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Risk-benefit perceptions of natural gas export in Oregon

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Public perceptions of fracking and natural gas have received significant scholarly attention recently. However, opinion research is scant with respect to natural gas export (the transport and sale of natural gas from one country to another via pipeline or ship) and its associated economic benefits and environmental risks. Understanding public views on export, particularly in places where export facilities are proposed, is important because the U.S. has rapidly increased its natural gas exports overseas in the wake of the shale revolution. Moreover, such facilities have been targeted by anti-fossil fuel and climate activists as a weak link in the chain of the fossil fuel economy, particularly on the U.S. West Coast where proposals for export terminals have proven unsuccessful. Using a web-based opinion survey in the state of Oregon (n=500), we evaluate risk and benefit perceptions of natural gas export and the role of socio-demographic, political ideology, and place-based factors in shaping these perceptions. We find that men, conservatives, urban residents, and those who perceive that their community's economic identity is tied to extractive industries are less likely to perceive risks and more likely to perceive benefits from natural gas export. Respondents with a bachelor's degree and those who perceive that their community's economic identity is tied to renewable energy are more likely to perceive risks and less likely to perceive benefits. Whereas much of energy social science is focused on sites of extraction, our results contribute to the growing understanding of the social dimensions of energy export.

Keywords: natural gas export, public opinion, risk-benefit, survey, liquefied natural gas

Introduction

The development of hydraulic fracturing and horizontal drilling technologies has unlocked large shale oil and gas domestic reserves that were once unrecoverable (Trembath 2012). In addition to provoking widespread replacement of coal-fired power plants with natural gas, this boost in production has pushed energy companies to develop Liquefied Natural Gas (LNG) export terminals along the nation's coasts to sell

to overseas markets. As a result, the U.S. became a net exporter of natural gas in 2017 (EIA 2020), largely driven by facilities located along the Gulf of Mexico.

Oregon and the greater Pacific Northwest (PNW) region represent an important area to study public perceptions of natural gas export. Environmental activists in this region have attempted to hold a “thin green line” between fossil fuel extraction sites in the Mountain West and Asian markets through a combination of public opposition and strict state permitting processes (Hazboun 2019). The region is known for being environmentally progressive (Hazboun and Boudet 2020) and hosts only about 48,000 miles of transmission lines and distribution pipelines (NGA 2014). Oregon itself has three interstate pipelines and no crude oil production or fuel-producing refineries (Halleran 2018). Yet, energy companies view Oregon as a strategic location for natural gas export to Asian Markets.

Several natural gas import and export projects have been slated for Oregon’s coast over the years: first as import facilities, largely to serve California markets before the “shale revolution” significantly increased domestic production, and then as export facilities to reach energy-hungry Asian markets. In total, six facilities have been proposed along the Oregon Coast (Ladd 2018; Stelmach and Boudet, 2021; Tran et al. 2019), none of which have succeeded and been built. The Jordan Cove Energy Project (JCP) – which included both an LNG export terminal located on the coast in Coos Bay, Oregon, and a 230-mile pipeline connecting Coos Bay to an existing pipeline in Malin – was the longest lasting proposal. It underwent a series of permit submissions, reviews, approvals, and denials beginning in 2004, and was withdrawn by developers in 2021. In this study, we examine the factors that predict Oregon residents’ risk and benefit perceptions about natural gas export, including individuals’ general proximity to the JCP proposal. Understanding the views of Oregon residents relevant to natural gas

export proposals provides insight into a region with notable social and political differences than the Gulf region, where most LNG facilities are currently in operation or under construction.

This paper proceeds as follows. We first review potential risks and benefits associated with natural gas export in communities slated for proposals, then review existing public opinion studies on natural gas export, including the factors found to be related to public perception of natural gas export. Next, we describe the survey data and methodology used in this study, and detail the results and discussion of two regression models. Finally, we discuss potential implications for energy policy and social science.

Literature Review

Risk and benefits of natural gas and LNG

Commonly cited risks of natural gas transport and export include impacts to the local or regional environment, global climate change, and public health (Boudet 2019; Graham et al. 2015; Pierce et al. 2018). Pipeline and terminal construction can create impacts to the local environment, particularly to coastal environments from the dredging for the terminal itself (Craig Law Center 2021) and to rivers and streams through crossings (Rogue Riverkeeper 2020). Once built, natural gas transported by pipeline has been shown to leak methane at higher rates than formerly thought, contributing increased greenhouse gas emissions, and sometimes explode, leading to public health and safety risks (Finkel and Hays 2013; Groeger 2012). Furthermore, LNG facilities require a special process to cool and compress the gas before storage and shipment abroad. This process bears risks, including the potential for explosion (Balisampang et al. 2018; Englund 2021). Moreover, the ships themselves have caused concerns among nearby residents and opponents, particularly related to their potential as

a target for terrorist activity, with some referring to them as “floating bombs” (Meador 2018).

