Public Perception of Natural Gas Export: The Jordan Cove Energy Project

By
Rachel L. Mooney

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APPROVED:

Hilary Boudet, representing Sociology

Alison Johnston, representing Political Science

David Bernell, representing Political Science

Rachel Mooney, Author

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Abstract

Fracking and natural gas have been widely studied in public opinion research over the years, but few studies evaluate natural gas export and the perceptions of its associated economic benefits and environmental risks. Since the shale revolution in the early 2000s, the U.S. transitioned from a net natural gas importer to exporter, all while concerns about the climate crisis have increased pressures to transition away from fossil fuels like natural gas to renewable energy sources. As a result, natural gas export projects, like the proposed Jordan Cove Energy Project in Oregon have become a subject of controversy, particularly in the Pacific Northwest where activists are attempting to hold a "thin green line" between fossil fuel extraction sites in the Mountain West and energy-hungry Asian markets. This study evaluates the role of place-based, socio-demographic, political ideology, and risk-benefit perception factors in shaping how the public perceives natural gas export in Oregon. 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. On the other hand, younger respondents, those without 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 from natural gas export. The overwhelmingly important factors in shaping support for natural gas export seem to be risk and benefit perceptions, with many of the other included people and place factors losing significance once risk/benefit perceptions are incorporated in the model of support. Overall, results indicate that any export proposal in the state will experience an uphill battle in terms of gaining public support.

Keywords: natural gas export, public opinion, risk-benefit perceptions, pipeline

Introduction

The oil shocks in the 1970s resulted in long-term instability in oil prices, natural gas shortages, recessions, high inflation, and stalled economic progress (Brown & Yücel, 2013), causing energy security to rise to the top of the political agenda (Bang, 2010). In the years that followed, the development of hydraulic fracturing and horizontal drilling technologies has unlocked large shale oil and gas domestic reserves that were once unrecoverable (Trembath, 2012). Due to a highly lucrative Asia Pacific market (Finizio et al, 2020), American companies have sought to increase exports – resulting in the U.S. becoming a net exporter in 2019 (U.S. Energy Information Administration [EIA], 2020a).

Natural gas is a fossil fuel that is a cheap, abundant, and relatively clean substitute for other fossil fuels (Weissman, 2016), positioning natural gas as a possible solution to both climate concerns and energy independence, as well as a transition fuel as renewable sources ramp up. However, in recent years, this view of natural gas as a bridge fuel to a renewable energy future has become a subject for debate as some argue it has increased the nation's reliance on fossil fuels and, instead, has become a "bride to nowhere" (Delborne et al, 2020). Natural gas export infrastructure has had a history of going unnoticed but has more recently become surrounded by controversy as climate concerns have intensified (Gravelle & Lachapelle, 2015).

The Pacific Northwest has very limited presence of natural gas infrastructure despite its key location for the exportation of natural gas to Asian markets (Northwest Gas Association, 2012). This has made the region a host of many failed proposals for import and export terminals (Tran et al, 2019), and most recently, the proposed Jordan Cove Energy Project (JCP). The JCP has undergone a series of permit submission, reviews, and denials for over 17 years, mainly attributed to local opposition and changing market conditions (Booker et al, 2020). It thus

becomes important to evaluate the views of Oregon residents toward natural gas export and what factors lead to these opinions.

Current literature suggests that women, minorities, liberals, college-educated, and individuals living in metropolitan areas tend to have lower levels of support for natural gas infrastructure (Edwards, 2018; Gravelle & Lachapelle, 2015; Hazboun & Boudet, 2020; Pierce et al, 2018). Community economic identity also plays a role in the favorability of fossil fuel development – highlighting the cultural significance tying the people to the industry due to its role in the community for decades (Bell & York, 2010). However, geographic proximity to energy infrastructure is less understood compared to other factors. Several studies have found the "not-in-my-backyard" (NIMBY) phenomenon is linked to public opposition with locally unwanted land uses (e.g., incinerators, landfills, and prisons) for residents living in close proximity (Kraft & Clary, 1991). Proximity has also been identified as being insignificant or there is the presence of "inverse NIMBY", where those living in close proximity are more supportive (Gravelle & Lachapelle, 2015; Pierce et al, 2014). Due to the potential economic benefits and environmental risks associated with new energy development, geographic proximity is a necessary factor to consider when examining public perception of natural gas infrastructure. However, due to its ambiguity in past studies, further analysis is needed. Studies have found that, to some extent, public opinion plays a role in energy policy decisions in the United States (Edwards, 2018), making these studies increasingly important in the transition to renewable energy.

This study evaluates the role of geographic location and proximity – as well as other place-based, socio-demographic, and risk-benefit perceptions factors – in public perception of natural gas export. The "technology, people, place, and process" framework for understanding

public perceptions of new energy technologies (Boudet, 2019) and cultural cognition of risk theories (Douglas & Wildavsky, 1982; Kahan, 2012) provide a framework to categorize these factors, and in combination with quantitative analyses, will identify key predictors of public perception of natural gas export, as well as highlight potential energy and environmental policy implications.

Two ordinary least squares (OLS) linear regressions modeled the perceived environmental risks and economic benefits associated with natural gas export in Oregon as a function of socio-demographics, geographic location and proximity, and perceived importance of the renewable energy and the mining, refining, and utilities industries. Next, an ordinal logistic regression modeled public perception of natural gas export in Oregon as a function of socio-demographics, political ideology, geographic location and proximity, risk-benefit perceptions, and perceived industry importance.

Analysis indicates that women, respondents with a bachelor's degree or higher, liberals and moderates, and younger respondents reported higher levels of environmental risk perceptions and lower levels of economic benefit perceptions associated with natural gas export, as well as lower levels of support for natural gas export. Respondents with higher perceived importance of the mining, refining, and utilities industry were associated with lower environmental risk perceptions, higher economic benefit perceptions, and lower levels of support for natural gas export. Respondents with higher perceived importance of the renewable energy industry were associated with higher environmental risk perceptions and lower economic benefit perceptions. In general, respondents living within an impacted county had lower economic benefit perceptions, higher environmental risk perceptions, and lower levels of support for natural gas export.

This study confirms prior studies regarding how socio-demographics and political ideology influence public perception of natural gas export, as well as the associated risk and benefit perceptions. There is vast research regarding risk-benefit perceptions, but few connect these perceptions to their role in support for natural gas export. Understanding the public's perceived risks and benefits associated with natural gas export can provide insight into the complex interactions between energy technologies and the communities they serve. Geographic location and proximity were inconsistent predictors, suggesting that individuals tend to rely on other predispositions when determining support for natural gas export. Moreover, due to the "thin green line" formed in Oregon and the Pacific Northwest, these projects will likely struggle to overcome the politics in the role natural gas has in the transition to a renewable energy future.

This paper proceeds as follows: I review information about the natural gas market, the framing of natural gas, the importance of public opinion research, and the potential factors that influence public perception of natural gas export. Next, I describe the survey data and methodology used in this study. Then, I detail the results and discussion of three regression models. Finally, I discuss these results and their potential energy policy implications.

Literature Review

Natural Gas Market

The oil shocks in the 1970s resulted in long-term instability in oil prices, natural gas shortages, recessions, high inflation, and stalled economic progress (Brown & Yücel, 2013), causing energy security to rise to the top of the political agenda (Bang, 2010). Due to the country's reliance on foreign imports, American producers were often small and did not have the ability or the incentives to invest in research and development to meet the country's goals (Wang

& Krupnick, 2013). To combat this, the federal government funded R&D programs for natural gas development, established tax credits to assist in the development in technology, and passed the Natural Gas Policy Act of 1978 (Wang & Krupnick, 2013). In the years that followed, 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 North America, the natural gas market is highly competitive, resulting in natural gas prices falling below $2 per thousand cubic feet in 2012 – while the price in East Asia was $15 per thousand cubic feet (Levi, 2012). The Asia Pacific region is the largest import market in the world (Finizio et al., 2020), and with the price of natural gas being over twice as much compared to North America (EIA, 2020b; BP, 2020), American companies have sought to increase exports. In response to the shale revolution, companies invested over $290 billion in oil and gas infrastructure from 2012 to 2016 (Petak et al., 2017). Investments in pipelines specifically – currently totaling an estimated 3 million miles in the U.S. (EIA, 2019) – averaged $16 billion per year in this time frame (Petak et al., 2017). As a result, the U.S. went from a net importer to exporter of natural gas in 2017 for the first time since the late 1950s (EIA, 2020b).

Why Oregon?

