by post development theory and the environmental justice movement, could offer an inclusively oriented framework. Citizen-led pathways are much more likely to result in true transformation based on alternative discursive framings of social relations and well-being. However, there is no blueprint for how to enact it. Such pathways may arise in any setting spontaneously or built up from a self-empowered community born out of resistance to dominant systems of exclusion and marginalization.

[What are the consequences of biomass energy as promoted by the European green transition?](#)

The European green transition wields significant power. As process toward sustainability, it follows ecological modernization. Within ecological modernization discourse, sustainability is contingent upon key institutions – governance, free markets and the scientific establishment (York et al., 2010). These institutions are held as benevolent, largely apolitical forces acting on

the interests of all citizens. Hence, there should be minimal pushback against it. This is the discursive power of the European green transition.

The extent of consequences from biomass energy begins within the green transition. As a policy, EU RED incentivized and encouraged European Member States to increase renewable energy consumption (European Union, 2009). This policy, along with CO₂ reduction targets, have effectively entrenched the use of wood pellet energy in Europe's renewables mix (European Commission, 2019). To ensure Europe's goals are not hampered, legislative negotiations over crucial sustainability definitions have taken place in a format with minimal transparency and public input (Rosén & Stie, 2022).

The consequences extend to North Carolina, US where the economies of scale source most of Europe's wood pellets. The chain of impacts is spread across local communities in three primary dimensions – environmental, economic, and social. Environmentally, biomass appears to reduce biodiverse hardwood forests and decrease biodiversity overall by relying on clearcutting and monocrop plantations (Williams, 2021). While biomass energy may not be responsible for entire tracts of clearcuts, its consumption of wood increases the economic incentives for additional deforestation (Abt et al., 2022). The replacement forests may indeed hold more volume due to selectively bred plantation species, but there is a trade-off (ibid.). The scale and manner of clearcuts arguably reduces the amount of soil carbon and the biological diversity of plants and animals (Achat et al., 2015; Carter Jr & Hillaker, 2021). Perhaps most consequentially for the environment, biomass energy leaves more CO₂ in the atmosphere than it sequesters due to a carbon accounting error and carbon payback timeframe (Booth, 2018; Searchinger et al., 2009; Sterman et al., 2018).

Economically, the communities around the Ahoskie and Garysburg facilities gained around 140 jobs which pay above the average local salaries (NC Dept. of Commerce, 2010; NC Dept. of Commerce, 2011). However, Enviva's subsidies from Northampton County contributed to property tax increases for all homeowners (Kamp, 2021). Socially, the impacts draw mixed

perspectives. Supporters of the industry appreciate the positive community relations Enviva brings, along with its donations and sponsorships of community events. Critics detail the heightened environmental justice concerns from the biomass processing facilities. The biomass energy industry did not create the conditions for EJ, but they arguably contribute to it. The additional impacts are increased air, noise, and dust pollution.

A final consequence of European green transition policy is the lack of focus on politics and power. Post development's emphasis on discursive power helps to reposition the chain of consequences. In acknowledging the ecological modernization discourse and its institutional priorities, one can recognize some consequences as predictable. Specifically, the same structures which create injustices and inequities are likely to repeat until the power and politics of transitions are better addressed.

In terms of pathways to sustainability, the IPCC highlights the importance of involvement at all levels across societies towards developing climate resilient pathways (IPCC, 2022). They stress the equity and justice components of such pathways (ibid.). Without that grounding, the risk of further harmful consequences will likely provoke contestation. By ignoring the politics of transformation, the European green transition is likely to perpetuate the disconnect between 'those who make decisions' and 'those who experience decisions.'

6.2 Implications

This research shows the challenges in implementing an energy transition in the name of climate change. It does so by focusing on the local level, where two communities in North Carolina experience individual and environmental impacts from the biomass industry. The consequences of biomass energy are largely contested and contextual to this case study. However, there are global implications as well.