Conversely, the benefits of natural gas export are usually discussed in terms of the economy, including more jobs, increased tax revenue, and general economic development (Boudet 2019; Graham et al. 2015; Pierce et al. 2018). Natural gas in the United States supports three million jobs, adds an additional \$385 billion to the national economy, and supplies more than half of the energy to residential and commercial customers (Snelson Companies Inc. n.d.). Furthermore, the positive perception of natural gas as a ‘bridge fuel’ – helping the US transition to a renewable energy system – remains strong (Weissman 2016), despite new framings by environmental groups of natural gas as a significant contributor to greenhouse gas emissions (Delborne et al. 2020).

Public perception of natural gas export

Several factors make the study of public perception of natural gas export valuable. First, as mentioned above, public attitudes toward natural gas are changing, including the role of natural gas in the global energy supply under climate change (Hazboun and Boudet 2021). Second, the shale revolution and resulting glut of natural gas in countries like the United States mean that patterns of global natural gas export are shifting, exposing new communities and publics to its risks and benefits. Lastly, while North American energy opinion research has focused extensively on natural gas extraction (hydraulic fracturing), very little literature has examined public perception of export, making it an understudied but highly relevant area (Boudet and Hazboun 2022).

A few studies do exist on public perception of natural gas export. Pierce et al. (2018) found U.S. citizens to be fairly supportive of increasing the export of natural gas to other countries. However, Hazboun (2019) and Hazboun and Boudet (2022) found

that individuals in the Pacific Northwest region are more opposed than supportive of natural gas export, though respondents were fairly uncertain about the issue. Studying changing opinions over time in the US, Zanocco et al. (2022) found a steady increase in support for natural gas export from 2013 to 2017. The study by Hazboun and Boudet (2021) suggests this rising trend may be at least partly attributable to a cognitive disconnect between natural gas extraction (most often involving the highly controversial method of hydraulic fracturing) and the perception of natural gas as a more environmentally friendly fossil fuel for electricity generation, particularly to coal.

The above opinion studies on natural gas export have generally found correlates of support that are similar to previous research on fossil fuels use and extraction, including fracking. Namely, being male, white, politically conservative, and having a connection to extractive industries are factors generally associated with support for fossil fuels use and extraction. Below, we review the factors included in our present study and present hypotheses relating to each.

Gender

Studies on the views of risky technologies, including energy technologies, have consistently shown a “white male effect” – where men often subconsciously downplay significant environmental concerns of technologies to protect their identity and elite status within institutions due to their hierarchical individualist worldviews (Hall 2019). For example, studies have found that the most prominent climate denial has been identified in white males, extending across a wide variety of elites including media, scientists, think tank representatives, and politicians (McCright and Dunlap 2011). Moreover, white men report less concern regarding health, technological, and environmental risks and more support for risky technologies compared to other socio-

demographic groups (Boudet 2019; Brasier et al. 2013; Finucane et al. 2000). We make the following hypotheses:

H_{1A}: Males are less likely to perceive that natural gas export poses environmental risks than females.

H_{1B}: Males are more likely to perceive that natural gas export poses economic benefits than females.

Race

Similarly, white men are more often involved in the creation, management, and control of technology, while people of color tend to be more vulnerable to and have less control over the risks, sparking concerns about environmental equity and environmental racism within the siting processes of new energy development (Ansolabehere and Konisky 2009; Finucane et al. 2000; Flynn et al. 1994). People of color that live near energy production facilities often have lower incomes and experience the negative health and environmental impacts of prolonged exposure to emissions (Patterson et al. 2014). While the oil and gas industry argues that their projects bring economic prosperity, in 2009, African Americans held only 1.1 percent of energy jobs and gained only 0.01 percent of the revenue from the energy sector (Patterson et al. 2014). For these reasons, they are also more likely to consider societal issues, like poverty and racism, to be environmental issues (Lefkowitz 2020). Research studying the relationship between race and public opinion on energy development is straightforward and conclusive. People of color tend to be less supportive of natural gas infrastructure (Ansolabehere and Konisky, 2009; Boudet et al. 2014), more likely to support renewable energy (Hazboun, Howe, and Leiserowitz 2018), more concerned about

climate change (Ballew et al., 2020), and less supportive of the construction of new power plants, including natural gas, coal, and wind (Ansolabehere and Konisky 2009; Bergquist, Konisky, and Kotcher 2020). Thus, we hypothesize:

H_{2A}: White respondents are less likely to perceive that natural gas export poses environmental risk than non-white respondents.

H_{2B}: White respondents are more likely to perceive that natural gas export poses economic benefits than non-white respondents.

Age

In addition to gender and race, age has also proven important in shaping views on energy development. Younger generations have been called the “climate change generation” because they have been born into a warming world, resulting in younger Americans that are more environmentally minded (Leber 2019). Due to the links between climate change and fossil fuels, younger people are more concerned about the environmental risks associated with fossil fuels (Boudet 2019). Additionally, because younger generations perceive climate change to be the most important issue in the world, they believe it should be taken more seriously than economic growth (Barbiroglio 2019). However, among people of color, due to the shared experience of environmental racism and environmental injustice, environmental values have been found to be persistent over generations with respect to perceived environmental risks from air pollution, climate change, and nuclear power plants (Macias 2015). We present the following hypotheses:

H_{3A}: Older respondents are less likely to perceive that natural gas export poses environmental risks than younger respondents.