The Pacific Northwest (PNW) is positioned between two large natural gas production areas – the Western Canadian Sedimentary Basin and the U.S. Rocky Mountains – making it a key location for the exportation of natural gas to Asian markets (Northwest Gas Association, 2012). As a result, the West Coast of the U.S. has been the host of many failed proposals for LNG terminals, beginning with import terminals when supplies were low, and now export terminals as the national supply exceeds demand (Tran et al., 2019). However, the PNW has

been attempting to hold a “thin green line” between fossil fuel extraction sites in the Mountain West and energy-hungry Asian markets through a combination of public opposition and strict state permitting and environmental processes during the proposal stages (Hazboun, 2019). This region is known as being environmentally progressive (Hazboun & Boudet, 2020), allowing these states to maintain a very limited presence of natural gas infrastructure, consisting of only about 48,000 miles of transmission lines and distribution pipelines (Northwest Gas Association, 2014). Oregon, specifically, currently only has three interstate pipelines and no crude oil production or fuel-producing refineries (Halleran, 2018).

Concerns over the climate crisis has caused an increase in natural gas production due to transitioning off dirtier fossil fuels but has also caused natural gas export projects to become a subject of controversy. Most notably, the Jordan Cove Energy Project (JCP) has been in the planning phase for over 15 years and stands to become the first export terminal on the West Coast if it gains the necessary permits.

Versen (acquired by Pembina in 2017), a Calgary-based company, originally proposed the JCP as an import terminal in 2004 to supplement the decrease in domestic production and increase in demand (EIA, 2004; Rapier, 2017), but was ultimately denied by Federal Energy Regulatory Commission (FERC) due to an unexpected growth in domestic production (Federal Energy Regulatory Commission, 2012). It was reintroduced as an export terminal in 2013 (Jordan Cove Energy Project, 2013) due to the potential profits in overseas markets. Although denied under the Obama Administration, Pembina has high hopes under the Trump Administration, who has announced his support for the project (Powell, 2018). Despite federal support and approval from the Federal Energy Regulatory Commission (FERC), JCP has yet to gain all state-level permits necessary to move forward (Samoya, 2020).

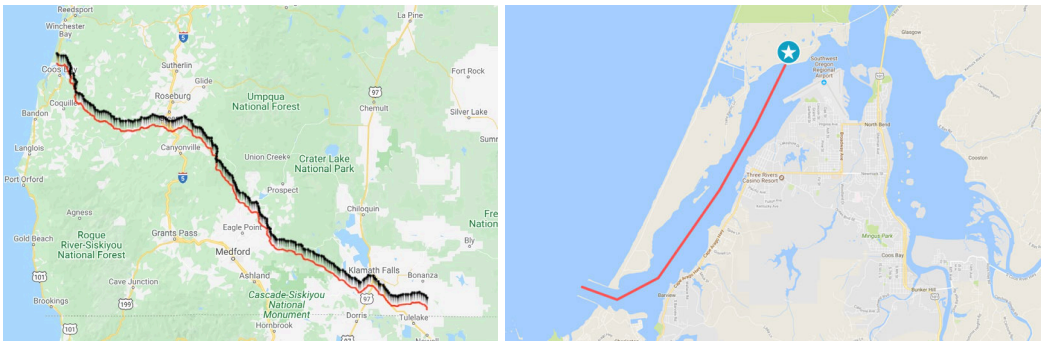


Figure 1. The images above are the proposed route of the Pacific Connector Gas Pipeline (left) and Coos Bay LNG export terminal location and channel transportation route (right) obtained from the Jordan Cove LNG website.

Under the proposal for the JCP, the Pacific Connector Gas pipeline would serve to transport natural gas from Western Canada and the Rocky Mountains region through southern Oregon to the Coos Bay export terminal and ship to Asian markets (Northwest Gas Association, 2014; Halleran, 2018). The gas pipeline would connect to existing pipelines near Malin, Oregon and extend 229 miles across Klamath, Jackson, Douglas, and Coos counties (Jordan Cove LNG, 2019).

The JCP has been promoted as a way to stimulate the local economy through tax revenue and jobs. It has the potential to generate over $100 million to state and local governments each year during operations, 6,000 short-term construction jobs, and an estimated 8,500 jobs related to hospitality, tourism, retail, and healthcare (Jordan Cove LNG, 2019). However, it has also been heavily criticized because of the environmental risks and threat of eminent domain. The pipeline has the potential to impact more than 480 bodies of water, 30 endangered and threatened species, and be the number one greenhouse gas emitter in the state of Oregon (Rogue Riverkeeper, n.d.).

The approval by FERC gave the right for the Canadian company to begin the process for eminent domain – estimated to impact 90 private landowners in Southern Oregon, most of which have already refused to sell easements to the company (Samayoa, 2020).

A Pembina-launched poll in 2018 within the state of Oregon determined strong opposition for the project, regardless of political affiliation (Evans & Grable, 2019). A majority of respondents reported that they strongly opposed (35%) or opposed (57%), while only 19% support and 4% strongly support the project (Evans & Grable, 2019). During the public comment period, over 43,000 comments were submitted – a record breaking number for the state – identified key concerns including potential environmental impacts and the threat of eminent domain (Western Environmental Law Center, 2019). If opposition is strong enough, it could influence state and federal departments to not grant the project necessary permits. Therefore, with this project looming over the state of Oregon, it is important to evaluate the views of Oregon residents toward natural gas export and what factors lead to these opinions.

Framing of Natural Gas

The presentation or "framing" of an issue by elites and in the media plays an important role in how the public interprets these issues (Chong & Druckman, 2007; Gearhart et al., 2019). Framing effects occur when "(often small) changes in the presentation of an issue or an event produce (sometimes large) changes of opinion" (Chong & Druckman, 2007). For example, when frames emphasize economic benefits, it leads to an increase in support for fracking, while focusing on environmental risks leads to a decrease in support (Gearhart et al., 2019).

Not only has natural gas been framed as the solution to energy security, but it has also been characterized as a "bridge fuel" that can meet U.S. energy needs during the transition from

dirtier fossil fuels toward renewable sources (Weissman, 2016). Currently, natural gas consumption in the U.S. has increased dramatically. In 2014, the U.S. used five times as much natural gas as 65 years earlier (Weissman, 2016). The increased dependence on natural gas has many questioning this metaphor, and asking "where does the bridge lead", "how long will we travel on the bridge", and "what qualities make the bridge more attractive than the departure zone" (Delborne et al., 2020)?

In an evaluation of the utilization of the "bridge fuel" metaphor in the media and literature, Delborne et al. (2020) identified several interpretations, including (1) transitional bridge, (2) renewable facilitator, (3) all of the above, (4) new energy foundation, and (5) bridge to nowhere. The transitional bridge and renewable facilitator emphasize that natural gas has a role in our energy future; the former specifies that it is only for a short period of time and the latter acknowledges that solar and wind are intermediate, so natural gas can be a source of stable energy supply in the long term. The "all of the above" interpretation advocates for a diverse energy portfolio that consists of fossil fuels and renewables. A "new energy foundation" refers to natural gas as the destination fuel, arguing that it is sufficient to reduce our carbon footprint. On the other hand, the "bridge to nowhere" interpretation emphasizes that the U.S. is increasing its dependency on fossil fuels, and instead, raises the question of whether natural gas is temporary, or, in fact, permanent.

The oil and gas industry has been engaged in rebranding natural gas as a clean fuel that does little harm to the environment (Powell, 2019), while also providing "economic viability" compared to wind and solar – which only provide intermittent energy (Delborne et al.et al.., 2020; Gürsan & de Gooyert, 2020; Podesta & Wirth, 2009). Indeed, the industry refers to natural gas as a "clean" fuel, not just "cleaner" compared to other fossil fuels, which creates a false

descriptor for the public (Powell, 2019). The mission of the natural gas industry to remain relevant in the transition to renewable sources has been largely successful, although opinions regarding natural gas and fracking remain largely divided among party lines (Gearhart et al., 2019). As the "renewable facilitator" interpretation (Delborne et al. 2020) of the bridge fuel metaphor would suggest, natural gas can directly affect the energy transition by being a constant source of energy and filling in the gaps of renewable energy (Delborne et al., 2020; Gürsan & de Gooyert, 2020). On the other hand, indirectly, it can have a "crowding-out" effect by drawing investments away from both coal and renewable energy industries (Gürsan & de Gooyert, 2020).

Public Opinion

Early public opinion research identified that people have "low-quality opinions, if they have opinions at all" about specific topics due to "doubts of competence of citizens to participate in political affairs (Chong & Druckman, 2007). However, more recent studies suggest that the public has views that are rooted in cultural theory (Finucane et al., 2000) and political predisposition (Zaller, 1992), and are, therefore, not as variable as once understood. Framing mechanisms are employed by political actors to "mobilize supporters and demobilize opposers" (Tran et al., 2019), suggesting that public opinion can play an important role in setting the policy agenda.

