The wood pellet industry in the United States South: an exploratory regional comparison of resident environmental, social, and economic perceptions

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ABSTRACT

This article is a companion to another article published in the same issue of the Journal of Forest Business Research.[1] As such, to preclude duplication, much of the background and literature review are not repeated in this article. While that article focuses on comparing rural and urban resident perceptions of the wood pellet industry, in this piece, we examine and compare residents by major pellet production sub-region in the US South across three dimensions: environmental, social, and economic attributes. The Southern region overall is the world's largest producer and exporter of wood pellets. The sub-regions are the Gulf Coast (Louisiana and Mississippi) and the Atlantic Coast (South Carolina, North Carolina, and Virginia). Two rounds of a web-based survey were sent to 7,500 residents in the two pellet-producing sub-regions within the US South. Within these regions, surveys were sent to randomly selected residents by zip code, 18 years or older. Overall, Gulf Coast respondents were more accepting of the pellet industry than Atlantic Coast respondents across the three attributes.

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[1] LeBlanc MT, Vlosky RP. 2023. What do people think about the environmental, social, and economic impacts of the wood pellet industry? An exploratory study of residents living near pellet plants vs. urban residents in States with pellet manufacturers. J.For.Bus.Res. 2(1): 20-37.

INTRODUCTION

Adverse environmental effects of fossil fuels accompanied by increasing world energy demand have stimulated global consciousness toward climate change issues and renewable sources of energy. Over the past 50 years, the reduction of greenhouse gas (GHG) emissions and utilization of renewable energy sources (RES) have received significant attention in global energy and environmental policy. As a result, biomass energy, in the form of wood pellets, has taken center stage in the realm of RES over the past decade, as a highly subsidized and widely utilized alternative to fossil fuels, particularly coal, for large-scale energy generation. Global consumption of wood pellets has been on an upward trajectory for the past decade, particularly in the two largest demand regions, the European Union (EU) and Asia; demand is expected to continue increasing under current policy conditions (Thrän et al. 2017).

Concurrent with increasing demand, the United States' (US) industrial wood pellet manufacturing industry has developed into the most significant global producer and exporter of pellets, predominately from the Southern region (UN-FAO 2018). Over 95% of production in the South is exported to the EU, where wood pellets have become an integral part of strategies to mitigate carbon dioxide (CO2) and other GHG emissions (Henderson et al. 2017). The US has received considerable attention as exports have increased from negligible amounts in the early 2000s to around 6 million metric tons (MMt) in 2018 (Greene 2019).

The literature on wood pellets has focused on chemical and energy characteristics compared to fossil fuels, carbon sequestration, GHG emissions and other pollutants. Other environmental and economic issues have also been studied. Examples of issues in the environmental area include timber harvesting, life-cycle analysis of pellet production, and energy expenditures in the supply chain from the forest to end-users. In the economic area, analyses tend to examine policy instruments, economic impacts, and investment opportunities that have evolved with increasing demand. However, while these aspects of wood pellets have been studied fairly intensively, a limited amount of research has focused on social dimensions of the industry.

Public concern is evident among wood pellet manufacturers. For example, Enviva, the largest pellet manufacturer in the world, recently created a new corporate-level position of Community Outreach Manager. This manager leads engagement and communicates the company's efforts in

sustainable forest management and restoration amongst other environmental initiatives, through education programs and community outreach. As the industrial wood pellet industry grows, it is vital to understand public perceptions, as they may have implications on the formation of policy, corporate investment in manufacturing facilities, the future of wood pellet bioenergy in the US, and future environmental, social, and economic impacts of this emerging industry.

This article examines and compares perceptions of residents in the two primary wood pellet-producing regions in the US South; the Gulf Coast, including Louisiana and Mississippi, which utilizes softwood pine as primary feedstock and the South Atlantic Coast, including North Carolina, South Carolina and Virginia, which utilizes hardwood as primary feedstock. We investigate the attitudes, awareness, behaviors, perceptions, and underlying issues of the wood pellet manufacturing industry from perceptions of the general public, combining responses from residents living near or in communities where pellet mills are located and urban residents. This study examines perceptions of the wood pellet sector in the context of environmental, social, and economic constructs.

METHODS

This study was conducted by administering a web-based survey to residents within a 50-mile radius of selected pellet mills and residents living within the two largest metropolitan statistical areas (MSA) in each state where these mills are located. Although it would be valuable to understand the pellet industry's perceptual dynamics from the perspective of many stakeholders, due to time and funding constraints, as well as the pressing need to study resident opinions, residents were the focal group.

In the study, "pellet manufacturing facility" or "pellet mill" refers to a facility where industrial pellets are produced and "power station" refers to an industrial facility that produces energy in the form of heat, electricity, or both. The US Census Bureau defines urban areas as areas with a population of 50,000 or more people, and rural areas are defined as areas not included within an urban area. However, since zip code boundaries, rather than cities, were used to identify residents within 50-mile radius of pellet mills, residents within the 50-mile radius were the rural sample and

residents within MSAs were the urban sample. The Census Bureau defines MSAs as core areas containing a substantial population nucleus, together with adjacent communities having a high degree of economic and social integration.

An email list of 7,500 residents, including demographic data, was purchased from the direct marketing services company, Exact Data. The list was randomly but proportionately selected by ZIP code and limited to residents 18 years or older that owned or rented homes within the collected ZIP code lists.

List parameters, spanning 171 counties and 1,139 ZIP codes for inclusion in the sample frame were: 1) Counties with a land mass of 50% or more contained within the 50-mile radius from selected pellet mills; 2) Counties within MSAs defined by the US Office of Management and Budget and; 3) Residents older than 18 years of age. As shown in Figure 1, the radii around mills 1 and 2 overlapped, as well as the radii around mills 2 and 3, causing duplicates amongst individual ZIP code lists. To resolve this issue, duplicates were kept in the list for mill one and deleted from mill two list. The same procedure was followed for mills two and three. Mill 2 maintained the duplicate codes, which were removed from mill 3. Duplicate ZIP codes also occurred between mill three and Baton Rouge and Memphis MSAs, mill four and Virginia Beach- Norfolk- Newport News MSA, mill five and Raleigh- Cary MSA, and mill six and Greenville- Mauldin- Easley and Columbia MSAs. To resolve this, every other duplicate was deleted from one list and maintained by the other. In the case that a mill's ZIP code list coincided with two MSAs, the procedure was repeated for the second MSA once the first was completed. In addition, ZIP codes with a population of zero were removed (Table 1).

As mentioned earlier in this section, mills in the Gulf Coast and Atlantic Coast vary by types of feedstock utilized for pellet production. The 50-mile radius around mills was chosen to gather data from residents who potentially experience direct impacts from the industry, supply forest feedstock to mills, or live in rural communities. MSAs were elected as an urban comparison, contrasting the potentially more intimate mill radii (Table 2). The quasi-control sample base of this study allowed us to draw comparisons between residential perceptions in Gulf Coast and the Atlantic Coast sub-regions.
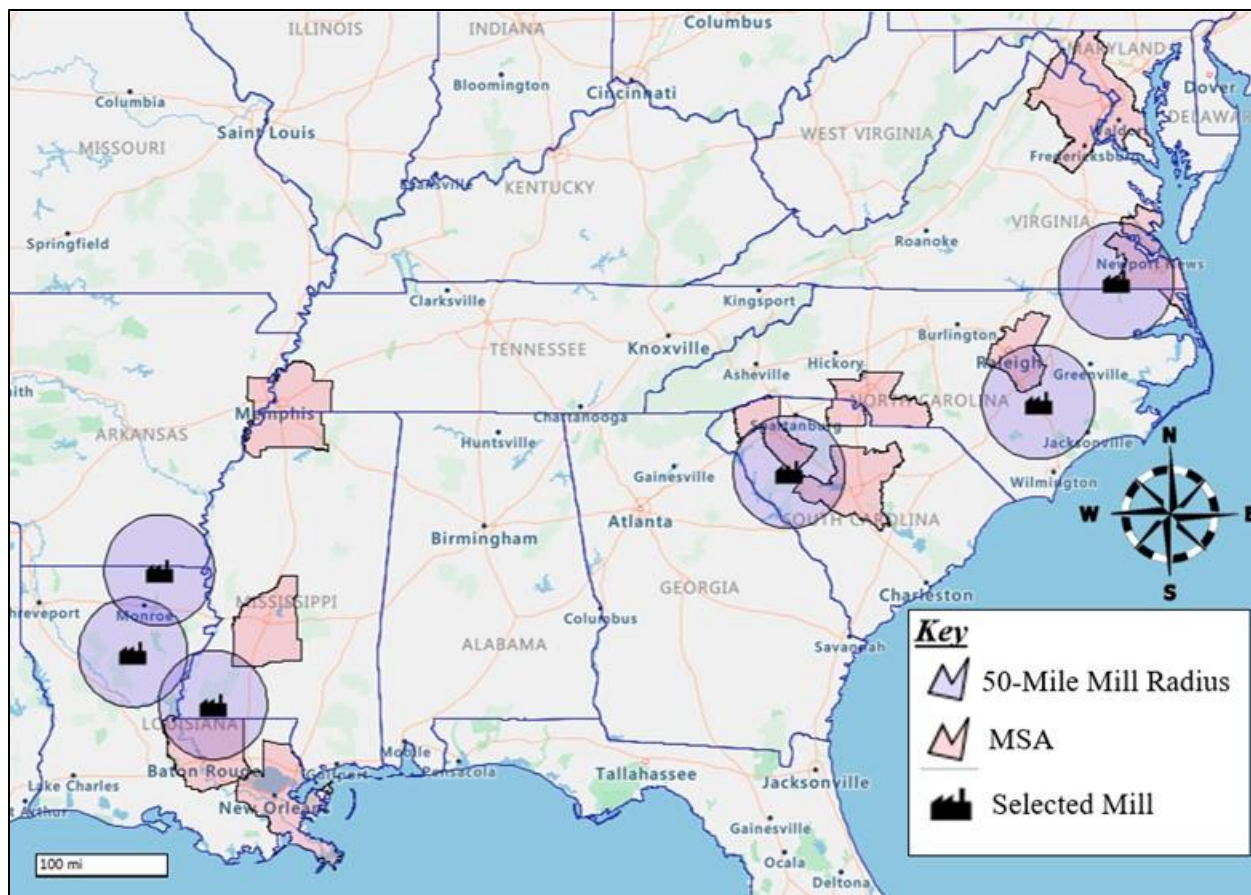
Figure 1. Study areas including six selected wood pellet mills and ten metropolitan statistical areas (created using eSpatial).

Table 1. Characteristics of selected wood pellet mills included in the study.

Mill	Morehouse	Lasalle	Amite	Southampton	Sampson	Greenwood
Mill Study Number	1	2	3	4	5	6
Sub-region	Gulf-Coast	Gulf-Coast	Gulf-Coast	Atlantic-Coast	Atlantic-Coast	Atlantic-Coast
Company	Drax Biomass	Drax Biomass	Drax Biomass	Enviva LP	Enviva LP	Enviva LP
State	LA	LA	MS	VA	NC	SC
City/ Town	Bastrop	Urania	Gloster	Franklin	Faison	Greenwood

Acquisition or Commission	2015	2017	2015	2013	2016	2018
Direct Employees	>60	>70	>60	70	90	80
2019 Capacity (Metric Tons)	525,000	525,000	525,000	550,000	500,000	600,000
Feedstock	SW	SW	SW	HW/SW	HW/SW	HW/SW
Transport from Mill to Port	Train	Train/ Truck	Truck	Truck	Truck	Truck
Exporting Facility Location	Baton Rouge	Baton Rouge	Baton Rouge	Chesapeake	Wilming-ton	Wilmington

Note: SW - softwood, HW – hardwood.

Table 2. Metropolitan statistical areas included in the study.