H_{3B}: Older respondents are more likely to perceive that natural gas export poses economic benefits than younger respondents.

Education

Finally, education levels have also been linked to views on energy development. Higher education institutions are locations where individuals are more likely to develop environmental awareness (Durmuş-Özdemir and Şener 2016). When evaluating the relationship between educational attainment and perceptions about environmental issues, Richardson, Milton, and Harrison (2020) found that those with only a high school education were more likely to discuss natural resources in terms of financial gain, had less knowledge regarding climate change, and felt disconnected from nature compared to those with post-high school education. However, a majority of participants in both educational groups perceived degraded natural resources have a negative impact on health and the environment (Richardson, Milton, and Harrison 2020). It has been suggested that the link between education and support for natural gas is because the benefits of job opportunities associated with construction become less important with higher levels of education (Gravelle and Lachapelle 2015). Based on the literature, we make the following hypotheses:

H_{4A}: Respondents with a bachelor's degree or higher are more likely to perceive that natural gas export poses environmental risks than those without.

H_{4B}: Respondents with a bachelor's degree or higher are less likely to perceive that natural gas export poses economic benefits than those without.

Political Ideology

Political predispositions can alter how frames are processed, especially with partisan issues (Wiest et al. 2015). Zaller (1992) suggests in his “Receive-Accept-Sample” model that – like cultural theory – people are more likely to accept information that fits within their values and beliefs and reject the messages that do not, and individuals that are more cognitively aware of these connections are more prone to accepting or dismissing information based on those predispositions. Political ideology can serve as a “cognitive shortcut” allowing individuals to rely on these predispositions to form opinions without extensive knowledge or consideration (Gravelle and Lachapelle 2015). Often, the political polarization within climate change and energy development can be attributed to the push-pull of balancing free enterprise or economic freedom with regulations to protect the environment (Antonio and Brulle 2011).

In the U.S. context, the white male effect has been further dubbed the “conservative white male effect” – highlighting how political ideologies create polarization in environmental and energy issues (Boudet 2019; Clarke et al. 2016; McCright and Dunlap 2011). Conservative Americans are more supportive of fracking (Gearhart et al. 2019) and natural gas export (Pierce et al. 2018) than liberals and are more likely to be climate skeptics (Ballew et al. 2019; PRC 2019). Conservatives tend to support fracking and natural gas export infrastructure due to the promise of jobs, free enterprise, and economic development associated with the fossil fuel industry (Clarke et al. 2016; Gravelle and Lachapelle 2015), while liberals often oppose pipeline projects because the benefits are awarded to corporations and the risks are imposed on the communities – a disconnect that does not align with their central values regarding collective goods and equality (Gravelle and Lachapelle 2015). The relationship between

political ideology and support for unconventional oil and gas development is strengthened when considering distance to extraction sites – where the further away an individual is from the site, the larger degree of polarization between conservative and liberal respondents, which can be attributed to an individual's reliance on political predisposition rather than direct experiences (Clarke et al. 2016; Zanocco et al. 2020). Regardless of political party affiliation, political ideology has been found to be one of the most consistent factors shaping views on energy development (Pierce et al. 2018). Thus, we make the following hypotheses:

H_{5A}: Liberals and moderates are more likely to perceive that natural gas export poses environmental risks than conservatives.

H_{5B}: Liberals and moderates more less to believe that natural gas export poses more economic benefits than conservatives.

Rural/Urban Location

Beyond these individual-level factors, context or place has also been shown to be important in shaping preferences related to energy (Boudet et al. 2016; Brasier et al. 2011; Davis and Fisk 2014; Schafft and Biddle 2015). In particular, people living in rural areas have been found to hold more favorable views on the economic opportunities with new energy development than those living in urban areas (Davis and Fisk 2014), possibly in part due to economic ties to extractive industries (Boudet et al. 2016) and perhaps also due to relative lack of other opportunities compared to urban areas. However, experience with previous development, if negative, can also contribute to less support due to the environmental degradation, threatened aesthetic quality (Brasier et al. 2011), and lower quality of life (Schafft and Biddle 2015) that follows economic

booms. Community members have reported seeing potential for economic opportunities in these environmental concerns, where local business can assist the industry in maintaining environmental quality in the area (Brasier et al. 2011). While large-scale energy development can be more favorable in rural areas, controversy can arise if it is perceived urban interests are placed above those of rural communities (Boudet 2019). For instance, community members in the Marcellus Shale have raised concerns that the increased revenues from development in rural areas would benefit larger cities – highlighting underlying urban-rural social divides (Brasier et al. 2011). We present the following hypotheses:

H_{6A}: Respondents living in metropolitan areas are more likely to perceive that natural gas export poses environmental risks than those in non-metropolitan areas.