In a country's energy transition, the path taken, and the pace of that path are shaped by the demand of its citizens (Bergquist et al., 2020). Public opinion research in democratic countries has found that public opinion influences policy and the more salient an issue, the stronger the relationship between public opinion and policy becomes. At the same time, the influence of interest groups, political parties, and economic elites can impede this relationship

(Burstein, 2003). Wlezien argues that public opinion and policy work like a thermostat in regard to salient policy issues – by signaling the government to turn up the policymaking when they deem the process as insufficient and to turn it down when it exceeds what the public wants (Wlezien, 1995). Furthermore, in democratic countries, we can measure the quality of the government by their responsiveness to the preferences of the public (Burstein, 2003). Yet, the role of public opinion in policy can be overestimated due to the considerable influence interest groups, party activists, and policymakers can have over public opinion (Burnstein, 2006). Regardless, public opinion research is a key aspect of the policymaking process and is necessary to guide future energy and environmental policy, or at least understand where the public stands on an issue at a given moment in time.

Technology, People, Place, and Process Framework

The "technology, people, place, and process" framework (Boudet, 2019) for understanding public perceptions of new energy technologies provides a framework to identify and categorize key factors influencing public perception of natural gas export. Although the factors often overlap categories, they provide a logical organization for the study. Technology refers to how the public perceives various factors regarding the technology, including perceived risks and benefits. The people category refers to the socio-demographics and political ideologies that influence perception of energy technologies. The place component refers to how local contexts shape public perception, including proximity, location, and perceived importance of local industries. Finally, although not discussed in this study, the process category highlights public engagement, procedural transparency, and fairness in the development processes of energy technologies.

Technology

Risk-Benefit Perceptions

Objective risks are associated with the calculated risk that is a "product of scientific research, experimental studies, epidemiological surveys, and probabilistic risk analyses" (Fischhoff et al., 1984). Many risk communicators work under the assumption that if people had complete information, then they would come to the same conclusions as experts (Finucane et al., 2000). However, people's risk perceptions are rarely completely rational – where public's subjective risk perceptions are often not aligned with the objective risks – due to the number of different considerations that are included in personal risk assessment (Slovic et al., 1981).

Commonly cited risks with regard to natural gas often relate to potential environmental risks (e.g., regional environment, public health, global climate), while benefits fall into economic categories (energy security, energy prices, jobs in the region, regional economy) (Boudet, 2019; Graham et al., 2015; Pierce et al., 2018). For instance, when evaluating the risk and benefit perceptions of fracking in both the UK and US, Thomas et al. (2017) determined that participants in both countries identified jobs, energy independence, and energy security as potential benefits, while citing water concerns, specifically water contamination, as potential risks. While perceptions do not always reflect reality, the growing concerns about the environmental risks of natural gas are justified. Methane is leaking at higher rates than predicted thereby increasing the rate of climate change, fracking chemicals have been found in drinking water, and air quality is jeopardized due to toxic fumes (Finkel & Hays, 2013). With that being said, economic benefit perceptions have also been justified – as it supports 3 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.).

Understanding risk-benefit perceptions are an important component of public opinion research and the associated policy implications because they can dictate policy agendas in regulatory agencies (Kunreuther & Slovic, 1996). While much of the natural gas risk-benefit perception research evaluates fracking or as an energy source, it's likely these opinions translate into perceptions around export. Thus, I make the following hypotheses:

H_{1A}: Respondents with higher environmental risk perceptions are less likely to support natural gas export; and

H_{1B}: Respondents with higher economic benefit perceptions are more likely to support natural gas export.

People

Research has expanded beyond the idea that the public perception of risks is due to irrationality or ignorance, but rather it can be attributed to the complexity of sociological and psychological processes when assessing risk (Brasier et al., 2013). Risk perceptions vary depending on socio-demographic (Flynn et al., 1994) and socio-political factors (Finucane et al., 2000). Cultural theory suggests that people form perceptions of risk that reinforce their "cultural way of life," and each worldview has a typical set of perceived risks that accepts some risks and disregards others (Kahan, 2008; McCright & Dunlap, 2011). For this reason, risk perceptions are less about the riskiness of the technology but rather more attributed to social and regulatory contexts.

In the absence of direct experience, risk-benefit perceptions are often determined based on preexisting beliefs and values (Graham et al., 2015; Slovic et al., 1981), which can result in

perceived risks that do not align with actual risk. In the case for nuclear power, after the Fuskushima nuclear accident, the public has been found to overestimate the risks of a nuclear accident, despite the objective probability of accidents being very low (Wang & Kim, 2018). In fact, nuclear power is found to be much safer than coal on a death-per-kilowatt-hour basis, yet the public sees nuclear as being riskier than coal (Kunreuther & Slovic, 1996). The opposite has been the case for climate change, where a significant amount of the population underestimates the impacts of climate change. Evidence suggests that climate science is often at odds with existing beliefs and values, and because the reality of climate change is so bleak, when faced with the facts, people often seek to "reason around the facts" (Hall, 2019).

Gender

The "white male effect" is a widely accepted concept by environmental sociology and public opinion scholarship. 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 & Dunlap, 2011). Men are more likely to be supportive of natural gas (Hazboun & Boudet, 2020), supportive of drilling for natural gas (Kriesky et al., 2013), siting of new coal- and natural gas-fired power plants (Ansolabehere & Konisky, 2009), and natural gas export (Pierce et al., 2018). White men report less concern regarding health, technological, and environmental risks compared to other socio-demographic groups (Boudet, 2019; Brasier et al., 2013; Finucane et al., 2000). Men often hold hierarchical individualist worldviews, making them subconsciously downplay significant environmental concerns in order to protect their identity and elite status within institutions (Hall, 2019). Similarly, they are more often involved in the creation, management, and control of

technology, while women and non-white men tend to be more vulnerable to and have less control over the risks (Finucane et al., 2000). Thus, those in positions of power tend to support the status quo due to receiving the benefits compared to other groups. I make the following hypotheses:

H_{2A}: Women are more likely to perceive that natural gas export poses a greater environmental risk than men;

H_{2B}: Women are more likely to perceive that natural gas export poses less economic benefit than men; and

H_{2C}: Women are less likely to support natural gas export than men.

Race

Minorities tend to be more vulnerable to and have less control over the risks of new energy technologies, sparking concerns about environmental equity and environmental racism within the siting processes of new energy development (Ansolabehere & Konisky, 2009; Finucane et al., 2000; Flynn et al., 1994). People of color that live near energy production facilities are often lower income and experience negative health and environmental impacts of prolonged exposure to emissions (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). The oil and gas industry argue that their projects bring economic prosperity; however, this has not been the case for primarily African American communities. In 2009, African Americans spent $41 billion on energy, yet they only held 1.1 percent of energy jobs and gain only 0.01 percent of the revenue from the energy sector (Patterson et al., 2014).

Research studying the relationship between race and energy support is fairly straightforward and conclusive. Minorities tend to be less supportive of natural gas infrastructure (Ansolabehere & Konisky, 2009; Boudet et al., 2014), more likely to support renewable energy (Hazboun et al., 2016), more concerned about climate change (Ballew et al., 2020), and less supportive to the construction of new power plants, including natural gas, coal, and wind (Ansolabehere & Konisky, 2009). All of which have been linked to environmental risk perceptions and experiences. I make the following hypotheses:

H_{3A}: Non-white respondents are more likely to perceive natural gas export poses a greater environmental risk than white respondents;

H_{3B}: Non-white respondents are more likely to perceive natural gas export poses less economic benefit than white respondents; and

H_{3C}: Non-white respondents are less likely to support natural gas export.

Education

Higher education has been known to be the location where individuals are more likely to attain environmental awareness (Durmuş-Özdemir & Şener, 2016). When evaluating the relationship between educational attainment and perceptions about environmental issues, Richardson et al. (2020) found that those with only a high school education were more likely to discuss natural resources in term 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 et al., 2020).

Education is less conclusive when it comes to support for hydraulic fracturing, where studies have found those with higher levels of education are more likely to support it (Boudet, 2014; Boudet et al., 2016), less likely to support it (Gravelle & Lachapelle, 2015), or the relationship is insignificant (Howell et al., 2017).

Educational attainment has been linked support for the siting of new coal-fired and wind power plants (Ansolabehere & Konisky, 2009), support for wind, solar, and geothermal energies more generally (Hazboun & Boudet, 2020), and those with more education are more likely to have an opinion regarding natural gas drilling and to oppose it (Willits et al., 2016). It's suggested that the link between education and support for natural gas is because the benefits of job opportunities associated with construction becomes less important (Gravelle & Lachapelle, 2015). On the other hand, because natural gas has been considered a bridge fuel to a renewable energy future, this metaphor could play a role in how more educated individuals perceive natural gas as a whole (Boudet, 2014). I present the following hypotheses:

H_{4A}: Respondents with a bachelor's degree or higher are more likely to perceive that natural gas export poses higher environmental risk, and

H_{4B}: Respondents with a bachelor's degree or higher are less likely to perceive that natural gas export poses more economic benefit.

