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Maria A. Stefanovich Petrova for the degree of Doctor of Philosophy in Environmental Science presented on September 9, 2010.

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Renewable energy resources, such as wind, solar, and wave, have a number of advantages compared to traditional fossil fuels. Numerous studies attest to the physical potential for wave energy development in Oregon. In transitioning from conventional fossil fuel to alternative energy provision, citizen understanding of the global energy problems and their causes and solutions is believed to be the key for the development of renewable energy. Using a statewide mail survey of 1,200 Oregonians this dissertation provides some insight and understanding about the determinants of public opinion with regards to renewable energy, the role these determinants play in public opinion formulation, and their relative importance in citizen support of or opposition toward wave energy development in Oregon. Citizen environmental values and value orientations, ideology preferences, climate change awareness and energy policy beliefs, familiarity with the technology, energy knowledge, and sociodemographic characteristics are examined. Using multiple regression analyses, the results reveal that several determinants serve as statistically significant predictors of attitudes toward wave energy development. Some of the most important are: familiarity with the technology, agreement with the possibility of increasing energy supplies while

protecting the environment, and awareness about rising global temperatures. Some policy and theoretical implications of the findings are discussed and suggestions for further research are proposed.

Key Words: Oregon Energy Policy, Wave Energy, Renewables, Public Opinion, Attitudes, Environmental Values, Environmental Concerns, Knowledge, Information Sources, Global Warming, Climate Change.

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Determinants of Public Opinion on Renewable Energy: The Case of Wave Energy Development in Oregon

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APPROVED

Major Professor, representing Environmental Sciences

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Dean of the Graduate School

I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Maria A. Stefanovich Petrova, Author

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To my parents, and especially my Mom,
who always wanted to have a 'doctor' in the family.

Determinants of Public Opinion on Renewable Energy:
The Case of Wave Energy Development in Oregon

INTRODUCTION

The world, as we know it today, is a bundle of energy transformations. Energy drives the economy, fuels our cars, and turns on the electrical appliances we use. All living creatures are involved in producing, distributing, or exchanging energy. From a thermodynamic point of view, humans are a complex system for processing energy; our survival depends on having an adequate access to energy sources. Our primary task as a society has always revolved around the procurement of sufficient amount of energy for our existence and development. The question is, can we do it sustainably?

Sustainable development has been defined in many ways and one of the most widely accepted is, "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland Report, 1987: 43). Ever-increasing energy demand, air and water pollution, rising global temperatures, and uncertainty of energy supplies are all posing numerous challenges to sustainable development. Two ways have been proposed for dealing with these challenges. First, decreasing energy demand by changing consumption patterns, and second, using a diverse portfolio of renewable energy sources in an efficient manner. Successful policy development, therefore, depends not only on accurate estimates for technological inventions and improvements, but also on understanding human attitudes, concerns, and behaviors.

The purpose of this dissertation is to shed some light on the determinants of public attitudes toward renewable energy development. In particular, the focus is on wave energy development in Oregon. I address such questions as, what is the role of environmental values and beliefs on public attitudes toward wave energy

development. Are people who are more knowledgeable about energy issues or more familiar with wave energy technology, more supportive of wave energy development than those who know less about energy issues or are less familiar with the technology? In addition, do Oregonians who believe climate change is real and it is human-caused, support wave energy development more strongly than those who do not believe in the reality of climate change and its human causes? Is there a difference in the level of wave energy support exhibited by people with liberal as opposed to conservative policy preferences? What sources of information do people use to get informed about energy policy issues and technologies?

Knowing the answers to these questions may lead to a better understanding of the factors that define support for renewable energy development and aide the renewable energy policy formulation. Since public opinion has been shown to play a crucial role in many policy decisions regarding energy policy and the protection of the environment, the successful transition to sustainable development will depend on a thorough understanding of citizen preferences, concerns, and motivations to adopt renewable energies faster.

In the following sections, the advantages and problems of renewable energy compared to fossil fuels will be discussed, with an emphasis on wave energy. Subsequently, the theoretical framework will be presented. After the main body, which consists of three separate articles sent for peer-reviewed publications in their abridged versions, the dissertation ends with a conclusion and recommendations for further research.

The Rocky Road to Renewables

If future generations are to remember us with gratitude rather than contempt, we must leave them more than the miracles of technology. We must leave them a glimpse of the world as it was in the beginning, not just after we got through with it.

-Lyndon B. Johnson (1908-1973) 36th President of the United States,
at the signing of the Wilderness Act, September, 1964.

Today, global communities are faced with a plethora of energy-related concerns – energy consumption is growing while the amount of conventional energy sources, i.e. oil, natural gas, and coal is decreasing, and the environmental degradation, inflicted by fossil fuel burning is posing some tangible threats on human health and the biosphere. Despite indications that "[n]ever has the world so self-consciously tried to move toward new sources of energy" (Kerr, 2010: 780), it has been suggested, based on past energy transitions, that the switch to renewables will not be easy (Bent et al., 2002; Kerr, 2010; Simon, 2007).

Renewable energy alternatives, such as solar, wind, hydro, geothermal, biomass, wave, and tidal are described as "relatively clean, widely available, and the supply is unlimited" (Komor, 2004: 1). For some renewable sources, mainly wind and solar, technological improvements in performance and cost have made electricity generated from them close to being competitive with fossil fuels (Table 1.1). Renewable energy production has grown in the United States from 6.8 percent in 2007 (EIA, 2008a) to nine percent in 2008, and is projected to reach a 17 percent share of the U.S. energy mix in 2035 (EIA, 2010a).

At the same time, demand for energy in general, regardless of its source of production, has been increasing as well. Analysts at the U.S. Department of Energy

predict that if the U.S. gross domestic product (GDP) grows at an average annual rate of 2.9 percent per year through 2030, the rate of electric power consumption needed to accommodate that growth will be 0.8 percent per year (EIA, 2008a). In other words, the demand for electricity will be about 43 percent greater in 2030 than it was in 2006.

TABLE 1.1. Renewable energy technologies: Summary. Adapted from (Komor, 2004; Yin, 2009).

Technology	Typical levelized[1] costs (US cents per kWh)	Advantages	Problems
Wind	4-5	Widespread resource, scalable	Difficult to site, intermittent
Photovoltaic	20-40	Ubiquitous source, silent, long lifetimes, scalable	Very expensive, intermittent
Biomass	4-9	Dispatchable, large resource	Has air emissions, expensive
Hydropower	4	Dispatchable, can be inexpensive	Has land, water, and ecological impacts
Geothermal	5-6	Dispatchable, can be inexpensive	Limited resource, depletable
Wave[2]	20-30	Widespread resource, high density, few aesthetic and noise concerns	Immature technology, expensive, unpredictable environment

Notes: Costs shown are typical for projects built in 2004. Costs will vary widely depending on project specifics (Komor, 2004: 7).
[1] Levelized means including first (capital), operating, maintenance, and fuel costs (Komor, 2004: 29).
[2] Costs for wave energy technology are discussed in Yin (2009) and the Ocean Energy Council (2008). Advantages and problems are described in publications on wave energy, mainly EPRI (2004); European thematic network on wave energy (2002); and World Energy Council (2007).

In terms of electricity consumption in the residential sector only, it has been shown that in 2006 for the first time, households in the U.S. used more electricity than natural gas, as warmer winter temperatures reduced the need for natural gas heating, and warmer summers increased the demand for air conditioning. The Energy Information Administration (EIA) expects this upward trend to continue – by 2030 electricity use for home cooling is projected to be 38 percent higher than in 2006, and

the total electricity consumption in the residential sector is projected to go up by 27 percent (EIA, 2008a). Except for climate variations, the trend of increased electricity use is attributed to the rising number of households, to the elevated demand for electrical appliances, and to life-style and technological changes, some of which are the building of larger houses and the conversion of older homes from room air conditioning to central air conditioning (EIA, 2008a). In addition, it has been found that the same number of people living in a larger number of residences consume more energy and materials (Schipper, 1996). For instance, a study conducted in the U.S. between 1900 and 1991 regarding the annual consumption of physical structure materials (defined as construction materials, industrial minerals, and forestry products) found that there was an almost five-fold increase in consumption – from two metric tons per year in 1900 to nine in 1991. This level of consumption amounted to over 50 kg of materials per person per day in 1990, excluding water (Wernick, 1997). Mining wastes (mainly for coal) were not included in these figures, but they were believed to be "huge and [to] represent another consequence of consumption mostly hidden from the public eye" (Wernick, 1997: 30). These examples show that the rise in materials and energy consumption is related not only to the growing number of people, but more importantly to the increased standard of living (McMullen and Jabbour, 2009).

The increased energy consumption poses several policy questions. Some relate to the way society views different energy sources. Fossil fuels, for example, are perceived as "a commodity rather than a pure public good" (Simon, 2007: 1). Public goods are described as being collective types of goods – all benefit from using them,

but when people overuse or misuse them, all are left worse off than they were at the initial stages of the resource use - a situation described by Hardin (1968) as “tragedy of the commons.” Perceiving fossil fuels as commodities has implications about resource distribution policies. Simon (2007) explains that while governments are unlikely to spend considerable time and effort thinking about distribution and use of relatively cheap and readily available resources, once the perception of these resources changes to being expensive and scarce, the political debate will center around questions, such as, “Are these resources marketable commodities or public goods?” and “How should their use and distribution be regulated?”

Another policy implication stemming from the increased energy consumption relates to the non-replenishable nature of fossil fuels. Morris makes the point that “we burn in one year what it took nature 15,000 years to make” (2006: 15). Despite disagreements about the “peak” timing for oil, natural gas, and coal production, the finite nature of these resources suggests that sooner or later – “whether it’s in 20 or 200 years” (Komor, 2004: 3) – they will have to be replaced. Resource availability is one of the major factors, among numerous social, economic, and technological factors, shown to have played a role in previous energy transitions as well - from wood to coal, and then to oil and gas. Besides the abundant supply of coal, oil, and natural gas, the higher energy density and ease of transport have made fossil fuels the preferred energy source in the industrialized world, especially for electricity production since the 1930s (Komor, 2004). Some believe that because of the continued abundance of fossil fuels,

"broad-based fears of energy shortages will not be driving a shift to renewables for the next decade or two" (Kerr, 2010: 780).

In many instances, the U.S. transition from an agricultural to an industrial, and then to a postindustrial society has been attributed to the low cost and "seemingly endless" supply of energy (Smith, 2002: 3). However, the gap between the total amounts of energy consumed and produced has been widening. While in the 1960s, the amount of energy produced was roughly equal to the amount of energy consumed, with the first oil crisis in 1973 the amount of energy consumed started going up faster than the amount of energy produced. Since then, the gap between energy production and consumption has been filled by imports (EIA, 2008b). According to data from the EIA, in 2007 the U.S. imported 35 and exported five quadrillion Btu,[1] and most of the imported energy was in the form of petroleum (Ibid). Since the 1990s, total energy imports have followed the same upward curve, as have petroleum imports (Fig. 1.1).

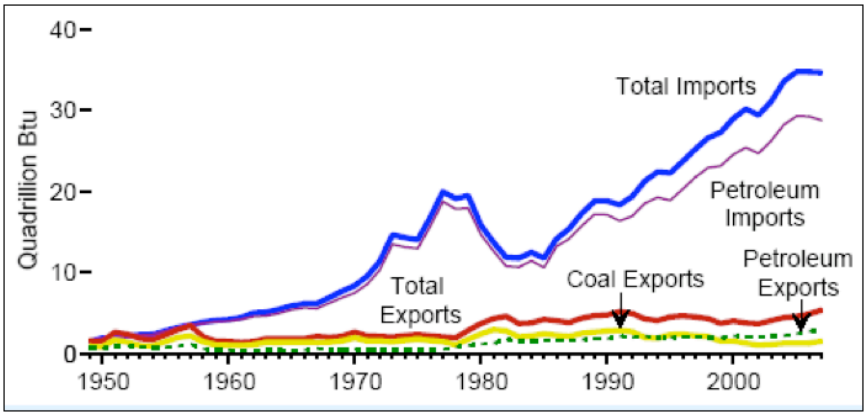

Figure 1.1 Total energy imports and exports, 1949 – 2007.
Source: Energy Information Administration (2008b).

Moreover, while only 20 percent of the consumed oil in the U.S. was imported in 1985, in 2008 that amount was up to 60 percent (EIA, 2008c). In addition, whereas most of the imported oil came from Canada and Mexico, a substantial amount was delivered from economically and politically unstable countries (Bittle et al., 2009). Importing oil from such problematic countries has made petroleum supply vulnerable to uncertainties, oil prices volatile, and financial planning complicated. Since the 1973 OPEC embargo on oil exports, which led to the shortage of oil, increased gasoline prices, and lines for gas at the gas stations, decreasing dependence on foreign energy sources has been made a national priority, and has received overwhelming public support, even though in many instances it has led to the U.S. involvement in costly and lengthy wars (Bailey, 2004). For example, it has been estimated that the cost of preserving security in the Persian Gulf war in the mid 1980s was around $40 billion (Smith, 2002).

Domestic oil drilling has been regarded as a relatively straightforward alternative for filling up a substantial part of the U.S. energy consumption gap - petroleum still continues to provide the highest percentage of the U.S. energy mix - almost 40 percent (Figure 1.2.). Public support for domestic oil development has been shown to fluctuate with shortages of imported oil, increased oil prices, and the economic conditions at the time support for oil drilling was measured (Smith, 2002). National surveys show that after the first and the second oil crises, support for domestic oil drilling rose and then ebbed slowly. For example, after the second energy crisis in 1979, support for domestic oil drilling went from 79 percent in 1980 to 55

percent in 1988 – two years after the collapse of oil prices in 1986 when Saudi Arabia decided to increase oil production and the U.S. oil imports rose again (Smith, 2002: 73). Asked which will help or hurt the "long-term energy situation in the United States" in 2006, after the price of crude oil had increased from $30 per barrel in 2001 to over $70 in 2005, 68 percent of the American public answered that "drilling for oil in the Alaskan Wildlife Refuge and the Gulf of Mexico" will help the situation, while only 24 percent answered that it will hurt the situation (Bolsen and Cook, 2008: 386).

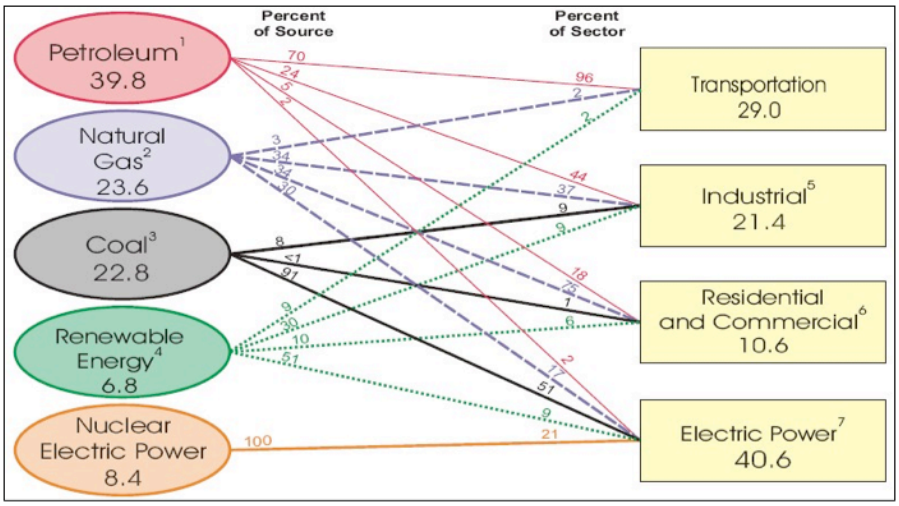

Figure 1.2 U.S. Primary energy consumption by source and sector in 2008 (Quadrillion Btu). Source: Energy Information Administration (2008b)

Although the U.S. is the third largest crude oil producer (EIA, 2009a), oil drilling poses large environmental and health hazards. The 1969 Santa Barbara oil spill is considered one of the most important events in the U.S. history that helped launch the environmental movement (Paehlke, 1989). And despite the fact that the consequences of both the Santa Barbara and the 1989 Exxon Valdez oil spills have been largely forgotten, the dangers associated with oil drilling, transportation, and

consumption of oil were once again made live after the explosion of the Deepwater Horizon rig in the Gulf of Mexico. When the rig sank on the fortieth anniversary of Earth Day - April 22, 2010, 11 workers lost their lives and the oil leak was not contained for several months, causing the most harmful U.S. oil disaster (BBC, 2010; NOAA, 2010).

Besides the negative impact oil drilling has on human health and the environment, fossil fuel burning, and especially the burning of coal, also has been demonstrated to have a huge environmental and human health impact. The Environmental Protection Agency (EPA) estimates that emissions from coal plants are the cause of death for 24,000 Americans annually (Morris, 2006). Yet, 52 percent of U.S. electricity still comes from coal-fueled plants, which emit two billion tons of CO_2 a year (Smith, 2008), making the U.S. the largest per capita CO_2 emitter in the world (Kerr, 2010).

At the same time, CO_2 emissions from the combustion of fossil fuels and industrial processes, which account for 98 percent of the total CO_2 emission, have been accelerating globally – from a growth rate of 1.1 percent per year between 1990 and 1999 to more than three percent per year between 2000 and 2004 (Raupach et al., 2007). This has made the electricity sector the largest industrial source of greenhouse gas emissions, which except for CO_2 accounts for 67 percent of sulfur dioxide (SO_2) – the leading component of acid rain and fine particulates, 25 percent of nitrogen oxides (NO) - a key component of smog and acid rain, and 34 percent of mercury (Hg) – a toxic heavy metal that is concentrated through the food chain (Komor, 2004). Some

other environmental problems that can be linked directly to fossil fuel consumption are ash waste disposal, mining runoff, and oil spills. Even bigger problems are global climate change, air pollution, and ocean pollution, International groups like the UN Intergovernmental Panel on Climate Change no longer question the causes for the rising global temperatures, but the level of temperature increase (IPCC, 2007), and make it clear that changing our energy mix and energy consumption patterns are fundamental to reducing greenhouse gas emissions.

Renewable energies, however, as shown in Table 1.1., are not without problems either. Besides having higher than fossil fuel costs, they have lower density, they are more intermittent, and are unevenly distributed around the globe. We learn, for example, that a coal mine or an oil field "yields five to 50 times more power per square meter than a solar facility, 10 to 100 times more than a wind farm, and 100 to 1000 times more than a biomass plant" (Kerr, 2010: 780). The diffuse energy content of renewables makes it hard for them to compete with conventional fossil fuels when measured in terms of amount of energy produced per square meter of Earth's surface.

Intermittency is also a big issue for renewables because electricity is hard to store, i.e. it must be used when it is produced. Engineers have not yet come up with suitable systems for storing electricity, which would most probably raise the cost of renewable energy additionally. With wind and solar energy in particular, intermittency is a big problem because energy is produced only when the wind blows or the sun shines. It has been estimated that while wind turbines operate 20 to 35 percent of the time, coal, gas, or nuclear power plants operate three quarters to 90 percent of the time

(Kerr, 2010). Because of the intermittency issue, some argue that neither solar nor wind would ever be able to replace the base load capacity provided by fossil fuels (Smith, 2008). Perceptions that "fossil fuels [in the United States] would solve economic problems and alleviate energy shortages" (Moan et al., 2007: 73) have dominated understanding about the benefits fossil fuels provide for at least the past 30 years. Such perceptions are still held by some. For example, the CEO of American Electric Power (AEP), one of the largest electricity producers in the U.S., argued in 2007 that America should not burn less, but rather more coal because,

> "If we don't build more base load generation and the U.S. economy continues to grow, we'll ultimately get to a blackout economic environment that will have tremendous impacts on what goes on in this country" (Smith, 2008).

There are those who believe, on the other hand, that renewable energy sources will not cause energy shortages, and can serve either as back-up source of electricity or even as baseline capacity. For example, if collections of wind turbines or solar panels are placed at different locations that are grid interconnected, those collections could act as power stations (Archer and Jacobson, 2003, 2007). Since the sun always shines and the wind continues to blow in some places, the electricity produced in locations, where the wind is blowing and the sun is shining, would compensate the decreased power output in places that are less windy or are cloudier. For example, since solar energy is most intense over desert areas, a European plan known as "Desertec" calls for building solar and other renewable power projects across North Africa and the Middle East. "Desertec" is projected to produce 500 gigawatts of

electricity (equal to 15 percent of Europe's electricity needs), which through a network of power cables will be transmitted to Europe (Clery, 2010).

Another shortcoming of renewables is that they are not equally distributed around the globe – some places get sunshine or wind all year round while others get them only sporadically. Since winds blow almost constantly over the oceans, for example, places located on the west side of continents with exposure to the prevailing wind direction, and away from the equator are most suitable for wave energy development (Figure 1.3).

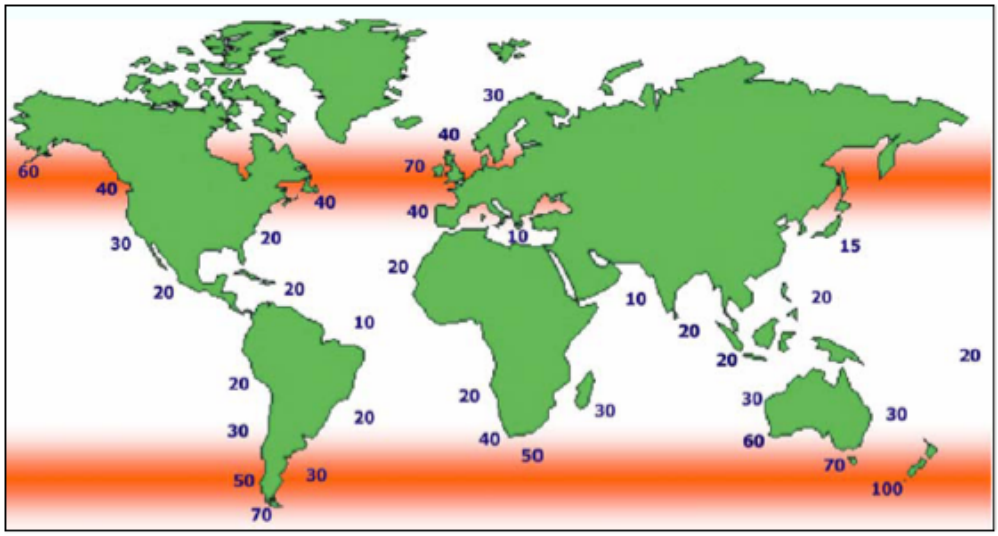

Figure 1.3. Global wave energy power distribution (kW/m). The numbers show wave energy power as proportional to the square of the wave height and to the period of the wavelength, measured in kW/m of wave crest length. The best wave power is found between ~30° and ~60° North and South latitude (European Thematic Network on Wave Energy, 2002: 9).

These conditions make the western coasts of the Americas, Europe, Southern Africa, Australia, and New Zealand particularly suitable for wave energy development. For example, using a typical Oregon wave with a period of seven seconds, wave height of 2.5 meters, and wave speed of 12 m/s (25mph) scientists

estimate that the power from a Pacific Northwest wave is 42,862 W/m of crest length - a little over 40 kW/m, as shown in Figure 1.3. (Brekken, 2007; Elwood et al., 2008).

Uneven geographic distribution is an attribute adherent to all sources of energy – both renewable and non-renewable. The problems associated with resource "patchiness" pertain to the lack of technologies necessary to store and transport the vast amounts of energy generated away from the places where the energy is produced to the places where people live and where the energy is most needed (Cho, 2010). However, as the "Desertec" idea described above shows, the uneven geographical distribution maybe the least of the renewable energy issues. Bigger issues relate to their ability to substitute fossil fuels while providing the same standard of living and the institutional transformations that need to take place in order for their adoption to be effective.