H_{6B}: Respondents living in metropolitan areas are less likely to perceive that natural gas export poses economic benefits than those in non-metropolitan areas.

Proximity

Another place factor potentially shaping views on energy development relates to proximity to the proposed development. The notion of the “not in my backyard” (NIMBY) phenomenon has often been linked with public opposition to development. NIMBY refers to opposition by residents living in proximity to proposals for locally unwanted land uses (e.g., incinerators, landfills, energy projects, prisons) (Kraft and Clary 1991). The idea is that, as proximity to this infrastructure increases, support decreases due to concerns of health and safety, decreased property values, decline in quality of life, undesirable rural aesthetics, and emotional attachment to current land uses (Krause et al. 2014).

Proximity is often modeled by a distance decay function, highlighting that intensity of opposition diminishes at further distances (Aldrich 2013). At closer distances, individuals consider local contexts, whereas individuals further away view the project more generally and rely on predispositions to form opinions (Trope and Liberman 2010). Yet, this function may be moderated by ideology and other factors (Gravelle and Lachapelle 2013; Zanoocco et al (2020).

NIMBY has been well studied in a variety of contexts since the 1980s; however, results indicate the phenomenon is not as simple and clear-cut as once understood (Krause et al. 2014). Furthermore, “inverse NIMBY” has been suggested, where individuals are more supportive of the facilities because they receive benefits through jobs, leasing payments, and taxes that stimulate the economy (Gravelle and Lachapelle 2015; Pierce et al. 2014). Those living within a proposed pipeline route are offered easements from the oil and gas company to gain the rights to use their property while allowing the landowner to maintain ownership. Indeed, the landowners that accept easements from the company are primarily concerned about “maximizing [the] income from the transaction”; however, they still acknowledge the environmental risks (Kriesky et al. 2013). Additionally, Sherran et al (2019) found that, in Canada, individuals who are more exposed to the energy technology (i.e., those that reported regularly seeing, smelling, or hearing any energy technologies), whether it was a renewable or non-renewable energy, were more likely to support that energy source.

Studies have also suggested that proximity is insignificant because other factors tend to be better predictors (Pierce et al. 2018; Michaud et al. 2008). The relationship between proximity and public opinion is “inherently variable” depending on the characteristics of the community, including experiences, discourse, and ideological values (Clarke et al. 2016). The ambiguity of the relationship between proximity and

public opinion indicates that further analysis is required. In this study, we operationalize proximity as residents within a county containing JCP infrastructure (i.e., pipeline and terminal). We present the following research question:

RQ₁: Will respondents in closer proximity to the JCP proposal be more likely to perceive that natural gas poses environmental risks than those not impacted?

Perceived Importance of Industry

A final place-based factor relates to the concept of “community economic identity” – first identified by Bell and York (2010) in Appalachia, where local citizens view the coal industry as being important to their community despite the decline in employment. They argued that there is a cultural significance tying the people to the industry due to its role in the community for decades. Studies suggest that community characteristics and experiences with extractive industries play a key role in understanding potential impacts to their communities (Brasier et al. 2011; Hazboun and Boudet 2020; Olson-Hazboun, Howe, and Leiserowitz 2018). Hazboun and Boudet (2020) determined that when individuals perceive the mining, refining, and utilities industry to be economically important to their community they are less likely to support renewable energies and more likely to support fossil fuels (Hazboun and Boudet 2020). The lack of support for renewable energy development (Hazboun, Howe, and Leiserowitz 2018) and climate policies (Mayer 2019) can be linked to the thought that they would negatively impact the industry. However, when studying this relationship in the Marcellus Shale, Brasier et al. (2011) determined that a community’s extractive history impacts economic benefit and environmental risk perceptions differently, where regardless of history, residents reported believing the industry would squeeze profits dry

and leave behind environmental problems for them to address. We make the following hypotheses:

H_{7A}: The higher a respondent's perceived importance of the mining, refining, and utilities industry, the less likely they are to perceive environmental risks from natural gas export.

H_{7B}: The higher a respondent's perceived importance of the mining, refining, and utilities industry, the more likely they are to perceive the economic benefits of natural gas export.

While scholarship on community economic identity has grown in recent years, it has yet to fully explore the role of the renewable energy industry. So far, research has identified that perceived importance of the renewable energy industry is an insignificant predictor of support for climate policies (Mayer 2019), fossil fuels, and wind energy (Hazboun and Boudet 2020). Mayer (2019) suggests that the insignificance may be due to the renewable energy industry's inability to solidify a place in America's cultural and economic identity, while the history of extractive industries is extensive and often romanticized. However, Hazboun and Boudet (2020) found that it was positively associated with support for solar, wave/tidal, and geothermal energy among a sample in the PNW. Our final hypotheses include:

H_{9A}: The higher a respondent's perceived importance of the renewable energy industry, the more likely they are to perceive the environmental risks of natural gas export.

H_{9B}: The higher a respondent's perceived importance of the renewable energy industry, the less likely they are to perceive the economic benefits of natural gas export.