Biomass energy is arguably not carbon neutral, which further increases climate change, contrary to its purpose. One concern is if the biomass energy model gains further support

globally, there could be a shift in exporting wood from the global south. This would likely have local consequences, especially in places where environmental and social safeguards are not as robust. It would also further jeopardize the biodiversity and carbon mitigation potential of more forests.

This research shows both local and global consequences of biomass energy as a climate change pathway. It may not be possible to always avoid negative consequences during times of transition. However, it is important that the people most impacted by those consequences have a voice and choice in resolving it.

6.3 Limitations

The research focused on 2 facilities at the community scale. These facilities are somewhat unique because of their proximity to abundant hardwood forests. Research near other facilities might not show forest impacts to be as detrimental or community concerns to be as great. This could be because of greater distance to pellet facilities, less hardwood forest loss, or greater satisfaction with the biomass production model. This research is specific to the US southeast, and the scale and quality of community impacts may not be the same in other countries where this industry exists.

While the range of participants was helpful in collecting experiences from a diversity of socio-political positions, the limited number of participants may not express the full range of community views on the issue of biomass. A broader community survey could more closely mirror the demographics of the community in question, such as age, gender, income, ethnicity, physical abilities, etc.

7. Conclusion

The aim of this thesis was to explore the impacts of biomass energy as a pathway of sustainability within the European green transition. To achieve this, I focused on two communities at the center of the biomass industry in North Carolina, US. I conducted 20 semi-structured interviews with residents of these communities, as well as others who have direct experience with Enviva or the biomass industry. The interviews were then transcribed and analyzed using a combination of thematic and discourse analyses, which then guided the theoretical choices of ecological modernization theory, post development theory, and transformations framework.

The themes uncovered from the interviews were: *environmental dimensions of biomass*, *economic dimensions of biomass*, *social dimensions of biomass*, *policy dimensions of biomass*, and *attitudes of biomass (Enviva)*. The leading discourse was *sustainability is a universal goal*. Two competing discourses were: *biomass energy is sustainable*; and *biomass energy is not sustainable*. There were several framings indicated which align with a pathway to transformation. They were primarily state-led, economy-led, or technocentric-led. Several opponents of biomass invoked citizens' rights and environmental justice, yet not as a form of agency for a sustainability pathway.

The thesis engaged in and answered the guiding question – what are the consequences of biomass energy as promoted by the European green transition? The research shows biomass energy has impacts of concern for local communities based on biodiversity loss, native hardwood forest loss, and environmental justice issues, such as air quality concerns, noise pollution, and marginalized voices of dissent. The carbon sequestration issues of biomass suggest it is not actually a carbon neutral process within the IPCC timeframe, and possibly not within any reasonable timeframe.

As biomass energy is part of the European green transition, it is implemented as a pathway to sustainability primarily using policy-led and market-led framings. The framings influence the network comprising biomass energy, which is rather limited and thus risks allocating significant power to the major actors within the industry. Furthermore, the EGD, as part of the green transition, follows an ecological modernization approach, which attempts to drive away climate change by using the same systemic thinking which caused it. Each pathway represents a set of politics, whether explicitly acknowledged or not. The framing of climate change and the pathways to sustainability guide which questions are asked, which answers are sought, and who is allowed to participate. The current positioning of biomass energy and its role suggests local residents are meant to accept the choices made by politicians and economists, regardless of how far removed they may be from its impacts. Hence, the politics of the biomass industry suggest it is not an inclusive process whereby equity and justice are guiding values.

The research suggests, based on a post development critique of biomass production, that citizen-led pathways are better positioned to mitigate climate change. Such pathways place equity and justice at the center of sustainability. Here, the politics are expressly connected to framing the climate crisis and how it should be addressed. It should be noted, however, this is not to suggest a smooth, harmonious pathway. Transformations at the scale and pace recommended by the IPCC will be disruptive. It is implied that citizen-led movements would seek to abolish the systemic causes of inequity and injustice, which would be turbulent (Schipper et al., 2020). However, ignoring the root causes of climate change will also be disruptive. The difference can be understood as disruption towards inclusivity that fosters deeper networks of resiliency and mutuality, which engage agency in a multitude of ways, all towards comprehensive sustainability.