The shift to renewables will most probably take a long time because once available, "it takes about 50 years for a new energy source to be accepted, implemented, and put into large-scale use" (Dashefsky, 1993: 81). Kerr (2010) explains that despite the advantages a resource may provide, it takes time to invent and improve the end-use technologies - to make the most efficient wind turbine or solar energy panel - to create the infrastructure around extracting, transporting, and converting the resource into a usable form, for consumers to adopt them, and the market to demand them. Moreover, a major barrier for the adoption of renewables is that they are competing in a mature market, where the goods and services they provide - fuel and electricity - have already been provided, and at a lower cost.

Some see renewable energy sources as a solution to the "triple threat" of challenges related to energy, economy, and the environment (Bittle et al., 2009). Others stress their minimal environmental impact compared to fossil fuels, and underline that the biggest advantage of renewables is their zero to small CO_2 output (Cho, 2010; Kerr, 2010). Unlike coal, oil, and gas, which currently account for more than two-thirds of electricity generation, and whose burning is the major contributor to global warming and a variety of public health and environmental concerns; wind, geothermal, and hydroelectric energy production release hundreds of times less CO_2 emissions (Figure 1.4).

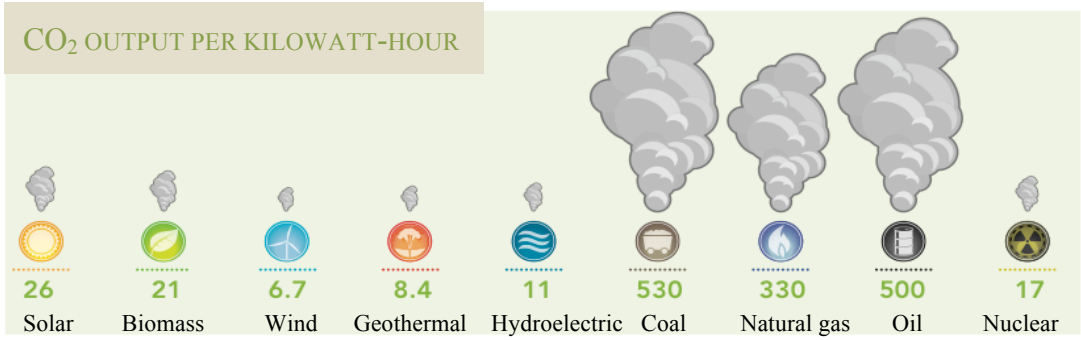

Figure 1.4. CO_2 output per kilowatt-hour. Source: Cho (2010: 787).

Wave energy production, moreover, is not related to the emission of any harmful gases. It has been estimated that the generation of seven MWh of electricity by a wave energy device called Wave Dragon will offset the release of about 10,000 tons of carbon dioxide every year and that the same device when placed in a high wave energy climate could produce 50 GWh of electricity per year, offsetting 39,000 tons of carbon dioxide (Wave Dragon, 2008).

Although renewables are much less damaging to human health and the biosphere in comparison to fossil fuels, they do have some negative environmental and social impacts. For example, while it takes only 1.8 liters of water to make one kilowatt-hour of electricity from coal, to produce the same output of electricity solar thermal technologies require 3.2 liters of water, which is 68 percent more (Cho, 2010). Dams built for hydropower inundate large areas of land and are an obstruction to fish passage and habitat (Komor, 2004).

The impact of wave energy conversion on the environment is generally expected to be minimal (Sorensen et al., 2003). However, due to the novelty of the technology and the fact that very few full-scale prototypes have been tested in the open ocean, the nature and extent of environmental concerns remain to be determined. Scientists believe that the potential impacts will most probably be site-specific because of the different physical and ecological factors around the world. Wave energy developers have been preparing Environmental Impact Statements (EIS) as part of their permit applications and have not found any significant environmental changes or damages from the initial stages of their projects (Fernandez Chozas et al., 2010). However, since the estimated life of most devices is between 20 and 30 years, many biological and ecological factors will need to be monitored. Before any commercial-scale devices are put in the water, scientists recommend that attention is paid to the effects of the energy absorbing structures on the physical environment, fish behavior, the pelagic and benthic habitat, and marine mammals and seabirds (Boehlert, 2007).

Socioeconomic concerns regarding renewable energy development also exist. Besides NIMBY – "Not In My Back Yard," which characterizes opposition to specific projects because of concerns regarding visual impact and noise, public acceptability depends also on other perceived impacts regarding conflicts of use in the project area and community well-being concerns (Conway et al., 2010; Hunter, 2009; Krohn and Damborg, 1999; Stefanovich and Fernandez Chozas, 2010). Some examples of the non-technical issues that wave energy developers need to address in their meetings with coastal communities are provided in Table 1.2.

Hansen et al., (2003) comment that it is highly possible for wave energy to become even more popular than wind energy because of the minimized visual aspect and noise (Figure 1.5 and Figure 1.6).

Fig. 1.5. Mutriku Breakwater, Spain 2008: water flowing through the turbine holes of the OWC. Photo credits: Félix Azpiazo.

Fig. 1.6. Hanstholm. Denmark, 2009: visual impact comparison between onshore wind turbine and a 150 scale of Wave Star. Photo credits: Julia Fernandez Chozas.

However, the authors remark that the biggest challenge for accepting wave energy is the "low public knowledge" (Hansen et al., 2003: 5). Despite the low public knowledge about wave energy in particular, and renewable energy in general, there is widespread public support for their development. For example, a 2007 national poll revealed 87 percent of respondents believe using renewable energy sources for electricity generation is a good idea because such sources are "readily available and better for the environment" (CBS/New York Times Poll, 2007: 12). In addition, 82 percent of Americans favor government requirements that electric utilities produce at least 20 percent of their electricity from renewables (Leiserowitz, 2007a).

TABLE 1.2. Non-technical issues wave energy developers need to address. Source: Stefanovich and Fernandez-Chozas (2010).

Issue:	Description:	Questions wave energy developers need to address:
Conflicts of use in the project area	• Commercial fishing • Recreational fishing & boating • Surfing	- Why are you interested in this particular site? - What is the footprint of the proposed project or the exclusion area of the wave energy converters (WECs)? - Is the project going to displace existing (fishing) jobs? - What would the effect be on the surfing waves?
Environmental Impact (EI) Concerns	• Bottom species habitat • Marine mammals& other species, including birds • Entanglement • Reproduction • Migration	-Can you prove that your project is benign to the environment? -Have you done any EI analysis? Have you thought of mitigation measures? Can you guarantee the survivability of your WECs? - Have any of your devices experienced accidents, e.g., sinking, hydraulic leaks, etc. during testing or at another location? What are the lessons learned? - Are you going to remove your devices after the deployment period?
NIMBY issues	• Visual impact • Noise impact • Aesthetic impact	- How does wave energy work? What types of devices are out there? - What type of devices will be deployed and why? - Shall we be able to see or hear the devices during operation? - How big are they – installed capacity and size-wise? - Are they aesthetically pleasing? - How far from the shore will they be located?
Community well-being concerns	• Employment • Income • Benefits /costs • Tourism	- How will the community be impacted? - Is the cost of electricity going to go up? - Is your commercial project going to be economically viable? - Will tourism flow increase or decrease?

Scholars have shown that Americans are starting to "place far more value on environmental quality" than at the time of the first national celebration of Earth Day on April 22, 1970, regarded as the start of the environmental movement (Dunlap, 1995: 104). In addition, willingness to pay higher taxes or prices to protect the environment, and even willingness to accept a lower standard of living if it means a cleaner environment, have also received strong public support (Farhar, 1994; Payne, 2007). The degree to which public support for environmental quality and various

energy options have influenced the course of U.S. energy policy has been documented (Dunlap, 1995; Moan et al., 2007; Smith, 2002). It has been shown, for example, that the public fear of nuclear energy development has altered the U.S. energy mix for the last several decades (Cravens, 2007). In general, efforts to protect the environment and improve public welfare (as opposed to efforts to protect private interests) have been significantly dependent on supportive public opinion (Pierce, 1982). However, longitudinal investigations show that while the U.S. public generally opposes new energy developments, it does not want to go without cheap, abundant energy, nor is it ready to conserve the available nonrenewable energy sources (Smith, 2002). Understanding the factors that define public opinion on renewable energy will help policy makers set priorities in transitioning to a renewable energy future.

Study Background: Wave Energy Development in Oregon

> *The dark aftermath of the frontier, of the vast promise of possibility this country first offered, is an inflated sense of American entitlement today. We want what we want, and we want it now. Easy credit. Fast food. A straight shot down the interstate from point A to point B. The endless highway is crowded with the kinds of cars large enough to take a mountain pass in high snow. Instead, they are used to take children from soccer practice to Pizza Hut. In the process they burn fuel like there's no tomorrow. Tomorrow's coming.*
> -Anna Quindlen, "It's about changing the way we all live now," Newsweek, September 19, 2005.

Wave energy is a type of ocean energy and it refers to the extraction of electricity from the up-and-down motion of ocean waves using buoys or floating turbines. Wave energy is the result of solar radiation. From the uneven heating of the air over the earth and ocean surface, wind currents are created that produce ocean waves (Figure 1.7).

Once set in motion, waves travel a long distance gaining momentum. Nearer the coastline, wave energy intensity decreases due to interaction with the seabed.

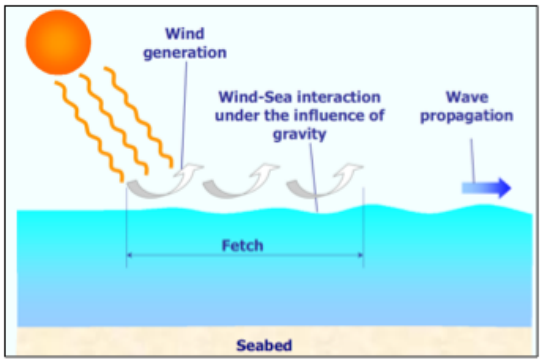

Figure 1.7 Ocean waves are generated by the wind.
Source: Coordinated Action on Ocean Renewable Energy (2006).

As described in the previous section, wave energy shares most of the advantages and problems associated with other renewable energy technologies – it does not produce harmful gases, but it is intermittent; it is nondepletable, but it is costly; and it is widely distributed, but unevenly. However, it is projected to have only minimal environmental impact, and unlike wind and solar energy, its density is much higher - water at sea level is about 800 times denser than air, and when water moves, it displaces more mass (Columbia Energy Partners, 2009). Wave energy is also easier to forecast and less intermittent than either wind or solar (EPRI, 2006). It is also a local resource that doesn't have to be imported and has low transmission costs – 37 percent of the world population lives within 60 miles of the coast, which makes for a good match between the resource and the demand for electricity (Cohen et al., 1997). It is estimated that if one-quarter of the U.S. wave resource were harnessed at 50 percent

efficiency, the electricity produced would satisfy 6.8 percent of the total net electricity generated in the U.S. in 2006 (EIA, 2008a: 38).

The main disadvantage of wave energy is that it is still expensive because it is in the early stages of its development, and it still lacks a technologically proven device design. There are many design prototypes – more than one thousand wave energy device patents have been applied for, and three hundred designs are in pre-commercial development (Bhuyan et al., 2008). There are several significant reviews of wave energy technology (EPRI, 2004; Lavrakas and Smith, 2009; World Energy Council, 2007; Yin, 2009). Four main types of wave energy technology exist, depending on the principle utilized for extracting energy (Brekken, 2007; Previsic et al., 2004):

- Overtopping devices (e.g., the Wave Dragon);
- Point absorbers or buoys (e.g., the BioWAVE, WaveRoller, OPT, AquaBuOY, and BeaverFloat);
- Attenuators (e.g., the Pelamis); and
- Oscillating Water Columns (e.g., Energetech OWC, Superbuoy, Mutriku, and Wavegen's LIMPET)

So far, at least three of the design prototypes: the Archimedes Wave Swing I, the AquaBuOY 2.0, and the Pelamis when tested in the open ocean, have shown various deficiencies. For example, the first prototype of the Archimedes Wave Swing I when tested in the ocean had balancing difficulties and sank off the Portuguese coast in 2004 (Prado, 2008). The AquaBuOY 2.0, the 72-foot Finavera prototype, filled up with water and also sank after nearly two months of open ocean testing off the Pacific

Ocean in fall 2007 (Widman, 2007). The AquaBuOY 2.0 was salvaged from the ocean floor a year later – in 2008. However, because the device lasted less than expected by the company in the ocean, coastal residents were wondering if any device would be able to withstand five, let alone 20 or 30 years in the harsh ocean environment. Also in 2008, three Pelamis devices experienced leaks in their buoyancy tanks and problems with the energy-conversion units during commercial testing off the Portuguese coast and were removed after being deployed for several months (Blum, 2009).

The immaturity of the technology and the initial costs associated with prototype building – Finavera's buoy cost two million dollars (Widman, 2007) and the three Pelamis devices cost 11.5 million dollars (Blum, 2009) - make wave energy costly to produce compared to conventional and other renewable types of energies (Table 1.1., Ocean Energy Council, 2008; Yin, 2009). It is estimated that with investments in research and development for the improvement of the technology, wave energy is likely to produce electricity at approximately 4.5 cents/kWh (Wave Dragon, 2008).

Because of its favorable exposure to the prevailing winds, long coastline of 360 miles (Figure 1.8.), and suitable bathymetry Oregon is ideally situated for wave energy development (EPRI, 2004). The total potential for energy generation off the whole Oregon coast is in the range of 13,800 MW; and because of Oregon's well-developed coastal transmission capacity, up to 2,000 MW could be added to the grid with no major grid changes (Brekken, 2007). In addition, there is a good match between the availability of the resource and the temporal and spatial demand for it –

wave energy has its highest potential in the winter months – the time Oregonians need electricity the most (EPRI, 2004). The presence of Oregon State University with its research facilities and its commitment to this new technology, in addition to the industrial infrastructure in the state, contribute to the state's suitability for wave energy development as well.

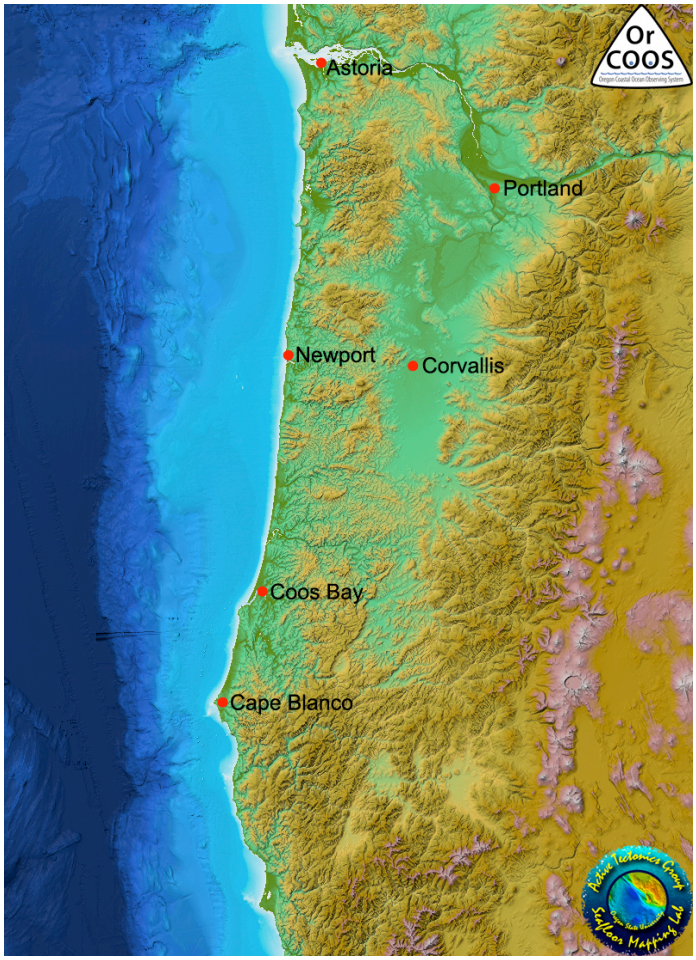

Figure 1.8 Oregon Coast Map.
Source: the Oregon Costal Ocean Observing System (OrCOOS, 2010).

In addition to good physical resources, Oregon has the political will to become a leader in renewable energy development. Oregon Governor Kulongoski (2002-2011) has said on numerous occasions,

> "This kind of clean, renewable technology [referring to wave energy] is the future of Oregon and our nation. Oregon has the opportunity to lead the transformation of energy consumption on a national and global scale, and we must make the most of that opportunity" (Kulongoski, 2007).

Oregon is one of the 30 states in the U.S. with a Renewable Portfolio Standards (RPS) policy, defined as "one of the most important drivers for renewable energy capacity additions" (Wiser and Barbose, 2008: 2). The RPS, known in Oregon as the Oregon Renewable Energy Act, or "25 by 25," requires Oregon's largest utilities to acquire 25 percent of their electricity from "new, homegrown renewable energy sources" by 2025 (Senate Bill 838, 2007). Smaller utilities have a lower target of five to ten percent for renewable energy by 2025 as well.

Since the adoption of the RPS and the publication of two major studies – one, identifying seven locations off the Oregon coast as suitable for wave development (EPRI, 2004), and the other suggesting approximately $750 billion will be invested in wave energy over the next 25 years (EPRI, 2005), the state has experienced a kind of 'gold rush' in permit applications for siting wave energy devices along the coast. In the summer of 2007, seven applications were filed for preliminary permits to develop wave energy off the Oregon coast with the Federal Energy Regulatory Commission (FERC), the authority in charge of wave energy permitting and licensing in the U.S. The number of permit applications went down to three in 2009. The reasons for the

downward trend in the number of permit applications are many and complex and will not be reviewed here. What this dissertation examines are the factors that determine citizen attitudes toward wave energy development in Oregon.

Conceptual Framework

> *The reason we had Ronald Reagan in the United States was because people voted for him. The reason we are going to have Barack Obama is because people have changed their minds.*
>
> Peter Morici, Economist, University of Maryland,
> BBC, One Planet, October 30, 2008.

Increased environmental awareness coupled with the energy crisis of the early 1970s has pointed attention to the importance of energy availability and has laid the foundation for examining public opinion on energy as a policy issue. Since the first energy crisis, the critical needs for policy-relevant energy and environmental knowledge among the public have been related to questions about the meaning of public opinion in a democracy. Citizen understanding of the global energy problems and their causes and solutions are believed to be key for the development of renewable energy. An informed public opinion is the basis of democratic theory; it is regarded as "one of the few potentially effective checks on leadership available in a democracy" (Glynn et al., 1999: 7). Public opinion plays an important role in the political world because "what people believe and what they do about those beliefs affects the creation of public policy" (Brooker and Shaefer, 2006: xvi). When the cognitive capacity of the public to rule itself and to make informed choices about its future is constrained, it is possible, even likely, that too much influence gets concentrated in the hands of the

elites, a situation described as "the domestication of mass belief" (Ginsberg, 1986: 32).

Public opinion has been selected as the unit of analysis of this dissertation because of its relevance and importance to policy making. Public opinion is defined as *"the expressed attitudes and views of ordinary people on issues of public concern"* (Brooker and Shaefer, 2006: 5). The previous section of the Introduction shows that issues related to energy and the environment are of public concern. Renewable energy is a multidimensional issue, it is related to both energy and the environment. Because of the composite nature of its parts, "renewable" and "energy," renewable energy embodies public policies that aim at protecting the natural world, while exploiting its resources in a way that allows for the extraction of the needed energy in a sustainable manner – one that requires attention to be paid to all living species and the biosphere. Designing such policies is a complicated task that calls for a "shift in existing belief systems" (Cahn, 1996: 211). In other words,

> "[m]eeting world energy needs in the twenty-first century is only half of the 'energy problem.' The other half is finding ways to do this in environmentally acceptable ways." (Bent et al., 2002: 5)

The question then becomes - do people view the available energy extraction options as being environmentally acceptable? Are citizen views based on deeply held values, energy policy knowledge, familiarity with the technology, or some other aspects? How do we operationalize public opinion, and more specifically, how do we measure public opinion on renewable energy issues? A review of studies related to the theoretical underpinnings of public opinion is presented.

Some political scientists present public opinion as an inverted pyramid-shaped cognitive structure, in which "attitudes are built upon beliefs and values, and are finally expressed as opinions" (Glynn et al., 1999: 106). Researchers also convey the notion that beliefs and values are fewer in number and are harder to identify than are attitudes and opinions (Stern et al., 1999; Stern et al., 1995; Vaske and Donnelly, 1999). The likelihood of impacting one's specific beliefs about and attitudes toward a problem or an issue increases when the information received is in agreement with individual's values and more general beliefs or worldviews (Smith, 2002; Stern et al., 1995; Zaller, 1992). Based on these studies and schematic representations, the following framework was developed (Figure 1.9).

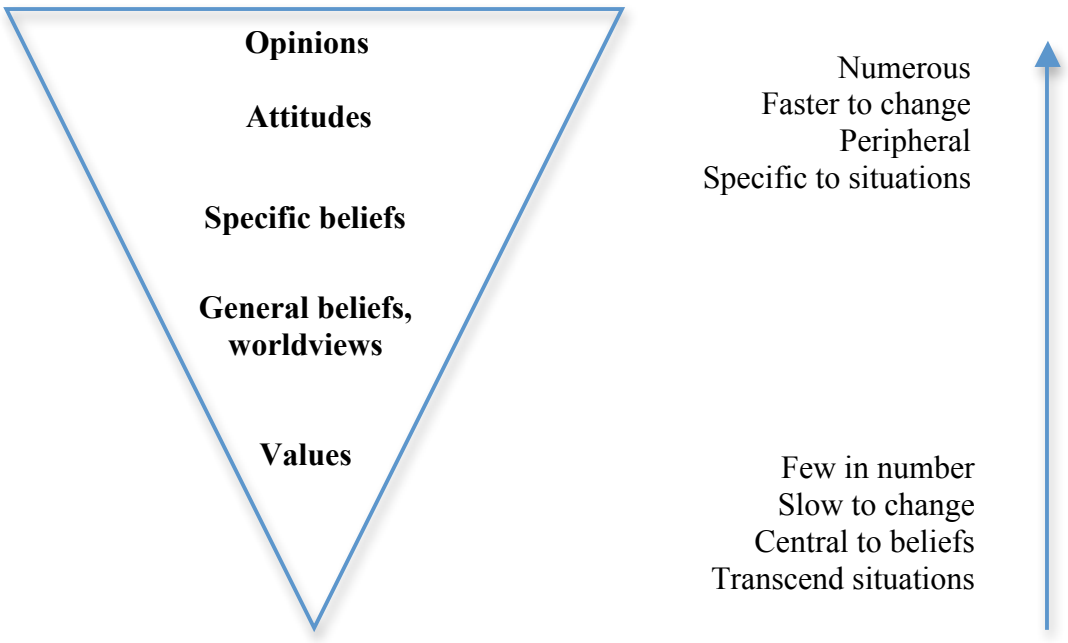

Figure 1.9. A schematic model of the cognitive structure of public opinion.
Adapted from: Glynn et al., (1999); Vaske & Donelly (1999); and Stern et al., (1995).

Attitudes are the "manifestations of our values as they come into contact with the physical world and take specific form" (Glynn et al., 1999: 106). They are preferences that don't become opinions until they are expressed – until people speak about them in some form (Brooker and Shaefer, 2006: 6). That is why, attitudes are defined as hypothetical constructs related to an individual's evaluation of, or orientation to an 'attitude object' – a thing, an idea, a person, or an action (Rokeach, 1973; Schwartz, 1992). They are postulated to consist of three components – cognitive, affective, and evaluative (O'Neill and Hulme, 2009; Schultz et al., 2004; Upham et al., 2009; Yin, 1999).