H_{4C}: The impact of education on support for natural gas export is ambiguous.

Age

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). Studies have found that there is a "global warming age gap" (Ballew et al., 2019), where younger generations are more likely to believe in global warming, say it is personally important to them, and engage in climate activism than older generations (Ballew et al., 2019; Ballew et al., 2020). However, among people of color, environmental values have been found to be persistent over generations in regard to perceived environmental risks from air pollution, climate change, and nuclear power plants (Macias, 2015). With that being said, due to the shared experience of environmental racism and environmental injustice, people of color have high risk perceptions. 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).

Younger individuals are more likely to oppose fossil fuels (Boudet, 2019), are more concerned about environmental risks (Boudet, 2019), have stronger beliefs in climate change (Hornsey et al., 2020), and have less favorable views of the siting of new natural gas power plants compared to older individuals (Ansolabehere & Konisky, 2009). However, age was an insignificant predictor of natural gas export (Pierce et al., 2018), but younger Americans were determined to be less supportive of natural gas pipelines (Gravelle & Lachapelle, 2015). Based on the literature, I make the following hypotheses:

H_{5A}: Younger respondents are more likely to perceive that natural gas export poses higher environmental risk than older respondents; and

H_{5B}: Younger respondents are less likely to perceive that natural gas export poses more economic benefits than older respondents.

H_{5C}: The relationship between age and support for natural gas export is ambiguous.

Political Ideology

Political predispositions can also alter how frames are processed, especially with partisan issues (Wiest et al., 2015). Zaller 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 are not consistent, and individuals that are more cognitively aware of these connections are more prone to accepting or dismissing information based on those predispositions (1992). Political ideology can serve as a "cognitive shortcut" allowing individuals to rely on these predispositions in order to form opinions without extensive knowledge or consideration (Gravelle & Lachapelle, 2015). Often, the political polarization in regard to 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 & Brulle, 2011).

The white male effect has also been considered the "conservative white male effect" – highlighting how political ideologies create polarization in environmental and energy issues (Boudet, 2019; Clarke et al., 2016; McCright & 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; Pew Research Center, 2019). Conservatives tend to support 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 & Lachapelle, 2015). Liberals often oppose pipeline projects because the benefits are awarded to corporations and the risks are imposed on the communities, which do not align with their central values regarding collective goods and equality (Gravelle &

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 (Clarke et al., 2016), which can be attributed to an individual's reliance on political predisposition rather than direct experiences.

Among Republicans, moderate or liberal leaning Republicans are less supportive of the expansion of fossil fuels (offshore drilling, hydraulic fracturing, coal mining) and more supportive of developing renewables (solar, wind) compared to conservative Republicans (Pew Research Center, 2019). Political divides also extend to policy preferences, where Republicans, regardless of age, are skeptical about climate policy and its impacts on the economy (Pew Research Center, 2019). Less political polarization about global warming beliefs and attitudes have been identified in younger generations (Ballew et al., 2019). Regardless of political party affiliation, political ideology has been considered one of the most consistent variables in energy development analyses (Pierce et al., 2018). Thus, I make the following hypotheses:

H_{6A}: Conservatives are more likely to perceive that natural gas export poses less environmental risks than liberals and moderates;

H_{6B}: Conservatives more likely to believe that natural gas export poses more economic benefits than liberals and moderates; and

H_{6C}: Conservatives are more likely to support natural gas export than liberals and moderates.

Place

Rural/Urban Location

Rural communities are disproportionately impacted by natural gas infrastructure because they have the spatial capacity to manage the several acres required for large-scale energy development (Kriesky et al., 2013). Small, isolated, rural communities that experienced rapid industrialization and growth due to new energy development have been referred to as "boomtowns" (Brasier et al., 2011; Kinchy et al., 2014). While most boomtown research has evaluated extractive industries, it is likely to extend to natural gas export. Projected economic benefits often include short-term retail and hospitality revenue – where communities are expected to experience an increase in economic activity during construction and are likely to face a decline after the project is completed.

People living in rural areas have been found to have more favorable views on the economic opportunities with new energy development (Davis & Fisk, 2014) due to economic ties to the extractive industry (Boudet et al., 2016). However, these local ties can also attribute to less support due to the environmental degradation, threatened aesthetic quality (Brasier et al., 2011), and lower quality of life (Schafft & Biddle, 2015) that follows the economic boom. Community members have reported seeing potential for economic opportunities in the 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 that urban interests are placed above that of rural communities (Boudet, 2019). Community members in the Marcellus Shale have raised concerns that the increased State revenue would benefit larger cities – highlighting underlying urban-rural social divides (Brasier et al., 2011).

H_{7A}: Respondents living in non-metropolitan areas are more likely to perceive that natural gas export poses less environmental risk; and

H_{7B}: Respondents living in non-metropolitan areas are more likely to perceive that natural gas export poses more economic benefits; and

H_{7C}: Respondents living in non-metropolitan areas are more likely to support natural gas export.

Proximity

When discussing proximity factors, the notion of the "not in my backyard" (NIMBY) phenomenon has often been linked with public opposition. NIMBY refers to the opposition of locally unwanted land uses (e.g., incinerators, landfills, and prisons) by residents living in close proximity (Kraft & Clary, 1991). In most research, as the 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). Those within close proximity are often more exposed to media coverage, often shaping the information to a local context, thereby, increasing awareness of both economic benefits and environmental risks (Gravelle & Lachapelle, 2015). Proximity is often modeled by a distance decay function, highlighting that intensity of opposition diminishes at further distances (Aldrich, 2013). At closer distances, individuals take into account local contexts, whereas individuals further away view the project more generally and rely on predispositions to form opinions (Trope & Liberman, 2010). Conservatives have been found to be just as likely to support pipelines regardless of spatial proximity, while liberals are more likely to favor pipelines as distance decreases (Gravelle & Lachapelle, 2013).

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 those living in close proximity to certain types of infrastructure are more supportive of the facilities because they receive the benefits through jobs, leasing payments, and taxes that stimulate the economy (Gravelle & Lachapelle, 2015; Pierce et al., 2014). Those living within the proposed pipeline route are offered easements from the oil and gas company in order to gain the rights to use their property, while allowing the landowner the maintain ownership. The landowners that accept easements from the company are primarily concerned about "maximizing [the] income from the transaction", while still acknowledging the environmental risks (Kriesky et al., 2013).

Studies have also identified 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). Several empirical studies have identified that opposition of projects are strongest in the planning phase, and weaker before the project is proposed or after the facility is operational (van der Horst, 2007). The lack of understanding of how the NIMBY phenomenon impacts an individual's opinion indicates that further analysis is required. I make the following hypotheses:

H_{8A}: Respondents impacted by the JCP are more likely to perceive that natural gas export poses greater environmental risks;

H_{8B}: Respondents impacted by the JCP are more likely to perceive that natural gas export poses more economic benefits; and

H_{8C}: The relationship between proximity to the JCP and support for natural gas export is ambiguous.

Perceived Importance of Industry

Bell and York (2010) identified the concept of "community economic identity" 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. Since then, a number of studies have incorporated this concept ranging from a variety of fossil fuel (Hazboun & Boudet, 2020) and renewable energy industries (Hazboun & Boudet, 2020; Hazboun et al., 2018) in attempt to gain a better understanding of public perception of new energy development.

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 & Boudet, 2020; Hazboun et al., 2018). Hazboun & 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 (wind, solar, wave/tidal, and geothermal) and more likely to support fossil fuels (coal and natural gas) (Hazboun & Boudet, 2020). Similar trends were identified for communities reliant on extractive industries and support for renewable energy development (Hazboun et al., 2018) and climate policies (Mayer, 2019) that would negatively impact the industry. However, Brasier et al. (2011) determined that a community's extractive history impacts economic benefit and environmental risk perceptions differently, where regardless of history, residents in the Marcellus Shale

reported believing the industry would squeeze profits dry and leave behind environmental problems for them to address.

H_{9A}: Respondents with higher perceived importance of the mining, refining, and utilities industry are more likely to perceive that natural gas export poses lower environmental risk;

H_{9B}: Respondents with higher perceived importance of the mining, refining, and utilities industry are more likely to perceive that natural gas export poses higher economic benefits; and

H_{9C}: Respondents with higher perceived importance of the mining, refining, and utilities industry are more likely to perceive support 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 (Hazboun & Boudet, 2020), and wind energy (Hazboun & 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 as of yet, while the history of extractive industries is extensive, and often romanticized. However, it was positively associated with support for solar, wave/tidal, and geothermal energy (Hazboun & Boudet, 2020). I provide the following hypotheses and research question:

H_{10A}: Respondents with higher perceived importance of the renewable energy industry are more likely to perceive that natural gas export poses higher environmental risk;

H_{10B}: Respondents with higher perceived importance of the renewable energy industry are more likely to perceive that natural gas export poses lower economic benefits; and

H_{10C}: The relationship between perceived importance of the renewable energy industry and support for natural gas export is ambiguous.