Data & Methods

Data Collection

We contracted YouGov to recruit the sample and administer our survey to 500 Oregon residents from August 12 to August 28, 2019. YouGov is well-known for their intricate sample matching and weighting procedures. They originally oversampled 690 respondents in Oregon, which they then reduced to N=500 by employing a matching and weighting procedure based on Census data to better represent Oregon's population. YouGov matches to a sampling frame based on gender, age, race, and education. As requested, YouGov also evenly split the sample between metro and non-metro areas. Their frame was constructed by stratified sampling from the 2017 American Community Survey one-year sample with selection within strata by weighted sampling with replacements. YouGov weights cases to this sampling frame using propensity scores (included: age, gender, race/ethnicity, education, region, and metro/non-metro). YouGov then combines the matched cases and frame, estimating a logistic regression for inclusion in the frame. They then group the propensity scores into deciles of the estimated propensity score in the frame and post-stratify according to these deciles. The weights were post-stratified on the 2016 Presidential vote choice, a four-way stratification of gender (4-categories), age (4-categories), race (4-categories), and education (4-categories), and a metro/non-metro distribution from the 2018 Current Population Survey (taken in November). This results in a final weighted variable provided by YouGov, which we use in our subsequent analysis to allow for generalization across the state.

Variable Measurements

Table 1 provides a full list of all variables and unweighted descriptive statistics, including socio-demographics, urban/rural location, proximity, political ideology, perceived importance of relevant industries, and perceived economic benefits and environmental risks.

[Table 1 near here]

To measure our dependent variables of interest (perceived risk and benefit perceptions of natural gas export), respondents were asked their perception of three commonly cited risks (global climate, regional environment, and public health) and benefits (energy security, energy prices, jobs in the region, and regional economy) associated with natural gas export. Risk perceptions were asked on a scale from 1 “no risk at all” to 5 “a great deal of risk” and benefit perceptions on a scale from 1 “no benefit at all” to 5 “a great deal of benefit”.

These responses were then grouped into two distinct factors via principal components exploratory factor analysis (see Supplemental Information). Exploratory factor analysis is a statistical technique used to identify response patterns within the variables (Vaske 2019). Factor 1 included: regional environment (health of animals, plants, and their habitat), public health (air quality, pollution, etc.), and global climate. Factor 2 was composed of energy security (reliable access to energy), energy prices, jobs in the region, and regional economy (tax base, businesses, etc.). These factors were labelled as “environmental risks” and “economic benefits.” Cronbach alpha reliability analysis indicated satisfactory internal consistency between variables for both factors (see Supplemental Information). Indices were computed of the mean value of its components, and respondents were required to have answered at least three of the questions associated with each index.

As a measure of proximity to proposed development, respondents provided their residential zip code on the survey, which was then coded into [1] “within” or [2] “outside” a zip code impacted by the Jordan Cove Energy Project (terminal and pipeline). Only 59 respondents were within an affected zip code, which represents a small portion of the sample (12%), causing the zip code dummy variable to be severely disproportionate. It was then expanded to county level to improve upon the comparison between variable categories. The proposed Jordan Cove Energy Project and pipeline crossed through four counties: Klamath, Douglas, Jackson, and Coos. The variable was then recoded to include all zip codes in these counties, which increased the number of proximate respondents to 124 (25%).

Analysis

To analyse the predictors of perceived environmental risks and economic benefits associated with natural gas export, we estimate two hierarchical OLS multiple regression models. Each model includes socio-demographic variables (gender, age, race, and education), geographic location (metro vs non-metro and proximity to proposed pipeline and export terminal), political ideology, and perceived importance of mining, refining, and utilities industry, as well as renewable energy.

Results

Figure 1 shows the unweighted responses to the perceived environmental risks associated with natural gas export, including global climate, regional environment, and public health. Comparatively, the perceived degree of risk was consistent across all three categories, with about a third of respondents considering natural gas export to pose a great deal of risk (31.8 to 32.6 percent) and fewer reporting no risk at all (12.4 to

14.4 percent). These results indicate that many respondents have some degree of concern as to how natural gas export will negatively impact the environment and human health.

[Figure 1 near here]

Figure 2 shows the responses to the perceived economic benefits associated with natural gas export, including jobs in the region, energy security, energy prices, and regional economy. Results indicate that a majority of respondents are somewhat skeptical of the economic benefits that natural gas export brings to the region. Respondents reported viewing energy security and energy prices as being less beneficial, while jobs and regional economy were viewed by more respondents as being potentially somewhat beneficial.