In the environmental science literature, attitudes are often treated as multidimensional constructs (Dietz et al., 1998; Pierce and Lovrich, 1980; Schultz et al., 2004; Schultz and Zelezny, 1999). A construct is multidimensional when it refers to several distinct but related dimensions treated as a single theoretical concept (Law and Wong, 1999). For example, environmental attitudes are defined as psychological orientations expressed through the evaluation of the natural environment (Milfont and Duckitt, 2010), or of environmentally related objects, including environmental problems and problem-solving actions (Yin, 1999).

There is an agreement among researchers that an attitude toward a particular object is determined by specific beliefs about the object (Ajzen and Fishbein, 1980). The more specifically the measured beliefs relate to the attitude, the stronger is the belief-attitude relationship (Pierce and Lovrich, 1980; Schwartz, 1992). In case of new or emerging attitude objects, which the individual has little knowledge of or

experience with (like wave energy), however, specific beliefs may not be completely constructed or accessible. In such cases, attitudes are formed on the bases of deeply held values and value orientations or more basic beliefs (Stern et al., 1998), considered most important to act upon in a specific situation (de Groot and Steg, 2009). In other words, values and beliefs act as "filters" for new information and ideas (Stern et al., 1995).

A characteristic of the attitude structure is that all environmental beliefs are jointly connected; i.e. they are made of tightly covarying domains (Milfont and Duckitt, 2010; Xiao and Dunlap, 2007). In other words, individuals who support environmental attitudes in a specific domain will tend to support those attitudes in other domains (Pierce and Lovrich, 1980). In that respect, it is not surprising that the structural determinants of environmental attitudes have served as a typical starting point in examining the structure of both climate change and renewable energy attitudes (Dunlap, 2010; Hansla et al., 2008; Schultz et al., 2004; Smith, 2002).

Researchers maintain that when belief systems are expressed as political orientations and include beliefs about "the role of government, ideas about public polices, and notions about which groups in society should properly exercise power," they are typically referred to as ideologies (Spitzer et al., 2006: 130). In discussing environmental issues, ideologies are considered important because they are linked to one of two environmental policy domains - liberal/preservationist or conservative/ developmental. A policy domain refers to beliefs about issues of public policy, grouped together because they share a similar substantive content (Pierce and Lovrich,

1980). In the U.S., as it stands today, liberalism implies support for political and social reform; extensive government intervention in the economy; the expansion of federal social services; support for medical care, welfare, women and minority rights, and greater concern for consumers and the environment. Conservatism, on the other hand, is believed to express support for the social and economic status quo, including minimal to no government intervention in or regulation of business (Spitzer et al., 2006).

Values are defined as enduring beliefs that make a specific mode of conduct or end-state of existence "personally or socially preferable to an opposite or converse mode of conduct or end-state of existence" (Rokeach, 1973: 5). Values are the guiding principles in life, the tools people use to evaluate situations and the environment around them (Fulton et al., 1996; Manfredo et al., 2004; Rokeach, 1973; Schwartz, 1992). In an overview of the application of the concepts of values and attitudes in human dimensions of natural resources, Manfredo et al., (2004) maintain that values are developed early in life under the influence of family, friends, and other significant groups, thus, becoming enduring personal characteristics that guide behavior. Once formulated, values are hard to change (Dietz et al., 2005). Therefore, the importance of values lies in their ability to "reveal the fundamental basis of an individual's thoughts, attitudes, and opinions" (Manfredo et al., 2004: 275).

Various approaches to examining values exist, but the one used in this dissertation to explain the development of environmental values is the postmaterialism approach, proposed by the political scientist Inglehart (1990, 1995). Following

Maslow's theory for the existence of a hierarchy of prepotency or needs (Maslow, 1943, 1970), which postulates that individuals pursue those needs that are immediately threatened, Inglehart (1990, 2000) suggests that environmentalism is an expression of postmaterialist values – values that favor quality of life and self-expression - as opposed to materialist values that stress the importance of tradition, respect for authority, and material well being.

Qualitative and quantitative studies show that Americans have become significantly more proenvironmental since the sixties, and especially since the eighties; that their environmentalism has gone deeper than just opinion or attitude to core values and fundamental beliefs about the world; and that their environmental views have been enmeshed in a core set of cultural beliefs and values (Inglehart, 1995; Kempton et al., 1995). Some studies show that there is a positive correlation between environmental values and income or socioeconomic status, and for studies coming from the UK, between environmental values and social class (Devine-Wright, 2007). Studies also show that concern about the negative consequences from climate change and perceived threat from climate change increase with social class (Upham et al., 2009) and income (Tjernström and Tietenberg, 2008), suggesting support for the postmaterialist approach. This leads us to hypothesize that people who hold postmaterialist values, i.e. those who have already developed a sense for a clean and safe environment, will be more aware of the human-caused climate change and will be more supportive of renewable energy development than those with materialist values.

Studies also show that concern about climate change is higher, and belief that climate change is real and human-caused is stronger among people who are more worried about environmental degradation and the negative human impact on the biosphere than those expressing less concern (Poortinga et al., 2004). In addition, people sharing strong environmental concerns are also shown to be more supportive of renewable energy development than those without strong environmental concerns (Devine-Wright, 2007; Ricci et al., 2008). Some of these studies rely on the variables proposed by the New Ecological Paradigm (NEP) - an approach, developed for measuring attitudes toward the environment (NEP, Dunlap and Van Liere, 1978; Dunlap et al., 2000). Rather than measuring specific attitudes, Dunlap and his colleagues compiled a series of statements to assess a person's ecological worldview or concern, defined as "beliefs about humanity's ability to upset the balance of nature, the existence of limits to growth for human societies, and humanity's right to rule over the rest of nature" (Dunlap et al., 2000: 427). When examining the basic propositions of the environmental movement in the 1970s, and the writings of numerous authors reflecting on the environmental degradation inflicted by human actions (e.g., Commoner et al., 1971; Daly, 1973; Meadows et al., 1972), Dunlap and Van Liere (1978) noted that these ideas were more than just an expression of attitudes and concerns about environmental issues. They argued the ideas constituted a fundamental shift in the perception of the human-nature relationship, a "paradigm" shift from the beliefs prevalent at the time (i.e.1960-80s), defined as the dominant social paradigm

(DSP), to the new ecological worldview, defined as the New Ecological Paradigm (NEP).

Dunlap and Van Liere (1978) developed, and later Dunlap et al., (2000) refined the scale for measuring the dimensions of this new worldview. When the NEP scale is presented as a continuum, as it has been done in some studies (Pierce et al., 2000; Steel et al., 1994; Vaske and Donnelly, 1999), on one end there are the people who exhibit a high level of environmental concern and are defined as "biocentric." At the opposite end, are those who believe that humans have the right to rule over nature, and are defined as "anthropocentric." All the ones in-between are labeled as "mixed" (Dunlap and Van Liere, 1978; Dunlap et al., 2000b). The anthropocentric perspective defines the basic goals for humanity to be an ever-increasing economic development and material well being through technological advances (Dunlap and Van Liere, 1978). The biocentric view, on the other hand, gives priority to environmental integrity and biodiversity. People with predominantly biocentric orientation are concerned with the consequences of rapid development and urbanization, exploitation of natural resources, and an exploding world population. They recognize the limits to and downsides of technology and are aware that many of the advances in technology (e.g., increased agricultural productivity, machinery, pesticides, nuclear energy, and weapons) have also contributed greatly to land and water degradation and pollution (Steel et al., 2003).

Because neither the postmaterialism approach, nor the NEP was specifically designed to measure attitudes toward renewable energy, several specific questions

reflecting the cognitive, evaluative, and affective components of citizens' knowledge and understanding of energy policy issues and climate change beliefs are included in this analysis. The *cognitive* component refers to a person's knowledge and awareness of environmental problems. Research has shown that a lack of knowledge and understanding of the causes and consequences related to climate change has contributed to an atmosphere of apathy and disinterestedness in supporting the search for solutions that can help mitigate the problem (Tjernström and Tietenberg, 2008; Yetano Roche et al., 2009). In that respect, people who do not believe that global temperatures are rising or that the rise has been caused by human activities, tend to worry less about the consequences of climate change, are less willing to support the introduction of government measures to reduce pollution and energy consumption, and are more reluctant to support renewable energy development (Devine-Wright, 2007; Leiserowitz, 2007b; Leiserowitz et al., 2009; Rabe and Borick, 2008).

The *affective* component refers to a person's emotional responses to environmental problems. While it is important to cognitively understand the issues surrounding climate change, research points to the need for people to be also emotionally motivated to take action (O'Neill and Hulme, 2009). It has been shown that those more concerned about environmental degradation and the consequences of climate change to themselves, their local communities, and future generations, are more willing to engage in conservation behavior (Leiserowitz et al., 2009).

The *evaluative* component is defined as "judgments or opinions about problem-solving actions concerning various environmental issues" (Yin, 1999: 63). In

examining environmental attitudes, Yin (1999) uses questions regarding performance evaluation of environmental protection actions and support for stricter environmental laws to measure evaluative attitudes. Concerning climate change and renewable energy policy, surveys have asked respondents to evaluate the importance of decreasing dependence on foreign oil and gas for national security and increasing government spending on research and development of alternative fuels (Baldassare et al., 2009; Laver, 2007). Research shows that 68 percent of Americans believe it is important to gain energy independence even if it increases the cost of gas, electricity, and heating fuel (Bittle et al., 2009).

A central issue in public opinion theory focuses on elucidating understanding about the way people form opinions. There is evidence that the immediate environment - family, friends, and coworkers - plays an important role (Jennings and Niemi, 1974, 1981). In formulating opinions on new issues, however, political elites and the mass media contribute to opinion formulation as well (Converse, 1964; Zaller, 1992). It has been shown that exposure to political news increases with political awareness and knowledge; when people are exposed to political messages, acceptance and awareness increase for those whose values are in agreement with the messages and decrease when values are in disagreement (Zaller, 1992). Moreover, knowledge of political issues helps individuals focus only on certain considerations about an issue and disregard others (Smith and Klick, 2007). Besides political knowledge, familiarity with energy and environmental issues, and understanding of the way the technology works, also contribute to increased level of acceptance expressed as a positive opinion

toward renewable energy development. Hansen et al., (2003) comment that it is highly possible for wave energy to become even more popular than wind energy because of the minimized visual aspect and noise. However, the authors remark that the biggest challenge for accepting wave energy is the "low public knowledge" (Hansen et al., 2003: 5). It is, therefore, important in selecting the most appropriate policy tools for energy policy formulation and implementation to have a clear idea of the level of public knowledge regarding renewables in general and wave energy in particular.

A summary of research on renewable energy support shows that attitudes vary with respect not only to the described above situation-specific factors - knowledge, ideology, values, and beliefs - but also with trans-situational factors - age, gender, education, income, and place of residence (Devine-Wright, 2007; Lovrich and Pierce, 1984). The latter are also known as social structural, personal, socio- or geo-demographic variables, and in the environmental science literature, as the social basis of environmental concern (Dunlap and Van Liere, 1980). Therefore, examining the two types of factors - the trans-situational and the situation-specific - would allow for a fuller understanding of the determinants of public opinion on renewable energy.

Based on the above description of the theoretical approaches to public opinion formulation and the variables used for measuring it, the following graphic representation of the conceptual framework is selected (Figure 1.10).

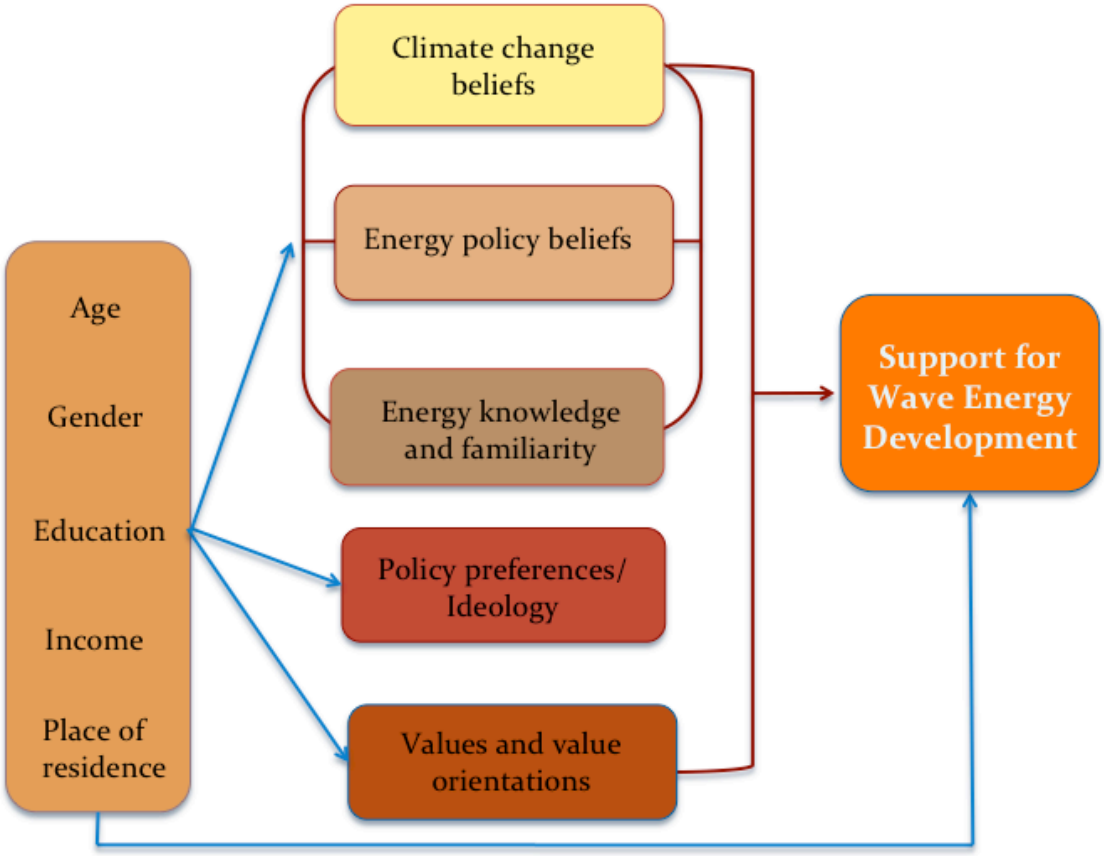

Figure 1.10. Graphic presentation of the conceptual framework based on the literature review.

Methods

Research is defined as an organized and formal inquiry into an area to obtain information in order to help answer questions and acquire new knowledge (Marczyk et al., 2005; Ruddick et al., 1983). Since the purpose of this dissertation is to provide insight and understanding about the determinants of public opinion on wave energy in the state of Oregon, data collected from a representative sample of Oregonians were needed.

Methodologically, public opinion is viewed as, “the distribution of all individual opinions on a public issue” (Corbett, 1991: 21). A common method for determining and interpreting the beliefs, preferences, and concerns of individuals is the survey, described as a way “of gathering information from a sample of individuals” (Scheuren, 2004: 9). Surveys can be conducted over the telephone, online, by mail, or in person. One of the advantages of the survey is that it utilizes a quantitative type of methodology. Other research method types exist, but a great majority of them are qualitative – ethnographic research, content analysis, focus group, participant observation, and case study (Garson, 2008). However, none of them serve the purpose of collecting data from a large number of individuals and analyzing the preferences of those individuals.

The main purpose of the survey is to gather valid (the extent to which the measurement process measures what it is intended to measure) and reliable data, which is relevant to the research questions and objectives. The reliability and validity of the data collected depend largely on the design of the questions and the structure of the survey. A valid question enables accurate data to be collected consistently. In addition, information is collected by means of a standardized procedure so that every individual is asked the same question with the same range of possible responses, in the same way, and in the same sequence. That is one of the main reasons for considering surveys a “speedy and economical means of determining facts about our economy and about people’s knowledge, attitudes, beliefs, expectations, and behaviors” (Scheuren, 2004: 10).

Survey research has been acknowledged to have several advantages over other qualitative and quantitative methods (Inglehart, 1990). First, surveys allow for a relatively large number of respondents to be reached, which is important for producing reliable results. Second, the sample frame could be representative of the population we wish to study, which is an important advantage when examining what is happening in a state or a nation, as a whole. And finally, despite seemingly large variations in individual opinions, the overall distribution has proven to produce reliable results in many studies (Inglehart, 1990; Needham and Vaske, 2008).

The population for this study was defined as adult (i.e. at least 18 years of age) residents of the state of Oregon. The sampling frame consisted of private households with a permanent mailing address in the State. Addresses were obtained from Survey Sampling, Inc. Data were collected using mail-back surveys, administered during September-October, 2008. Residents were sampled from two randomly selected household samples, which included a statewide sample of 1,200 households and a subsample of 400 coastal households (i.e. those within approximately 20 miles of the coastline). The coastal subsample was used to ensure adequate representation of coastal community residents within the general population sample and to help establish any differences in wave energy attitudes between coastal residents and people living elsewhere in the state.

The mail survey procedure was designed and implemented following Dillman's (2000) mail survey method, which requires three waves of mailings, including an introductory postcard announcing the survey and two subsequent waves

of the survey with a cover letter, sent within two weeks of each other. There were no restrictions on the participant population in terms of gender, race, and ethnicity; the only restriction was on age – only participants 18 years of age and older were included. The following statement was made part of the survey cover letters: "Only respondents 18 years of age or older are eligible to participate in this survey."

The survey was pretested with a group of 35 randomly selected Oregon State University students and with 20 random households in an apartment complex in Corvallis, Oregon, in order to ensure that respondents were able to understand the questions and that their responses would produce the desired data, suitable for SPSS manipulation.

To ensure a high response rate, several of the design strategies known to produce a high response rate were applied (Needham and Vaske, 2008; Scheuren, 2004):

- The survey was printed on high quality U.S. letter format peach color paper and had the official OSU logo in orange in the middle of the front page in order to emphasize "professionalism, quality, and attractiveness" (Scheuren, 2004: 10).
- A great deal of care was applied into selecting and designing the 19 survey questions, which were organized in three sections (a copy of the survey is available as Appendix 4). Though there are many issues that are extremely important in designing an affordable, achievable, and popular renewable energy policy for Oregon based on public input that could have been probed (e.g., willingness to pay and contingency analysis), it was decided that respondents

would get confused by a survey that seemed too long with questions that required a lot of knowledge and financial thinking, especially regarding an issue they do not know much about.

- The wording of the questions was kept as simple as possible. Moreover, to ensure that questions were straightforward, unambiguous, and logical, the survey was pretested before the final questions, wording of questions and answers, and the sequence of questions were finalized.
- Questions were close-ended with the exception of one, which asked respondents to list an extra information source in addition to the ones they were provided with that helped them learn more about Oregon's energy situation and policy. Only two types of answer choice formats were used - either circling a number that most closely represented respondent views or rank-ordering answers.
- There were no direct benefits to participants. However, for interested participants a copy of the aggregated survey results was prepared and mailed to them. This strategy is known also to increase survey participation by providing a small benefit for those interested in the topic. Twenty-one respondents requested a copy of the survey results.

A potential problem associated with mail-back surveys is that the presence of non-responses can lead to sample selection bias. It is reasonable to expect that those with a strong positive or negative opinion about renewable energy development in general, and wave energy in particular, are more likely to answer and return the surveys. Given the heightened interest in wave energy development in Oregon during

the time of the survey, the extensive media coverage of some of the wave energy projects, in addition to the spike of oil prices in the summer of 2008, it is not surprising that the response rate was 58 percent (n=232) for the coastal and 56 percent (n=674) for the statewide samples.

Plan of the Dissertation

We, the generation that faces the next century, can add the . . . solemn injunction "If we don't do the impossible, we shall be faced with the unthinkable."

Petra Kelly, German Green Party founder, January, 1993.

This dissertation consists of five parts – Introduction, Conclusion, and three Chapters, organized as separate articles, which have been sent for publication to peer-reviewed journals in their abridged versions.

The first part – the Introduction –consists of five sections. The first section, entitled, *The rocky road to renewables* describes the advantages and problems renewables have compared to fossil fuels. It examines the U.S. energy mix and the importance of a sufficient energy supply for the efficient functioning and development of the U.S. economy. Environmental and energy priorities have shifted in the 21st century. Traditional energy sources are depleting fast, reliance on foreign oil is getting more costly and endangering national security even further. Moreover, climate change is becoming a pressing issue that needs urgent response and action. What role has public opinion played in energy policy formulation?

The second section describes the issues related to wave energy generation in particular and the reasons Oregon has been selected as the place for this research. Obviously, the main reason is practical – Oregon State University, which sponsors this research, is in Oregon. However, there are several other reasons. Wave energy is a good match for Oregon from an economic and geopolitical perspective. The switch to renewable energy will require the sources of energy to be readily available and tailored to the local environment. Therefore, Oregon presents an interesting case study for examining the determinants of public opinion with regard to a particular renewable energy type available locally – wave energy, and allows for comparisons to be made with other places and other types of renewables.

The third section of the Introduction sets the conceptual framework for examining public opinion and operationalizes the concepts and variables used. A graphic representation of the model used for measuring public opinion is exhibited and its parts are discussed.

The fourth section describes the methods. The survey is used for collecting reliable and valid information from a large number of randomly selected respondents. The section also defines the sample frame and the types of questions used. It provides a justification for selecting and organizing the survey questions. The last section of this Introduction presents the plan of the dissertation – what would one expect to find (and not find), and where.

The three article-type chapters that follow the Introduction share a similar structure and organization. All three discuss several of the determinants of public

opinion. Each of them starts with a literature review on the particular determinants analyzed in that chapter, and then discusses their significance and applicability to the present research. Based on the theoretical review, research questions are formulated to test the applicability and significance of each determinant. After that, the findings of the survey relevant to that determinant are presented, applicable statistical models are used to tease out the most significant information from the results of the survey, and finally the findings are discussed in light of the theoretical approaches presented at the beginning of each chapter.

More specifically, Chapter 1 discusses the impact of values and value orientations on public support for wave energy development. It also examines the values and value orientations of the statewide respondents separately from those of the coastal residents. One of the policy implications of this chapter lies in answering the question: does one's place of residence determine different values and value orientations? In particular, could opinion on renewable energy be based on how close people live to the proposed development sites?

Chapter 2 looks at public familiarity with wave energy technology and energy-relevant knowledge as determinants in expressing support of or opposition toward wave energy development. The chapter answers questions such as – does the public have enough information to express an informed opinion on wave energy? What sources of information do people use to get informed? Does it matter if one has more liberal or more conservative views and how do ideologies influence support or opposition? How can policy makers best approach citizens based on their level of

familiarity with the technology, energy-relevant knowledge, and sociodemographic characteristics to formulate more efficient renewable energy policies?

Chapter 3 addresses the importance of values, value orientations, climate change beliefs, and energy policy beliefs to assess the role they play in determining public opinion on renewable energy. Many theories point in different directions – which one best explains support for wave energy development? Which of the determinants are most salient in defining support for wave energy development? In addition, this chapter looks at the profile of Oregonians who are most aware climate change is happening, and those who most strongly believe it is human-caused, and compares it to the national U.S. profile. This comparison has a double significance. First, it shows some similarities and differences between the national and the state views on climate change as they were in fall 2008. Second, because more recent national data is available, it allows for projections to be made about the direction and intensity of Oregonians' climate change beliefs. The policy implications are many. Understanding the link between climate change beliefs and support for renewable energy options could help policy makers focus on either providing knowledge about what causes climate change, or educating the public about the benefits of adopting renewable energy with respect to reducing climate change.