State	MSA 1	MSA 2
LA	New Orleans-Metairie	Baton Rouge
MS	Memphis	Jackson
NC	Charlotte-Gastonia-Rockhill	Raleigh-Cary
SC	Greenville-Mauldin-Easley	Columbia
VA	Washington-Arlington-Alexandria	Virginia Beach-Norfolk-Newport News

Note: LA - Louisiana, MS - Mississippi, NC - North Carolina, SC - South Carolina, VA – Virginia.

Survey instrument design and implementation

Environmental, social, and economic constructs were included in four sections within a web-based questionnaire. Each of the four sections contained questions regarding perceived impacts relevant to issues of the industry, such as pollution, effects on municipal infrastructure, and employment opportunities. An awareness section was included to measure the general awareness and knowledge of residents concerning the wood pellet manufacturing industry. The final section was

comprised of socio-demographic inquiries to compare sample data to the population data gathered from data provided by the list company, ExactData.

The survey instrument contained fixed response, open-ended, and scale questions to measure the environmental, social, and economic constructs, which were independent variables influencing the dependent variable, company profiles. Scale questions were adapted from Likert-type scale found in Bruner et al. (2001) *Marketing Scales Handbook,* volume III, and Bearden et al. (2011) *Handbook of Marketing Scal*es, 3rd edition. Open-ended questions were designed to give respondents the opportunity to present answers that were not included in the survey instrument.

Procedures, follow-up efforts, and data analysis were implemented using a modified version of the Tailored Design Method (Dillman et al. 2014). The survey instrument was developed and administered using Survey-Monkey®. The initial mailing was sent to 7,500 recipient emails. A second mailing was sent ten days after the initial mailing to non-respondents and partial respondents to remind them to complete the questionnaire. At the time of the second mailing, Hurricane Dorian was threatening the Gulf and Atlantic Coasts, which may have impacted the ability of potential respondents in its path to complete the questionnaire, affecting the response rate of the survey.

Data management and analysis

The survey variables were exported from Survey-Monkey® into a database in Microsoft Excel® to ease the process of further analysis. The Excel database stored records of returned responses from each mailing, demographic variables from the list provider ExactData, and data obtained by the survey instrument. Statistical data analysis was performed using SPSS version 25; a statistical program widely used in social science research. Descriptive statistics, including frequencies and mean responses, independent sample two-tailed t-tests, χ^2 test, and Analysis of Variance (ANOVA) tests, were utilized for the analysis.

RESULTS

Response rate and respondent demographics

Of the 7,500 surveys administered, 1,112 were either undeliverable or inappropriate due to respondents' previous unwillingness to participate in Survey-Monkey® based surveys, or their unwillingness to participate in this survey. The total number of useable surveys received was 122, for an overall adjusted response rate of 2%. Due to such a low response rate, the study can only be positioned as exploratory.

An adjusted response rate was calculated using the following formula:

Adjusted Response Rate = Useable Surveys / [Total Sample – (Undeliverables + Unusable)] %

Nonresponse bias was measured using an independent sample two-tailed t-test conducted on age, zip code, and income, comparing respondents and non-respondents that did not fall into the undeliverable or unusable categories. No statistically significant difference was detected at α = 0.05 significance level. In addition, research has shown that late respondents typically respond similarly to non-respondents (Armstrong and Overton 1977). Accordingly, respondents to the second mailing were used as a proxy for non-respondents and compared to first mailing respondents using 84 continuous variables. Less than 5% of all continuous variables comparing first and second-mailing respondents were found to be statistically significantly different at α = 0.05 significance level; therefore, nonresponse bias was not a problem.

Approximately 53.8% (n=65) of respondents were female. Annual 2018 household income was more than $100,000 for 52.3% (n=63) of respondents, and 58.5% (n=65) were 55 or older. In terms of ethnicity, 84.4% (n=64) of respondents were white or Caucasian, and 66.2% (n=65) have a college (B.S. or B.A.) or advanced degree (M.S., Ph.D., MBA, JD). As for political affiliation, 38.5% identified as Republican, while 33.8% identified as Democrat and 16.9% identified as independent (n=65). Of the 122 respondents, 72.1% were urban, and 27.9% were rural. The density of responses received is geographically represented by Figure 2, which was based on respondent ZIP codes.
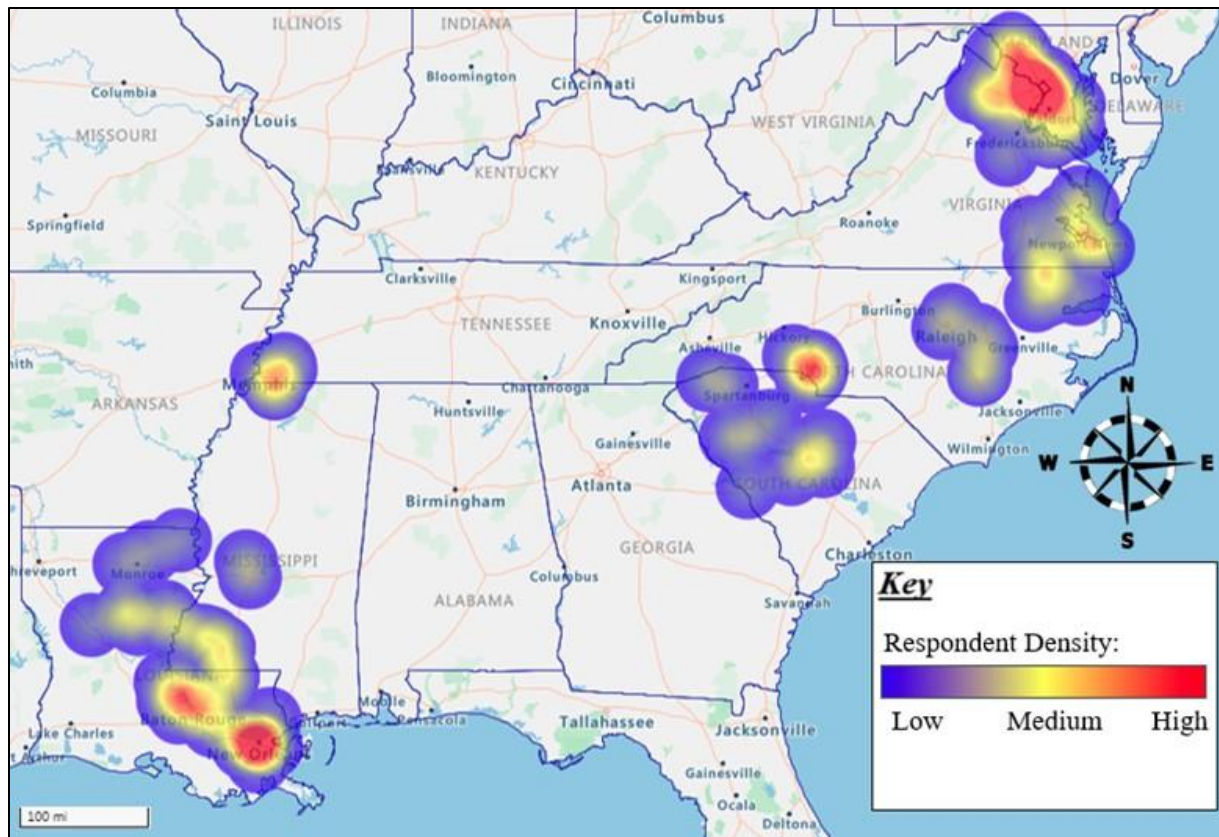
Figure 2. Geographic distribution and density of responses (n=122).

Gulf Coast and Atlantic Coast regional comparisons

Although this study focused on five states that contained selected wood pellet mills (LA, MS, NC, SC, & VA), due to the geographic border of the two largest MSAs of each state, respondents from Maryland, Washington DC, Tennessee, and West Virginia were included.

Therefore, the Gulf Coast region contained the states of Louisiana, Mississippi, and Tennessee, and the Atlantic Coast included the states of Maryland, North Carolina, South Carolina, Virginia, Washington DC, and West Virginia. As mentioned in the methodology section of this study, the Gulf Coast region contained three Drax Biomass mills that primarily used softwood feedstock, and the Atlantic Coast region had three Enviva mills that primarily used hardwood feedstock (Figure 3). Of the 122 respondents, 39.2% were from the Gulf Coast, and 60.7% were from the Atlantic Coast.
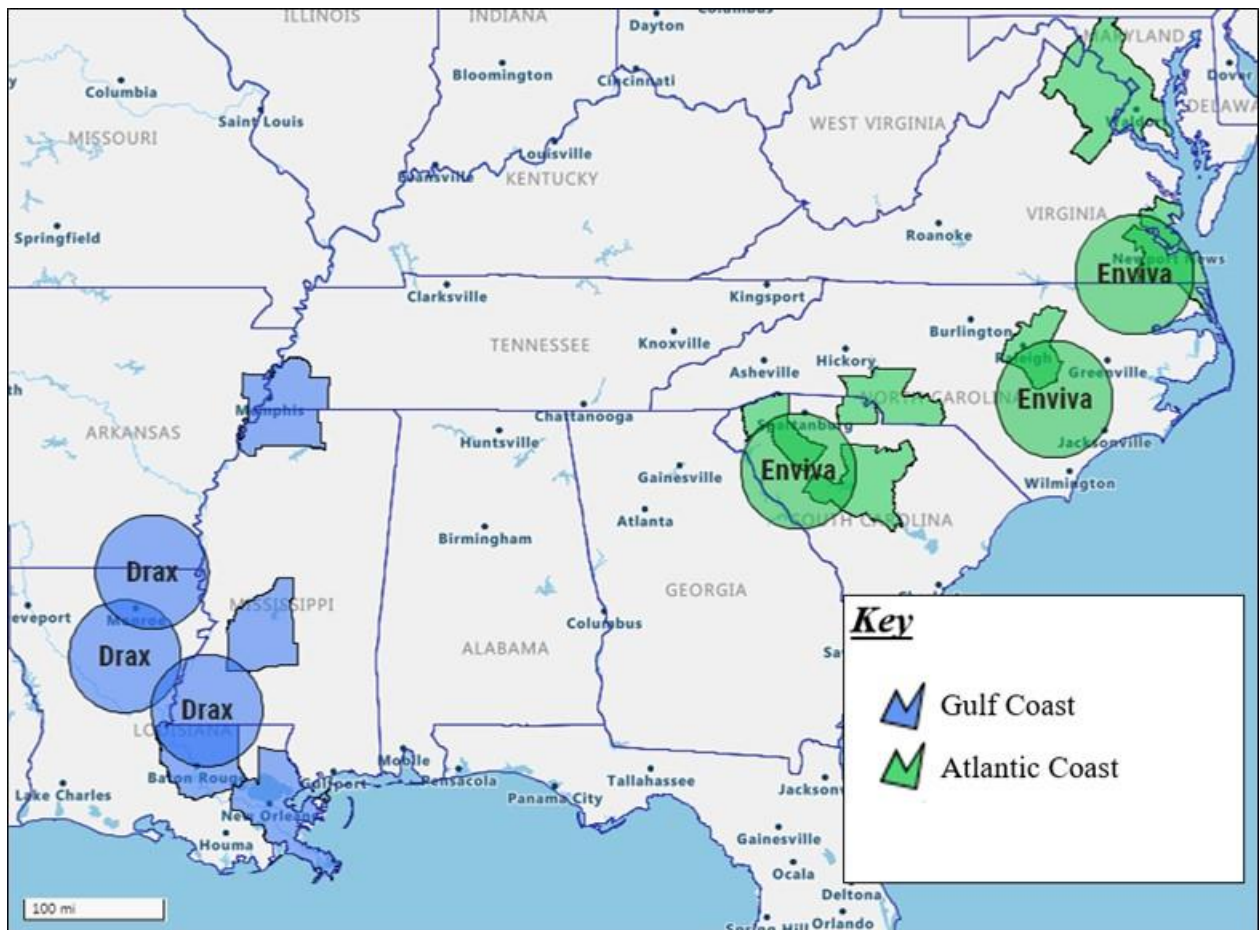
Figure 3. Map of Gulf Coast and Atlantic Coast regions.