[Figure 2 near here]

Table 2 presents the results of the two regression models predicting risk and benefit perceptions. Beta coefficients are standardized and weighted. First, with respect to the Risk model, males ($\beta=-0.063$, $p=0.060$) had lower risk perceptions than females, and respondents with a bachelor's degree or higher ($\beta=0.170$, $p<0.001$) had higher risk perceptions than those with less than a bachelor's degree. Respondents living in metropolitan areas ($\beta=-0.104$, $p=0.005$) reported lower environmental risk perceptions compared to non-metro respondents. Ideology was the largest predictor, with liberals and moderates ($\beta=0.516$, $p<0.001$) reporting higher levels of risk perceptions than conservatives. Individuals with higher perceived importance of the mining, refining, and utilities industry ($\beta=-0.240$, $p<0.001$) had lower environmental risk perceptions compared to those with lower perceived importance of the industry. However, individuals with higher perceived importance of the renewable energy industry had

higher risk perceptions ($\beta=0.189$, $p<0.001$). These results show clear support for the following hypotheses: H_{1A}, H_{4A}, H_{5A}, H_{7A}, and H_{8A}.

[Table 2 near here]

Turning to the Benefits model, males ($\beta=0.117$, $p=0.001$) had higher economic benefit perceptions than females, while those with a bachelor's degree or higher ($\beta=-0.116$, $p=0.002$) reported lower benefit perceptions than those with less than a bachelor's degree. Respondents living in a metropolitan area ($\beta=0.106$, $p=0.007$) reported higher economic benefit perceptions than those living in non-metro areas. Individuals living in a county impacted by the proposed JCP ($\beta=-0.077$, $p=0.040$) reported lower economic benefit perceptions compared to those living outside these counties. Like risk perceptions, ideology was the main predictor of economic benefit perceptions, with liberals and moderates ($\beta=-0.552$, $p<0.001$) reporting lower economic benefit perceptions than conservatives. Respondents with higher perceived importance of the mining, refining, and utilities industry ($\beta=0.185$, $p<0.001$) reported higher levels of benefit perceptions than respondents reporting lower perceived importance. The opposite is the case for the renewable energy industry, where respondents with higher perceived importance of the renewable energy industry ($\beta=-0.146$, $p<0.001$) reported lower economic benefit perceptions than those with lower perceived importance. Results indicate support for hypotheses H_{1B}, H_{2B}, H_{4B}, H_{5B}, H_{7B}, and H_{8B}.

Discussion

Results indicate that a majority of our Oregon respondents perceived a lot or a great deal of risk from natural gas export to the global climate (53%), regional environment (53%), and public health (52%); few respondents indicated little to no risk at all in these categories (29%, 30%, and 30%, respectively). In terms of economic

benefit perceptions, respondents were most likely to report perceiving natural gas export as providing a moderate benefit to jobs in the region (32%), no benefit at all to energy security (32%) and energy prices (29%), and a little benefit to the regional economy (31%). Few respondents reported perceiving a lot or a great deal of economic benefit, ranging from only 21 to 27 percent. Based on the sample of respondents, results suggest that Oregonians are more skeptical of the economic benefits of natural gas export and more concerned about its environmental risks. The implication is that any export proposal in the state will experience an uphill battle in terms of overcoming these perceptions to gain public support.

Consistent with the reviewed literature and hypotheses, men reported lower environmental risk perceptions and higher economic benefit perceptions than women. Additionally, the literature suggests that educational attainment is linked with higher levels of environmental awareness (Durmuş-Özdemir and Şener 2016; Richardson, Milton, and Harrison 2020). The results of this study suggest that this is the case among our Oregon sample, as respondents with a bachelor's degree or higher reported higher environmental risk perceptions and lower economic benefit perceptions.

Aligning with other public opinion studies on energy, political ideology was the strongest predictor of risk-benefit perceptions, with conservatives reporting lower environmental risk and higher economic benefit perceptions. This result supports the idea that political predispositions can serve as a “cognitive shortcut” when forming opinions about energy development (Gravelle and Lachapelle 2015; Zaller 1992).

We found respondent perceptions of local economic identity to different industries to be important as well, in keeping with other studies on public opinion of natural gas fracking (Boudet et al. 2016) and other fossil fuels. Perhaps this is because people who feel connected to the fossil fuels industries perceive not only higher

economic benefit perceptions but are also more willing to downplay the potential risks. Conversely, respondents with higher perceived importance of the renewable energy industry to the local economy reported higher environmental risk and lower economic benefit perceptions associated with natural gas export. This finding was somewhat unsurprising, given that renewable energy has yet to solidify a place in the economic identity of many US states; however, wind energy development is well-established in Eastern Oregon.

Public opinion and risk-benefit perceptions have been extensively examined with respect to fracking, fossil fuels, climate change and renewable energy. However, they are understudied with respect to natural gas export. In many ways, our findings about export align with existing studies of extraction: males, conservatives, and those with economic ties to extractive industries were less risk adverse to natural gas export. These results may lend credence to frameworks and theories in the social sciences, which suggest that, because people often have neither the time nor the resources to evaluate new technologies in detail, they instead rely on mental shortcuts (e.g., beliefs about similar technologies, elite opinions, values, ideological predispositions, etc.) to determine their attitudes (Clarke et al. 2015; Ho et al. 2018; Jacquet 2012; Vasi et al. 2015). In the case of natural gas export (a potentially unfamiliar concept), our respondents may have drawn on their perceptions of more familiar, related concepts (e.g., natural gas, export) to construct their perceptions. Moreover, the debate about natural gas export in Oregon, as reported in the media and in comments during regulatory hearings, certainly echoed the environment vs. economy divide expressed in our respondents' risk-benefit perceptions (Stelmach & Boudet 2021). Such social constructions of new phenomena, including energy development, have been shown to be important in shaping public perceptions (Evensen, Clarke and Stedman 2014;

Evensen and Stedman 2016). Yet, these social constructions may shift over time and may differ by place.