Finally, the Conclusion of this dissertation provides a synthesis of the findings from the three chapters and proposes ideas for further research. It discusses how the findings could be utilized to help policy makers formulate more efficient policies for the faster adoption of renewable energies. In transitioning from conventional fossil

fuel to alternative energy provision, the successful implementation of renewable energy projects is often seen as a convergent point of three separate paths, those of industry, government, and [civil] society (Mallon, 2006). Research suggests that rather than enforcing new energy policies on people, behavioral change is much more effective in getting people to change their habits and start viewing renewables not as a mandatory requirement but as an option for sustainable living. Understanding public opinion on renewable energy is the first step in that direction.

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Notes

[1] Conversion, even though confusing, is pretty straightforward when knowing that a British thermal unit (abbrev. Btu) is: 1. a unit of energy equal to 1,055 joules or 252 calories; or 2. the amount of energy needed to raise the temperature of one pound of water one degree Fahrenheit; or 3. the approximate amount of energy in one match tip. Kilowatt-hour (abbrev. kWh; pl. Kilowatt-hours) is: 1. a unit of energy equal to 3,413 Btu or 3,600,000 joules; or 2. an amount of energy that results from the steady production or consumption of one kilowatt of power for a period of one hour.

For an explanation on energy units, energy conversion factors, and a comparison of energy unit sizes, see (Bent et al., 2002).

Conversion:
1kWh (kilowatt-hour) = 1,000 watt-hours = 3,413 British thermal units (Btu)
1 MWh (megawatt-hour) = 1,000 kWh = 1,000,000 watt-hours = 10^6 kWh
1 GWh (gigawatt-hour) = 1,000 MWh = 1,000,000,000 watt-hours = 10^9 kWh
1 TWh (terawatt-hour) = 1,000 GWh = 1,000,000,000,000 watt-hours = 10^{12} kWh

The U.S. average annual electricity consumption per household in 2008 was 11,040 kWh, an average of 920 kilowatt-hours (kWh) per month. Source: (EIA - Energy Information Administration, 2010b) Available at: http://www.eia.doe.gov/ask/electricity_faqs.asp, last accessed July 31, 2010.

ATTITUDES TOWARD WAVE ENERGY DEVELOPMENT IN OREGON: DO ENVIRONMENTAL VALUES AND CONCERNS EXPLAIN SUPPORT?

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Abstract

Understanding the impact of environmental values and concerns on public attitudes toward renewable energy could help in formulating policies that make the transition to renewable energies smoother and faster. The research reported here takes place in Oregon, and the type of renewable energy investigated is wave energy. Findings of a statewide survey, conducted in 2008, reveal that most Oregonians have a positive attitude toward wave energy development, but more than one-third do not consider themselves informed enough to form an opinion about it. Results indicate that both the postmaterialism value approach and the factors used in the six-item New Ecological Paradigm (NEP) scale for measuring environmental concerns, do not accurately explain support for renewable energy development and that there are regional variations in both familiarity with wave energy and support for its development. Although respondents who live closer to the proposed development sites are more informed about wave energy development, their attitudes are also more polarized compared to those of respondents who live elsewhere in the state. Possible determinants of these variations are considered. Both theoretical and policy implications of the findings are discussed, and revision of the theoretical approaches is suggested. More specific research is proposed to examine the "missing link" between environmental values and concerns, on one hand, and attitudes toward renewable energy, on the other.

Introduction

Today, global communities are realizing that increased consumption leads to faster depletion of traditional energy sources - oil, coal, and natural gas. The finite nature of these resources suggests that sooner or later, "whether it's in 20 or 200 years" (Komor, 2004: 3), they will have to be replaced. Conservation, innovative technology, and new energy policies are needed to prevent severe disruptions of our societies. It has become clear that:

> "… part of developing a national energy policy lies in understanding public opinion about existing energy sources, public support for various energy strategies, and what the public might be willing to do in order to conserve energy and reduce U.S. reliance on foreign oil." (Bolsen and Cook, 2008: 364)

Numerous studies and polls show overwhelming support for the development of renewable energy alternatives. A national poll revealed 87 percent of respondents believe using renewable energy sources for electricity generation is a good idea because such sources are "readily available and better for the environment" (CBS/New York Times Poll, 2007: 12). Scholars have shown that Americans are starting to "place far more value on environmental quality" than at the time of the first national celebration of Earth Day on April 22, 1970, regarded as the start of the environmental movement (Dunlap, 1995: 104). In addition, willingness to pay higher taxes or prices to protect the environment, and even willingness to accept a lower standard of living if it means a cleaner environment, have also received strong public support (Farhar, 1994; Payne, 2007).

Despite this overwhelming support for environmental protection and quality, not many studies have examined the impact of environmental values and concerns on public attitudes toward various types of renewable energy policies and projects. Advances on this topic are necessary for two main reasons. First, demand for energy, regardless of its source, is growing worldwide. Renewable energies are proposed as viable alternatives that can satisfy energy demand while protecting the environment.

Second, there is a gap in our understanding of public attitudes toward renewable energy. This gap is explained, on one side, by the fact that "very little has been asked by polling organizations about alternative energy sources" (Bolsen and Cook, 2008: 373), and, on the other, by the nature of attitudes, which has been described as "highly variable, dynamic, and sometimes contradictory" (Sorensen et al., 2003: 306). In addition, specific attitudes toward renewable energy developments have been difficult to define and categorize because the term *renewable energy* is multifaceted. All energy transformations have environmental consequences but the way those consequences are accounted for has not typically been based on definitions of sustainability, where the cost of pollution and destruction of nature is added to the cost of labor and materials. As Bent, Orr, and Baker (2002: 5) note, "[m]eeting world energy needs in the twenty-first century is only half of the 'energy problem.' The other half is finding ways to do this in environmentally acceptable ways." The question then becomes if attitudes toward renewable energy development are based on values and concerns that take into consideration whether energy extraction is done in environmentally acceptable ways. Understanding the impact of environmental values

and concerns on public attitudes toward renewable energy will thus help in formulating policies that make for a smoother and faster transition to renewable energies.

In many respects, support for renewable energy development is reminiscent of early environmental policy and legislation development in the U.S. When the American people first became aware of the human relationship to environmental degradation in the 1960s, they were not sure how stringent environmental policies should be. It took a while for them (about a decade) to establish the link between local air and water pollution, human health, and "limits to growth." Although support for environmental protection policies has been growing since the 1970s, the issues that have dominated the policy agenda and, more importantly, the perceptions of those issues have shifted. While environmental problems were regarded as primarily aesthetic and local, related to wilderness protection, litter disposal, recycling, air and water pollution in the 1970s, by the 1990s these issues had escalated to global proportions, threatening human health and well-being. Moreover, the environmental problems began to be perceived as parts of a complex ecosystem, interrelated and overexploited; in other words, "pollution" gave way to "ecological problems," and "concerns about the natural environment expanded to worries about human health and well-being" (Dunlap, 1995: 95).

In addition to global concerns, renewable energy studies suggest that there is a difference in attitudes between the local to the project population and the general population. For example, Devine-Wright (2005a) has noted that the literature on wind

energy assumes people living in proximity to the development site to have the most negative attitudes. That is not always the case, however. Sometimes individuals living closer to renewable energy developments tend to have more positive attitudes in comparison to those living further away (Devine-Wright, 2007; Warren et al., 2005). Since public acceptability of renewable energy projects is determined to a large extent by local perceptions, it is important to investigate differences in attitudes toward renewable energy development of local-to-the-projects (in this case – coastal) versus statewide respondents. To accomplish this objective, we examine one particular type of renewable energy - wave energy - in the study area of the state of Oregon.

This distinction has important policy implications. For example, if coastal residents have predominantly negative attitudes while statewide respondents have mainly positive, or vice versa, it would mean that there is a gap in perception of the benefits wave energy development could provide and that gap would need to be further investigated. If the gap comes from differences in respondents' level of knowledge or awareness about wave energy, then policy makers would need to know that and provide more information. If, however, the gap comes from differences in values and concerns between statewide and local respondents, adequate policy mechanisms would need to be created to increase the acceptability of wave energy development.

This paper investigates differences in wave energy attitudes between coastal and statewide Oregonians. In addition, it investigates the relationship between environmental values and concerns and attitudes toward renewable energy. In

particular, the question it aims to answer is how suited environmental values and concerns are for explaining attitudes toward renewable energy development.

Oregon's Environmental and Energy Policy Overview and Wave Energy Potential

Oregon is considered an environmentally friendly state. It was rated the second-greenest state in the nation in 2007, due to having one of the five lowest carbon footprints per capita, and more LEED-certified "green buildings" per capita than any other state (Evilsizer, 2009). Oregon's biggest city – Portland – was also ranked as "the greenest city in the United States" in 2008 (Miller and Spoolman, 2009: 604). Oregon is one of the few states that guarantees free public access to all of its beaches (Bailey, 1998). It was the first state to introduce a *Bottle Bill* in 1971 for recycling soft drink and beer containers (OregonDEQ, 1971). Beginning in January 2009, a new electronics recycling program, called E-Cycles, was introduced. The program made it illegal to dispose of any electronic equipment in the general garbage containers and designated more than 200 collection sites throughout the state for free disposal of unwanted televisions, computers, and monitors (Oregon DEQ, 2010). To better manage and protect the marine resources within the state's three-mile territorial sea limit, the Oregon State Legislature adopted the Territorial Sea Plan in 1994 (Oregon Legislature, 1994).

In the absence of a coherent federal energy policy, Oregon has deemed it necessary to develop its own path to energy sustainability. The state ranks third in the U.S. in hydroelectric power development. Hydropower supplies more than half of the

state's energy needs (EIA, 2009b). There are no nuclear power plants in Oregon (city-data.com, 2010). Only eight percent of the electricity generated in Oregon comes from coal, as compared to 50 percent in the U.S. (DOE, 2008b). As of early 2010, Oregon ranks sixth in the country in capacity of installed wind power systems - 1,758 MW (Preusch, 2010).

Studies have shown the state of Oregon to be ideally suited for wave energy development (EPRI, 2004). Wave energy refers to the extraction of electricity from the up-and-down motion of ocean waves using buoys or floating turbines. The conversion of the kinetic energy of the ocean, which covers nearly three quarters of the Earth's surface, has potential for cheap, renewable production of commercial electricity. The global wave power resource has been estimated to be more than two terawatts, the equivalent of twice the world's electricity production (Thorpe, 1999; World Energy Council, 2007). Not all countries, however, could benefit from this tremendous resource because wave energy is not equally distributed around the globe. Places that have the best potential are typically located on the west side of continents with exposure to the prevailing wind direction, and away from the equator. These conditions make the western coasts of the Americas, Europe, Southern Africa, Australia, and New Zealand particularly suitable for wave energy development. It is estimated that if one-quarter of the U.S. wave resource were harnessed at 50 percent efficiency, the electricity produced would satisfy 6.8 percent of the total net electricity generated in the U.S. in 2006 (EIA, 2008a: 38).

The impact of wave energy conversion on the environment is generally expected to be minimal. However, due to the novelty of the technology and the fact that very few full-scale prototypes have been tested in the open ocean, the nature and extent of environmental concerns remain to be determined. Scientists believe that the potential impacts will most probably be site-specific because of the different physical and ecological factors around the world. Wave energy developers have been preparing Environmental Impact Statements (EIS) as part of their permit applications and have not found any significant environmental changes or damages from the initial stages of their projects (Fernandez Chozas et al., 2010). However, the estimated life of most devices is between 20 and 30 years, thus necessitating the monitoring of many biological and ecological factors. At this initial point, it has been recommended that substantial baseline information be obtained before any commercial-scale devices are put in the water and that long-term attention be paid to the effect of the energy absorbing structures on the physical environment, fish behavior, the pelagic and benthic habitat, and marine mammals and seabirds (Boehlert, 2007).

Wave energy is categorized as an immature technology because it is in the initial stages of its development and still lacks a technologically proven device design. There are many design prototypes – more than one thousand wave energy device patents have been applied for, and three hundred designs are in pre-commercial development (Bhuyan et al., 2008). There are several significant reviews of wave energy technology (EPRI, 2004; World Energy Council, 2007; Yin, 2009)., Four main types exist, depending on the principle utilized for extracting energy: (a) overtopping

devices (e.g., the Wave Dragon); (b) point absorbers or buoys (e.g., the BioWAVE, WaveRoller, OPT, and BeaverFloat); (c) attenuators (e.g., the Pelamis); and (d) Oscillating Water Columns (e.g., Energetech OWC, Superbuoy, and Wavegen's LIMPET) (Brekken, 2007). In addition, wave energy is still costly to produce compared to conventional and other renewable types of energies – 20 to 30 cents/kWh (Ocean Energy Council, 2008). It is estimated that with improvement of the technology, wave energy is likely to produce electricity at approximately 4.5 cents/kWh (Wave Dragon Aps., 2008).

Despite its cost, wave energy has many advantages. It is predictable, renewable, and clean. It has been estimated that the generation of seven MWh of electricity by a wave energy device called Wave Dragon will offset the release of about 10,000 tons of carbon dioxide every year and that the same device when placed in a high wave energy climate could produce 50 GWh of electricity per year, offsetting 39,000 tons of carbon dioxide (Elwood et al., 2008; Previsic, 2008). The fact that the vast majority of the world's population lives within 30 km of the coast makes wave energy a suitable technology for providing electricity close to where it will be consumed, thus reducing energy waste and minimizing grid cost.

Oregon has tremendous wave resources, a long coastline - extending 360 miles - a well-developed coastal transmission capacity, suitable bathymetry, and a good match between the availability of the resource and the temporal and spatial demand for it. The presence of Oregon State University with its research facilities and its

commitment to this new technology, as well as the industrial infrastructure in the state, contribute to the state's suitability for wave energy development.

In addition to good physical resources, Oregon has strong leadership and a capacity for innovation in renewable energy. Oregon is one of the 30 states in the U.S. with a Renewable Portfolio Standards (RPS) policy, defined as "one of the most important drivers for renewable energy capacity additions" (Wiser and Barbose, 2008: 2). The RPS, known in Oregon as the Oregon Renewable Energy Act, or "25 by 25," requires Oregon's largest utilities to acquire 25 percent of their electricity from "new, homegrown renewable energy sources" by 2025 (Senate Bill 838, 2007). Smaller utilities have a lower target of five to ten percent for renewable energy by 2025 as well.

Since the adoption of the RPS and the publication of two major studies – one, identifying seven locations off the Oregon coast as suitable for wave development (EPRI, 2004), and the other suggesting approximately $750 billion will be invested in wave energy over the next 25 years (EPRI, 2005), the state has experienced a kind of 'gold rush' in permit applications for siting wave energy devices along the coast. In the summer of 2007, seven applications were filed for preliminary permits with the Federal Energy Regulatory Commission (FERC), the authority in charge of wave energy permitting and licensing in the U.S. The number of permit applications went down to three in 2009. The reasons for the downward trend in the number of permit applications are many and complex and will not be reviewed here. What this paper

examines is how citizens' environmental values and concerns might influence their attitudes toward wave energy development in Oregon.

Theoretical Background

Statewide versus Coastal Attitudes toward Renewable Energy Development

Increased environmental concern coupled with the energy crisis of the early 1970s has pointed attention to the importance of energy availability and has laid the foundation for examining public opinion on energy as a policy issue. Research defines public opinion as "the expressed attitudes and views of ordinary people on issues of public concern" (Brooker and Shaefer, 2006: 5). Attitudes are the positive or negative evaluations of objects (e.g., person, issue, action) and reflect personal likes and dislikes (Glynn et al., 1999; Vaske, 2008; Zaller, 1992).

In investigating the factors that have influenced public opinion on both traditional and renewable energy generating resources, scholars single out environmental values and concerns for the natural environment as major determinants of attitudes toward energy development (Kempton and Neiman, 1987; Smith, 2002). In review of survey research undertaken to investigate public attitudes toward various renewable energy technologies – hydroelectric, geothermal, tidal, and wind – Walker (1995) notes that people are not generally opposed to renewable energy developments, but to the scale, location, or other characteristics of the project development. Local negativity has often been attributed to NIMBY – "not in my back yard" syndrome – describing the theoretical support for renewable energy development but opposing specific local projects because of the perceived consequences concerning primarily

noise and visual impact (Devine-Wright, 2005b; Krohn and Damborg, 1999). Many researchers consider NIMBY to be too simplistic to explain all the variables determining the general and local public acceptance of a specific project (Devine-Wright, 2005a; Firestone and Kempton, 2007; Firestone et al., 2009; Krohn and Damborg, 1999; Wolsink, 2000). Moreover, some researchers have found evidence for exactly the opposite effect: that local people become more favorable toward wind farms after their construction and that the degree of acceptance increases with proximity to them (Warren et al., 2005). Research on attitudes toward oil drilling in California confirms this, and shows that in 1998 people living on or close to the coast were more likely to support offshore oil drilling than people living elsewhere in the state (Smith et al., 2004).

While U.S. and European survey results show overwhelming national support for renewable energy development, researchers have come to the conclusion that local acceptability cannot be presumed solely on the basis of national surveys. More specifically, when examining support for marine energy projects, they point out that public opinion is better understood when it is divided into two categories: national views (in this paper - views from the state-wide sample), which present respondent thinking about issues in a more abstract and remote way; and local views (those of the coastal residents) based upon views from actual experiences (Hansen et al., 2003; Walker, 1995).

Since coastal Oregonians have been exposed to numerous discussions about wave energy in general, and about specific wave energy projects, we would expect

them to be more informed about wave energy development. In addition, we would expect their level of support to differ from that of statewide residents in a negative direction because of the "gold rush" mentality created by the numerous permit applications filed with FERC between 2004 and 2007 and the developers' anxiety and strife to secure as much ocean space for their projects as possible, often without taking into consideration pre-existing interests and uses including fishing, crabbing, recreational boating, and surfing.

Values, Attitudes, and Renewable Energy Support

Two social science concepts that aim at explaining the rise of environmental concern through change in values and beliefs are the postmaterialism approach and the New Ecological Paradigm (NEP). According to research that examines the link between values, attitudes and behavior, values are defined as fundamental building blocks that serve as guiding principles in people's lives (Rokeach, 1973; Schwartz, 1992). In an overview of the application of the concepts of values and attitudes in human dimensions of natural resources, Manfredo et al., (2004) maintain that values are developed early in life under the influence of family, friends and other significant groups, thus becoming enduring personal characteristics that guide behavior. Once formulated, values are difficult to change (Converse, 1962; Zaller, 1992). As such, the importance of values lies in their ability to "reveal the fundamental basis of an individual's thoughts, attitudes, and opinions" (Manfredo et al., 2004: 278).

The approaches used in this research – postmaterialism and NEP – aim at measuring people's values and concerns, and propose explanations about the shape of the human relationship with the environment. Since renewable energy development is closely related to concern for the environment and desire for sustainable development – development that "meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundlandt Report, 1987: 43) – it is important to examine the influence of those values and concerns on the level of support for renewable energy development.

Postmaterialism and Support for Renewable Energy

Postmaterialism, developed by the political scientist Ronald Inglehart in the late 1970s explains the emergence of people's environmental values with the attainment of a relatively high and stable level of economic development. Following World War II, the advanced industrial societies experienced unprecedented economic growth combined with the emergence of the welfare state, profound scientific and technological developments, and changes in the international system (Inglehart, 1990). All these socioeconomic developments had an impact on and altered basic values concerning work, religion, politics, and the family. These value changes took a long time to take effect because a "substantial time lag is involved for one's basic values reflect the conditions that prevailed during one's pre-adult years" (Inglehart, 2000: 220). Inglehart (1990) uses survey data to show that it took a whole generation to move away from a postwar mindset concerned with daily needs for food and shelter to

one concerned with "belonging, self-expression, and the quality of life" (Inglehart, 1990: 66). This fundamental societal shift in values is what Inglehart (1990, 1995, and 2000) defines as the shift from materialist to postmaterialist values. He describes this as a global process, transforming human lifestyle in more than one dimension – it has permeated consumer patterns, fertility rates, and changed many of the socially accepted norms in child upbringing, sexual behavior, and environmental concern (Inglehart, 2008).

The emergence of the new environmental attitudes has been captured through longitudinal data of the several waves of the World Values survey (1981, 1990, 2000 and 2008), showing that the younger generations are more willing to pay higher taxes and undertake other actions, such as participate in anti-pollution demonstrations and environmental meetings, in order to protect the environment. Inglehart (1995) maintains that this is not simply a life–cycle effect – people do not have postmaterialist values only when they are young and materialist when they age. The shift in values is a generational process; the younger surveyed cohorts start off as embracing stronger postmaterialist values than the preceding cohorts. Therefore, every subsequent generation has a larger number of postmaterialist supporters, while the number of people with materialist values gradually decreases.

Inglehart's postmaterialism explanation has often been used in research attesting stability and change in patterns of public opinion because of its emphasis on the political, economic, and social environment in the formulation of fundamental values (Pierce, 1982: 30). The point of a major shift in values, however, has brought

tension in scholarly circles, especially when discussed in relation to the environment. For example, there is disagreement about the ability of the questions used by Inglehart regarding the priorities an individual or a nation should have – fighting rising prices, protecting freedom of speech, giving people more say in important government decisions, and maintaining order in the nation - because none of these four questions asks directly about environmental issues. Postmaterialism, maintains Inglehart, combines aspirations for civil and political liberties with aspirations for ecological, aesthetic, and ethical quality of life, and therefore, the postmaterialism index is still a valid reflection of environmental values (Welzel and Inglehart, 2001: 14).

To test the postmaterialism approach in explaining attitudes toward conventional energy sources (nuclear power and oil drilling), Smith (2002) hypothesized that people with postmaterialist values - those who have already developed a preference for a clean and safe environment - would oppose nuclear power and oil drilling in natural parks and protected forest areas. The findings revealed, contrary to the expectations, that postmaterialism offered no insight as to why people would support or oppose a particular type of energy development. Not only did all of the relationships proposed by Inglehart's approach turn out to be statistically insignificant, but knowledgeable materialists were also more likely than postmaterialists to oppose nuclear power and oil drilling (Smith, 2002).

The question remains about how well Inglehart's postmaterialism concept can be applied to explaining attitudes toward renewable energy development. In particular, if postmaterialist values were an expression of ecological aspirations, we would expect

people with postmaterialist values to be more concerned about the quality of the environment and to be more supportive of renewable energy development than people with materialist values. In addition, one of the characteristics materialists share, is the idea of "fighting rising prices." So, if people with materialist values see wave energy as an expensive source of energy, they may tend to have negative attitudes toward its development. Therefore, we would expect people with materialist values to have a negative attitude toward wave energy development, especially if they believe wave energy will be more expensive than non-renewable energy sources, while those with postmaterialist values to have positive attitudes.

New Ecological Paradigm (NEP) and Support for Renewable Energy

Another approach that examines one's level of environmental awareness and support is the New Ecological Paradigm (NEP). Developed by the sociologists Dunlap and Van Liere in the late 1970s, it was originally called the New Environmental Paradigm to reflect the range of environmental issues prominent at that time – air and water pollution, loss of aesthetic values, and resources, and especially those related to energy conservation (Dunlap and Van Liere, 1978). Subsequently, the recognition that human activities were altering the ecosystems on which they and other species depended, led to a revision of the terminology, alteration of some of the measures of proenvironmental orientation, and the renaming of the resulting scale to the New Ecological Paradigm to better reflect these changes (Dunlap et al., 2000).