7.1 Recommendations

While this research has explored the theoretical constructions driving biomass energy and illustrated other theoretical propositions for alternative pathways to transformation, I have not

given explicit attention to the personal levels of transformation. Citizen-led pathways contain many accounts, at times competing, from their motivations to how to enact transformations. This can be seen in the diverse field of environmental justice activism. Complementary to this study, I suggest exploring the personal-practical implications of citizen-led transformations at the local levels and their leading discourses. This could illuminate the diverse scales and relationalities of transformation toward sustainability and how individual motivations navigate various discursive terrain. Further, it could offer another accounting of consequences that may not be easily recognized by the outside observer. What an outsider may deem harmful consequences may be acceptable in a given scale, quality, and timeframe if chosen collectively and consciously by those living among the consequences. This would add context for framing questions of 'harm' or 'consequences' relating to climate change mitigation. Citizen-led pathways are not uniform, prescriptive, nor predictable; they may, however, provide guidance for collective action informed by alternative discourses.

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Appendices

As mentioned in the Findings under 5.1.2 Harvest Methods. Enviva claims they 'never' source from forests undergoing land-use change.



Figure 4 Author standing in middle of clearcut which provided wood to Enviva. Edenton, NC - January 2023



Figure 5 Commercial lots for sale at the same clearcut. Edenton, NC - January 2023

Interview Guide

Residents (and Trucker) of nearby Enviva plants

1. Tell me about yourself and this community.
2. How do you feel about the Enviva factory and the work it does?
3. How has this community been affected by Enviva?
4. What concerns or issues are you aware of regarding Enviva?
5. How do you see Enviva's role in terms of climate change?
6. Who do you recommend I talk to next?

Employees at city hall (other city workers)

1. Tell me about Enviva's role in this community.
2. Why did Enviva choose this community to set up a factory?
3. How has Enviva been received by the community?
4. What has been the economic impact of Enviva in this community?
5. What kind of challenges or issues have arisen during Enviva's operations?
6. How do you see Enviva's role in terms of climate change?
7. Who do you recommend I talk to next?

Journalist

1. What has been the evolution of biomass energy policies since its inception?
2. What negotiations took place on the carbon-neutrality aspect of woody biomass leading up to the 2009 EU RED?
3. What can you tell me about the trajectory of woody biomass energy as a whole?
4. How important do you think subsidies are for Enviva and the biomass industry?
5. Are there indications the US will begin its own consumption of biomass energy?
6. What reasoning does Governor Cooper (of North Carolina) give for not supporting woody biomass consumption?
7. Who are Enviva's major customers?
8. What additional uses of biomass are being discussed within the industry?
9. What are the biggest biomass topics at stake for the Trilogues?
10. Is there anything else you consider important to this discussion?
11. Who do you recommend I talk to?

Enviva

1. Why did Enviva initially choose North Carolina for its operations?
2. How has Enviva impacted the forests of North Carolina?
3. Which types of forests does Enviva source from?
4. How does Enviva ensure the forests it sources from do not change land use after harvesting?
5. What percentage, on average, of harvested forest does Enviva purchase from a given tract?
6. How has Enviva impacted the communities surrounding pellet production facilities?

7. How does Enviva view the concerns around the topic of Environmental Justice, specifically surrounding Enviva's operations?
8. Which proposals being discussed at the Trilogue process in Europe does Enviva support or not support (if any)?
9. According to the SBP scheme for meeting RED II, released in November 2022, the harvesting criteria should ensure that there is no biodiversity degradation in the regenerated forest area, including that primary forests and natural or semi-natural forests are not degraded to or replaced with plantation forests. What are the practical implications (if any) of this change for Enviva's current/future operations?
10. How important are government subsidies (for consumers of biomass) to Enviva's business model?
11. Which countries make up Enviva's largest consumers of wood pellets?
12. What makes the US South unique for the biomass industry?
13. Which definition of sustainability does Enviva use?
14. How does Enviva view its role in terms of climate change?
15. Which industrial uses of wood-pellet biomass is Enviva most excited about?
16. Who else would you recommend I talk to?