Data & Methods

Data Collection

We contracted YouGov to recruit the sample and administer the survey to 500 Oregon residents. YouGov is well-known for their intricate sample matching and weighting procedures. Their goal is to select as representative a sample as possible from a non-randomly selected respondent pool. YouGov 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, geographic location and proximity, political ideology, perceived importance of relevant industries, and perceived economic benefits and environmental risks.

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

Variable	Question/Category	Descriptive Statistics[2]
Gender	Please indicate your gender. (1) Male (2) 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	89% (White)
Education	Please indicate the highest level of educate you have completed	
	(1) No HS	2%
	(2) High school graduate	15%
	(3) Some college	26%
	(4) 2-year	15%
	(5) 4-year	26%
	(6) Post-grad	16%
Ideology	In general, your ideology is:	
	(1) Very liberal	20%
	(2) Liberal	22%
	(3) Moderate	25%
	(4) Conservative	18%
	(5) Very conservative	10%
	(6) Not sure	5%
Metro	Please indicate if you live in a metro or non-metro area. (1) Metro or (2) Non-Metro	50% Metro (N=250)
County with proposed LNG development	Please indicate your zip code of residence. Coded: (1) Within, or (2) Outside Klamath, Douglas, Coos, or Jackson County	25% Within (N=124) 75% Outside (N=376)

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
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%
Stance	Based on what you know, to what extend to you oppose or support the U.S. exporting natural gas to other countries? (1) Strongly oppose (2) Somewhat oppose (3) Somewhat support (4) Strongly support (5) Not sure	 35% 18% 20% 18% 9%

[1] Sample size, N=500
[2] Percentages may not equal 100 due to rounding.

Respondents were asked their perception of 4 commonly cited risks (global climate, regional environment, public health, and private property) 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 grouped into two distinct factors via principal components exploratory factor analysis (see Supplementary 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.), global climate, and private property (property values, eminent domain, etc.). 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 labeled as "environmental risks" and "economic benefits".

Cronbach alpha reliability analysis was used to evaluate internal consistency between the variables associated with each factor for both perceived economic benefits and environmental risks (Table 2). The Cronbach alpha reliability coefficient for environmental risk was 0.92. The variables in this factor ranged from 0.87 to 0.94. The removal of perceived risk to private property would increase the overall Cronbach alpha, therefore it was removed from subsequent analyses. The overall Cronbach alpha for economic benefits was 0.93. Given satisfactory internal consistency between the variables, and the fact that the removal of any of the variables would result in a decrease in the overall Cronbach alpha, every variable was utilized when computing mean composite indices for the economic benefit index. For respondents to be included in the computed indices they were required to have answered at least three of the questions associated with each index.

Table 2. Reliability analysis of reasons for perceived risks and benefits of natural gas export

Perceived risks and benefits	*M*	Standard Deviation	Item-Total Correlation	Alpha if Item Deleted	Cronbach Alpha
Factor 1 (Environmental risks)					0.92
Regional environment	3.43	1.41	0.89	0.87	
Public health	3.40	1.46	0.89	0.87	
Global climate	3.38	1.51	0.83	0.89	
Private property[1]	2.86	1.31	0.67	0.94	
Factor 2 (Economic benefits)					0.93
Energy security	2.48	1.31	0.84	0.90	
Energy prices	2.58	1.35	0.88	0.89	
Jobs in the region	2.85	1.18	0.76	0.93	
Regional economy	2.72	1.30	0.85	0.90	

[1]Variable was removed in subsequent analyses due to higher Cronbach Alpha if item deleted.

Figure 2 shows the unweighted responses to the perceived risks associated with natural gas, including global climate, regional environment, and public health. Comparatively, the perceived degree of risk was consistent across all three categories, with most respondents considering natural gas 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 most respondents have some degree of concern of how natural gas export will negatively impact the environment and human health.

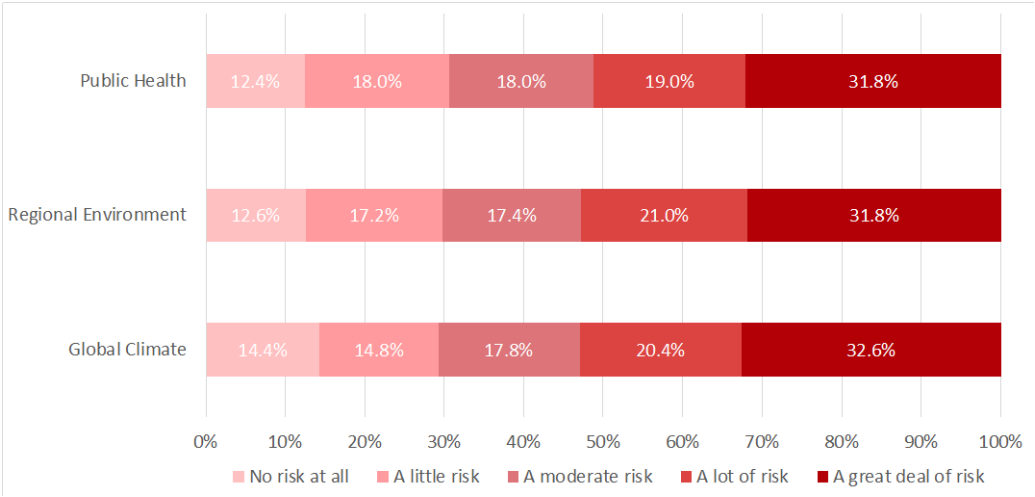


Figure 2. Unweighted responses to perceived risks associated with natural gas export, including global climate, regional environment, and public health.

Figure 3 shows the responses to the perceived benefits associated with natural gas export, including jobs in the region, energy security, energy prices, and regional economy. These results indicate that a majority of respondents are somewhat skeptical of the economic benefits that natural gas export brings to the region. For instance, 32 percent reported perceiving no benefit at all to energy security, while only 7 percent reported a great deal of benefit. More respondents reported that they perceived natural gas export to provide a great deal of benefit to the regional economy (10%) than any of the four categories, while the least viewed there to be a great deal of benefit to jobs in the region and energy security (6% and 7% respectively).

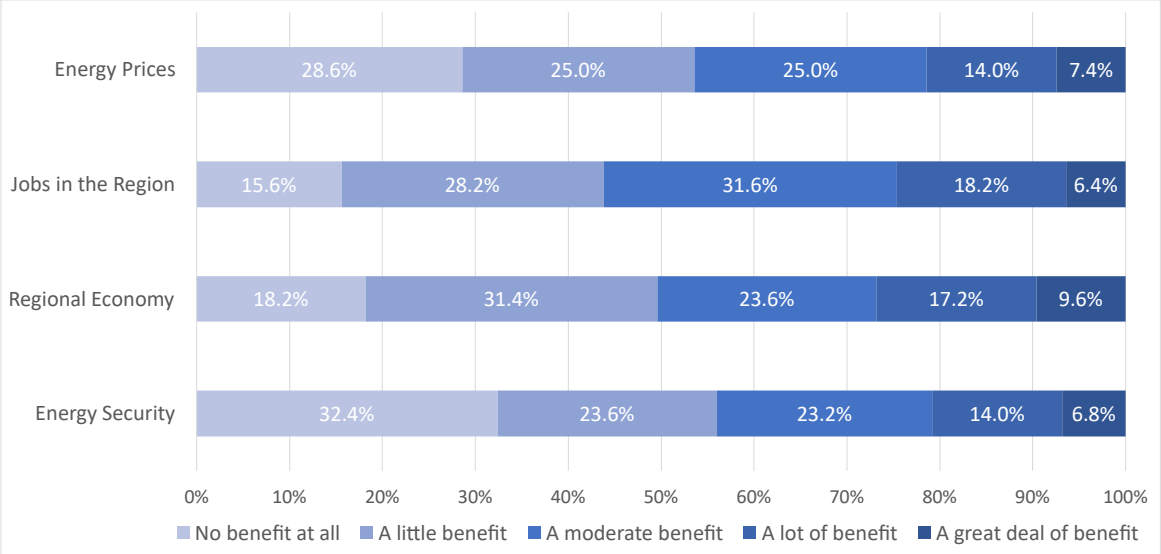
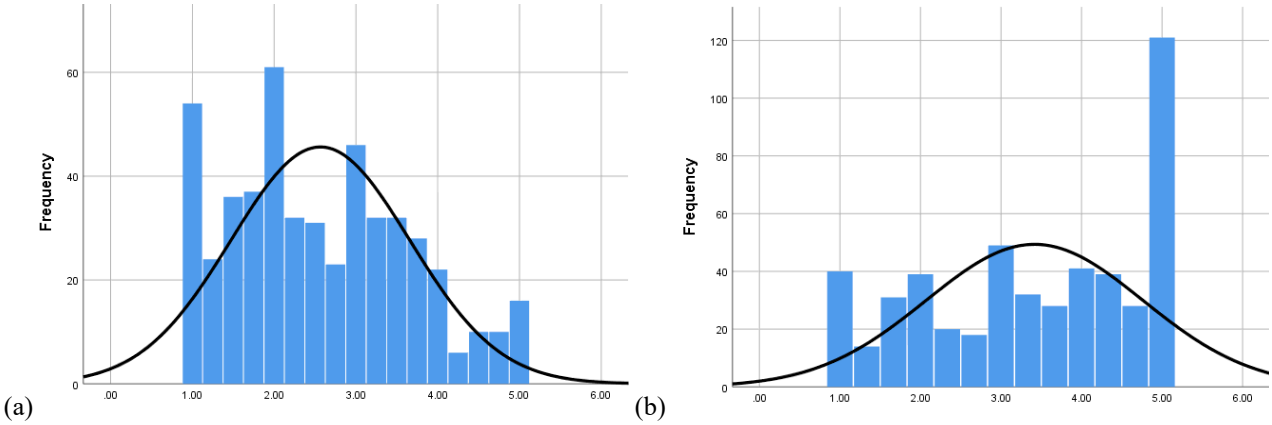