Demographics

Table 3 reports the F-statistic and significance of one-way ANOVA test for the four continuous variables of population, age, education, and income as well as the value and asymptotic significance of Pearson's χ^2 test for the categorical variables of gender, ethnicity, and political affiliation.

Figure 4 presents the population of respondents' City/Town. A one-way ANOVA test determined that the difference in populations between Gulf Coast and Atlantic Coast respondents was not statistically significant at $\alpha = 0.05$ significance level.

Table 3. One-way ANOVA and χ2 results for demographic variables.

Demographic	F-statistic	Significance (at α = 0.05)* (at α = 0.01)**	Demographic	Pearson's χ2 value	Asymptotic significance (at α = 0.05)* (at α = 0.01)**
Population of City/ Town	0.007	0.935	Gender	0.934	0.334
Age	0.177	0.675	Ethnicity	7.111	0.13
Level of Education	3.332	0.073	Political Affiliation	13.579	0.004
Level of Income	2.475	0.121			
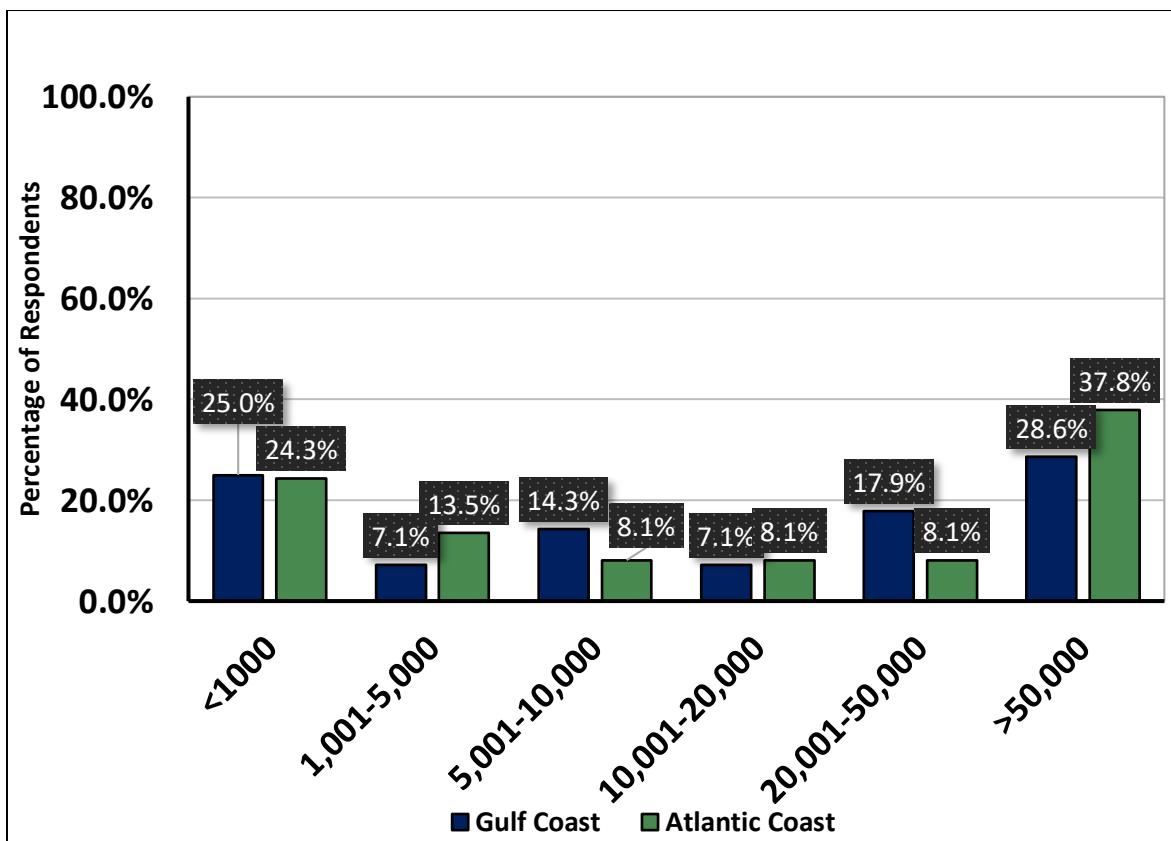
Figure 4. Population of respondent City/ Town (n=65).

A one-way ANOVA did not find any statistical significant difference between Gulf Coast and Atlantic Coast respondents and age at α = 0.05 significance level. Age was roughly even among respondents (Figure 5).

Using Pearson's χ^2 test, no statistically significant association was found between gender and region at α = 0.05 significance level. However, more females responded from the Gulf Coast at 60.7% compared to the nearly even gender of Atlantic Coast respondents (Figure 6). Similarly, using a one-way ANOVA, no statistically significant difference was found between the level of education of Gulf Coast and Atlantic Coast respondents at α = 0.05 significance level. However, Atlantic Coast respondents were more educated, as 70.2% had a college degree or higher compared to the 60.7% of Gulf Coast respondents (Figure 7).
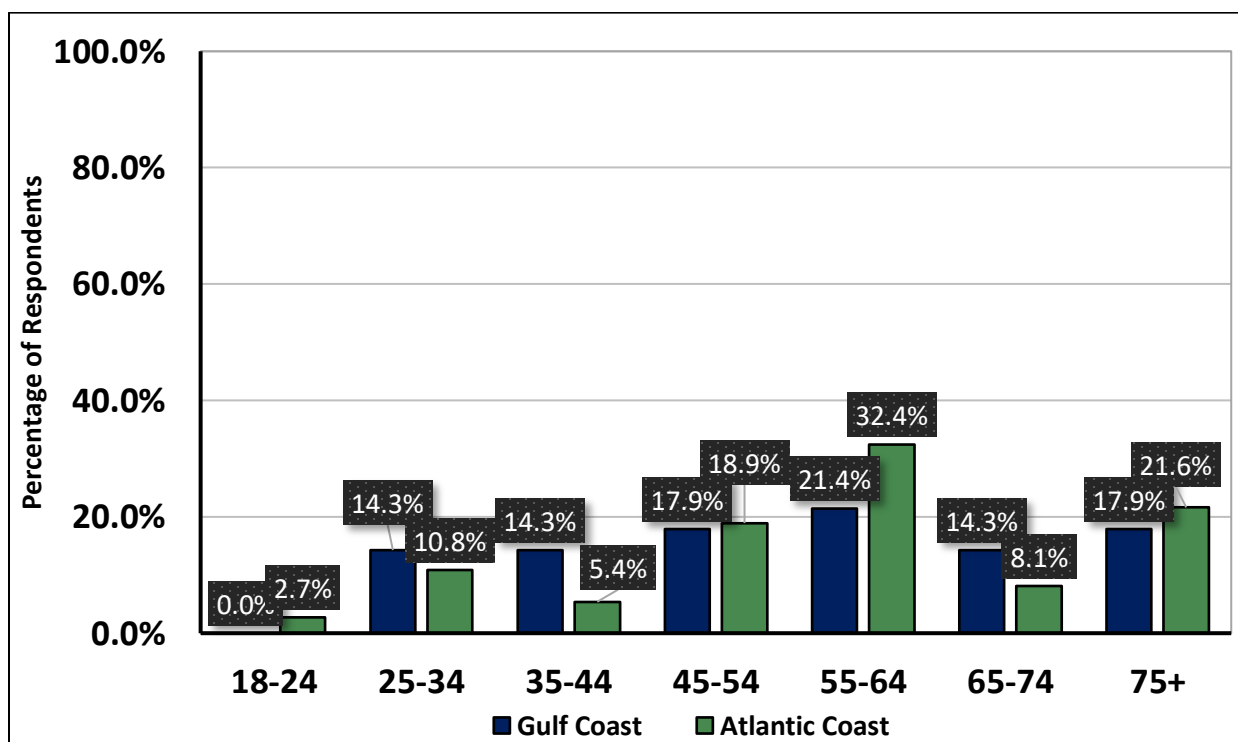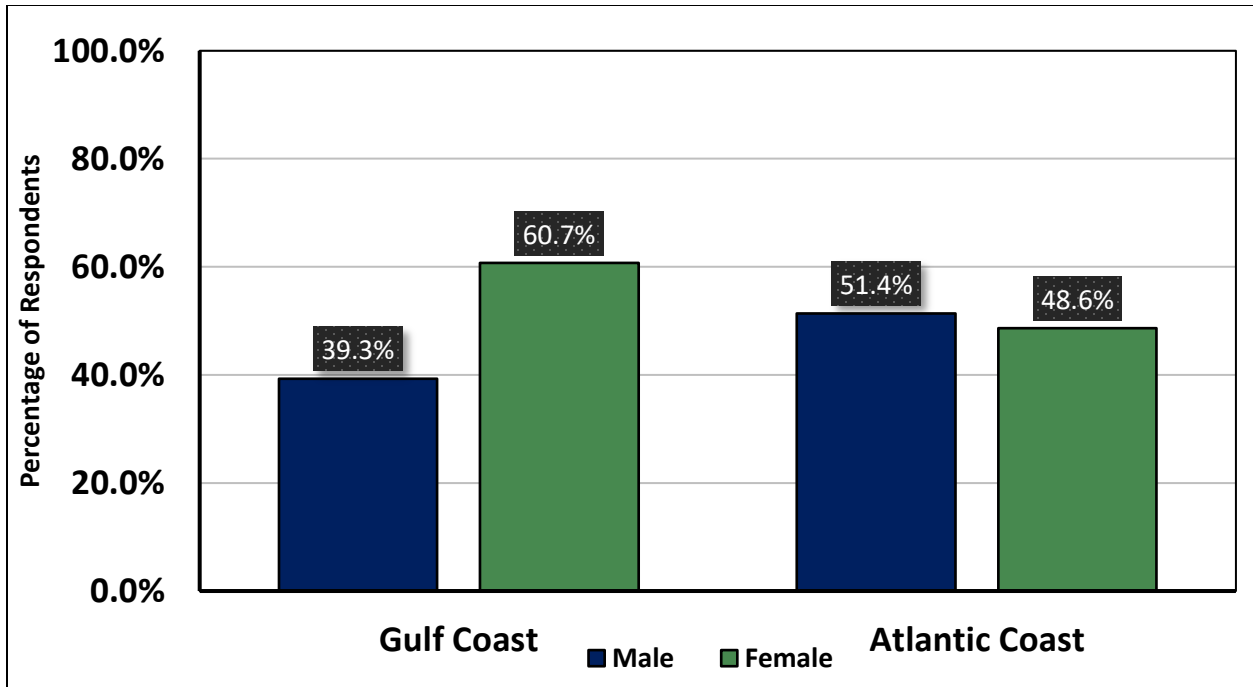