North Carolina Department of Air Quality (DAQ)

1. Can you explain to me how the air permitting process works?
2. Where do the standards come from which are used to approve a permit? Federal or state?
3. Why would certain industries, such as Enviva, fall under air quality versus some other kind of permit?
4. What role does the environmental justice report have on the permitting process?
5. How should the report be interpreted? Can it alone determine whether a permit is approved or not?
6. How does the DEQ handle public comments on air quality permits? Are permitting decisions made based on public feedback?
7. Why is Enviva still waiting for an air quality renewal permit?
8. Is there anyone else you recommend I talk to?

Forestry officials/ academics

1. What is your opinion about the wood pellet industry, specifically the stated benefit of being carbon neutral?
2. How do you think the wood pellet industry has affected NC's forests?
3. How effective are plantations versus natural forests at sequestering carbon?
4. How do you see the wood pellet energy industry in terms of its goal to reduce carbon emissions?
5. What environmental laws must landowners follow before or after selling timber for wood pellets?
6. Are there specific best practices the Forest Service follows regarding environmental considerations?
7. What is the average age of plantation trees before being logged?
8. How would you assess the quality of NC forests in general, and since the arrival of Enviva?

9. Are there any concerns that you are aware of about cutting trees for bioenergy?
10. Are there any landowners I could speak with who have sold trees to Enviva?
11. Can you recommend anyone for me to talk to?

FERN

1. What can you tell me about the European policy surrounding the original RED?
2. How was the topic of carbon accounting handled during the first RED negotiations?
3. What have been the major changes between RED I and RED II and now RED III proposals?
4. What major decisions are up for discussion during the Trilogue?
5. Which European countries currently burn wood pellets? How many source from Enviva?
6. How do you view transitioning away from coal by using wood pellet energy?
7. Who do you recommend I talk to?

SELC

1. What can you tell me about SELC's work regarding the biomass industry in general and Enviva, specifically?
2. What kind of litigation has SELC engaged in regarding Enviva, if any?
3. How does SELC engage in environmental justice work in North Carolina?
4. How does the EJ component of DAQ impact communities?
5. How does SELC view the air quality standards and permitting processes towards facilities like Enviva's?
6. How does SELC view the Trilogue discussions on biomass?
7. Are there indications US domestic policy will encourage biomass?
8. How does SELC see biomass evolving?
9. How important are subsidies for the industry?
10. Are there any other concerns about the biomass industry and/or Enviva?
11. Is there anyone else you recommend I talk to?

Doctor

1. Can you tell me a little bit about yourself and how you got involved in air quality issues?
2. What can you tell me about air quality in North Carolina, specifically concerns around the biomass industry?
3. How do facilities generally test their air quality?
4. How do you view DAQ air quality regulations?
5. What are the health impacts from different levels and types of polluted air?
6. What does health care treatment involve for issues of polluted air?
7. Are there any particular studies of local air issues you can point me to?
8. Are there any other concerns about air quality and health that we have not discussed which you find important?
9. Is there anyone else you recommend I talk to?

Introductory Letter + Consent Form

Are you interested in taking part in the research project:
“The Development of the Wood Pellet Industry for Climate Change Mitigation”

This is an inquiry about participation in a research project where the main purpose is to look at how the implementation of a green transition development model works in practice and what consequences it may have. In this letter we will give you information about the purpose of the project and what your participation will involve.