The New Ecological Paradigm proposes the emergence of a ‘paradigm’ shift from an anthropocentric to a biocentric view of the environment. A paradigm provides general guidance for individual and social behavior, and as such is used to describe the dominant worldview at a particular point in time (Kuhn, 1970). Environmental problems arise, note Dunlop and Van Liere (1984) because people believe in a Dominant Social Paradigm, characterized by eight distinct factors: 1. Commitment to limited government, 2. Support for free enterprise, 3. Devotion to private property rights, 4. Emphasis upon individualism, 5. Fear of planning and support for the status quo, 6. Faith in the efficacy of science and technology, 7. Support for economic growth, and 8. Faith in future abundance. The proponents of the Dominant Social Paradigm (DSP), those who grew up in a time of individualism, progress, growth, and market economy, have an anthropocentric view of the environment. They believe optimistically that technological advances will overcome most natural resource dilemmas or shortages (Dunlap and Van Liere, 1984). DSP supporters view economic growth and productivity as keys to an ever-increasing standard of living for the world’s growing population. The DSP is centered on immediate gratification and economic gains, not on the long-term consequences of natural resource exploitation and the degradation of land and water. In the early 1970s, this anthropocentric interpretation of the meaning and the purpose of the world came in contact with a new ecological one, characterized by the terms “balance of nature” (Commoner et al., 1971), “limits to growth” (Meadows et al., 1972), and “steady-state economy” (Daly, 1973). It was subsequently transformed into a new biocentric interpretation of the

world, laconically described by the metaphor “spaceship earth” (Dunlap, 1975; Dunlap and Van Liere, 1978).

While the anthropocentric perspective defines the basic goal for humanity to be an ever-increasing economic development and material well-being through technological advances, the biocentric view, on the other hand, gives priority to environmental integrity and biodiversity. People with predominantly biocentric orientation are concerned with the consequences of rapid development and urbanization, exploitation of natural resources, and an exploding world population. They recognize the limits to and downsides of technology and are aware that many of the advances in technology (e.g., increased agricultural productivity, machinery, pesticides, nuclear energy and weapons) have also contributed greatly to land and water degradation and pollution (Steel et al., 2003).

The work, done by Dunlop and Van Liere (Dunlap et al., 1993; Dunlap and Van Liere, 1978, 1980; Dunlap and Van Liere, 1984; Dunlap et al., 2000; Dunlap, 2008a; Dunlap, 2008b; Dunlap and Van Liere, 2008) incorporates the writing of many researchers, who have described how human values, attitudes, and beliefs change in response to environmental degradation and based on those writings, develops a set of survey questions that establish the positive relationship between NEP and environmental concern. High scores on the NEP scale indicate proenvironmental attitudes, defined as “beliefs about humanity’s ability to upset the balance of nature, the existence of limits to growth for human societies, and humanity’s right to rule over the rest of nature” (Dunlap and Van Liere, 1978).

The original NEP scale consisted of twelve survey questions designed to measure level of environmental concern. Eight of the twelve questions were worded in a way, in which agreement indicated acceptance of the NEP (e.g., "we are approaching the limit of the number of people the earth can support," "the balance of nature is very delicate and easily upset," or "the earth is like a spaceship with only limited room and resources"), whereas agreement with the remaining four showed acceptance of the DSP (e.g., "humans have the right to modify the natural environment to suit their needs," "mankind was created to rule over the rest of nature," or "plants and animals exist primarily to be used by humans"). When the scale was revised, the number of questions in it was increased to fifteen to improve on the existing three dimensions – balance of nature, limits to growth, and human domination over nature - and to add a new one, human exemptionalism, to describe the idea that humans, unlike other species, are exempt from the constraints of nature (Dunlap et al., 2000).

The survey questions forming the NEP scale have shown internal consistency and unidimensionality, and the scale has proven explanatory, content and construct validity (Dunlap and Van Liere, 1984; Dunlap et al., 2000). Using the original 12-question scale, survey results have shown that out of the eight dimensions representative of the DSP, three stand out as having consistently strong negative effect on environmental concern. These three are: support for private property rights, support for economic growth, and faith in material abundance (Dunlap and Van Liere, 1984: 1018). Support for the status quo, belief in the omnipotence of science and technology, and commitment to individual rights also influence concern for environmental

protection, but not as much as the other three dimensions (Dunlap and Van Liere, 1984). In a longitudinal study from 1976 and 1990, using the original sample frame and data collection techniques, Dunlap et al., (2000) found only a modest increase in environmental concern exhibited by residents of the state of Washington. The largest increase (+18%) was shown in the questions pertaining to the likelihood of an ecological catastrophe, which the authors attributed to the effect major ecological problems like global warming and ozone depletion had on the public (Dunlap et al., 2000).

Some researchers use the original or the revised scale in measuring endorsement of ecological concern (Erdogan et al., 2009; Pierce et al., 2000; Rauwald and Moore, 2002; Schultz and Zelezny, 1999; Steel et al., 1994; Stern et al., 1995; Vining and Ebreo, 1992). Others use parts of the scale or a minimized version, including six (Pierce et al., 2000), seven (Stern et al., 1995), or ten (Cordell et al., 2002) of the questions. Here, we use the six-item NEP scale, developed by Dunlap and Van Liere in 1984. Numerous scholars find it to be sufficiently representative (Bostrom et al., 2006; Pierce et al., 2000; Pierce et al., 1992; Stern et al., 1995; Widegren, 1998). Regardless of the number of questions used to form the NEP scale, most researchers maintain that it is a reliable scale and a valid tool for measuring concern for environmental problems.

The relationship between environmental concern and renewable energy development has proven to be somewhat complex (Devine-Wright, 2007). On one hand, support for renewable energy policies is led by a desire for reducing the human

impact on the environment by endorsing energy conservation and renewable energy technologies. On the other, people concerned about the human impact on the environment, worry about the consequences renewable energy technologies might have on the local flora and fauna. In a qualitative survey conducted in November 2008, comprised of 47 semi-structured interviews with Oregon coastal residents, Hunter (2009) found that participants made reference to the effects wave energy could have on both local marine ecosystems and global climate patterns. In investigating the underlying factors for public opinion about offshore wind power on Cape Cod, Massachusetts, Firestone and Kempton (2007) identified the top three most important factors influencing supporters of the project: environmental effects, electricity rates, and foreign oil dependence. The top three factors influencing opponents were: environmental effects, aesthetics, and fishing/boating interests. When presented with further information about the impact of the offshore wind energy project, it became clear that supporters expected negative aesthetic impacts, but that other positive factors, such as job creation, lowered electricity rates, and energy independence were more important to their decision (Firestone and Kempton, 2007). Overall, the positive impact that a switch from coal to renewable energy could have on air quality and improved health, had little effect on increasing public acceptability of offshore wind energy development (Firestone and Kempton, 2007). This preference is contrary to preferences of the majority respondents in the UK, who would rather see an increased deployment of renewable energies than the building of more coal or nuclear power plants (Poortinga et al., 2006).

If attitudes toward renewable energy development reflect the biocentric orientation as defined by the 6-item NEP scale (i.e., people believe that "the balance of nature is delicate and easily upset by human activities," "plants and animals have as much right as humans to exist," and that "we are approaching the limit of people the earth can support;") (Dunlap and Van Liere, 1984), and they think not only in terms of having a predictable supply of affordable energy, but also in terms of where that energy would come from and what would getting it, storing it, and burning it do to the environment, then we would expect them to be supportive of renewable energy development. If, on the other hand, people have anthropocentric orientations (i.e., they believe that "the so-called 'ecological crisis' has been greatly exaggerated," that "humans have the right to modify the natural environment to suit their needs," and that "humans were meant to rule over the rest of nature") (Dunlap and Van Liere, 1984), then we would also expect them to support renewable energy development but for entirely different reasons – such as the need to satisfy our growing demands, and belief in technological "fixes."

Methods

Sampling and Data Collection

The research reported here presents a case study for investigating the relationship between environmental values and concerns on one hand, and attitudes toward renewable energy development on the other. It establishes baseline information about Oregonians' environmental values and concerns that influence their attitudes toward

the development of wave energy in the state. The population for this study was defined as adult (at least 18 years of age) residents of the state of Oregon. The sampling frame consisted of private households with a permanent mailing address. Residents were sampled from two randomly selected household samples: a statewide sample of 1,200 households and a coastal subsample of 400 households (i.e., those with an address on the coast or within approximately 20 miles of the coastline). The addresses for both samples were obtained from Survey Sampling, Inc. The coastal subsample was used to ensure adequate representation of coastal community residents within the general population sample and to help establish any differences in level of awareness and support between coastal residents and people living elsewhere in the state.

Data were collected using mail-back surveys, administered during September-October, 2008. The mail survey procedure was designed and implemented following Dillman's (2000) mail survey method, which requires three waves of mailings, including an introductory postcard announcing the survey and two subsequent waves of the survey with a cover letter, sent within two weeks of each other. There were no restrictions on the participant population in terms of gender, race, and ethnicity; the only restriction was on age – participants 18 years of age and older were only included. The following statement was made part of the survey cover letters: "Only respondents 18 years of age or older are eligible to participate in this survey."

The survey was pretested to a group of 35 randomly selected Oregon State University students and to 20 random households of an apartment complex in Corvallis, Oregon in order to ensure that respondents were able to understand the

questions and that their responses would produce the desired data suitable for SPSS manipulation.

A potential problem associated with mail-back surveys is that the presence of non-responses can lead to sample selection bias. It is reasonable to expect that those with a strong positive or negative opinion about renewable energy development in general, and wave energy in particular, are more likely to answer and return the surveys. Given the heightened interest in wave energy development along the Oregon coast during the time of the survey and the extensive media coverage of some of the wave energy projects, it is not surprising that the response rate was 58 percent (n=232) for the coastal and 56 percent (n=674) for the statewide samples.

Measurement of Variables

To examine the relationship between environmental values and concerns, on one hand, and attitudes toward wave energy development, on the other, general attitude toward wave energy development was set as the dependent variable. Two independent variables were examined – postmaterialism values and environmental concerns.

To measure attitudes toward wave energy development, respondents were asked directly about them with the question: "Wave energy refers to the extraction of electricity from the up-and-down motion of ocean waves using buoys or devices in the form of "wave energy farms." What is your general attitude toward the development of wave energy off of the Oregon coast?" Respondents were given six choices: "very positive," "positive," "neutral," "negative," "very negative," and "do not have enough

information to form an opinion." The last option was included because of the newness of wave energy as a renewable alternative and because it allowed for comparing the level of awareness of coastal residents and of people living elsewhere in the state.

Individual values were measured following Inglehart's postmaterialism/ materialism index scale, which includes four statements (Inglehart, 1995). Respondents were asked to define "what our country's goals should be for the next ten to fifteen years" by rank ordering two of the following four statements: "maintaining order in the nation," "giving people more say in important governmental decisions," "fighting rising prices," and "protecting freedom of speech" (Inglehart, 1990, 2008; Welzel and Inglehart, 2001). The rankings were combined to construct the index with scores ranging from zero to two. Respondents who selected the second and the fourth statements were given a score of two and were defined as postmaterialist, those who selected the first and the third were given a score of zero and were classified as materialist. Respondents who selected one materialist and one postmaterialist goal were given a score of one and were labeled as mixed.

Measuring one's level of environmental concern was done with a battery of survey questions to assess a person's level of agreement or disagreement (on a scale from 1 "Strongly disagree" to 5 "Strongly agree") with six statements, proposed by Dunlap and Van Liere (1984). Three of the six questions were worded in a way, in which agreement indicated acceptance of the NEP - "the balance of nature is very delicate and easily upset," "we are approaching the limit of the number of people the earth can support," and "plants and animals have as much right as humans to exist."

Agreement with the other three statements showed acceptance of the DSP - "humans have the right to modify the natural environment to suit their needs," "the so-called 'ecological crisis' has been greatly exaggerated," and "humans were meant to rule over the rest of nature." Statements were grouped into their basic belief domains (biocentric-anthropocentric) with reverse coding applied to the items representing anthropocentric orientation. Statements were then tested for internal consistency using Cronbach's alpha. Frequency analysis and analysis of the means were performed. Subsequent cluster analysis showed the existence of a third generally acceptable value orientations cluster, labeled "mixed."

Results

Statewide versus Coastal Attitudes toward Renewable Energy Development

The results indicate that the predominant attitude toward wave energy development in the whole state is *positive* (Table 2.1).

TABLE 2.1. General attitude toward wave energy development: Oregon statewide and coastal samples.

	Statewide		Coast	
	Percent	Number	Percent	Number
Very positive	25	165	29	66
Positive	27	179	30	70
Neutral	11	71	12	28
Negative	2	12	3	7
Very negative	1	4	3	7
Do not have enough information to form an opinion.	35	234	23	53
Total		665		231

Note: The differences in attitudes between the statewide and the coastal samples are statistically significant (χ^2= 18.62, p<.01), but the effect size (Cramer's V=.15) suggests weak to medium (Cohen 1988) or minimal to typical (Vaske et al., 2002) differences in attitudes between the two samples.

The expectation that more coastal residents will have a negative attitude toward wave energy development than people living elsewhere in Oregon is only partially accurate. Although 59 percent of the coastal respondents have "very positive" or "positive" attitudes toward the development of wave energy off the Oregon coast, compared to 52 percent of the statewide respondents, the percent of respondents with "negative" or "very negative" attitudes is higher for the coastal sample - six percent compared to only three percent for the statewide sample. This could indicate that coastal respondents have better defined opinions or are more informed compared to a statewide respondent. Indeed, as hypothesized, coastal residents are more informed about wave energy than people living elsewhere in the state. On average, about one-third (35%) of Oregonians, excluding the coastal residents, report that they "do not have enough information to form an opinion." The percentage of coastal respondents not having enough information to form an opinion about wave energy development is about 50 percent lower than the statewide residents – less than one-quarter (23%) of coastal respondents report not having enough information to form an opinion.

The percent of statewide and coastal respondents, who have a *neutral* attitude toward wave energy development is similar – 11 percent for the former and 12 percent for the latter. In further analysis, where attitude toward wave energy is set as the dependent variable, the response categories "neutral" and "do not have enough information to form an opinion" have been combined into one. Specifically, research has shown that providing respondents with more response categories, especially nonsubstantive (e.g., no opinion, neutral, unsure, don't know), does not force

respondents who do not have an attitude toward an issue, or do not have enough knowledge about a topic, to express an opinion (Dillman, 2000; Vaske, 2008). Although it was recognized that the items "neutral" and "do not have enough information to form an opinion" could mean something completely different (e.g., Dillman, 2000; Needham and Vaske, 2008), it should be noted that the survey did not probe respondents to explain the reasoning for their "neutral" attitude, which provided justification for combining the two items.

Postmaterialism and Support for Wave Energy Development

The distribution of respondents in the statewide and coastal sample according to their postmaterialism index score is presented in Table 2.2. The results of the frequency analyses show similar distributions regarding Inglehart's postmaterialism index in the statewide and the coastal samples, the majority of respondents have mixed values (50% for the statewide and 62% for the coastal samples), followed by postmaterialist (28% for the statewide and 23% for the coastal samples), and materialist (22% and 15% analogously) values.

TABLE 2.2. Percent and number of respondents in the statewide and coastal samples according to their postmaterialist/materialist values.

	Statewide Sample		Coastal Sample	
	Percent	Number	Percent	Number
Materialist	22	134	15	32
Mixed	50	313	62	131
Postmaterialist	28	176	24	50
Total		623		213

To examine the role of environmental values in defining support for or opposition to wave energy development in Oregon a series of crosstabs, followed by reliability analysis, were performed. It was hypothesized that people with postmaterialist values will have a positive attitude toward wave energy development and that people with materialist values will have a negative attitude toward wave energy development. The results show that the majority of the statewide respondents with postmaterialist (54%) and mixed (57%) values have positive attitudes toward wave energy development (Table 2.3). Similar results were obtained for the coastal sample, 72 percent of respondents with postmaterialist and 62 percent of respondents with mixed values have positive attitude.

TABLE 2.3. Wave energy attitude and postmaterialist/materialist value index for the statewide and coastal samples.

Postmaterialism index:	Wave energy attitude (%)			χ^2	p-value	Effect size (V)
	Materialist	Mixed	Postmaterialist			
Statewide sample				10.03	<.001	.09
Negative attitude	2	3	1			
Positive attitude	42	57	54			
Not enough info to form an opinion	56	41	45			
Total n=619	n=132	n=311	n=176			
Coastal sample				26.7	<.001	.24
Negative attitude	13	5	0			
Positive attitude	22	62	72			
Not enough info to form an opinion	66	32	28			
Total n=212	n=32	n=130	n=50			

These results, however, also show that there is not enough evidence to support our expectation that people with materialist views will have outright negative attitudes

towards wave energy (or are neutral). The majority of the respondents with materialist values do not have enough information to form an opinion about wave energy development in the statewide (56%) and the coastal (66%) samples. Only two percent of the statewide and 13 percent of the coastal respondents with materialist values have negative attitudes toward wave energy development.

The results are statistically significant for both the statewide (χ^2=10.03, p<.001) and the coastal (χ^2=26.7, p<.001) samples. Effect sizes (Cramer's *V*) ranged from .09 to .24, suggesting weak to medium (Cohen, 1988) or minimal to typical (Vaske et al., 2002) differences among respondents with materialist, mixed, and postmaterialist values.

New Ecological Paradigm (NEP) and Support for Wave Energy Development

The distribution of respondents according to their environmental concerns – biocentric, anthropocentric, and mixed – was examined first (Table 2.4). While the majority of the statewide respondents exhibit biocentric (42%) and mixed (37%) value orientations, the majority of the coastal respondents have anthropocentric (59%), followed by mixed (29%) and biocentric (12%) value orientations.

TABLE 2.4. Percent and number of respondents in the statewide and coastal samples according to their anthropocentric/biocentric value orientations.

	Statewide Sample		Coastal Sample	
	Percent	Number	Percent	Number
Anthropocentric	21	137	59	134
Mixed	37	246	29	67
Biocentric	42	279	12	28
Total		662		229

Before examining the impact of value orientations on attitudes toward wave energy development, the six items forming the NEP scale were tested for internal consistency using Cronbach's alpha. Results indicated a strong overall consistency of the value orientations and the overall NEP scale (Table 2.5).

TABLE 2.5. Items and reliability results for the NEP scale.

	Cronbach's Alpha[1]
Biocentric	.69
The balance of nature is very delicate & easily upset by human activities.	
We are approaching the limit of people the earth can support.	
Plants and animals have as much right as humans to exist.	
Anthropocentric	.78
Humans have the right to modify the natural environment to suit their needs.	
The so-called 'ecological crisis' has been greatly exaggerated.	
Humans were meant to rule over the rest of nature.	

[1]The overall Cronbach's Alpha for the NEP scale is .77

The relationship between environmental concern and support for wave energy development was examined next. Because wave energy is a type of renewable energy, which entails biocentric value orientations, including an understanding that the balance of nature is easily upset by human activities, on one hand and on the other allows for modification of the natural environment to meet human needs, it was hypothesized that people with either biocentric or anthropocentric concerns would have a positive attitude toward wave energy development. The results show support for our hypothesis (Table 2.6).

The predominant attitude toward wave energy development is positive for people with biocentric and anthropocentric environmental orientations in the state

(Table 2.6, 51% and 69% correspondingly) and on the coast (54% and 67% correspondingly).

TABLE 2.6. Wave energy attitudes and biocentric/anthropocentric value orientations for the statewide and the coastal samples.

NEP scale	Wave energy attitude (%)			χ^2	p-value	Cramer's V
	Anthropo-centric	Mixed	Biocentric			
State				30.04	<.001	.15
Negative attitude	4	2	2			
Positive attitude	69	43	51			
Not enough info to form an opinion	27	55	47			
Total n=665	n=137	n=241	n=277			
Coast				19.32	<.001	.22
Negative attitude	2	8	21			
Positive attitude	67	45	54			
Not enough info to form an opinion	31	48	25			
Total n=228	n=49	n=86	n=93			

These results are statistically significant for both the statewide (χ^2=30.04, p<.001) and the coastal (χ^2=19.32, p<.001) samples. Effect sizes (Cramer's *V*) ranged from .15 to .22, suggesting weak to medium (Cohen, 1988) or minimal to typical (Vaske et al., 2002) differences among respondents with biocentric, mixed, and anthropocentric environmental concerns.

Frequency distributions of the level of agreement with each of the six NEP items were performed in order to examine areas in which the scale may need revision (Table 2.7). Overall, the responses show consistency with the purpose of the NEP scale: agreement with the three odd-numbered items and disagreement with the three even-numbered items indicate pro-NEP responses. To check if the six items can be

treated as measuring a single construct and could really be combined together, the consistency of the responses was examined.

TABLE 2.7. Frequency distributions and corrected item-total correlations for each of the six items in the NEP scale [1] for the statewide sample (N=674)

Do you agree or disagree that: [2]	Agree[3] (%)	Neutral (%)	Disagree (%)	r_{i-t}	Number of responses
1. The balance of nature is very delicate & easily upset by human activities.	67	16	17	.54	671
2. Humans have the right to modify the natural environment to suit their needs.	32	18	50	.35	672
3. We are approaching the limit of people the earth can support.	46	28	26	.45	668
4. The so-called 'ecological crisis' has been greatly exaggerated.	33	19	48	.40	670
5. Plants and animals have as much right as humans to exist.	66	14	19	.52	672
6. Humans were meant to rule over the rest of nature.	31	20	49	.62	670

1. Question wording: "Listed below are statements about the relationship between humans and the environment. For each one, please indicate your level of agreement."
2. Agreement with the three odd-numbered items and disagreement with the three even-numbered items indicate pro-NEP responses.
3. The response scale was a five-point one: "Strongly disagree," "Mildly disagree," "Neutral," "Mildly agree" or "Strongly agree". " In this table, the two positive answers are combined in the column "Agree" and the two negative in the column "Disagree".

All of the corrected item-total correlations are reasonably strong, ranging from a low of .35 to a high of .62. This indicates that when considering the consistency of the scale, confirmed by the high Cronbach's Alpha of .77 (Table 2.5), and the item-total correlations (Table 2.7), the scale can be used as unidimensional.

Despite the unidimensionality of the scale, the reason for the inconsistency of the results in explaining support for renewable energy development is still not clear. To verify that the questions used in the 6-item scale are suited not only for explaining level of environmental concern, but also for indicating support for renewable energy

development, the relationship between each of the six items and wave energy attitude was explored (Table 2.8).

TABLE 2.8. Examining the relationship between wave energy attitude and each of the six questions forming the NEP scale.

Do you agree or disagree that: [1]	Wave energy attitude (%)			χ^2	p-value	Cramer's V	Number of responses
	Negative	Positive	Not enough info				
1. The balance of nature is very delicate & easily upset by human activities.	2	55	43	55.96	<.001	.18	663
2. Humans have the right to modify the natural environment to suit their needs.	8	63	30	56.38	<.001	.18	664
3. We are approaching the limit of people the earth can support.	2	59	39	47.19	<.001	.17	660
4. The so-called 'ecological crisis' has been greatly exaggerated.	7	55	38	28.48	<.001	.13	663
5. Plants and animals have as much right as humans to exist.	6	60	34	33.23	<.001	.14	663
6. Humans were meant to rule over the rest of nature.	50	35	24	18.78	<.001	.10	663

[1] Percent "mildly agree" and "strongly agree" for the six questions forming the NEP scale with reverse coding applied to the pro-DSP items (two, four, and six).

Agreement with the three odd numbered and disagreement with the two of the three even-numbered items indicate positive attitude toward wave energy development. Item six, however, makes an exception. It indicates that people who disagree with the statement, "Humans were meant to rule over the rest of nature" rather than having a positive attitude toward wave energy development, have a negative attitude. These results are statistically significant for all items ($18.78 \leq \chi^2 \leq 56.38$, $p<.001$). Effect sizes (Cramer's *V*) ranged from .10 to .18,

suggesting weak to medium (Cohen, 1988) or minimal to typical (Vaske et al., 2002) differences among the six items (Table 2.8).

Discussion

The objective of this study was to examine the relationship between environmental values and concerns on one hand, and attitudes toward wave energy development, on the other. In addition, because attitudes toward renewable energy projects have been shown to differ between the general and the local populations, differences between attitudes of the two were examined.