Figure 5. Age of respondents (n=65).
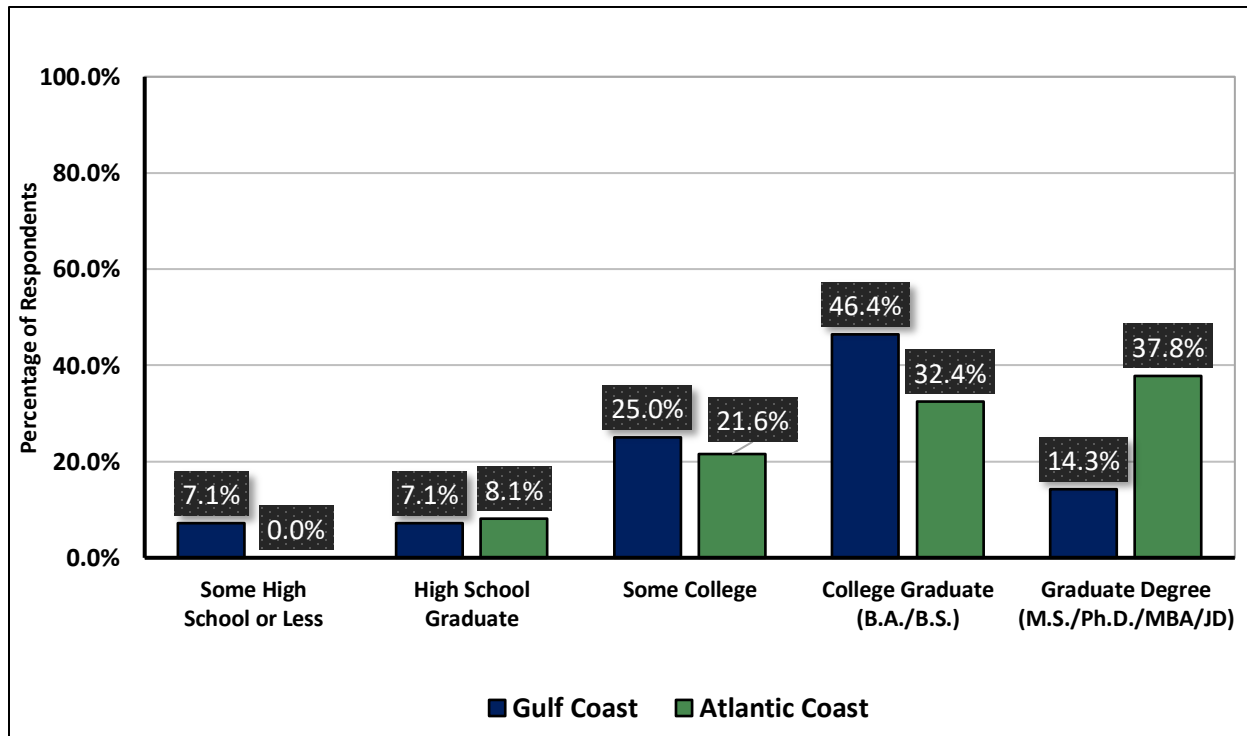
Figure 6. Gender of respondents (n=65).

Figure 7. Respondent level of education (n=65).

No statistically significant association was found between ethnicity and region at α = 0.05 significance level using Pearson's χ^2 test. Respondents from both regions were predominantly white (Figure 8). Similarly, using a one-way ANOVA, no statistically significant difference was found between the level of income of Gulf Coast and Atlantic Coast respondents at α = 0.05 significance level. Nearly 41% of Gulf Coast respondents had a household income of less than $80,000 compared to the Atlantic Coast 27.9% (Figure 9). Comparable to level of education, this result was to be expected because of the association between education and income.

Lastly, Pearson's χ^2 test revealed a statistically significant association between political affiliation and the region at α = 0.05 significance level. Atlantic Coast respondents were only 21.6% Republican compared to the Gulf Coast 60.7% (Figure 10). Over 48% of Atlantic Coast respondents reported they were Democrats compared to the 14.3% of Gulf Coast respondents.
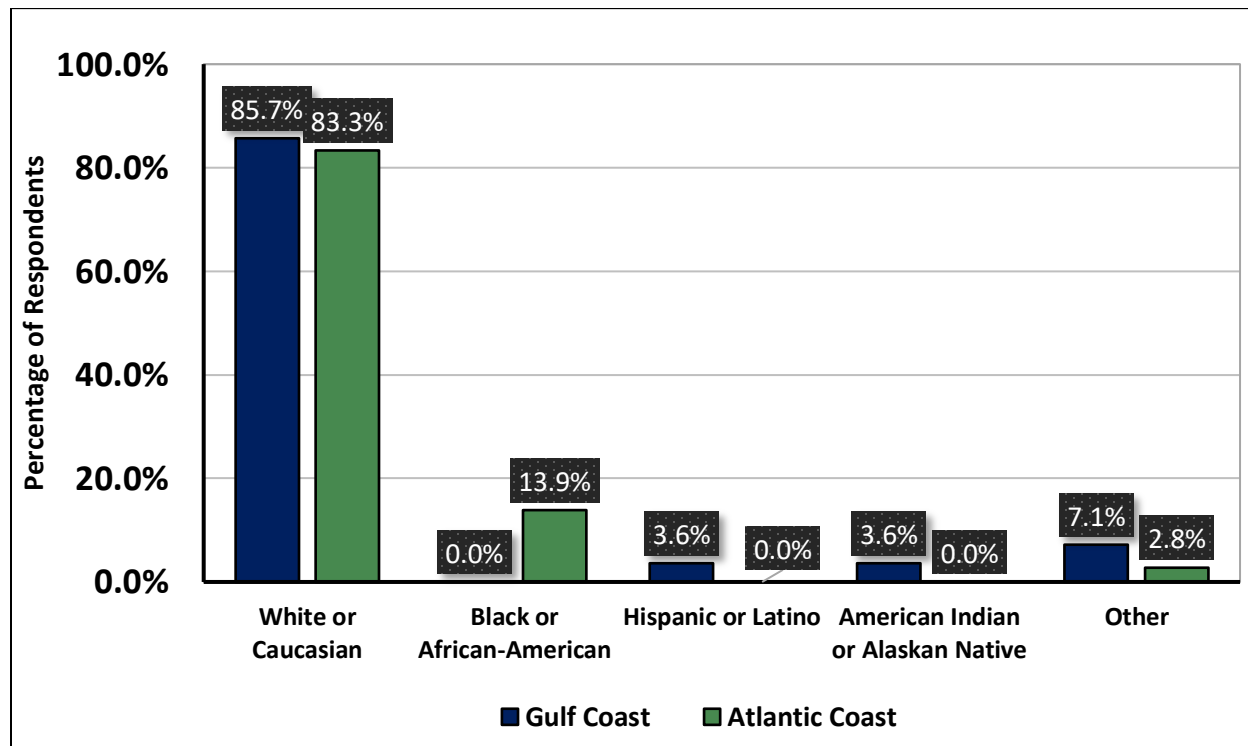

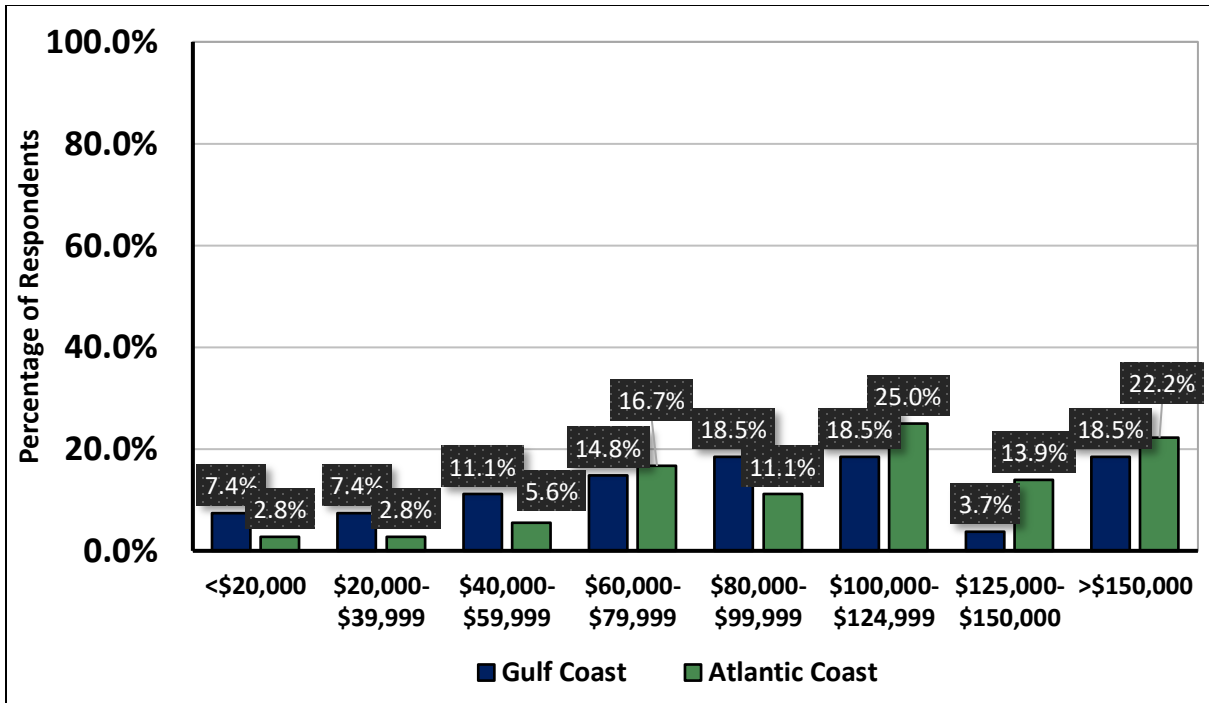*Figure 8. Ethnicity of respondents (n=64).*

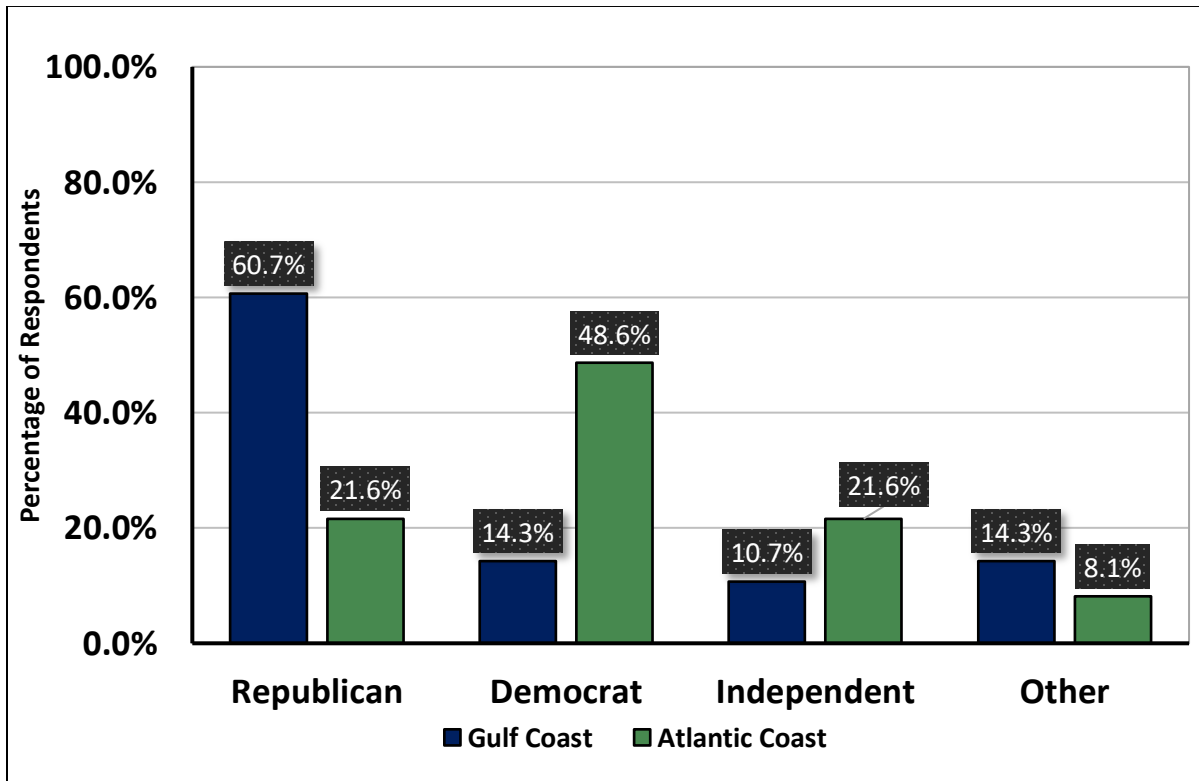*Figure 9. Respondent level of income (n=63).*

Figure 10. Political affiliation of respondents (n=65).