Purpose of the project

This is a master’s thesis research project. The master’s student/ researcher will look at the local wood pellet industry in North Carolina and its impacts on the local communities (economically, socially, environmentally) and how it aligns with the Paris Climate Accord’s goals of reducing carbon dioxide emissions within the energy industry.

No personal data collected will be used for purposes beyond the writing of this thesis.

Who is responsible for the research project?

The Norwegian University of Life Sciences (NMBU) is the institution responsible for the project.

Why are you being asked to participate?

I consider you to have valuable experience and opinions which are important for my research. Your background provides a unique perspective to looking at the details within the bigger picture of this industry. I hope to conduct at least 20 interviews in order to collect a range of experience, perspectives, and opinions.

What does participation involve for you?

For this research, I plan to conduct in-person interviews or online surveys (where necessary).

The interviews will take approximately 45 minutes. This will be a semi-structured format, which means I will have 7 questions prepared but you can choose to answer all of them or only certain ones. You are welcome to expand on any questions or share further information that you think may be useful to this research. The interview will be recorded by me either taking notes or with an audio recording.

The survey will take approximately 15 minutes. There will be 7 questions. You can choose to answer all of them or only certain ones. You are welcome to expand on any questions or share further information that you think may be useful to this research. Your answers will be recorded electronically.

All information provided will be anonymized in the project.

Participation is voluntary

Participation in the project is voluntary. If you choose to participate, you can withdraw your consent at any time without giving a reason. All information about you will then be made anonymous. There will be no negative consequences for you if you choose not to participate or later decide to withdraw.

Your personal privacy – how I will store and use your personal data

We will only use your personal data for the purpose(s) specified in this information letter. We will process your personal data confidentially and in accordance with data protection legislation (the General Data Protection Regulation and Personal Data Act).

The data will only be accessible to the student researcher and the student's supervisor. To guarantee data privacy, your personal data will be replaced with a code. You will not be identified in the research thesis; at most, your occupation will be mentioned, unless it clearly identifies you as the source.

What will happen to your personal data at the end of the research project?

The project is scheduled to end in June 2023. After the submission of the research thesis, all personal data, including any recordings, will be deleted and destroyed.

Your rights

So long as you can be identified in the collected data, you have the right to:
access the personal data that is being processed about you
request that your personal data is deleted
request that incorrect personal data about you is corrected/rectified
receive a copy of your personal data (data portability), and
send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data

What gives us the right to process your personal data?

I will process your personal data based on your consent.

Based on an agreement with the Norwegian University of Life Sciences (NMBU), NSD – the Data Protection Services, has assessed that the processing of personal data in this project is in accordance with data protection legislation.

Where can you find out more?

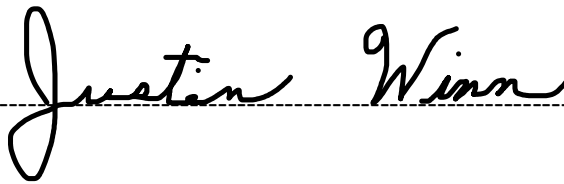
If you have questions about the project, or want to exercise your rights, contact:
Norwegian University of Life Sciences (NMBU)] via
Justin Winn, student researcher, justin.cody.winn@nmbu.no
Andre Marin, supervisor, andrei.marin@nmbu.no

Our Data Protection Officer: Hanne Pernille Gulbrandsen, personvernombud@nmbu.no
Data Protection Services, by email: (personvertjenester@sikt.no) or by telephone: +47 53 21
15 00.

Yours sincerely,

Project Leader
(Researcher/supervisor)

Student (if applicable)



Consent form

I have received and understood information about the project *“The Development of the Wood Pellet Industry for Climate Change Mitigation”* and have been given the opportunity to ask questions. I give consent:

to participate in *(an interview)*

to participate in *(an online survey) – if applicable*

for information about me/myself to be published in a way that I can be recognised – if applicable

I give consent for my personal data to be processed until the end date of the project, approx. *[June 15, 2023]*

(Signed by participant, date)



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