The results show, similar to previous research (Sorensen et al., 2003; Warren et al., 2005), that attitudes toward wave energy development in Oregon are predominantly positive with some differences in attitudes between statewide and coastal respondents. Consistent with findings from Walker (1995), coastal residents seem to have more information to form an opinion and to have better defined opinions than the statewide respondents – not only does a larger percentage of coastal respondents have more negative attitudes, but more positive attitudes as well. It is rather surprising that 59 percent of the coastal residents have positive attitude, compared to 52 percent of residents from elsewhere in Oregon when considering the image of strong fishermen opposition toward wave energy development as projected in the coastal press. For example, some of the titles of the regional newspaper "The World: Serving Oregon's South Coast," covering the wave energy debate since 2007, have included *Wave energy worries fishermen* (April 10, 2007), *Wave energy and*

fishing conflict rises to new level (June 10, 2007), *Wave energy vs. fishermen* (June 14, 2007), *Questions mark wave energy meeting* (June 15, 2007), *Trust is main hurdle in wave energy talks* (March 21, 2008), *Fishermen seek more input on wave energy* (September 29, 2008), and *Wave energy regulatory war brews* (October 18, 2008). However, the higher percentage of coastal respondents having positive attitudes toward wave energy development seems to be balanced by the percentage of coastal respondents with negative attitudes – while only three percent of the residents from the statewide sample hold "negative" or "very negative" attitudes, six percent of the coastal residents have "negative" or "very negative" attitudes. A possible explanation is that people whose livelihoods depend on the ocean may feel threatened by the conflicting interests over the same ocean space and new ocean uses because they want to preserve their traditional occupations. These considerations have an impact on respondents' values and concerns and are captured in the attitudinal differences between the coastal and the statewide population, suggesting yet another explanation (besides NIMBY) for the expressed local negativity and the uneven spread of environmentalism.

The findings reveal that while the majority of respondents from the statewide sample have biocentric value orientations (42%), the majority of the coastal respondents have anthropocentric value orientations (59%). This difference in the value orientations of the two samples could be explained by the rural nature of the coastal sample. Rural communities are said to typically attribute a utilitarian function to the environment and to see their relationship with it as a means for satisfying basic

needs (Schultz and Zelezny, 1999; Shen and Saijo, 2008). Most of the coastal communities along the Oregon coast are small and rural, relying on some type of an extractive industry to sustain their livelihoods. Since the 1990s, however, these communities have seen a decline in socioeconomic opportunities because of diminishing natural resources - dwindling fish stocks or curtailed logging (Davis and Radtke, 2006). So they may not understand how the new renewable technology works, but what they do understand is that it involves a human intervention and an extraction process; and that in order to "harness" the power of the wind or the waves, humans need to be able to "rule over nature."

Moreover, establishing an immediate relationship between biocentric values as described by the 6-item NEP scale and support for renewable energy development is not as straightforward as it may seem. When selecting among the six NEP items, people with biocentric value orientations are put between a rock and a hard place. On the one hand, they may perceive of renewable energies as necessary for the long-term survivability of the human species and the planet and disagree that "the so-called 'ecological crisis' has been greatly exaggerated." However, on the other, because of the newness of the renewable technologies and the limited information about their environmental impact, the biocentric respondents may think of them still as a form of energy extraction, which puts the species in proximity at risk. Supporting renewable energy development, therefore, is inconsistent with the dimensions provided by the 6-item NEP scale. New dimensions that capture attitudes relevant to renewable energy as a multidisciplinary concept need to be sought. Perhaps such dimensions could be

found in the original NEP scale (Dunlap and Van Liere, 1978; Dunlap and Van Liere, 1984). In establishing the relationship between commitment to the Dominant Social Paradigm and concern for the environment, Dunlap and Van Liere (1984) originally used eight dimensions, which included support for the status quo and faith in science and technology. A few of the items that were part of these two dimensions included, "most problems can be solved by applying more and better technology," "scientists can solve any problem we might face if they are given enough time and money," and "we should know if something new will work before taking a chance on it." Since support for renewable energy development is formulated on the bases of perceptions not only toward the environment but also toward technology, including items that measure such value orientations may be more indicative of the dimensions leading to the formulation of renewable energy attitude.

Our findings also suggest that the postmaterialism thesis does not seem to be a good tool for explaining attitudes toward renewable energy. Although statewide support comes more strongly from respondents with mixed values, coastal respondents with postmaterialist values are most supportive of wave energy development. Also, the majority of respondents with materialist values, rather than having a negative attitude toward wave energy development, report they do not have enough information to form an opinion or are neutral toward wave energy. Very few of the respondents with materialist values (only 2% in the statewide and 13% in the coastal sample) have negative attitudes toward wave energy development. A possible explanation could be found in the examination of the contextual factors by linking respondents' values with

the economic situation at the time the survey was taken. This explanation, suggested by Inglehart (1995), maintains that in a time of economic recession, as in the mid 1970s and the early 1980s, the number of people exhibiting materialist values in each age cohort tends to increase, but then to quickly decline again after the recession. Therefore, "[i]n the long run, the values of a given birth cohort seem remarkably stable" (Inglehart, 1995). Since this survey was conducted in a time of recession (September-October, 2008), it would be warranted to repeat the survey using the same sample frame and data collection techniques after the recession subsides in order to verify that the values captured in it were not part of a short-term trend but of a stable process toward postmaterialist values.

Summary and Implications

It has been acknowledged that "public policy fights over energy policy will continue for many decades to come" (Smith, 2002: 5). Many scholars have discussed factors that determine the speed of public acceptability of renewable energy policies and technologies (Wüstenhagen et al., 2007; Zoellner et al., 2008). Understanding citizen concerns and motivations, providing avenues for public involvement in discussions about particular renewable energy projects, and educating the public about the environmental and social impact of new renewable energy technologies have been attested to lead to faster adoption of the technologies (Douvere et al., 2007; Firestone and Kempton, 2007; Krueger, 2007; Pavlides, 2008).

To be able to speed up acceptability of renewable energies, policy-makers must understand how the public feels about particular energy development options. The theoretical approaches examined here - environmental values and concerns – show two main things. First, the existing theoretical approaches need to be reexamined if they are to explain not only attitudes toward environmental issues but also attitudes toward renewable energy. Multidisciplinary approaches may be better suited to explain support for renewable energy development.

Second, people are still unsure of the benefits and costs associated with renewable energies. Oftentimes they hop on the renewable energy bandwagon without understanding why. For example, although the postmaterialism approach defines support for "fighting rising prices" as one of the characteristics of people with materialist values, and although the cost associated with wave energy development has been mentioned as one of the barriers anticipated by coastal residents in previous research (Hunter, 2009), the findings of this research reveal that many people really do not yet have enough information about wave energy in order to express support for or opposition to its development. Therefore, since support is conditional on perceptions about the socio-economic benefits and costs associated with renewable energy development, policy formulation needs to take those considerations into account and offer incentives to both renewable energy developers and energy consumers to lessen the financial burden associated with renewables or provide more information about the costs and benefits they may have.

The fact that more respondents with anthropocentric value orientations support wave energy development than respondents with biocentric ones, also confirms that its development is viewed more as a technological and economic opportunity producing jobs and increasing economic prosperity, rather than as a tool that could be used to fight pollution and global warming. People with biocentric orientations have a hard time deciding if they should support or oppose wave energy development. The policy implications of this finding are twofold. First, to get people to adopt wave energy faster, the urgency of the climate situation and the depletion of traditional energy sources should be made clear. Second, to increase the acceptability of wave energy, policy makers should stress the socioeconomic benefits it could provide, rather than just the environmental ones. In addition, policy makers could support developers in the collection of baseline data about the biophysical impacts of wave energy development so that they could inform residents, especially those with biocentric environmental concerns, about the actual rather than perceived impact these new technologies have on the environment. Moreover, when presenting the benefits of these new technologies to the general population, it should carefully be explained that although all energy technologies represent some form of natural resource extraction, renewable energy technologies are less harmful to the environment in the long run than traditional sources as a whole.

To better understand the motivating factors that will help people adopt renewable energy faster, it is necessary to examine their sociodemographic characteristics in relationship to attitudes and behaviors conceptually linked to

renewable energy. Follow-up research probing into respondents' sociodemographic characteristics, together with specific values and concerns, is needed to get a better understanding of the role these variables play in defining support for or opposition to the broad array of proposed renewable energy options.

Renewable energies are only now becoming a prevalent policy alternative. "One of our best hopes for a viable sustainable energy policy is in the clear evidence that environmental concerns have not declined" (Orr, 2002: 182). Understanding which dimensions of environmental values and concerns may lead to support for renewable energy alternatives should stand as a major policy and research priority.

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ATTITUDES TOWARD WAVE ENERGY DEVELOPMENT IN OREGON: DO KNOWLEDGE AND FAMILIARITY LEAD TO SUPPORT?

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Abstract

Renewable energy resources, such as wind, solar, and wave, have a number of advantages compared to traditional fossil fuels. Numerous studies attest to the physical potential for wave energy development in Oregon. In transitioning from conventional fossil fuel to alternative energy provision, citizen understanding of the global energy problems and their causes and solutions is believed to be the key for the development of renewable energy. Using a statewide mail survey of 1,200 Oregonians, this paper investigates some situation-specific and trans-situational determinants of respondents' level of familiarity with wave energy technology, energy knowledge holding, and support for wave energy development. In addition, this paper examines the sources of information citizens use to familiarize themselves with energy issues. The findings reveal that gender plays a significant role in explaining level of familiarity with wave technology, knowledge of energy issues, and support for wave development. Age is significant in explaining only support for wave energy development. Education has significant power in explaining respondents' energy knowledge but not their familiarity with the technology or their support. Concern for protecting the environment, together with climate change beliefs and level of familiarity with wave energy technology, turn out to be the strongest correlates of expressed support for wave energy development. Of all information sources, only radio has some significance for explaining level of familiarity but not energy knowledge holding. Policy implications of the findings are discussed.

Introduction

Numerous studies attest to the physical potential for ocean energy development in the Pacific Northwest. The state of Oregon in the U.S. has been identified as one of the most suitable places for wave energy development on the west banks of the North Pacific Ocean. Oregon has enacted a Renewable Portfolio Standard, setting goals of 25 percent of the state's energy to be supplied by renewable resources by 2025.

Despite political and financial endorsement from state and local governments, wave energy development has not yet reached commercialization in Oregon. Some of the reasons for that may be the low level of policy-relevant public knowledge and familiarity with renewable energy technologies and projects, in addition to the low public awareness and knowledge of the issues related to ocean and coastal ecology (Hansen et al., 2003; Steel et al., 2005). Findings from ongoing research into public perceptions of renewable energy projects suggest that there are certain misconceptions about the utility, size, and impact of offshore projects arising from low public familiarity with the technologies and the poor understanding and interpretation of scientific findings (Fatuzzo, 2009; Hunter, 2009). Sarmento et al,. (2004) comment that public acceptability can have various origins, usually to be found in a mixture of societal aspects and competing uses of the area proposed for development. Often public acceptability of renewable energy projects can be increased when familiarity with the technology rises and personal experiences and observations of the technology in operation become possible (Pavlides, 2008). Moreover, early public involvement

has been identified as key for the successful implementation of renewable projects (Dalton, 2009).

Public acceptability of renewable energy projects has been shown to depend, among other things, on the social basis of environmental concern, defined as age, sex, education, economic and social status, and political ideology (Devine-Wright, 2007; Dunlap and Van Liere, 1980; Pierce et al., 2000; Steel et al., 2005a). Studies on environmental/ecological concern, awareness, and belief systems maintain that younger adults, women, the better educated, political liberals, and individuals with higher incomes express more concern about the environment than do their respective counterparts (Dunlap and Van Liere, 1978). A summary of research on renewable energy support shows that attitudes vary with respect to three main factors – *personal* (e.g., age, gender, and income), *psychological* (e.g., degree of awareness and understanding of renewable energy technologies, political orientation, and environmental values and beliefs), and *contextual* (Devine-Wright, 2007). For example, national UK survey results show that both levels of awareness and opposition are lower in younger than in older cohorts, women tend to be less aware but more supportive of renewable developments locally than men, and that individuals with higher earnings are more supportive of renewables than are those with lower earnings (Devine-Wright, 2007).

Since wave energy has been defined as a potentially significant source of renewable energy supply in Oregon, it is important to assess the level of public familiarity with and the correlates of public support for wave energy development. It

is also necessary to understand where people tend to acquire their information about wave technologies and to evaluate the scope and depth of energy knowledge among the public. In addition, the strength of the relationship between energy knowledge and support for wave energy development needs to be assessed. Specifying the link between knowledge holding and support for wave energy development more clearly would allow both policy makers and wave energy developers to undertake proper education and information dissemination strategies.

The objectives of this study are to provide some insight and understanding about the determinants of public acceptability with regard to wave energy and the role these determinants play in defining public support for wave energy development. The study first tests the existing theories about the determinants of environmental concern, and then it explores the relative importance of these determinants in relation to one's level of familiarity with wave technologies and support for wave energy development in Oregon. The empirical data gathered in this research derive from public opinion surveys conducted in the state during fall of 2008.

Background

Renewable energy resources, such as wind, solar, and wave, have a number of advantages compared to traditional fossil fuels: they are clean, their supply is not depleted over time, and they are, at least from a fuel standpoint, free. In transitioning from conventional fossil fuel to alternative energy provision, the successful implementation of renewable energy projects is often seen as a convergent point of three separate paths, of industry, government, and [civil] society (Mallon, 2006).

Citizen understanding of the global energy problems and their causes and solutions are believed to be the key for the development of renewable energy. Longitudinal investigations have shown that while the U.S. public generally opposes new energy development, it does not want to go without cheap, abundant energy, nor is it ready to conserve the available nonrenewable energy sources (Smith, 2002). This is probably one of the reasons behind the strong support for renewable energy development; nationwide opinion polls show 82 percent favor government requirements for electric utilities to produce at least 20 percent of their electricity from renewables (Leiserowitz, 2007a).

Despite the overwhelming general acceptance of renewable energy development and the strong public support for government policies that require utilities to produce more alternative energy and businesses to use energy more efficiently, specific renewable energy projects are often shelved because of strong local resistance. Some researchers have attributed local resistance to the NIMBY ("not in my back yard") syndrome, which describes a theoretical support for renewable energy development but opposition to specific local projects because of the perceived consequences concerning primarily noise and visual impact (Devine-Wright, 2005b; Krohn and Damborg, 1999). Many researchers consider NIMBY to be too simplistic to explain all the variables determining the general and local public acceptance of a specific project (Devine-Wright, 2005a; Firestone and Kempton, 2007; Firestone et al., 2009; Krohn and Damborg, 1999; Michaud et al., 2008; Smith, 2010; Wolsink, 2000). Moreover, some researchers have found evidence for exactly the opposite

effect: local people becoming more favorable toward wind farms after their construction and the degree of acceptance increasing with proximity to them (Pavlides, 2008; Warren et al., 2005). Research on attitudes toward oil drilling in California also shows that people living on or close to the coast were more likely to support offshore oil drilling in 1998 than people living elsewhere in the state (Smith et al., 2004). Other researchers find that attitudes change positively with level of familiarity with a specific project (Douvere et al., 2007; Firestone and Kempton, 2007; Krueger, 2007).

Besides familiarity with specific projects and understanding of the way the technology works, knowledge of energy and environmental issues in general also contributes to increased level of acceptance. Hansen et al., (2003) comment that it is highly possible for wave energy to become even more popular than wind energy because of the minimized visual aspect and noise. However, the authors remark that the biggest challenge for accepting wave energy is the "low public knowledge" (Hansen et al., 2003: 5). It is, therefore, important in selecting the most appropriate policy tools for energy policy formulation and implementation to have a clear idea of the level of public knowledge regarding renewables in general and wave energy in particular. Because studies that measure only claimed familiarity "run the clear danger of greatly over-estimating the degree to which a policy has been successfully communicated" (Archer et al., 1986: 77), two measures of familiarity are typically used in research – objective and subjective. While the subjective measure is based on asking respondents to directly identify their self-assessed level of familiarity with an

issue, the objective measure asks respondents to give specific answers to questions about an issue (Delli Carpini and Keeter, 1996). Nevertheless, both measures are used as complementary to each other in helping researchers better understand the determinants of public knowledge and support.

Public knowledge is also "essential if citizens are to discern their *real interests* (emphasis added) and take effective advantage of the civic opportunities afforded them" (Delli Carpini and Keeter, 1996: 3). Daigle (2003: 230) argues the need for greater public involvement in coastal policy issues, stating "the only hope for further progress on environmental protection and sustainable development lies with a public that is not only informed but also engaged." Both researchers and project developers acknowledge the need for and the importance of public involvement in renewable energy projects (Smith, 2010). Given the importance of public participation in renewable energy policy making and in siting individual renewable energy projects, it is imperative in explaining support for wave energy development in Oregon to understand citizen level of energy-relevant knowledge and familiarity with wave technology.

Levels and determinants of policy-relevant energy knowledge

As noted, measuring the level and depth of public knowledge of wave energy as a technology and of energy as a policy option could improve our understanding of public attitudes toward wave energy. Many writers have commented that, despite the shortage of energy during the first energy crisis in the winter of 1973-74, the U.S. public viewed it as a political problem rather than as an actual indication of the finite

nature of natural resources (Murray et al., 1974; Warren, 1974). Skepticism concerning the reality of the energy crisis and the lack of policy relevant energy knowledge have led to the prevalence of citizen preferences for "technical" solutions for expanding the search for new energy sources that would permit energy use at increasing levels rather than to "behavioral" solutions, requiring citizens and industry to use less energy and to use it more efficiently (Anderson and Lipsey, 1978). Since the first energy crisis, the critical need for policy-relevant energy and environmental knowledge among the public has been related to questions about the meaning of public opinion in a democracy. An informed public opinion is the basis of democratic theory; it is regarded as "one of the few potentially effective checks on leadership available in a democracy" (Glynn et al., 1999: 7). Public opinion plays an important role in the political world because "what people believe and what they do about those beliefs affects the creation of public policy" (Brooker and Shaefer, 2006: xvi). When the cognitive capacity of the public to rule itself and to make informed choices about its future is constrained, it is possible, even likely, that too much influence gets concentrated in the hands of the elites, a situation described as "the domestication of mass belief" (Ginsberg, 1986: 32).

Several explanations exist that deal with knowledge acquisition and knowledge holding, on one hand, and individual's attitudes, expressed as either opposition to or support for particular policy options, on the other. Research on knowledge acquisition centers on elucidating understanding about the way people form opinions. There is evidence that the immediate environment - family, friends, and coworkers - plays an

important role (Jennings and Niemi, 1974, 1981). In formulating opinions on new issues, however, political elites and the mass media contribute to opinion formulation as well (Converse, 1964; Zaller, 1992). It has been shown that exposure to political news increases with political awareness and knowledge; i.e., when people are exposed to political messages, acceptance and awareness increase for those whose values are in agreement with the messages and decrease when values are in disagreement (Zaller, 1992). Moreover, knowledge of political issues helps individuals focus only on certain considerations about an issue and disregard others (Smith and Klick, 2007).

Explanations of opinion formulation and holding like the ones described above rely on *situation-specific* factors. They suggest that when controlling for socioeconomic status (SES) characteristics, situational factors will influence policy-relevant knowledge. In that vein, individuals who see a particular stake in policy outcomes (Steel et al., 1990), those who are strongly committed to their policy views (Pierce et al., 1992; Pierce and Lovrich, 1986), and those who discuss policy issues frequently (Delli Carpini and Keeter, 1996) are shown to exhibit higher level of knowledge-seeking and knowledge-holding than those who do not. Thus, one might expect higher levels of energy-relevant knowledge and familiarity with wave energy among citizens who are more concerned about national dependence on foreign oil and gas for a secure energy supply as well as among those who believe climate change is happening.

Another explanation about knowledge-holding is based on an individual's SES attributes – age, gender, education, income, and occupation - known as *trans-*

situational factors (Lovrich and Pierce, 1984). When correlated with environmental knowledge holding, these trans-situational factors have been shown to serve as predictors of environmental concern and policy support (Delli Carpini and Keeter, 1996; Pierce et al., 2000; Pierce et al., 1992; Pierce et al., 1990). Trans-situational factors are also said to be responsible for the so-called "knowledge gap," which accounts for vast differences in the distribution of public knowledge between men and women and among age cohorts in a number of public policy areas (Banwart, 2007; Leal Filho et al., 2009; Lovrich and Pierce, 1984). For example, research demonstrates that with regard to environmental issues, the young exhibit lower levels of knowledge compared to older cohorts (Steel et al., 1990), men hold higher levels of policy-relevant knowledge, including knowledge of the political process and of public policy making than women (Delli Carpini and Keeter, 1996), while young women tend to be more informed about environmental issues and more engaged in environmentally responsible behavior than older women (Steel, 1996).

Both trans-situational (i.e., age, gender, education, income, and occupation) and situation-specific factors, which reflect the personal relevance of a particular policy context, are used in explaining differences in policy-relevant knowledge holding among citizens. Sometimes the latter factors have been proven more important. For example, despite research that shows men consistently exhibiting higher levels of policy-relevant knowledge holding than women, Nash and Hoffman (2009) show that gender acts as a moderator in explaining level of political knowledge holding. The authors explain that men have higher levels of political knowledge not

because they are men, but because they enjoy keeping up with the news more than do women. However, since women are beginning to use new media as much as men, the knowledge gap is expected to be slowly closing.

If policy-relevant knowledge were rooted just in trans-situational factors, the prospects of increasing knowledge levels may be limited because of the static nature of these factors (i.e., it is difficult to change one's educational attainment, occupation, or socioeconomic status quickly; Steel et al., 2005a). Moreover, if trans-situational factors accounted for one's level of knowledge-holding, knowledge-deficient citizens may be less able to protect and promote their interests than the better informed ones (Delli Carpini and Keeter, 1996). Thus, when assessing respondents' level of familiarity with wave energy technology and energy-relevant knowledge, it is necessary to explore both the situational and the trans-situational factors.

Information Sources

In addition to establishing the level, depth, and character of the factors related to knowledge holding among citizens, it is important also to determine which sources of information are associated with higher levels of energy-relevant knowledge and familiarity. Research demonstrates that citizens use many different sources of information to familiarize themselves with various policies and that the scope of sources used depends on a number of factors. Those factors vary with the content of the policy area, the information medium, and the personal (e.g., education), cognitive (e.g., information base), and affective (e.g., ideological orientation) attributes of the individual (Pierce et al., 1992). In addition, one's motivation or self-interest, also

defines the preferences given to the sources of policy-relevant knowledge used (Nash and Hoffman, 2009; Pierce et al., 1988). For example, Steel et al., (2005a) found that some sources of information are more directly connected to knowledge holding than others, with newspaper readership most popular among the senior population and internet use among the junior. These findings are similar to those published in a 2008 report by the Department for Business, Enterprise and Regulatory Reform (BERR) in Great Britain. Summarizing the results of the third wave of a general public opinion survey on renewable energy, the report mentions that 32 percent of respondents under the age of 45 were likely to say that the internet had an influence on their renewable energy views, compared to only 16 percent of those 45 and over (BERR, 2008).

Among the mass media sources typically preferred by older cohorts for gaining policy-relevant knowledge is radio. For example, about half of respondents aged 55-64 in the UK, are more likely than any other age group to cite national radio as a renewable energy source of information. Irrespective of age, national radio listening was found to be positively correlated with knowledge holding of acid rain in Canada, but negatively in the U.S (Steger et al., 1988). Other research suggests only a slightly positive correlation between general policy knowledge holding and radio listening (Delli Carpini and Keeter, 1996). Contrary to the findings regarding radio listening, the relationship between frequency of newspaper reading and policy-relevant knowledge of the environment and other issues has been found to be both strong and positive (Jamieson, 2000; Pierce et al., 1992; Steger et al., 1988).