Wood pellet manufacturing industry awareness

Using an independent sample two-tailed t-test, no statistically significant difference was found at α = 0.05 significance level between Gulf Coast and Atlantic Coast respondents for awareness of the wood pellet manufacturing industry (Figure 11). The mean response to this question was 2.4 for Gulf Coast respondents and 2.5 for Atlantic Coast respondents on a five-point Likert-type scale, indicating a generally low awareness for both regions (1=Not at all aware; 2= Not very aware; 3= Neither aware nor unaware; 4= Somewhat aware; 5= Very aware). When asked if they were aware of any pellet manufacturers, 39.3% of Gulf Coast respondents reported they were, compared to 28.9% of Atlantic Coast respondents.
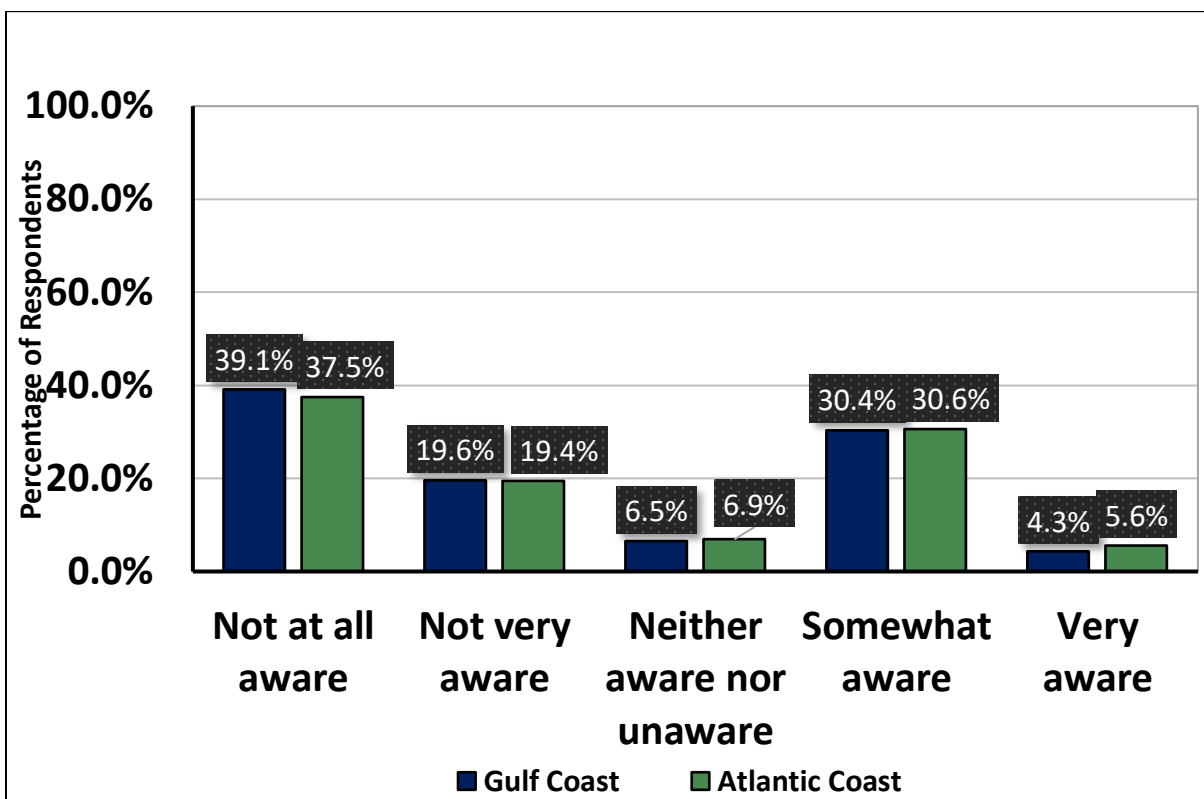

Figure 11. Awareness of the wood pellet manufacturing industry (n=118).
Note: 1 - Not at all aware; 2 - Not very aware; 3 - Neither aware nor unaware; 4 - Somewhat aware; 5 - Very aware.

Independent sample two-tailed t-tests were employed to examine whether the awareness and knowledge of pellet manufacturers and industry differed between the regions (Table 4). The mean differences of both items were not statistically significant between Gulf Coast and Atlantic Coast respondents at α = 0.05 significance level. However, even though Gulf Coast respondents had a

higher mean for both statements, the means for both regions were below the neutral point of three, indicating respondents from neither region claimed to be aware of in-state manufacturers or very knowledgeable about the industry.

Table 4. Awareness and knowledge of the wood pellet manufacturing industry (n=68).

Item	Gulf Coast x̄	Atlantic Coast x̄	Significance (at α=0.05)* (at α=0.01)**
I am aware of wood pellet manufacturers in my state.	2.8	2.3	p=0.184
I am very knowledgeable about the wood pellet manufacturing industry.	2.2	1.9	p=0.274

Note: 1 - Strongly disagree; 2 - Somewhat disagree; 3 - Neutral; 4 - Somewhat agree; 5 - Strongly agree.

Figure 12 and Figure 13 present what Gulf Coast and Atlantic Coast respondents think wood pellets are made from and what they are used for, respectively. Both figures are ranked in descending order based on Gulf Coast responses.
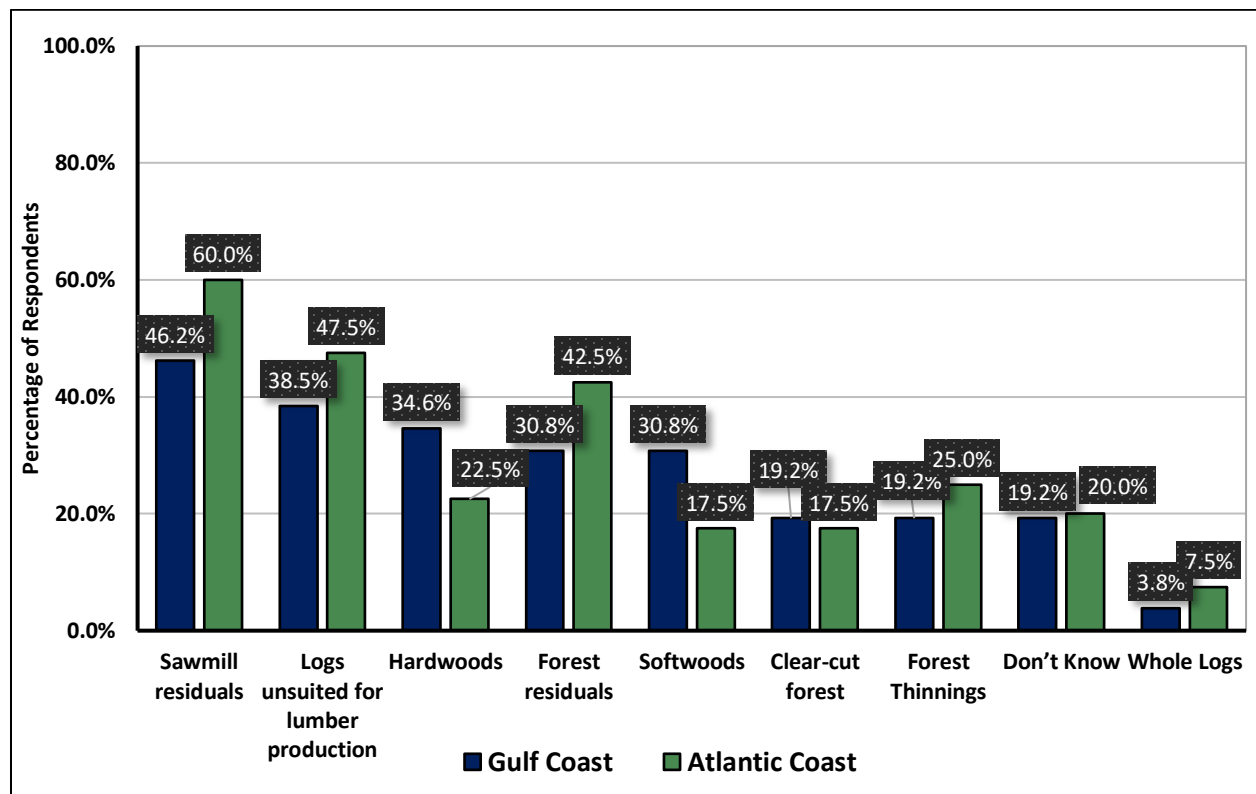

Figure 12. What Gulf Coast and Atlantic Coast respondents think wood pellets are made from (n=66) (multiple responses possible).
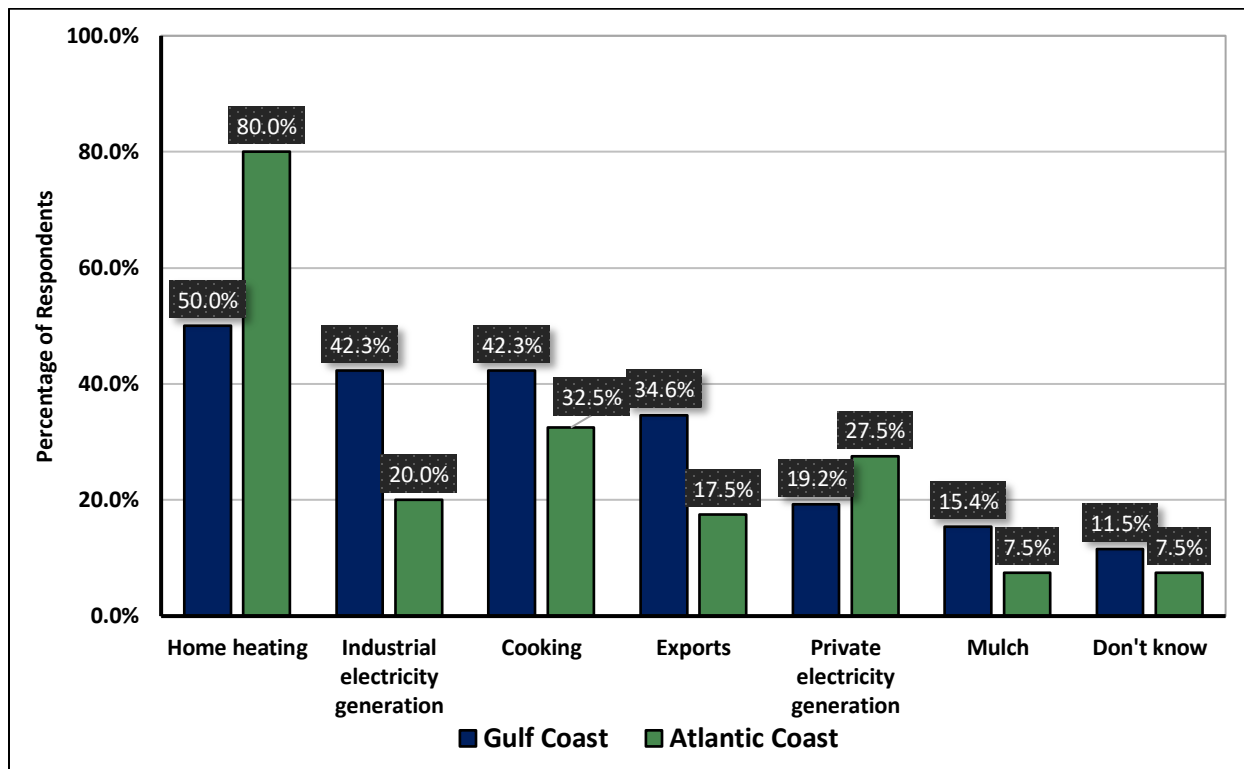
Figure 13. What Gulf Coast and Atlantic Coast respondents think wood pellets are used for (n=66) (multiple responses possible).