Indeed, our study complicates the literature in some ways as well – especially with respect to respondents’ geographic location as we found metro residents generally perceive less risks and more benefits from natural gas export, while respondents located in counties impacted by JCP to perceive less benefits. These findings suggest something of a NIMBY effect – as most proposals for natural gas export in Oregon have been in non-metro areas and the JCP was the one remaining proposal at the time of our survey. Overall, more research is needed in the role of place and proximity in shaping attitudes toward natural gas export, particularly given shifting public attitudes about the role of natural gas in our energy system.

Conclusion and Policy Implications

Since the collection of this survey data, the Jordan Cove Energy Project – the last remaining natural gas export proposal in the state – was denied several critical state permits, and the developer cancelled the project. Nationally, the Biden Administration has expressed an interest in moving beyond fossil fuels in terms of domestic energy use to address the climate crisis, although Biden himself has stated he does not intend to ban fracking. It remains unclear what this means for natural gas export. If Asian markets remain a lucrative business opportunity for American natural gas producers, there will likely continue to be pressure to develop new LNG export projects along the nation’s coasts, including the Pacific Northwest.

As the natural gas industry continues to position itself as a main energy source in the country’s and the world’s energy transition, it is important to understand how the

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public perceives natural gas as an energy source *and* its export to other countries, particularly in areas slated for such development. Our findings suggest that, overall, Oregonians have higher risk perceptions than benefit perceptions related to natural gas export and that new LNG facilities are likely to continue to meet a high level of social resistance in this region. That being said, public perceptions are not monolithic and may change over time, with certain populations being more or less receptive to claims about its risks and benefits.

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Ethics Approval: This study was reviewed and acknowledged by the Oregon State University Human Research Protection & Institutional Review Board (IRB) IRB-2019-0183. Because survey responses were recorded in such a manner that the identity of the human subjects cannot be readily ascertained, the study received exempt determination.

Data Availability Statement: Data is available upon request.

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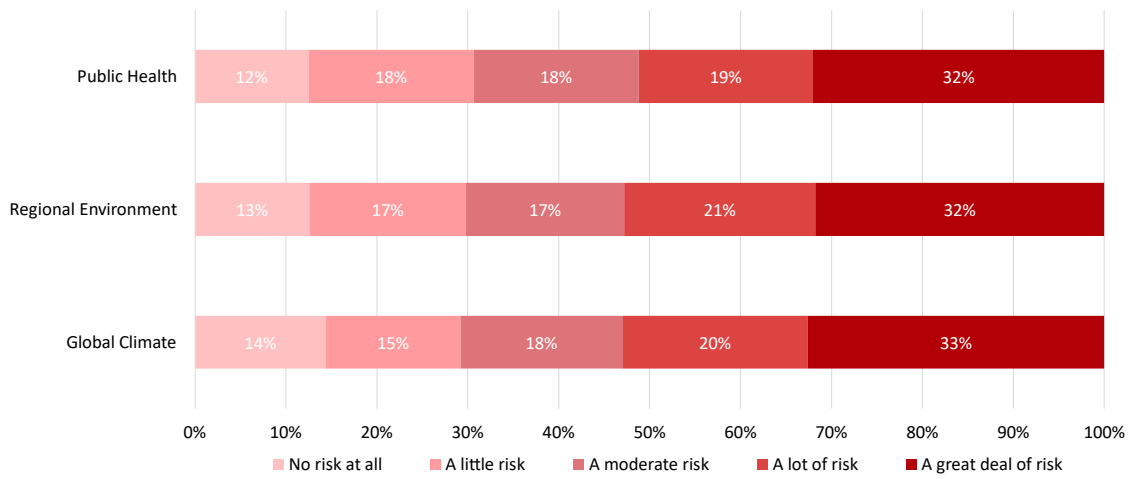


Figure 1. Perceived risks of natural gas export (unweighted).