Figure 3. Unweighted responses to perceived benefits associated with natural gas export, including jobs in the region, energy security, public health, and regional economy.

The newly computed environmental risks and economic benefits indices are used moving forward as independent variables to analyze the impact of risk and benefit perceptions on support for natural gas export. These indices are also used as dependent variables to examine how various factors – including socio-demographic, geographic location and proximity, political ideology, and perceived importance of relevant industries – impact an individual's risk and benefit perceptions. As seen below (Figure 1), the residuals are continuous and normally distributed between 1 and 5; therefore, analysis will be conducted through ordinary least squares (OLS) regression.



(a) (b)

Figure 4. (a) Histogram represents the distribution of responses for the economic benefit perceptions computed index, and (b) Histogram represents the distribution of responses for the environmental risk perceptions computed index, and a normal distribution curve is indicated on each graph.

The race variable was recoded from an 8-category variable to a dichotomous variable, "white" vs "non-white" (due to the severe under-representation of non-white racial categories in the sample). Respondents were asked how important they view the renewable energy industry (e.g., wind, solar, hydroelectric) and the mining, refining, and utilities industry on a scale from 1 "not at all important" to 4 "very important". The average age of the sample was 56.67 years old and is maintained as a continuous variable in the analysis.

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 project. 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 LNG facility and pipeline cross through four counties: Klamath, Douglas, Jackson, and Coos. The variable was then recoded to include all zip codes in these counties, which increased the "in" category to 124 respondents (25%).

For analysis, the respondents that responded "not sure" or failed to respond in regard to their opinion on natural gas export were removed listwise from the sample in order to focus on respondents that have a stance on this issue. Similarly, those that responded "not sure" in regard to their ideology were removed listwise from the sample. For the environmental risks and economic risk perception models, the sample size ranges from N=462 to 500. The ordinal logistic regression analysis for opinion on natural gas export had models ranging from N=410 to 437. [1]

Analysis

To analyze the predictors of perceived economic benefits and environmental risks associated with natural gas export, we developed a hierarchical multiple regression model. The baseline model included socio-demographic variables (gender, age, race, and education), then builds in a stepwise manner to include geographic location (metro vs non-metro and proximity to proposed pipeline and export terminal), followed by political ideology, and perceived importance of relevant industries (renewable energy and mining, refining, and utilities industry). The overall model for environmental risk perception is as follows:

$$Env_{Risk} = \beta_0 + \beta_1 male + \beta_2 white + \beta_3 bach_{higher} + \beta_4 age + \beta_5 metro + \beta_6 impact + \beta_7 libcons + \beta_8 renew + \beta_9 mru$$

The overall model for economic benefit perceptions:

$$Econ_{ben} = \beta_0 + \beta_1 male + \beta_2 white + \beta_3 bach_{higher} + \beta_4 age + \beta_5 metro + \beta_6 impact + \beta_7 libcons + \beta_8 renew + \beta_9 mru$$

A similar method was followed for modeling support of natural gas export using ordinal logistic regression. Analysis began with demographics (gender, age, race, and education) as the

[1] Household income was not included in the final models because it reduced the sample size to 381.

baseline model then followed by geographic location (metro vs non-metro and proximity to proposed pipeline and export terminal), political ideology, perception of economic benefits and environmental risks, and perceived importance of relevant industries (renewable energy and mining, refining, and utilities industry). Moreover, this third model captures the impact of these variables that were included in the first two models outside of their effect on risk-benefit perceptions. The model for public perception of natural gas export is as follows:

$$OP = e^{\beta_0+\beta_1 male+\beta_2 white+\beta_3 bach_{higher}+\beta_4 age+\beta_5 metro+\beta_6 impact+\beta_7 libcons+\beta_8 econ+\beta_9 env+\beta_{10} renew+\beta_{11} mru}$$

The proportional odds/parallel regression assumption is a key assumption of the ordinal logistic regression because it determines whether one can interpret the model in terms of odds ratios. It assumes that the relationship between each pair of outcome groups is the same (Long & Freese, 2014). Across all five models, the "Brant Test" is significant at a 95% significance level [2], providing evidence that the proportional odds assumption is violated, and the beta-coefficients are interpreted in general terms.

The pairwise correlation coefficient also indicated a significant and slightly negative correlation between metro and the impacted county dummy variables [3]. Because both variables are insignificant when both are included in the regression model, I analyzed this correlation further. With the exclusion of the metro variable, the beta-coefficient on the impacted county dummy variable became negative, but it remained insignificant. Similarly, the exclusion of the impacted county dummy variable did not impact the significance for the metro variable [4]. However, because theory suggests that both proximity and location could play a role in an

[2] Results of the Brant Test: Model 1 $p<0.001$; Model 2 $p<0.001$; Model 3 $p<0.001$; Model 4 $p<0.001$; Model 5 $p<0.001$

[3] pwcorr = -0.380, $p < 0.001$.

[4] Metro is insignificant with the exclusion of the county-level dummy variable ($p = 0.926$). Similarly, the location dummy variable is insignificant with the exclusion of metro ($p = 0.847$).

individual's likelihood of supporting or opposing natural gas export both variables are included in the final model.

Results

Environmental Risk Perceptions

Environmental risk perception associated with natural gas export was modeled via OLS linear regression, where the beta coefficients are standardized and weighted (Table 3). A positive beta-coefficient reflects higher levels of environmental risk perceptions and a negative beta-coefficient reflects lower levels of environmental risk perceptions.

Table 3. Evaluating factors influencing perception of environmental risks in natural gas export.

	Model 1		Model 2		Model 3		Model 4	
Constant	3.623	***	3.789	***	2.553	***	2.576	***
Male *vs Female*	-0.145	***	-0.139	***	-0.071	***	-0.063	*
White *vs Non-white*	0.094	**	0.105	**	0.038		0.038	
Bachelor's degree or higher *vs Less than bachelors*	0.371	***	0.376	***	0.201	***	0.170	***
Age	-0.167	***	-0.151	***	-0.065	*	-0.041	
Metro *vs Non-metro*			-0.071		-0.091	**	-0.104	***
Impacted county *vs Not impacted county*			-0.074	*	0.018		0.017	
Liberal/Moderate *vs Conservative*					0.569	***	0.516	***
Industry – Mining, refining, utilities							-0.240	***
Industry – Renewable Energy							0.189	***
R-Squared	18%		18%		45%		53%	
F-Statistic	26.55	***	18.37	***	54.80	***	56.57	***
N	500		500		462		462	
AIC	236.80		237.11		49.47		-11.75	

Note: Beta-coefficients are standardized, and data is weighted.
* p < 0.100, ** p < 0.050, *** p < 0.010

Women, whites, respondents with a bachelor's degree or higher, and younger respondents reported higher risk perceptions than males, non-whites, respondents with less than a bachelor's degree, and older respondents. Respondents living in a county impacted by the Jordan Cove Project reported higher environmental risk perceptions than those not living in an impacted county; however, there is only a significant difference between the two groups in model 2.

Race and respondents living in an impacted county are no longer significant with the inclusion of ideology. Younger respondents do not report significantly different environmental risk perceptions compared to older respondents. Similarly, respondents living in metropolitan areas did not report significantly different environmental risk perceptions compared to those living in non-metro in Model 2. However, there is a significant difference between those living in metropolitan and non-metropolitan areas in models 3 and 4, where respondents living in a metropolitan area reported lower environmental risk perceptions than those living in non-metro areas. Ideology is the largest predictor, with liberals and moderates reporting higher levels of risk perceptions than conservatives.