General environmental, social, and economic perceptions

Respondents were asked to rank their level of agreement for three banks of statements to reveal general environmental, social, and economic perceptions on five-point Likert-type scales (1= Strongly disagree; 2= Somewhat disagree; 3= Neutral; 4= Somewhat agree; 5= Strongly agree).

We used an adapted version of the New Environmental Paradigm scale (Dunlap et al. 2000) to examine overall environmental affinity. Two items were statistically significantly different between regional respondents at $\alpha = 0.05$ significance level for the (Table 5). For these two items, Atlantic Coast respondents reported a statistically significantly higher environmental affinity. Atlantic Coast respondents more strongly disagreed that "climate change caused by humans has been greatly exaggerated." They more strongly agreed that "humans are accelerating the rate of global warming."

Regarding the differences of the eight items that were not statistically significant, the means showed that the two regions had different relationships to the environment. Gulf Coast respondents

did not agree as much as Atlantic Coast respondents that "If things continue on their present course, we will soon experience a major climate change catastrophe." However, they more strongly disagreed that "Humans have the right to modify the environment to suit their needs" and "The balance of nature is strong enough to cope with the impacts of industrialization."

Table 5. General *environmental affinity of respondents (n=98).*

	Gulf Coast x̄	Atlantic Coast x̄	Significance (at α=0.05)* (at α=0.01)**
Humans have the right to modify the environment to suit their needs.	2.5	2.7	*p*=0.316
Human economic needs are more important than protecting the environment.	2.0	2.1	*p*=0.491
When humans interfere with the environment it often produces disastrous consequences.	3.7	3.9	*p*=0.303
The balance of nature is strong enough to cope with the impacts of industrialization.	1.9	2.3	*p*=0.094
Humans are accelerating the rate of global warming.	3.1	3.8	*p*=0.01*
Climate change caused by humans has been greatly exaggerated.	3.4	2.6	*p*=0.003**
Humans were meant to rule over the rest of nature.	2.4	2.4	*p*=0.962
Humans will eventually learn enough about global warming to be able to control it.	2.7	2.7	*p*=0.814
If things continue on their present course, we will soon experience a major climate change catastrophe.	3.0	3.5	*p*=0.072
Climate change is a naturally occurring phenomena, not caused by humans.	3.0	2.6	*p*=0.089

Note: 1 - Strongly disagree; 2 - Somewhat disagree; 3 - Neutral; 4 - Somewhat agree; 5 - Strongly agree.

In the social/community issues scale, three items were found to be statistically significantly different between the two regions at α = 0.05 significance level, including two that were significantly different at α = 0.01 (Table 6). Atlantic Coast respondents more strongly agreed that "It is important to me that the companies in my community do not harm the environment", "I/my family recycles materials such as glass, plastic, and paper", and "My community has a recycling program in place for materials such as glass, plastic, and paper." Respondents from both regions were generally concerned about natural resources within their community and were generally willing to be inconvenienced in order to positively affect their community. However, while all mean differences were not statistically significant, Atlantic Coast respondents more strongly agreed with all statements than Gulf Coast respondents.

Table 6. General social perceptions of respondents (n=93).

	Gulf Coast x̄	Atlantic Coast x̄	Significance (at α=0.05)* (at α=0.01)**
It is important to me that the companies in my community do not harm the environment.	4.1	4.4	*p*=0.049*
I/my family recycles materials such as glass, plastic, and paper.	3.4	4.2	*p*=0.001**
My community has a recycling program in place for materials such as glass, plastic, and paper.	2.7	4.4	*p*=0.000**
I am generally concerned about the natural resources in my community such as forest, air, and water.	4.2	4.4	*p*=0.311
I am willing to be inconvenienced in order to participate in recycling that is environmentally friendly in my community.	3.8	4.1	*p*=0.306

Note: 1 - Strongly disagree; 2 - Somewhat disagree; 3 - Neutral; 4 - Somewhat agree; 5 - Strongly agree.

One item in the general economic scale was found to be statistically significantly different at α = 0.05 significance level between respondents from the two regions (Table 7). Atlantic Coast

respondents more strongly agreed that their community has a strong economy. Although the mean differences were not all statistically significant, Atlantic Coast respondents also more strongly agreed that governments should provide financial support to develop local businesses compared to Gulf Coast respondents, who slightly agreed more that industry should stand on its own.

Table 7. General economic perceptions of respondents (n=91).

	Gulf Coast $\bar{X}$	**Atlantic Coast** $\bar{X}$	**Significance (at α=0.05)* (at α=0.01)****
Job creation is important to my community.	4.5	4.2	*p*=0.199
My community has a strong economy.	3.3	3.8	*p*=0.036*
A strong economy is important to my community.	4.4	4.5	*p*=0.868
Local government should provide financial support to develop/ maintain businesses in my community.	2.9	3.4	*p*=0.114
State government should provide financial support to develop/ maintain businesses in my community.	2.9	3.4	*p*=0.072
The Federal Government should provide financial support to develop/ maintain businesses in my community.	3.0	3.2	*p*=0.448
Industry should stand on its own without government support/ intervention.	3.4	3.3	*p*=0.897

Note: 1 - Strongly disagree; 2 - Somewhat disagree; 3 - Neutral; 4 - Somewhat agree; 5 - Strongly agree.

Respondents were asked to provide their level of agreement on a five-point Likert-type scale regarding the need for different energy sources to be a priority in the US. According to independent sample two-tailed t-tests, no statistically significant difference was found between Gulf Coast and Atlantic Coast respondents at α = 0.05 significance level. The means of both regions ranked solar, followed by hydro energy to be the highest priorities. In contrast, woody biomass ranked second

to last for Gulf Coast respondents and fourth to last for Atlantic Coast respondents. Coal was the least prioritized for both groups (Figure 14).
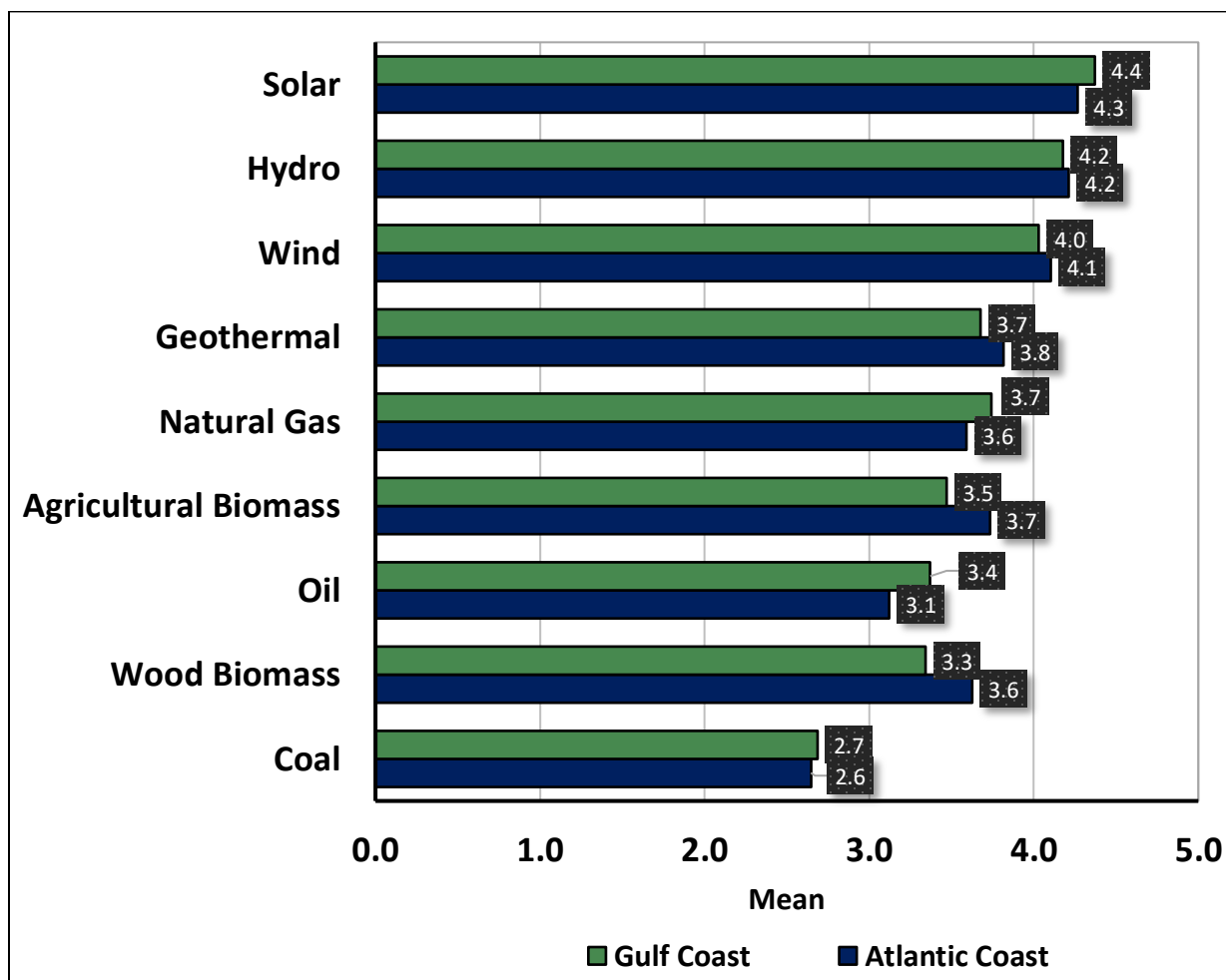

Figure 14. Level of agreement regarding prioritization of different energy sources (n=84).
Note: 1 - Strongly disagree; 2 - Somewhat disagree; 3 - Neutral; 4 - Somewhat agree; 5 - Strongly agree.

Drilling down: perceptions of the wood pellet manufacturing industry

Respondents were also asked for their level of agreement regarding wood pellets as a viable energy alternative to fossil fuels. No statistically significant difference was found at $\alpha = 0.05$ significance level; the means were 3.2 for respondents of both regions on a five-point Likert-type scale (1= Strongly disagree; 2= Somewhat disagree; 3= Neutral; 4= Somewhat agree; 5= Strongly agree), indicating both groups slightly agreed. Similarly, the overall opinion of using wood pellets for energy was not statistically significantly different at $\alpha = 0.05$ significance level between regions;