The relationship between television watching and policy-relevant knowledge of the environment can be described as controversial. Despite the fact that television watching has been identified as the most common source of environmental information gathering, questioning the reliability of information provided by this medium is widespread (Pierce et al., 1992; Steel, 1997; Steel et al., 1992). When examining the relationship between television use and environmental knowledge, some researchers have found it to be negative (Pierce et al., 1992; Steger et al., 1988), but others have found no relationship at all (Jamieson, 2000). As far as the ability of television as a medium to deliver renewable energy information and shape opinion on renewable energy, it has been found that of all British media sources, national television had the most influence (BERR, 2008). Nevertheless, its influence, together with the impact of other major opinion sources like local television and the government, has been diminishing (BERR, 2008).

Methods

The research reported here presents a case study for investigating the relationship between the determinants of public acceptability with regard to wave energy and the role these determinants play in defining general familiarity with wave energy technology, knowledge of energy issues, and public support for wave energy development. It establishes baseline information about the trans-situational and situation-specific variables that influence attitudes toward the development of wave energy in Oregon. In addition, it looks at the sources of information people use to familiarize themselves about wave energy technology.

The population for this study was defined as adult (i.e., at least 18 years of age) residents of the state of Oregon. The sampling frame consisted of private households with a permanent mailing address in Oregon. Addresses were obtained from Survey Sampling, Inc. Residents were sampled from randomly selected household samples, which included a statewide sample of 1,200 households. Data were collected using mail-back surveys, administered during September-October, 2008. The mail survey procedure was designed and implemented following Dillman's (2000) mail survey method, which requires three waves of mailings, including an introductory postcard announcing the survey and two subsequent waves of the survey with a cover letter, sent within two weeks of each other. There were no restrictions on the participant population in terms of gender, race, and ethnicity; the only restriction was on age – only participants 18 years of age and older were included. The following statement was made part of the survey cover letters: "Only respondents 18 years of age or older are eligible to participate in this survey."

The survey was pretested with a group of 35 randomly selected Oregon State University students and with 20 random households of an apartment complex in Corvallis, Oregon, in order to ensure that respondents were able to understand the questions and that their responses would produce the desired data, suitable for SPSS manipulation.

A potential problem associated with mail-back surveys is that the presence of non-responses can lead to sample selection bias. It is reasonable to expect that those with a strong positive or negative opinion about renewable energy development in

general, and wave energy in particular, are more likely to answer and return the surveys. Given the heightened interest in wave energy development in Oregon during the time of the survey, the extensive media coverage of some of the wave energy projects, in addition to the spike of oil prices in the summer of 2008, it is not surprising that the response rate was 56 percent (n=674).

To examine the relationship between the determinants of public acceptability with regard to ocean energy and the role these determinants play in defining public support for ocean energy development, general familiarity with wave energy technology, knowledge of energy issues, and attitude toward wave energy were set as the dependent variables.

Public Knowledge of and Familiarity with Energy Issues

Two indicators of public knowledge holding were devised: one, defined as subjective (self-assessment), and the other as objective. The indicator of subjective knowledge holding is based on asking respondents to identify their level of familiarity with wave energy technology with the question: "How familiar are you with specific renewable energy technologies, including … wave energy?" Respondents were provided with a choice of four possible answers: "not familiar," "somewhat familiar," "familiar," and "very familiar." The majority of respondents indicated that they were either "not familiar" or "somewhat familiar" with wave energy technology. The frequency distributions associated with the subjective indicator of public knowledge are displayed in Table 3.1.

TABLE 3.1. Public familiarity with wave energy

	Familiarity with wave energy in Oregon
Not familiar	40.9 %
Somewhat familiar	37.8
Familiar	16.6
Very familiar	4.6

Note: The response rate for this question was 100% for Oregon (n=674)

The indicator of objective knowledge holding is formulated from the answers to an Energy Quiz comprised of three multiple choice questions about energy-related issues: what is the largest electricity generating source in the respondent's state, which economic sector uses the most electricity in Oregon, and what is meant by the term "off-grid." Electricity, rather than energy, has been selected as a point of reference for assessing energy knowledge for the following reasons:

- Energy is a very general term – it could mean energy in the form of fuel for transportation, energy for heating, and energy for electricity.
- Not everyone may be using fuel for driving an automobile, but everyone uses electricity – if not for heating, then for lighting their homes.
- Everyone in the state of Oregon, regardless whether they own or rent a home, receives an electric bill that needs to be paid monthly.
- Most of the renewable energy sources being developed – wind, solar, and wave - are used for producing electricity.
- Wave energy, when converted to usable energy, produces electricity.

Respondents were presented with the question: "Here are a few specific questions about energy. Many people don't know the answers to these questions, so if

there are some you don't know just leave them blank and continue." The option of not answering a Quiz question if respondents were not sure about its answer was provided in order to check respondents' "real" level of energy knowledge since "don't know" was not an available answer choice.

TABLE 3.2. Energy Quiz questions with their respective percent correct answers and response rates.

Energy Quiz questions with correct answers in bold.	Percent correct answers (Percent response rate)
The largest source of energy for electricity in Oregon comes from?	81.1 (91.1)
Coal	
Hydroelectric	
Natural Gas	
Nuclear	
Most electricity in Oregon is used by which sector?	35.8 (83.4)
Residential Sector (e.g., households)	
Commercial Sector (e.g., retail stores)	
Industrial Sector (e.g., factories and mills)	
Transportation Sector	
Being "off-grid" means?	62.2 (86.4)
Producing one's own electricity	
Getting electricity from another state	
Having no electricity	
Being energy efficient	

Not many respondents skipped a Quiz question even if they were not sure about the answer - less than ten percent omitted Quiz question one, close to 20 percent skipped Quiz question two, and about 15 percent did not volunteer an answer to Quiz question three (Table 3.2, Response rate in brackets). Of those who provided answers to the Quiz questions, 81 percent answered Quiz question one about the largest source of electricity in their state correctly, while only about one third provided correct

answers to the question about the sector with the highest electricity consumption. Close to two-thirds of respondents knew the correct definition of the term "off-grid."

Since less that 20 percent of respondents skipped answering any of the Quiz questions, the number of responses is high enough to depict a realistic profile of the "real" level of energy knowledge of respondents in Oregon. Variables associated with the levels of knowledge holding and familiarity will be used in the forthcoming regression analyses to explain the level of support for renewable energy development.

To examine the relationship between the trans-situational and situation-specific variables and energy knowledge holding, a dichotomous knowledge holding summary index was constructed (based on the number of correct responses provided to the three Quiz questions): index ranged from 0 = zero or one correct answers corresponding to low level of energy knowledge and 1 = two or three correct answers, or high level of energy knowledge (Table 3.3).

TABLE 3.3. Number and percent of correct answers to the Energy Quiz questions.

	Percent correct answers
Zero correct answers	10.3 %
One correct answer	33.3
Two correct answers	38.6
Three correct answers	17.7

Note: Total valid responses=648, Mean=1.64

Given the responses to the subjective and objective indicators of knowledge, what can be said about the level of energy-relevant knowledge and familiarity with wave technology of the majority of Oregonians? As previous studies regarding ocean issues have acknowledged, we can say that "the glass is either half empty or half full"

(Steel et al., 2005a: 42). If we look at the number of correct answers to the Energy Quiz questions (Table 3.3), we notice that more respondents gave two or three correct answers than did zero or one.

An overwhelming majority of respondents (81%, Table 3.2) answered correctly the question about the largest source of electricity in Oregon. Historically, most of the electricity consumed in the Pacific Northwest has been generated by hydropower. According to the Energy Information Administration, Oregon is one of "the Nation's leading generators of hydroelectric power," which accounts for more than two-thirds of Oregon's electricity generation (EIA - Energy Information Administration, 2009b). It is, therefore, not surprising that so many of the respondents answered the question about the largest source of electricity generation correctly. It is also not surprising that about 62 percent of respondents show familiarity with the term "off-grid." Despite the fact that it is a relatively new term, it has been used frequently in recent years in public discussions about "green" building materials, household efficiency projects, and the construction of small-scale hydro, wind, or solar installations for individual homes.

An interesting finding worthy of attention is the low level of familiarity of respondents with the highest electricity consumption sector - the correct answer was provided by only about one third of respondents. Also, of all three Quiz questions, most respondents elected not to answer this particular one. In 2005 most electricity in Oregon was used by the residential sector (39%), the commercial sector (33%), the industrial sector (27%), and about one percent by the transportation sector (U.S.

Department of Energy, 2008a). Oregonians, however, believe the industrial sector to be the largest consumer of electricity, while in fact it is the third largest. The industrial sector is not only third in volume of electric consumption, but it uses far less electricity than both the residential and the commercial sectors.

An argument could be made to justify the small percentage of correct answers to this question. It is possible that respondents may have been thinking about energy consumption rather than electricity consumption, since the lead-in to the three Energy Quiz questions read: "Here are a few specific questions about energy…" In addition, the title page of the survey itself introduced it as an "Energy Policy Survey." So, if respondents were thinking in terms of energy rather than electricity, their responses should reflect that.

The largest energy consumer in Oregon is the transportation sector with 307.3 BTUs, followed closely by the industrial (278.6 BTUs) and the residential (258.6 BTUs) sectors (EIA, 2009b). The commercial sector uses the least amount of energy (204.6 BTUs) in Oregon (EIA 2009). Nevertheless, most respondents (40%) selected the industrial sector, 36 percent thought it was the residential, and 20 percent - the commercial sector. Only four percent of the respondents selected the transportation sector for their answer to this question. These percentages lead us to believe that while it is possible for respondents to have been confused about this particular question, still the majority of them did not provide the correct answer. In addition, the results of the pretested surveys did not indicate confusion. The low percentage of correct answers to the question about the largest consuming sector of electricity in the state shows that

Oregonians truly do not know the correct answer to this question, regardless if they were confused or not.

A less surprising finding is respondents' self-assessed low level of familiarity with wave energy technology. Despite the fact that the advantages of wave energy were obvious at least two centuries ago - the first written records come from 1799 French patents on wave energy devices - wave energy is still in its infancy. In the U.S., federal funding for Ocean Energy Systems started with the creation of the Department of Energy in 1977 and continued through 1994 (EIA 2008, 38). Later on, the Energy Policy Act of 2005 (EPACT) and the Energy Independence and Security Act of 2007, further encouraged the development of wave technology. Finally, in 2008 the U.S. Department of Energy announced $7.5 million in federal funding for research and development of advanced waterpower systems, and established two regional centers in the Pacific Northwest – one for wave energy development in Oregon and one for tidal energy testing in Washington (Environment News Service, May 5, 2008). State initiatives started a little earlier. For example, the Oregon legislature established the Oregon Wave Energy Trust in 2007 to encourage wave energy development (Lavrakas, 2009).

Using the subjective and objective indicators of knowledge holding, in addition to the situation-specific and trans-situational determinants discussed earlier, what can be said about respondents' level of familiarity with wave energy technology and knowledge of energy issues? Moreover, how do the various sources of information impact the level of familiarity with energy and wave technology? To

address these questions we ran two logistic regressions with the dependent variables set from the estimates on familiarity (Table 3.1) and energy knowledge holding (Table 3.3).

The description and summary measures of all independent variables used to explain respondents' level of familiarity with wave energy technology and knowledge of energy issues, in addition to their level of support for wave energy development, which is discussed later, are presented in Table 3.4. The trans-situational variables included are: age in years, gender, formal education with seven categories,[1] and income with ten categories.[2] As discussed earlier, we expect familiarity with wave energy technology and energy knowledge to have the same antecedent correlates as environmentalism, and thus we expect women, younger people, the better educated, and people with higher incomes, to be more informed and more supportive of wave energy development (Jones and Dunlap, 1992; Michaud et al., 2008; Smith, 2002).

The situation-specific variables used here are: expressed level of agreement with the importance for decreasing dependence on foreign oil and gas to preserve national security, agreement with possibility to increase energy supplies while protecting the environment, and the expressed belief in climate change, measured with the question: "From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades, or not?" The answers to the climate change question were re-coded as a dummy variable, with all who expressed agreement with this statement were grouped together and all who gave negative or "Don't know" answers were put in another group.

TABLE 3.4. Independent variables.

Variable name	Variable description/coding	Mean (S.D.)
Age	Age in years (range=18 to 94 years)	54.65 (17.86) n=672
Gender	Gender dummy variable [1=female; 0=male]	0.54 n=674
Education	Formal educational attainment [1=grade school to 7=graduate school]	4.93 (1.45) n=672
Income	Income in ten categories [1= less than $10,000 to 10=more than $200,000]	4.98 (1.96) n=653
Knowledge	Dummy variable [0=zero or one correct answers to 1=two or three correct answers]	0.89 n=648
Familiarity	Dummy variable, self-assessed familiarity with wave energy [1=familiar and very familiar; 0=other]	0.86 n=668
TV	Frequency of use for information related to energy policy: Television [1=never to 4=very frequently]	2.79 (0.85) n=666
Radio	Frequency of use for information related to energy policy: radio [1=never to 4=very frequently]	2.23 (0.93) n=657
Newspaper	Frequency of use for information related to energy policy: Newspapers [1=never to 4=very frequently]	2.19 (1.00) n=654
Internet	Frequency of use for information related to energy policy: Internet [1=never to 4=very frequently]	2.30 (1.00) n=657
Dependence	Level of agreement with decreasing dependence on foreign oil and gas [1=strongly disagree to 5=strongly agree]	4.39 (0.98) n=668
Protect	Level of agreement with possibility of increasing energy supply while protecting the environment [1=strongly disagree to 5=strongly agree]	4.28 (0.98) n=670
Climate	Dummy variable concerning evidence of global warming [1=believe evidence of warming; 0=other]	0.45 n=667
Ideology	Subjective political ideology [1=very liberal to 5=very conservative].	2.95 (1.00) n=657

In addition, a variable that measures respondents' subjective political orientations was also used.[3] Numerous studies show that citizens with liberal political

preferences in the U.S. are more supportive of environmental protection and reform than are citizens with conservative political preferences (Dunlap, 1975; Fransson and Garling, 1999; Pierce et al., 2000; Smith, 2002).

Many political leaders with liberal and conservative preferences have taken clear stands on opposite sides of the spectrum regarding energy policy. Clear evidence of that was provided in the 2008 U.S. presidential election, in which conservative views embraced the slogan, "Drill, baby, drill," while liberals stressed the development of renewable energy alternatives (Judkis, 2008). As suggested previously, we expect a higher level of familiarity with wave technology and energy knowledge, as well as greater support for wave energy development, among respondents who have liberal political preferences believe in rising global temperatures, and those who are more concerned about energy dependence for reasons of national security.

The sources of information included in explaining respondents' level of familiarity and energy knowledge are television, radio, newspapers, and the internet. The survey question read, "We would like to know which of the following information sources you currently use or would use to learn more about your state/province energy situation and policy. Please circle the number of the frequency of your use." Respondents were given a set of four choices: "never," "infrequently," "frequently," and "very frequently."

Regression estimates for familiarity with wave energy technology are presented in Table 3.5. The model is significant (χ^2= 24.353, $p \leq .01$) and the cases

explained correctly are 79 percent. However, the low pseudo R^2 shows that only 5.8 percent of respondents' level of familiarity is explained by the model variables.

TABLE 3.5. Logistic regression estimates for familiarity with wave energy.

	Familiarity with wave energy
	Coefficient (SE)
Age	.003 (.007)
Gender	-.429* (.203)
Education	.037 (.076)
Dependence	.177 (.117)
Climate	.266 (.243)
TV	-.267* (.122)
Radio	.250* (.109)
Newspaper	.066 (.103)
Internet	.126 (.111)
Constant	-2.980*** (.796)
% Cases Predicted	79%
Chi-Square	24.353**
Nagelkerke R^2	.058
N	633

Significance level $^{*}p \leq .05$; ** Significance level $p \leq .01$; *** Significance level $p \leq .001$.
Note: The dichotomous dependent variable is from Table 3.1 with "very familiar" and "familiar" = 1, and other = 0.

From the trans-situational variables included in the model, only gender produces statistically significant results. The negative sign of the coefficient for gender shows that men tend to be more informed about wave energy technology than women. Although this finding is consistent with previous findings about gender, technology, and policy (Steel, 2005a), it contradicts findings that show women to be more concerned about the environment and to be more supportive of environmental

protection (Dunlap, 1975; Dunlap and Van Liere, 1980; Fransson and Garling, 1999). The results also show that neither age nor education is a significant predictor of familiarity with wave energy technology. The two situation-specific variables used in this model also turned out to be insignificant.

Among all of the information sources people use to familiarize themselves with wave energy technology, only TV and radio turn out to be important sources of information in Oregon. However, while the relationship between level of familiarity and radio listening is positive (i.e., the more Oregonians listen to the radio, the higher the probability that they are more informed about wave energy technology), the relationship between level of familiarity and television watching is negative - the more Oregonians watch TV, the less informed they become about wave technology. These findings are consistent with previous research, which shows a negative relationship between television watching and knowledge of important environmental issues (Pierce et al., 1992; Steger et al., 1988).

We next examined the relationship between the trans-situational, situation-specific variables, and information sources to explain respondents' energy knowledge level (Table 3.6). The results show that this model explains fewer cases with accuracy (66.4%) than the familiarity model despite its higher significance levels (χ^2= 81.519, $p \leq .001$). The knowledge-holding model also has a better explanatory power – pseudo R^2 is 16.7 percent. It seems that although both models use the same nine variables, these variables are better predictors of respondents' energy-relevant knowledge than of their level of familiarity with wave technology. In explaining energy-relevant

knowledge, gender again plays a significant role, and again men are more likely to have higher levels of energy knowledge than women. These findings are consistent with others related to the different levels of policy-relevant knowledge holding between the sexes and the attestations of the existing "knowledge gap" (Delli Carpini and Keeter, 1996; Lovrich and Pierce, 1984).

TABLE 3.6. Logistic regression estimates for the Energy Quiz knowledge index.

	Energy-relevant knowledge
	Coefficient (SE)
Age	.001 (.006)
Gender	-.419* (.181)
Education	.403*** (.068)
Dependence	.350*** (.094)
Climate	.106 (.204)
TV	-.266* (.112)
Radio	.061 (.096)
Newspaper	.057 (.091)
Internet	.015 (.097)
Constant	-2.947*** (.690)
% Cases Predicted	66.4%
Chi-Square	81.519***
Nagelkerke R2	.167
N	614

Significance level $^{*}p \leq .05$; ** Significance level $p \leq .01$; *** Significance level $p \leq .001$.
Note: The dichotomous dependent variable is from Table 3.3 with two and three correct answers = 1, and other = 0.

As expected, education is positively related with energy knowledge holding – people who have a higher level of education are more likely to know more about energy-relevant issues (Dunlap and Van Liere, 1984; Smith, 2002). Contrary to results

from other analyses, which show age to play an inconsistent but significant role in explaining either environmental or energy awareness and knowledge (Devine-Wright, 2005b; Dunlap et al., 2000; Steel et al., 1990), the findings here indicate that age does not play a significant role in explaining either familiarity with wave energy technology or energy-relevant knowledge in Oregon.

Of the situation-specific factors explaining respondents' level of energy knowledge, concern for dependence on foreign oil and gas, rather than belief in global warming, exhibits a significant positive relationship for explaining one's level of energy knowledge. It is interesting that in explaining familiarity with wave energy technology neither of these variables had an effect (Table 3.5). This finding underscores the multi-faceted nature of the energy-environment relationship and shows how different situation-specific factors give priority to respondents' learning different types of information. While with each energy crisis the public has realized that decreasing dependence on foreign oil and gas is important for national security, and with that it has improved its understanding of some energy aspects (for example, it has become aware of the largest source of energy used in the state for producing electricity), it does not seem to see the need to become familiar with various renewable technologies because of increasing global temperatures. Despite the fact that in discussing various energy policy options both government officials and media sources mention energy conservation and development of low carbon technologies as primary mitigating factors for climate change and combating energy shortages, these

discussions have not had an impact on either improving familiarity with alternative technologies or increasing respondents' energy-relevant knowledge.

None of the information sources used in the model serve as significant predictors of energy knowledge. The only source of information that exhibits any level of significance is TV ($p \leq .05$). And again, just as the findings for wave energy familiarity indicate, people who watch TV less often are more likely to be more knowledgeable about energy than those who watch it frequently.

We also ran a variety of logistic regressions to ascertain the impact of other independent variables on the two indices – familiarity and knowledge. We included income and occupation, but the results obtained had no significant impact and did not improve the explanatory power of the models. Similar to research by Steel et al., (2005a), we created an interaction variable for age and gender to find if younger women might be more knowledgeable than older women or younger men. However, the interaction variable did not yield significant results.

In summary, our findings indicate that while gender plays a significant explanatory role in both one's level of familiarity with wave technology and knowledge of energy issues, age does not. Education has a significant power in estimating respondents' energy knowledge but not their familiarity with the technology. People who are more concerned about dependence on foreign oil and gas tend to have higher energy knowledge, but one's climate change beliefs do not play a significant explanatory role for level of familiarity with the technology nor for respondents' energy-relevant knowledge. Of all information sources, only radio is

significant in explaining level of familiarity but not in explaining energy knowledge holding. In general, the amount of TV watching is inversely related to respondents' energy knowledge and familiarity with wave energy technology.

Having investigated the level and sources of information regarding respondents' familiarity with wave energy technology and their level of energy knowledge holding, it is important now to investigate the impact of knowledge holding and familiarity on public support for wave energy development in Oregon. As noted earlier, one of the major barriers for the adoption of wave energy is low public knowledge on the topic.

The consequences of public knowledge and familiarity with energy issues

To measure the impact of public knowledge on attitudes toward wave energy development, respondents were asked to directly identify their level of support with the question: "Wave energy refers to the extraction of electricity from the up-and-down motion of ocean waves using buoys or devices in the form of "wave energy farms." What is your general attitude toward the development of wave energy off of the Oregon coast?" Respondents were given six choices: "very positive," "positive," "neutral," "negative," "very negative," and "do not have enough information to form an opinion." The last option was included because of the newness of wave energy as a renewable alternative. Since wave energy has not yet become an agreed-upon policy alternative with measurable targets, and there have not been as many public discussions about its implementation as there have been about oil drilling and nuclear

development, it was assumed that the majority of the population would not be familiar with it yet and, therefore, would not be able to express an informed opinion. The findings (Table 3.7) support our assumption. On average, more than four out of ten respondents do not have enough information to form an opinion, or they have a "neutral" attitude toward wave energy development. Since the reason(s) for having a neutral attitude cannot be defined at this point because respondents were not presented with specific questions about their attitudes, the percentage of respondents not having enough information to form an opinion about wave energy development was grouped together with the percentage of respondents who indicated that they have a "neutral" attitude.

TABLE 3.7. Attitudes toward wave energy development in Oregon

	Attitudes toward wave energy development in Oregon
Very Positive	25 %
Positive	27
Neutral/Not enough information	46
Negative	2
Very Negative	1

Note: Response rate =98.7% (n=665).

The results from Table 3.7 indicate that the predominant attitude toward wave energy development in Oregon is positive. In particular, 52 percent of the respondents from Oregon have "very positive" and "positive" attitudes toward the development of wave energy. Only three percent of Oregonians have "negative" and "very negative" attitudes toward wave energy development. In general, the results show that the

majority of Oregon residents support wave energy development, are neutral, or have not formed an opinion about it yet.