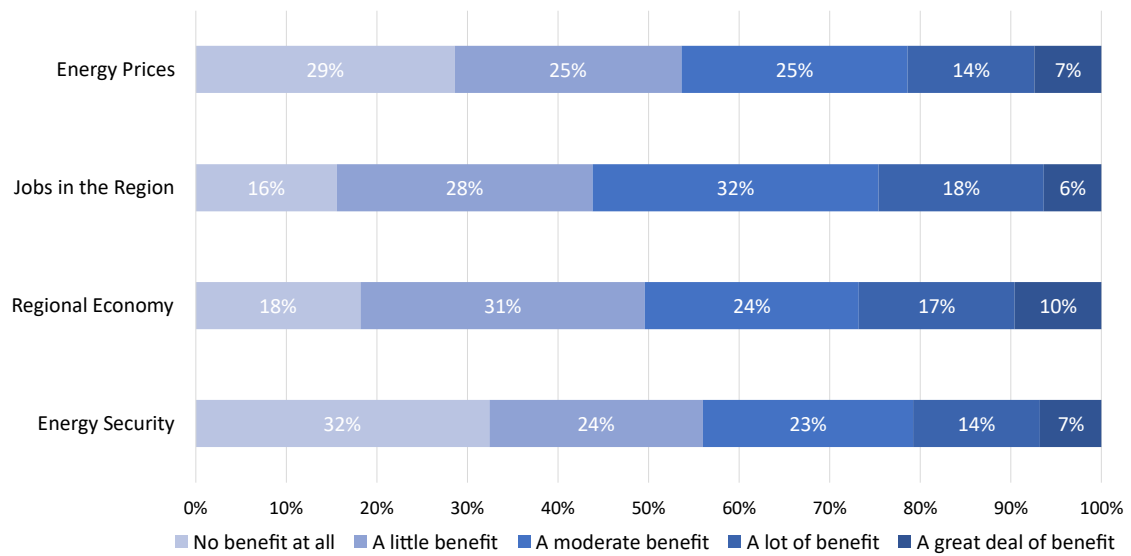


Figure 2. Perceived benefits of natural gas export (unweighted).

Table 1. Unweighted descriptive statistics for independent and dependent variables.¹

Variable	Question/Category	Descriptive Statistics ²
Gender	Please indicate your gender. (1) Male (0) Female	59% (Female)
Age	Please indicate the year you were born (subtracted from survey year, 2019)	M=56.67, SD=14.64
Race	Please indicate your race. (1) White, (2) Black, (3) Hispanic, (4) Asian, (5) Native American, (6) Mixed, (7) Other (8) Middle Eastern. <i>Recoded: (1) White, (0) Non-white</i>	89% (White)
Education	Please indicate the highest level of educate you have completed. <i>Recoded: (1) Less than a bachelor's degree and (0) Bachelor's degree or higher</i> (1) No HS (2) High school graduate (3) Some college (4) 2-year (5) 4-year (6) Post-grad	2% 15% 26% 15% 26% 16%
Ideology	In general, your ideology is: <i>Recoded: (1) Liberal/Moderate and (0) Conservative</i> (1) Very liberal (2) Liberal (3) Moderate (4) Conservative (5) Very conservative (6) Not sure ³	20% 22% 25% 18% 10% 5%
Metro	Please indicate your zip code of residence. Coded: (1) Metro or (0) Non-Metro	50% Metro (N=250)
Proximity	Please indicate your zip code of residence. <i>Recoded: (1) Within, or (0) Outside Klamath, Douglas, Coos, or Jackson County</i>	25% Within (N=124) 75% Outside (N=376)
Industry – Mining, Refining, Utilities	Please indicate the degree of importance: (1) Not at all important (2) A little important (3) Moderately important (4) Very important	38% 41% 15% 5%
Industry – Renewable Energy	Please indicate the degree of importance: (1) Not at all important (2) A little important (3) Moderately important (4) Very important	13% 31% 31% 24%

Variable	Question/Category	Descriptive Statistics ²
Environmental Risk	Please indicate the degree of risk: (1) No risk at all, (2) A little risk, (3) A moderate risk, (4) A lot of risk, (5) A great deal of risk. Variables in the index include regional environment, public health, and global climate (Cronbach's alpha=0.94)	M=3.42, SD=1.35
Economic Benefit	Please indicate the degree of benefit: (1) No benefit at all, (2) A little benefit, (3) A moderate benefit, (4) A lot of benefit, (5) A great deal of benefit. Variables in the index include energy security, energy prices, jobs in the region, regional economy (Cronbach's alpha=0.93).	M=2.57, SD=1.09

¹ Sample size, N=500

² Percentages may not equal 100 due to rounding

³ Respondents reporting "not sure" were removed from analysis

Table 2. OLS regression models evaluating factors influencing environmental risks and benefits in natural gas export

	Risks		Benefits	
Constant	2.576	***	3.612	***
Male	-0.063	*	0.117	**
White	0.038		0.063	
Bachelor's degree	0.170	***	-0.116	**
Age	-0.041		-0.122	**
Metro	-0.104	*	0.106	**
Proximity	0.017		-0.077	*
Liberal/Moderate	0.516	***	-0.552	***
Industry – Mining, refining, utilities	-0.240	***	0.185	***
Industry – Renewable energy	0.189	***	-0.146	***
R-Squared	53%		47%	
F-Statistic	56.57	***	45.00	***
N	462		462	
AIC	-11.75		-126.143	

Note: Beta-coefficients are standardized, and data is weighted.

* p < 0.05, ** p < 0.01, *** p < 0.001