the means were 3.4 for respondents of both regions on a five-point Likert-type scale (Figure 15). Both regions had a generally positive opinion of using wood pellets for energy with 45.2% of Gulf Coast and 50% of Atlantic Coast respondents reporting either somewhat positive or extremely positive.
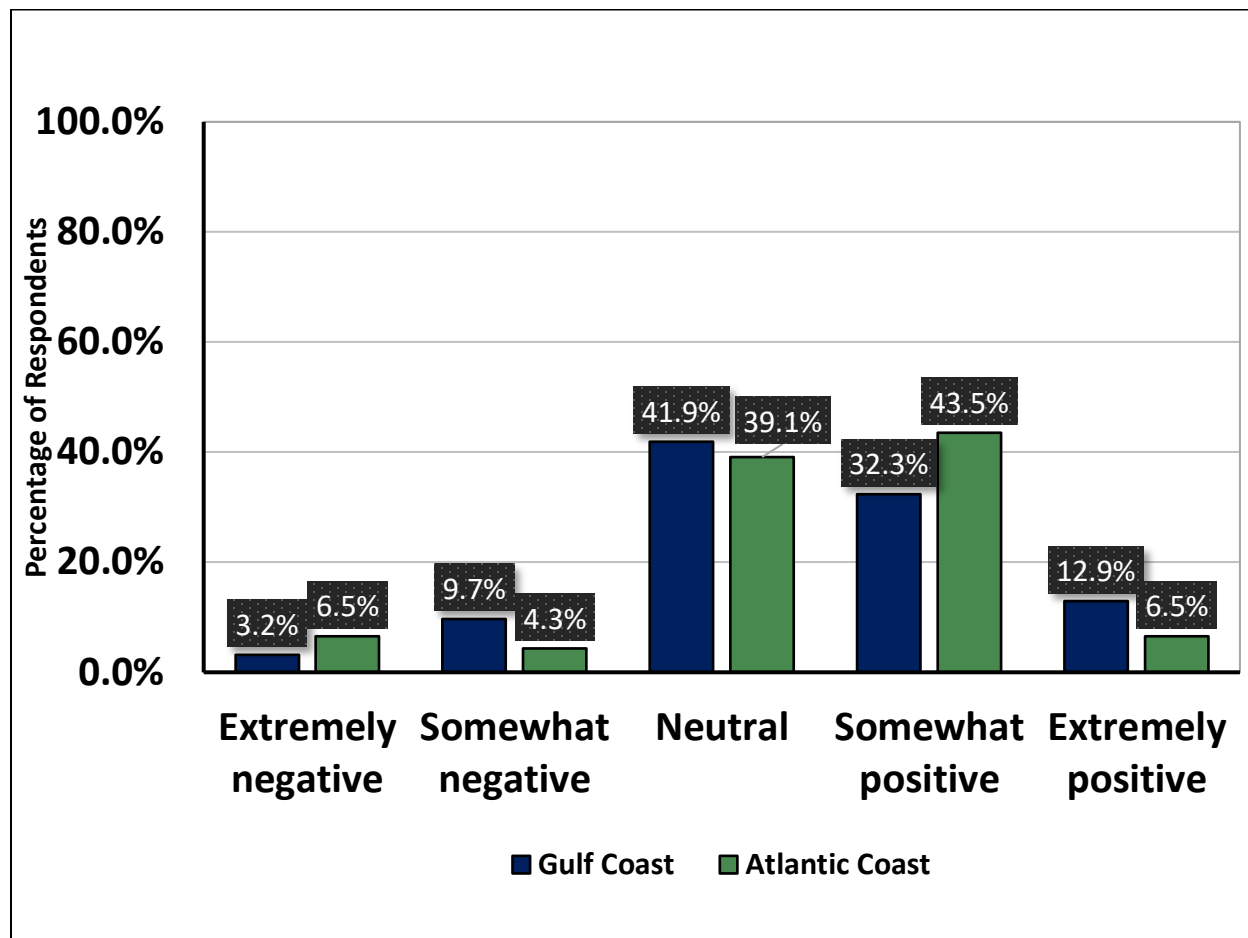

Figure 15. Overall opinion of using wood pellets for energy (n=77). Note: 1 - Strongly disagree; 2 - Somewhat disagree; 3 - Neutral; 4 - Somewhat agree; 5 - Strongly agree.

Environmental perceptions of the wood pellet manufacturing industry

Table 8 summarizes Gulf Coast and Atlantic Coast responses regarding five environmental statements dealing with the industry. Overall, respondents were generally neutral toward these statements. Using independent sample two-tailed t-tests, no mean differences were statistically significant between regions at $\alpha = 0.05$ significance level. However, while not statistically

significantly different, Atlantic Coast respondents disagreed more that "Harvesting trees to manufacture wood pellets is not harmful to the environment."

Table 8. Environmental perceptions regarding the wood pellet manufacturing industry (n=79).

	Gulf Coast $\bar{x}$	Atlantic Coast $\bar{x}$	Significance (at α=0.05)* (at α=0.01)**
I trust the wood pellet manufacturing industry to act in the best interest of the environment.	3.2	3.1	*p*=0.624
I think the wood pellet manufacturing industry utilizes appropriate forest management practices.	3.3	3.2	*p*=0.625
Currently, the wood pellet manufacturing industry is effective in its efforts to help protect the environment.	3.2	3.1	*p*=0.287
Wood pellets are an environmentally superior alternative method of energy generation relative to fossil fuels.	3.3	3.2	*p*=0.314
Harvesting trees to manufacture wood pellets is not harmful to the environment.	3.2	2.8	*p*=0.115

Note: 1 - Strongly disagree; 2 - Somewhat disagree; 3 - Neutral; 4 - Somewhat agree; 5 - Strongly agree.

Regarding opinions of the wood pellet manufacturing industry's impact on the environment, Table 9 summarizes Gulf Coast and Atlantic Coast responses on six items, followed by the environmental impact index. Items are ranked by least negatively impacted to most negatively impacted by average of the means. Using an independent sample two-tailed t-tests, five items were found to be significantly different between Gulf Coast and Atlantic Coast respondents at α = 0.05 significance level, including the environmental impact index. The industry's impact on "sustainable forest", "forest-based recreation", "soil quality", and "air quality was perceived more negatively by respondents from the Atlantic Coast. Respondents from the Atlantic Coast reported that the industry more negatively impacted all environmental items compared to Gulf Coast respondents,

indicated by the lower means and the statistically significant difference of the environmental impact index.

Table 9. Opinions of the wood pellet manufacturing industry's environmental impacts (n=73).

	Gulf Coast $\bar{x}$	Atlantic Coast $\bar{x}$	Significance (at α=0.05)* (at α=0.01)**
Sustainable Forests	3.3	2.8	*p*=0.019*
Forest-based Recreation	3.3	2.6	*p*=0.003**
Soil Quality	3.2	2.7	*p*=0.011*
Water Quality	3.1	2.8	*p*=0.112
Air Quality	3.0	2.6	*p*=0.042*
Wildlife Habitat	2.9	2.8	*p*=0.608
Environmental Impact Index	3.2	2.7	*p*=0.004**

Note: 1 - Strongly disagree; 2 - Somewhat disagree; 3 - Neutral; 4 - Somewhat agree; 5 - Strongly agree.

Social perceptions of the wood pellet manufacturing industry

Table 10 summarizes Gulf Coast and Atlantic Coast responses regarding six social statements dealing with the industry. Overall, respondents from the Gulf Coast reported a higher level of agreement with all of the statements, indicating that they more approved of the industry's social interactions than Atlantic Coast respondents. Independent sample two-tailed t-tests revealed that two statements were statistically significantly different between Gulf Coast and Atlantic Coast respondents at α = 0.05 significance level. Gulf Coast respondents more strongly agreed that the wood pellet manufacturing industry "creates quality jobs" and "is a superior industry for communities."

Table 10. Social perceptions regarding the wood pellet manufacturing industry (n=68).

	Gulf Coast $\bar{x}$	Atlantic Coast $\bar{x}$	Significance (at α=0.05)* (at α=0.01)**
Is concerned about the needs of communities.	3.1	2.9	*p*=0.381
Contributes to community economic health.	3.4	3.1	*p*=0.067
Contributes to community activities and services.	3.1	2.8	*p*=0.055
Is a good industry to work for.	3.3	3.1	*p*=0.163
Creates quality jobs.	3.6	3.2	*p*=0.018*
Is a superior industry for communities.	3.4	3.0	*p*=0.014*

Note: 1 - Strongly disagree; 2 - Somewhat disagree; 3 - Neutral; 4 - Somewhat agree; 5 - Strongly agree.

Gulf Coast and Atlantic Coast respondent levels of concern for 11 social issues associated with converting wood to pellets for energy production are presented in Figures 16 and 17, ranked in order of highest to lowest concern. The means of these 11 social issues were averaged for all respondents to create a production concern index. Independent sample two-tailed t-tests did not reveal any statistically significant differences between Gulf Coast and Atlantic Coast respondents at α = 0.05 significance level. However, although not statistically significantly different, Atlantic Coast respondents had a higher production concern index of 3.5 compared to the Gulf Coast 3.4, indicating that Atlantic Coast respondents were slightly more concerned with production issues compared to Gulf Coast respondents. In fact, Atlantic Coast respondents were more concerned with all of the issues presented besides "Road quality/ damage."
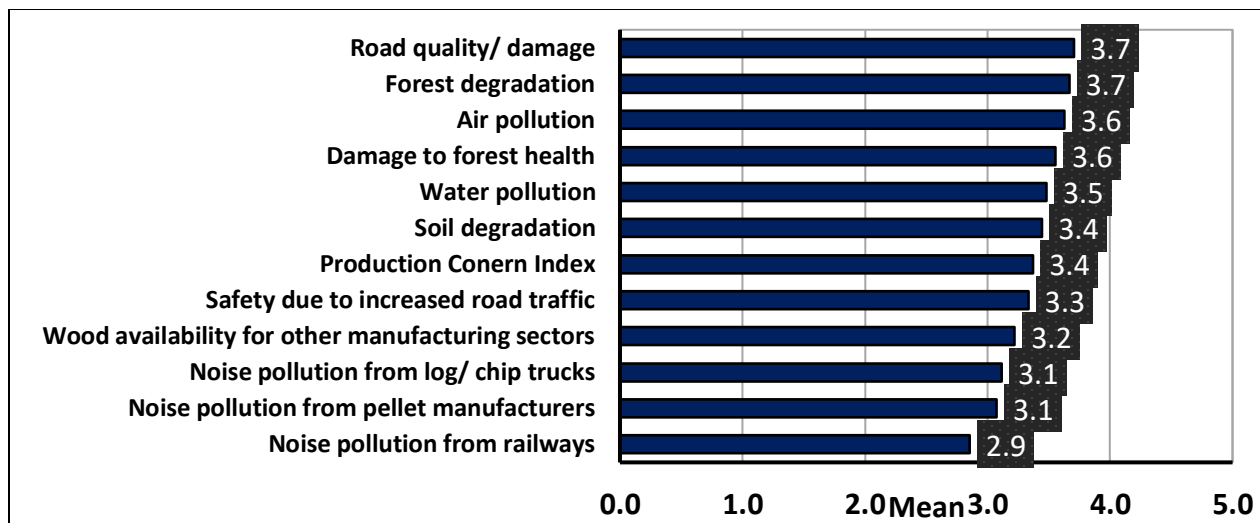
Figure 16. Social production concern issues of Gulf Coast *respondents (n=27). Note: 1 - Not concerned at all; 2 - Not very concerned; 3 - Neutral; 4 - Somewhat concerned; 5 - Very concerned.*
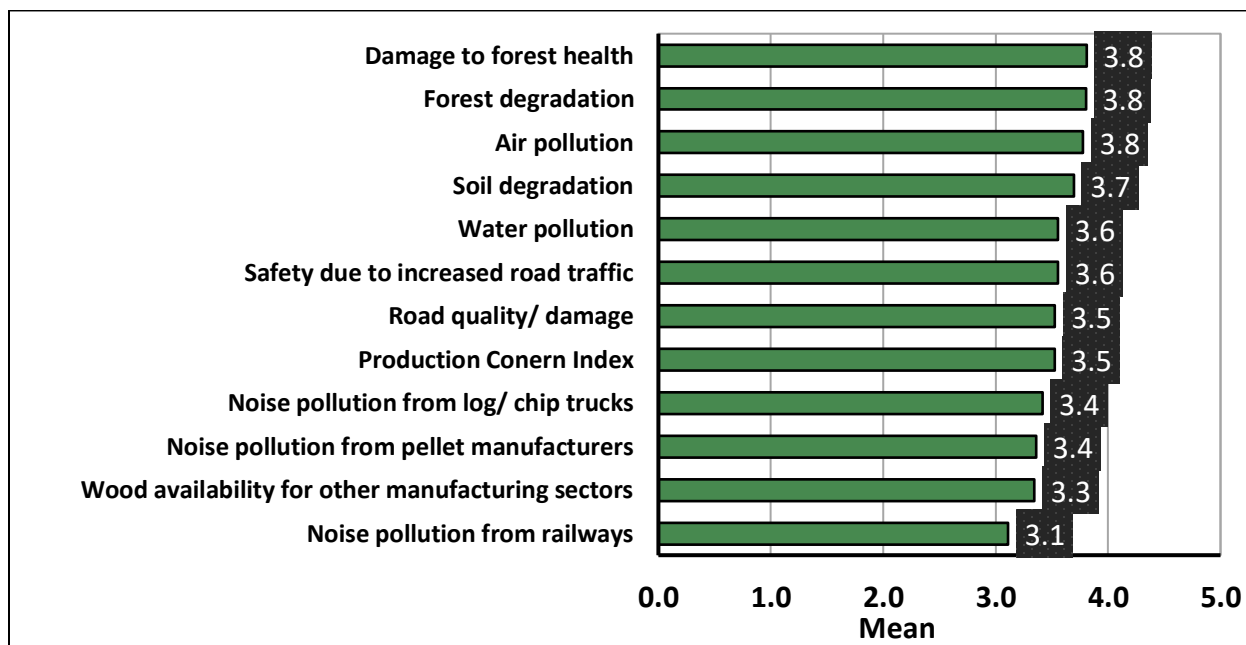

Figure 17. Social production concern issues of Atlantic Coast *respondents (n=37). Note: 1 - Not concerned at all; 2 - Not very concerned; 3 - Neutral; 4 - Somewhat concerned; 5 - Very concerned.*

Economic perceptions of the wood pellet manufacturing industry

Of the 30.3% of respondents that owned forestland in their state of residence, 35% were Gulf Coast respondents and 65% were Atlantic Coast respondents. On average, respondents from the Atlantic Coast region owned 21.3 more acres of forestland than those from the Gulf Coast region. Using

an independent sample two-tailed t-test, there was no statistically significant difference at $\alpha = 0.05$ significance level between Gulf Coast and Atlantic Coast respondents regarding the amount of forestland owned.