As perceived importance of the renewable energy industry increases, environmental risk perception increases. An individual with higher perceived importance of the mining, refining, and utilities industry has lower environmental risk perceptions compared to those with lover perceived importance of the industry.

Economic Benefit Perceptions

Economic benefit perception associated with natural gas export was modeled via OLS linear regression, where the beta coefficients are standardized and weighted (Table 4). A positive

beta-coefficient reflects higher levels of economic benefit perceptions and a negative beta-coefficient reflects lower levels of economic benefit perceptions.

Table 4. Evaluating factors influencing perception of economic benefits of natural gas export.

	Model 1		Model 2		Model 3		Model 4	
Constant	2.779	***	2.793	***	3.626	***	3.612	***
Male *vs Female*	0.190	***	0.186	***	0.123	***	0.117	***
White *vs Non-white*	-0.038		-0.048		0.062	*	0.063	*
Bachelor's degree or higher *vs Less than bachelors*	-0.319	***	-0.331	***	-0.140	***	-0.116	***
Age	0.003		-0.003		-0.103	***	-0.122	***
Metro *vs Non-metro*			0.026		0.096	**	0.106	***
Impacted county *vs not impacted county*			-0.056		-0.077	**	-0.077	**
Liberal/Moderate *vs Conservative*					-0.592	***	-0.552	***
Industry – Mining, refining, utilities							0.185	***
Industry – Renewable Energy							-0.146	***
R-Squared	13%		13%		43%		47%	
F-Statistic	18.23	***	12.61	***	48.96	***	45.00	***
N	500		500		462		462	
AIC	94.024		93.353		-94.391		-126.143	

Note: Beta-coefficients are standardized, and data is weighted.
* p < 0.10, ** p < 0.050, *** p < 0.01

Respondents that were women and those with a bachelor's degree or higher reported lower economic benefit perceptions than men and respondents with less than a bachelor's degree. This trend was consistent across all four models. Ideology was the main predictor of economic benefit perceptions, with liberals and moderates reporting lower economic benefit perceptions than conservatives. Respondents with higher perceived importance of the mining, refining, and utilities industry 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 reported lower economic benefit perceptions than those with lower perceived importance.

Whites and geographic location and proximity were insignificant in in models 1 and 2; however, there is a significant difference for the three variables in models 3 and 4. Whites reported higher economic benefit perceptions than non-whites. Respondents living in a metropolitan area reported higher economic benefit perceptions than those living in non-metro areas. Individuals living in a county impacted by the proposed Jordan Cove Project reported lower economic benefit perceptions compared to those living outside an impacted county. Younger respondents reported higher economic benefit perceptions than older respondent; however, this result is inconsistent across models.

Natural Gas Export

Public perception of natural gas export in Oregon was modeled via ordinal logistic regression, where beta-coefficients are standardized, and data is weighted (Table 5). Gender, race, and education were consistent across all five models. Women, whites, and respondents with a bachelor's degree or higher reported lower levels of support for natural gas export than men, non-whites, and respondents with less than a bachelor's degree. Perceived importance of the mining, refining, and utilities industry is a significant predictor; however, respondents with higher perceived importance of the mining, refining, and utilities industry reported lower levels of support for natural gas export than respondents with lower perceived importance.

Table 5. Evaluating factors influencing support for natural gas export

	Model 1		Model 2		Model 3		Model 4		Model 5	
Male *vs Female*	0.876	***	0.877	***	0.874	***	0.611	***	0.688	***
White *vs Non-white*	-0.945	***	-0.943	***	-0.635	**	-0.761	***	-0.686	**
Bachelor's degree or higher *vs Less than bachelors*	-1.757	***	-1.756	***	-1.117	***	-0.760	***	-0.811	***
Age	0.004		0.004		0.001		0.005		0.006	
Metro *vs Non-metro*			-0.018		0.564		0.225		0.119	
Impacted county *vs Not impacted county*			-0.016		-0.275		0.056		-0.049	
Liberal/Moderate *vs Conservative*					-2.061	***	0.461		0.472	
Economic benefits							1.025	***	1.036	***
Environmental risks							-0.904	***	-0.938	***
Industry – Mining, refining, utilities									-0.218	*
Industry – Renewable energy									-0.187	
Pearson Chi-Squared	978.70	***	1074.51	*	1015.48		997.10		992.11	
N	437		437		410		410		410	

Note: Beta-coefficients are standardized, and data is weighted.
* p < 0.10, ** p < 0.050, *** p < 0.01

Economic benefit and environmental risk perceptions were the most significant predictors of support for natural gas export in Oregon. Respondents that reported higher environmental risk perceptions were associated with lower levels of support for natural gas export compared to those with lower risk perceptions. On the other hand, respondents that reported higher economic benefit perceptions were associated with higher levels of support for natural gas export.

Political ideology was significant in model 3, where liberals and moderates reported lower levels of support for natural gas export than conservatives. Conversely, liberals and moderates did not report significantly different support for natural gas export compared to conservatives in models 4 and 5. The varying in significant may be due to the slight correlation[5]

[5] Environmental risk/Ideology pwcorr=-0.517, p<0.001 and Economic benefit/Ideology pwcorr=0.443, p<0.001

between ideology and risk-benefit perceptions. Additionally, age and geographic location were insignificant predictors of support for natural gas export across all five models.

Discussion

Men reported lower environmental risk perceptions, higher economic benefit perceptions, and higher levels of support for natural gas export than women. Results are consistent with the literature and cultural theory, highlighting that men downplay environmental concerns and weigh economic benefits more heavily when determining support for new energy technologies. Thus, hypotheses H_{2A}, H_{2B}, and H_{2C} are supported.

White respondents reported lower levels of support for natural gas export than non-white respondents – which does not support the literature or H_{3C}. Furthermore, results provide no support for H_{3A} and some support for H_{3B}, which predicted that non-white respondents would perceive greater environmental risk and less economic benefits associated with natural gas than white respondents. The relationship between race and risk-benefit perceptions varied in significance. White respondents reported higher environmental risk perceptions, but this relationship became insignificant with the inclusion of political ideology. Literature suggests that, generally, minorities hold higher environmental risk perceptions (Finucane et al., 2000; Flynn et al., 1994); however, due to the "thin green line" in Oregon and the primarily white population, this result is somewhat unsurprising. The opposite is true for economic benefit perceptions, where race was insignificant until the inclusion of political ideology. White respondents reported higher economic benefit perceptions than non-white respondents.

Literature suggests that educational attainment is linked with higher levels of environmental awareness (Durmuş-Özdemir & Şener, 2016; Richardson et al., 2020). The results

of this study suggest that this is the case in Oregon. Respondents with a bachelor's degree or higher reported higher environmental risk perceptions and lower economic benefit perceptions, thus, hypotheses H_{4A} and H_{4B} are supported. Education is less conclusive within the literature in its relationship with new energy development – suggesting an ambiguous relationship between the two variables (H_{4C}). Education was, in fact, significant, indicating that those with a bachelor's degree or higher are less likely to support natural gas export than those with less than a bachelor's degree.

Similarly, the relationship between age and support for natural gas export is ambiguous in the literature (H_{5C}). Results indicate that age is not a significant predictor for support for natural gas export in Oregon and varied in significance for economic benefit and environmental risk perceptions. There is some support for H_{5A}– that younger respondents would report higher environmental risk – but there is no support for H_{5B}, as older respondents reported lower economic benefit perceptions than younger respondents.

Political ideology was the strongest predictor of risk-benefit perceptions and confirms hypotheses H_{6A} and H_{6B}, 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 (Gravelle & Lachapelle, 2015; Zaller, 1992). However, the hypothesis that liberal and moderate respondents would have lower levels of support for natural gas export (H_{6C}) was only partially supported. Political ideology was only significant in model 3 and became insignificant with the inclusion of risk-benefit perceptions. The pairwise correlation coefficient was slightly above the accepted value – suggesting that multicollinearity is a factor in why it drops out of significance with the inclusion of risk-benefit

perceptions. Although, due to the important role political predispositions play when forming stances on an issue, it is necessary to include both ideology and risk-benefit perceptions.

The literature suggests that people living in rural areas tend to have more favorable views on the economic benefits associated with new energy development (Davis & Fisk, 2014) and the environmental concerns that arise (Brasier et al., 2011). Thus, hypotheses H_{7A} and H_{7B} predict that respondents living in non-metro areas will have lower environmental risk and higher economic benefit perceptions. However, results show no support for H_{7A} and H_{7B} because respondents living in metro areas reported lower environmental risk and higher economic benefits than those living in non-metro areas, but these relationships varied in significance across the models. The lower risk perceptions of individuals living in metropolitan areas could be a result from residents being more removed from the environmental risks, while still receiving economic benefits that the government spreads around the state. On the other hand, rural individuals in Oregon have higher risk perceptions likely due to the potential of experiencing environmental degradation, threatened aesthetic quality (Brasier et al., 2011), and lower quality of life (Schafft & Biddle, 2015). Results also indicate no support for H_{7c} – predicting that respondents in non-metropolitan areas are more likely to support natural gas export – because urban/rural location was insignificant across all models.