Regarding the types of financial support that respondents believe local, state, and federal governments should provide to the wood pellet manufacturing industry, state governments received the most responses. Overall, state government received the largest proportion of responses from both Gulf Coast (46.1%) and Atlantic Coast (44.1%) respondents across all items, indicating respondents from both areas thought government funding should primarily be provided by state governments.

DISCUSSION AND CONCLUSIONS

The study revealed that Gulf Coast respondents were more aware of the wood pellet manufacturing industry than Atlantic Coast respondents. Overall, results indicated that Gulf Coast respondents more strongly approved of the industry's environmental, social, and economic impacts and contributions toward local communities. Gulf Coast respondents reported only wildlife habitat to be negatively impacted, while Atlantic Coast respondents reported all environmental items to be negatively impacted. Similarly, Gulf Coast respondents were overall less concerned with social production concern issues compared to Atlantic Coast respondents. Gulf Coast respondents generally held the wood pellet manufacturing industry in higher regard compared to Atlantic Coast respondents.

Implications and future research

The general public plays a crucial role in the outcome of an extractive project. The human, social, and financial capital presented by the general public are of significant interest to companies seeking long-term success. Local communities expect transparent and responsible use of natural resources in return for these sources of capital. In the context of the wood pellet manufacturing industry, companies are developing initiatives to communicate environmental efforts through community outreach programs better. Regarding the research on business-community relationships of the wood pellet manufacturing industry to assist these initiatives, there is a

significant gap in the knowledge base. Overall, no prior primary empirical research has been conducted that examines residents' environmental, social, and economic perceptions as they relate to the industry.

The findings of this research are a foundation for Southern wood pellet manufacturing companies to develop community engagement programs amongst the strategies to remain socially responsible and transparent with the public. The revelation of this emerging industry's environmental, social, and economic perceptions allows companies in the South to align their goals to that of resident public perception and examine potential future impacts based on respondent perceptions. The research findings are also useful to local and state governments for formulating new policies to promote sustainable industrial practices in the South. In the future, public policy is likely to place increasing importance on environmentally responsible business practices that affect the overall health of the general public, sustainability of natural resource extraction, and mitigation of climate change.

Going forward, future research should investigate perceptions from a broader range of stakeholders involved with the wood pellet manufacturing industry. The collection of perceptions from stakeholders such as forest landowners, forest supply chain employees, and government entities would further depict and explain the perceptions and overall attitudes toward the wood pellet manufacturing industry.

CONFLICT OF INTERESTS

The authors declare no conflict of interest.

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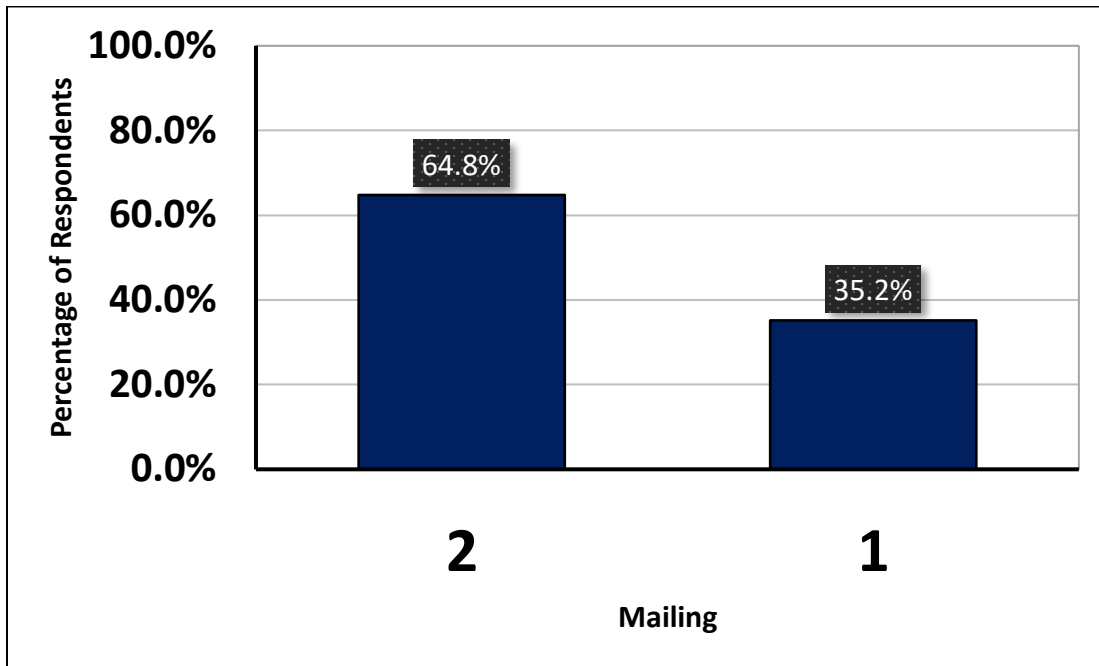
APPENDIX A. OVERALL SURVEY RESULTS

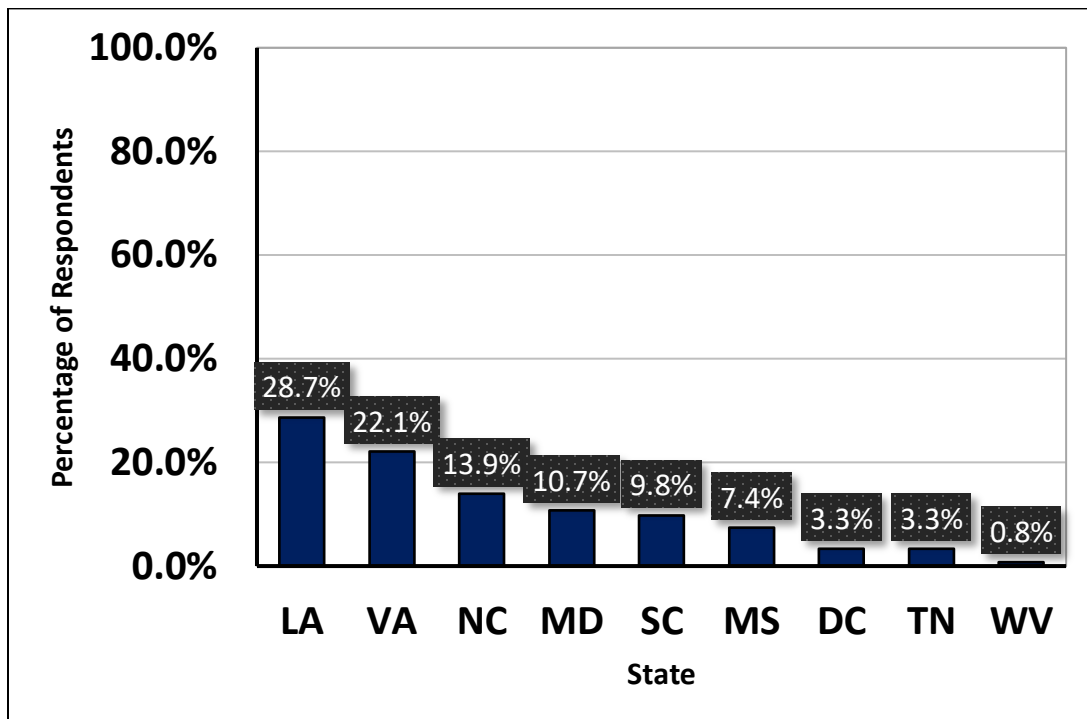*Figure B.1. Responses by mailing (n=122).*
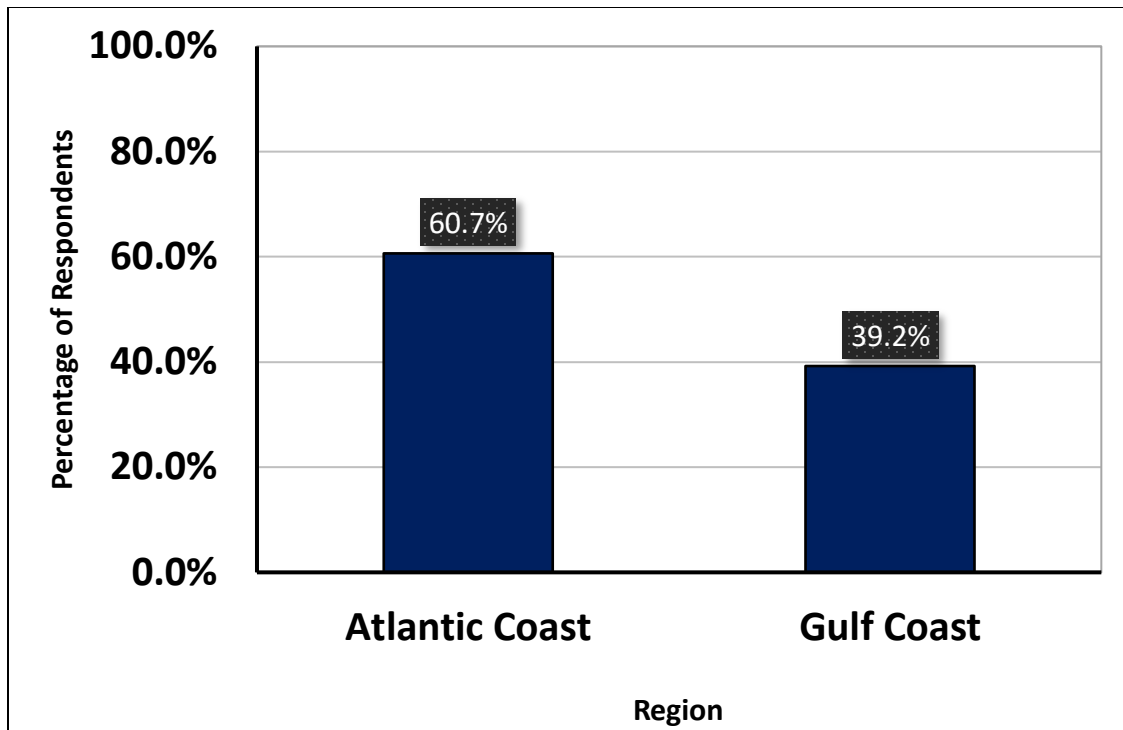

Figure B.2. Respondents by state (n=122).

Figure B.3. Percentage of respondents by region (n=122).