In terms of proximity to development, I do not find support for H_{8A} and H_{8B}. Respondents living in a county impacted by the JCP reported lower environmental risk and lower economic benefit perceptions associated with natural gas export; however, significance varied across both models. The relationship between proximity and new energy development in both renewable and fossil fuel energy industries is ambiguous (H_{8C}) – with studies varying in results from "not in my backyard" to inverse NIMBY to insignificant results. In this study, proximity to the JCP was an

insignificant predictor of support for natural gas export. As identified in the literature, the relationship between proximity and public opinion is inherently variable due to the number of considerations while forming opinions (Clarke et al., 2016). Public opposition has been found to be strongest in the planning phases (van der Horst, 2007), but because the JCP has been in the planning phase for over 17 years, public interest may have varied over the years, as residents become more aware of the risks and benefits associated with these projects. As a result, proximity may not be as important of a factor when forming opinions and, while future studies will still need to evaluate the role of proximity, instead, studies need to incorporate community characteristics that take into account local experiences, discourse, and ideological values.

Respondents with higher perceived importance of the local mining, refining, and utilities industry reported lower environmental risk and higher economic benefit perceptions. Thus, this result provides clear support for H_{9A} and H_{9B} and is consistent with the literature. However, H_{9C} is not supported, as respondents with higher perceived importance of the local industry reported lower levels of support for natural gas export. The opposition is most likely attributed to the fact that exportation projects do not provide the local mining, refining, and utilities industry with the profits, nor does it provide the community with the energy. As a result, the export projects can be perceived as harmful to the local industry rather than beneficial.

There is clear support for H_{10A} and H_{10B}, where respondents with higher perceived importance of renewable energy industry to the local economy reported higher environmental risk and lower economic benefit perceptions associated with natural gas export. The renewable energy has yet to solidify a place in the economic identity of many US states; however, the wind energy development is well established in Eastern Oregon and wave/tidal energy development is

expanding in Oregon, resulting in its growing role in communities in this region of the country. Yet, it proved to be an insignificant factor in predicting support for natural gas export in general.

Finally, somewhat unsurprisingly, economic benefit perceptions (computed index composed of energy security, energy prices, jobs in the region, and regional economy) and environmental risk perceptions (computed index composed of regional environment, public health, and global climate) were the most significant predictors of natural gas export in Oregon and clearly supported H_{1A} and H_{1B}. As suggested by the literature, respondents with higher economic benefit perceptions reported higher levels of support for natural gas export and those with higher environmental risk perceptions reported lower levels of support. Results suggest that individuals may be making rational calculations in determining their support for export project based on personal risk-benefit analyses. However, in the absence of direct experiences, these perceptions can be based on preexisting beliefs and values (Graham et al., 2015; Slovic et al., 1981) – highlighting the important role political predispositions play in the formation of risk-benefit perceptions.

Policy Implications and Future Research

Our sample of respondents suggests that Oregonians are generally more opposed to natural gas export than supportive, with 53 percent of Oregonians expressing opposition and 38 percent expressing support. The implication is that any export proposal in the state will experience an uphill battle in terms of gaining public support. Indeed, since the collection of this survey data, the one remaining natural gas export proposal in the state – the Jordan Cove Energy Project – was denied several critical state permits, and these state level decisions have been upheld by federal permitting authorities. It is difficult to see how the JCP could move forward

through the regulatory permitting process at this point, particularly with the change in administrations from Trump to Biden. The U.S. reached record highs for natural gas production under the Trump Administration due to his fossil fuel-friendly agenda. Early in the administration, President Trump pushed for the JCP and similar projects to happen (Jaquiss, 2021). In contrast, on President Biden's first day in Office, he revoked the Keystone XL Pipeline's permits – another project aimed at fossil fuel export (Blum, 2021) – and named Richard Glick – former government affairs director for Avangrid Renewables and general counsel for the Senate Energy and Natural Resources Committee – chair of the Federal Energy Regulatory Commission. The Biden Administration has expressed an interest in moving beyond fossil fuels in terms of domestic energy use to address the climate crisis, although he has stated he does not intend on banning fracking – making it remains unclear how this may translate to natural gas export.

The future of the natural gas exports may also be impacted by the COVID-19 pandemic, which has greatly depressed demand for oil. Though the pandemic is considered to have had little impact on demand for natural gas compared to other fossil fuels in 2020; it is expected to threaten the domestic market over the next 10 to 20 years (Joseph, n.d.). While domestic demand is predicted to decrease by more than 9 percent by 2030 (Joseph, n.d.), the market in the Asian Pacific region continues to remain strong (IEA, 2020). As long as the Asian markets are a lucrative business opportunity for American natural gas producers, export projects are likely to continue to be proposed in the Pacific Northwest, despite the "thin green line" formed in this region of the country. However, the pandemic is expected to result in delays or cancellation in several export facilities, hindering the U.S.'s ability to export domestic resources to these Asian markets (Watters & O'Donnell, n.d.).

Results indicate that a majority of respondents perceive there to be a lot or a great deal of risk toward the global climate (53%), regional environment (53%), and public health (52%). On the other hand, few respondents indicated little to no risk at all in these categories (29%, 30%, and 30% respectively. In terms of economic benefit perceptions, a majority of respondents reported perceiving natural gas export to provide 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 21 to 27 percent. Results suggest that Oregonians are more skeptical of the economic benefits from natural gas export, while being more concerned about the environmental risks it poses. Moreover, this further supports the implication that it will be difficult for companies to gain public support in this state.

In terms of the technology, people and place factors shaping these perceptions, I find that men, conservatives, urban residents and those who perceive that their community's economic identity is tied to mining or other extractive industries are less likely to perceive risks and more likely to perceive benefits from natural gas export. Younger respondents, those without 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 from natural gas export. When included in a model of support (as opposed to risk/benefit perceptions), some of these findings hold: men, in particular, are more supportive of natural gas export than women, while those with bachelor's degrees are less supportive than those without. However, the overwhelmingly important factors in shaping support seem to be risk and benefit perceptions, with many of my other included people and place factors losing significance once risk/benefit perceptions are incorporated in the model of support. This could suggest that people and place

factors may be important in terms of how they influence risk and benefit perceptions, though it could also be an artifact of my modeling approach (i.e., modeling risk/benefit perceptions first and then support).

In many ways, these findings confirm what we know from existing studies of views on fracking and other energy development. Perhaps the two exceptions are education and urban/rural location. In previous studies, evidence about how education relates to views on natural gas were inconclusive. At least in Oregon, it appears education – in the form of a bachelor's degree or advanced degrees – is associated with higher risk perceptions, lower benefit perceptions, and less support for export. My findings about the role of rurality, which in previous studies has sometimes been tied to support for natural gas development, show that in Oregon, rural residents have higher risk perceptions and lower benefit perceptions of natural gas export – thought these do not necessarily translate into a strong tie to support or opposition. Given that most natural gas export proposals are in rural areas, it is important to understand how rurality relates to views on development and how this may change across locations.

Fracking and natural gas has been widely studied in public opinion research over the years, but few studies evaluate natural gas export and the perceptions of its associated economic benefits and environmental risks. Because there are so few studies, future studies need to build upon this study. Public opinion research raises the question of whether risk and benefit perceptions are formed before an individual's stance on an issue, or rather the risk-benefit perceptions are shaped to support their stance. While this research suggests that individual's make "rational" considerations when determining their stance on natural gas export, social construct plays a key role in the formation of these opinions. Moreover, research should track

public perception of natural gas export over the course of the project (i.e., from proposal to implementation) to identify how stance and risk-benefit perceptions are formed.

Supplemental Section

Table 6. Exploratory factor analysis of perceived risks and benefits associated with natural gas export [1]

Variable	Factor 1 (Environmental Risks)	Factor 2 (Economic Risks)
Perceived Risks [2]		
Regional environment	0.908	
Public health	0.905	
Global climate	0.845	
Private property	0.780	
Perceived Benefits [3]		
Energy prices		0.892
Regional economy		0.887
Energy security		0.847
Jobs in the region		0.816
Percent variance explained [4]	40.72%	40.62%

[1] Items that cross-loaded were retained in scales where loadings were highest.
[2] Variables were coded on a 5-point scale from 1 “no risk at all” to 5 “a great deal of risk”
[3] Variables were coded on a 5-point scale from 1 “no benefit at all” to 5 “a great deal of benefit”
[4] Total variance explained = 81.67%.

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