In order to investigate the impact of knowledge holding and familiarity, in addition to the trans-situational and situation-specific variables described in Table 3.4, attitude toward wave development was set as the dependent variable and was coded dichotomously with "very positive" and "positive" =1, and other =0.[4]

The regression estimates (Table 3.8) form a significant model for explaining support for wave energy development in Oregon ($p \leq .001$). The cases explained correctly are 66.3 percent. Although the pseudo R^2 is low – 23 percent of respondents' level of wave energy support is explained by the variables used in the model – it is in line with findings from other attitudinal studies. For example, it has been shown that sociodemographic variables typically explain only 10-15 percent in models measuring environmental concern (Greenbaum 1995, cited in Xiao and Dunlap, 2007).

The large variation not explained by the ten variables used in this regression model makes it hard to summarize the key results about the determinants of support for wave energy development. Nevertheless, the model shows that seven of the variables have a significant impact on defining wave energy support. Of the four trans-situational variables three – age, gender, and income – turn out to be significant predictors of support for wave energy development, while education is not. Consistent with other renewable energy studies and with the results from the previous two regressions of familiarity with wave energy technology and energy-relevant knowledge, men are more supportive of wave energy development than women.

TABLE 8. Logistic regression estimates for public support for wave energy.

	Public support for wave energy development in Oregon
	Coefficient (SE)
Age	.015** (.005)
Gender	-.785*** (.194)
Education	.105 (.077)
Income	.113* (.054)
Knowledge	.277 (.194)
Familiar	.533* (.221)
Dependence	.180 (.099)
Protect	.352*** (.099)
Climate	.620** (.231)
Ideology	.258** (.101)
Constant	-5.251*** (.796)
% Cases Predicted	66.3%
Chi-Square	114.672***
Nagelkerke R2	.23
N	606

*Significance level *p≤.05; ** Significance level p≤.01; *** Significance level p≤.001.
Note: The dichotomous dependent variable is from Table 3.7 with "very positive" and "positive" = 1 and other = 0.

Age and income are positively correlated with support for wave energy development, indicating that respondents with higher incomes are more likely to support wave energy development than their counterparts – findings consistent with the literature about the relationship between the SES characteristics and both environmental concern (Dunlap and Van Liere, 1978) and renewable energy (Devine-Wright, 2007; Smith, 2002). The positive coefficient for age, however, indicates that older respondents are more likely to support wave energy development than younger ones – contrary to the indictors of environmental concern and of support for renewable

energies. A possible explanation can be found in the way age was coded - as a continuous rather than as a categorical variable (Xiao and Dunlap, 2007). For example, survey results that have used age as a categorical variable show lower opposition to renewable energy projects among younger and older cohorts (ages 16-24 and 65+) in comparison to middle-aged respondents (ages 35-44 and 55-64; Devine-Wright, 2007). Which age group is most supportive of wave energy development in Oregon is not clear; the only thing our results show is that support for wave energy increases with age.

Of the six situation-specific variables used in the model, the most significant predictors of support for wave energy development are familiarity with wave energy technology, climate change beliefs, political preferences, and respondents' level of agreement with the possibility of increasing energy supplies while protecting the environment at the same time. Energy-relevant knowledge and concern for dependence on foreign oil and gas are the two variables that do not have a significant impact on determining support for wave energy development.

How can these results be interpreted? Which of the variables included here – the trans-situational or the situation-specific – do a better job in explaining respondents' level of support for wave energy development? Is familiarity with the technology or energy-relevant knowledge more important in indicating support for wave energy development?

The results indicate that both the trans-situational and the situation-specific variables play an important role in explaining respondents' level of support for wave

energy development. This is an important finding because it indicates that citizen attitudes toward renewable energies are shaped not only by who they are but by what they know and what they believe in. Respondents who are more familiar with the technology and those who believe that it is possible to increase energy supply while protecting the environment are more likely to support renewable energy development than those who are less familiar or more skeptical about the capability of increasing energy supply while simultaneously protecting the environment.

Summary and Conclusions

Because citizens are directly or indirectly involved in shaping the energy future, it is important to assess the scope and depth of their energy-relevant knowledge, to identify their sources of information, and to understand the link between energy-relevant knowledge and support for ocean energy development. Ultimately, the questions this study answers are: a) what is the level of public familiarity with wave technology and energy-relevant knowledge in Oregon; b) which information sources are linked with the higher levels of familiarity and knowledge-holding; and c) is there a relationship between knowledge holding and support for ocean renewable energy development.

Our findings support the existence of a knowledge gap that has been associated with almost all renewable energy developments. As Hansen et al., (2003: 5) point out, the biggest challenge for implementing wave energy currently, "is regarded to be the low public knowledge." While five out of ten Oregonians have a positive attitude toward wave energy development, almost the same number do not have enough information to form an opinion about wave energy, and more than four out of ten

admit that they are not familiar with wave technology. One of the reasons for stressing the importance of familiarity is that people must understand how the technology works, in addition to its legitimacy and usefulness, before being able to accept it (Hansen et al., 2003). Obviously, the low familiarity is reflected in respondents' level of support for wave energy development – many respondents are unsure about its impact and are unable to form an opinion. The fact that women are less supportive of wave energy development shows that there are some inconsistencies in the way it is perceived because, according to research on the determinants of environmental concern, women should exhibit a higher level of concern about the environment than men. Therefore, what the results here show is that wave energy may seem to be a good technological innovation to most men, but most women do not see it as an environmental improvement or they don't understand how it can be seen as an environmental improvement. These findings suggest three things. First, more research is necessary to show the environmental impact of the wave devices, and, second, appropriate communication strategies and channels of communication (e.g., radio) should be used so that both men and women can get a better understanding of the possible environmental consequences of extracting electricity from ocean waves. Third, since men also exhibit higher energy-relevant knowledge than do women, the link between energy and the environment needs to be explained better. It might be the case that respondents do not see energy as an environmental but as a techno-economic issue.

An indication of the perception of wave energy as a techno-economic issue comes from the finding that more conservative respondents support wave energy development than do liberal, indicated by the positive sign of the estimate for ideology in the regression about public support for wave energy development. Policy preferences are typically defined based on one's political beliefs about economic and social policies and the government's role in them. Usually citizens with conservative preferences have been pro-business and pro-development and against government intervention in the market. One of the reasons conservatives are against environmental reforms is because environmental reforms are considered extensions of government regulations and, as such, hamper development (Dunlap, 1975). Liberals, on the other hand, are pro-innovation, pro-government support for those in need, and pro-environmental protection from business. Studies maintain that people who have liberal policy preferences are more pro-environmental than are people with conservative policy preferences (Fransson and Garling, 1999). The fact that support for wave energy development in Oregon comes predominantly from people with conservative preferences may suggest that wave energy development is perceived as a technological innovation that can be used to satisfy our growing energy needs rather than as an ecological savior that can reduce the human impact on the environment while providing clean energy.

It is precisely this relationship, embedded in the techno-economic-environmental nature of renewable energy that is not well understood by the majority of respondents. Instead of seeing renewable energy as a technological innovation that

can reduce the human impact on the environment, it is dichotomized and perceived as either one or the other: as a technical object of human innovation that can lead to economic development or as a device that may harm the ocean environment.

This study shows that policy efforts need to concentrate on elucidating the connection between renewable energy technologies and the environmental benefits they could provide. The relationship between the need for renewables and climate change has to be made clear as well, especially in light of the findings that support for wave energy development increases with belief in rising global temperatures.

Since both the trans-situational and the situation-specific factors have been shown to play a significant role in influencing support for wave energy development, well-stratified and targeted information campaigns need to be undertaken. For instance, as suggested by Smith and Klick (2007), politically knowledgeable and better-educated individuals will likely be aware of global and local environmental problems and, when presented with arguments about the perceived consequences of renewable energy, will be able to "neutralize" the negatives and focus on the positives. For people with low levels of education and policy understanding, more simplified explanations should be made. These people may not be able to understand well all the factors that influence energy policy-making because of the complexity of the issues involved, but there are still a few aspects about energy that the average person should easily understand: whether they get enough electricity in their homes, whether the cost of electricity has been increasing or decreasing over the past five years, whether there are lines at the gas station. As Delli Carpini and Keeter (1991) suggest, it is critical for

people to have the civic "contextual knowledge" in order to be able to better understand the information presented to them by policy makers and the news media.

In conclusion, the findings presented here suggest that the enhancement of citizen energy-relevant knowledge of and familiarity with wave technology is critical to the development of public support for wave energy development in Oregon. Intensive information campaigns need to be undertaken in order to elucidate the relationship between renewable energy development and environmental protection. Citizen energy-relevant knowledge needs to be increased and some misconceptions about energy use dispelled. For example, although people express concern about dependence on foreign oil and gas, they do not know what they can do to contribute to energy conservation and security; they do not know that the residential sector consumes the largest amount of electricity, more than the commercial and the industrial sectors. In addition to showing people how to make their homes energy efficient, people need to know why they need to do it. The sooner they starting understanding why, the more receptive the public will be to new wave energy technologies.

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Notes

[1] The indicator and response categories used are: What level of education have you completed? (1) Grade School, (2) Middle or junior high school, (3) High school, (4) Vocational school, (5) Some college, (6) College graduate, and (7) Graduate school.

[2] The question and response categories used are: Which category best describes your household income (before taxes) in 2007? (1) Less than $10,000, (2) $10,000-$14,999, (3) $15,000-$24,999, (4) $25,000-$34,999, (5) $35,000-$49,999, (6) $50,000-$74,999, (7) $75,000-$99,999, (8) $100,000-$149,999, (9) $150,000-$199,999, and (10) $200,000 or more.

[3] The indicator for measuring subjective political ideology is: On domestic policy issues, would you consider yourself to be? The response categories used are: (1) Very Liberal, (2) Liberal, (3) Moderate, (4) Conservative, and (5) Very Conservative.

[4] Attitude toward wave energy is a categorical variable since it contains the option "do not have enough information to form an opinion." When set as a dependent variable it requires the use of a Discriminant Function Analysis. All attempts at performing a Discriminant Function Analysis yielded meaningless results, which entailed the recoding of the variable as a dichotomous and thus, allowed for the use of a logistic regression, the results of which are presented here.

ATTITUDES TOWARD WAVE ENERGY DEVELOPMENT IN OREGON: DOES CONCERN FOR GLOBAL WARMING EXPLAIN SUPPORT?

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Abstract

Renewable energies are proposed by some as viable alternatives that can at least partly satisfy our growing energy demands while protecting the environment, especially by reducing CO_2 and other greenhouse gases produced by carbon-based fuels. In transitioning from conventional fossil fuel to alternative energy provision, citizen understanding of the global energy problems and their causes and solutions is believed to be the key for the development of renewable energy. Numerous studies attest to the potential of wave energy development in Oregon, USA. This paper examines first, if the social basis for environmental concerns explain global warming awareness that temperatures are rising, and beliefs in its anthropogenic sources; and second, if people who are aware of the human impact on the rising global temperatures are more supportive of renewable energy development. Findings from a statewide survey, conducted in September-October 2008, reveal: 1) the majority of Oregonians are aware of the human-caused temperature rise and 2) they have a positive attitude toward wave energy development. However, the results indicate that the environmental values and concerns shaping understanding of the causes and consequences of global warming do not necessarily lead to support for renewable energy development. Policy and theoretical implications of these findings are discussed.

Introduction

Demand for energy, regardless of its source, is growing worldwide. Since 1980 electricity consumption has been growing on average by two percent per year, and is projected to continue to grow at 1.6 percent annually from 3,279 billion kilowatt-hours (kWh) in 2004 to 5,208 billion kWh in 2025 (EIA, 2008). In the U.S. alone, "the per capita average consumption of electricity in 2000 was more than seven times as high as in 1949" (EIA, 2007: 1). Electricity generation based on fossil fuels is one of the major contributors to air pollution and climate change. More specifically, ninety-eight percent of carbon dioxide emissions come from the combustion of fossil fuels and industrial processes (IPCC, 2007). The leading international body on climate science states that global warming is "unequivocal" and that human activity has "very likely" been causing most of the rise in temperatures since the mid-twentieth century (IPCC, 2007).

Concerns about energy security and climate change are significant driving forces of energy policy development in Oregon, USA. Oregon has enacted a Renewable Portfolio Standard, setting goals of 25 percent of the State's energy to be supplied by renewable resources by 2025 (Senate Bill 838, 2007). The State ranks third in the U.S. in hydroelectric power development. Hydropower also supplies more than half of the State's energy needs (EIA, 2009b). Only eight percent of the electricity generated in Oregon comes from coal, compared to 50 percent in the US (DOE, 2008b). As of early 2010, Oregon ranks sixth in the country in capacity of installed wind - 1,758 MW (Preusch, 2010).

A renewable resource that has been estimated to have a great potential for development in Oregon is wave energy (Brekken, 2007; EPRI, 2004). Oregon has not only the physical capacity - long coastline extending 360 miles, well-developed coastal transmission network, suitable bathymetry, and good match between the availability of the resource and the temporal and spatial demand for it, but also the political will to back it up. Oregon's Governor has been instrumental in creating a welcoming atmosphere for wave energy development by institutionalizing capacity and establishing organizations to aide its development. For example, in 2007 the Oregon State Legislature provided $4.2M to the recently established Oregon Wave Energy Trust (OWET) for the development of wave energy (Kulongoski, 2007). Since then, OWET has made efforts to facilitate wave energy development by identifying ecological and economic research needs, addressing the complex state and federal regulatory framework, and developing outreach strategies to work with coastal communities (Stevenson, 2009).

Despite these major efforts, there are no commercial wave energy projects in Oregon yet. Public acceptability of renewable energy technologies and understanding of the global energy problems and their causes and solutions are believed to be some of the reasons for that lack (Hansen et al., 2003; Sorensen et al., 2001). For example, research acknowledges that familiarity with wave energy technology, awareness of rising global temperatures, and understanding the importance of protecting nature while satisfying growing energy needs lead to increased support for wave energy development in the Pacific Northwest (Stefanovich, 2010). In addition, consumers of

green electricity and individuals who express a positive attitude toward green electricity, are found to have pro-environmental orientations and to be more concerned about the adverse consequences of environmental problems for both humans and the biosphere (Clark et al., 2003; Ek, 2005).

In examining the values and beliefs that motivate people to learn about energy, researchers use questions related to knowledge of energy issues, and concerns about global warming and dependence on foreign energy resources (Bittle et al., 2009). Findings suggest that citizens do not seem to realize the magnitude of their personal contribution to climate change and more importantly, do not make the connection between energy consumption and rising temperatures (Ungar, 2000). Despite the fact that most citizens are concerned about the risks inflicted by climate change (e.g., flooding and drought) they do not believe that climate change will affect them personally or tend to think that it is the government's responsibility to deal with the consequences of climate change (Dunlap et al., 1993; Lorenzoni and Pidgeon, 2006). Thus, personal detachment from climate change, uncertainty of its consequences, conflicting knowledge claims, and multiple engaged interests – mostly political and economic – have led researchers to label climate change as a "wicked issue" (O'Neill and Hulme, 2009; Turnpenny et al., 2009).

Public acceptability of renewable energy projects has been shown to depend, among other things, on the social basis of environmental concern, defined as age, sex, education, economic and social status, and political ideology (Devine-Wright, 2007; Dunlap and Van Liere, 1980; Pierce et al., 2000; Steel et al., 2005a). Studies on

environmental/ecological concern, awareness, and belief systems maintain that younger adults, women, the better educated, political liberals, and individuals with higher incomes express more concern about the environment than do their respective counterparts (Dunlap and Van Liere, 1978). A summary of research on renewable energy support shows that attitudes vary with respect to three main factors – *personal* (e.g., age, gender, education, and income), *psychological* (e.g., degree of awareness and understanding of renewable energy technologies, and environmental values and beliefs), and *contextual* (Devine-Wright, 2007). For example, national UK survey results show that both levels of awareness and opposition are lower in younger than in older cohorts, women tend to be less aware but more supportive of renewable developments locally than men, and that individuals with higher earnings are more supportive of renewables than are those with lower earnings (Devine-Wright, 2007).

Given the importance of these factors to the successful transition to renewable energies, it is, therefore, critical to examine some of the determinants related to citizens' level of awareness and understanding of energy and climate change issues. Comprehending the factors that precede and to some extent determine acceptability – attitudes, beliefs and values – is only the first step towards eliciting behavioral responses, which is believed to be the most fundamental, yet most challenging step in the sustainability transformation (Bent et al., 2002). Failure to map and interpret attitudes accurately can lead to delays in decision-making, to less widely accepted decisions, and to less stable policy outcomes.

Since wave energy has been defined as a potentially significant source of renewable energy supply in Oregon, it is important to assess the correlates of public support for its development. It is also necessary to investigate the determinants of climate change beliefs among Oregonians and the impact of these beliefs on attitudes toward wave energy development. Specifying the link between individuals' climate change beliefs and their motivations to support wave energy development could aid the development of a comprehensive renewable energy policy in Oregon and promote understanding of the relationship between climate change and adoption of renewables. In the broader context, the link between climate change attitudes and support for wave energy development could help policy makers understand if citizens' environmental knowledge and awareness of climate change issues increase their support for developing renewables. If people's climate change knowledge and beliefs do not serve as motivators for environmental remediation and adoption of renewables, the reasons for that lack of motivation would need to be investigated so that appropriate policies addressing the efficient adoption of renewables could be formulated.

The objectives of this study are to provide some insight and understanding about the determinants of public acceptability with regard to wave energy and the role these determinants play in defining public support for wave energy development. The empirical data gathered in this research derive from public opinion surveys conducted in Oregon during fall of 2008. Since the results presented here provide only a snapshot of a single place (Oregon), and time (September-October 2008), comparing Oregonians' views on climate change with national views from the same, and a later

time, would allow us to examine some trends in opinion and make inferences of 1) how Oregonians' climate change views are likely to change, and 2) how climate change beliefs are likely to impact national views on renewable energy developments. The study first tests the relative importance of the determinants of environmental concern in relation to one's beliefs that climate change is real and human-caused, compares them to the national views, and then explores the relative importance of those beliefs for determining support for wave energy development.

Conceptual Framework for Measuring Wave Energy Attitudes

Attitudes are hypothetical constructs related to an individual's evaluation of, or orientation to an 'attitude object' – a thing, an idea, a person, or an action (Rokeach, 1973; Schwartz, 1992). They are postulated to consist of three components – cognitive, affective, and evaluative (O'Neill and Hulme, 2009; Schultz et al., 2004; Upham et al., 2009; Yin, 1999). In the environmental science literature, attitudes are often treated as multidimensional constructs (Dietz et al., 1998; Pierce and Lovrich, 1980; Schultz et al., 2004; Schultz and Zelezny, 1999). A construct is multidimensional when it refers to several distinct but related dimensions treated as a single theoretical concept (Law and Wong, 1999). For example, environmental attitudes are defined as psychological orientations expressed through the evaluation of the natural environment (Milfont and Duckitt, 2010), or of environmentally related objects, including environmental problems and problem-solving actions (Yin, 1999).

There is an agreement among researchers that an attitude toward a particular object is determined by specific beliefs about the object (Ajzen and Fishbein, 1980).

The more specifically the measured beliefs relate to the attitude, the stronger is the belief-attitude relationship (Pierce and Lovrich, 1980; Schwartz, 1992). In case of new or emerging attitude objects, which the individual has little knowledge of or experience with (like wave energy), however, specific beliefs may not be completely constructed or accessible. In such cases, attitudes are formed on the bases of deeply held values and value orientations or more basic beliefs (Stern et al., 1998), considered most important to act upon in a specific situation (de Groot and Steg, 2009).

At the broadest level are values, defined as desirable, trans-situational goals, varying in importance that serve as guiding principles in people's lives (Rokeach, 1973; Schwartz, 1992). In an overview of the application of the concepts of values and attitudes in human dimensions of natural resources, Manfredo et al., (2004) maintain that values are developed early in life under the influence of family, friends, and other significant groups, thus, becoming enduring personal characteristics that guide behavior. Once formulated, values are hard to change (Dietz et al., 2005). Therefore, the importance of values, lies in their ability to "reveal the fundamental basis of an individual's thoughts, attitudes, and opinions" (Manfredo et al., 2004: 275).

One approach that explains the development of environmental values is the postmaterialism approach, proposed by the political scientist Inglehart (1990, 1995). Following Maslow's theory for the existence of a hierarchy of prepotency or needs (Maslow, 1943, 1970), which postulates that individuals pursue those needs that are immediately threatened, Inglehart (1990, 2000) suggests that environmentalism is an expression of postmaterialist values that favor quality of life and self-expression as

opposed to materialist values that stress the importance of tradition, respect for authority, and material well being.

Qualitative and quantitative studies show that Americans have become significantly more proenvironmental since the sixties, and especially since the eighties; that their environmentalism has gone deeper than just opinion or attitude to core values and fundamental beliefs about the world; and that their environmental views have been enmeshed in a core set of cultural beliefs and values (Inglehart, 1995; Kempton et al., 1995). Some studies show that there is a positive correlation between environmental values and income or socioeconomic status, and for studies coming from the UK, between environmental values and social class (Devine-Wright, 2007). Studies also show that concern about the negative consequences from climate change and perceived threat from climate change increase with social class (Upham et al., 2009) and income (Tjernström and Tietenberg, 2008), suggesting support for the postmaterialist approach. This leads us to hypothesize that people who hold postmaterialist values, i.e. those who have already developed a sense for a clean and safe environment, will be more aware of the human-caused climate change and will be more supportive of renewable energy development than those with materialist values.

Studies also show that concern about climate change is high, and belief that climate change is real and human-caused is strong, among people who are worried about environmental degradation and the negative human impact on the biosphere (Poortinga et al., 2004). Many of these studies rely on the variables proposed by the New Ecological Paradigm - an approach, developed for measuring attitudes toward the

environment (NEP, Dunlap and Van Liere, 1978; Dunlap et al., 2000). Rather than measuring specific attitudes, Dunlap and his colleagues compiled a series of items to assess a person's ecological worldview or concern, defined as "beliefs about humanity's ability to upset the balance of nature, the existence of limits to growth for human societies, and humanity's right to rule over the rest of nature" (Dunlap et al., 2000: 427). When examining the basic propositions of the environmental movement in the 1970s, and the writings of numerous authors (e.g., Commoner et al., 1971; Daly, 1973; Meadows et al., 1972), reflecting on the environmental degradation inflicted by human actions, Dunlap and Van Liere (1978) noted that these ideas were more than just an expression of attitudes and concerns about environmental issues, but that they constituted a fundamental shift in the perception of the human-nature relationship, a "paradigm" shift from the beliefs prevalent at the time (i.e.,1960-80s), defined as the dominant social paradigm (DSP), to the new ecological worldview, defined as the New Ecological Paradigm (NEP).

Dunlap and Van Liere (1978) developed, and later Dunlap et al., (2000) refined the scale for measuring the dimensions of this new worldview. When the NEP scale is presented as a continuum, as it has been done in some studies (Pierce et al., 2000; Steel et al., 1994; Vaske and Donnelly, 1999), on one end there are the people who exhibit high level of environmental concern and are defined as "biocentric." At the opposite end, are those who believe that humans have the right to rule over nature, and are defined as "anthropocentric." All the ones in-between are labeled as "mixed" (Dunlap and Van Liere, 1978; Dunlap et al., 2000b). The anthropocentric perspective

defines the basic goals for humanity to be an ever-increasing economic development and material well being through technological advances (Dunlap and Van Liere, 1978). The biocentric view, on the other hand, gives priority to environmental integrity and biodiversity. People with predominantly biocentric orientation are concerned with the consequences of rapid development and urbanization, exploitation of natural resources, and an exploding world population. They recognize the limits to and downsides of technology and are aware that many of the advances in technology (e.g., increased agricultural productivity, machinery, pesticides, nuclear energy and weapons) have also contributed greatly to land and water degradation and pollution (Steel et al., 2003).

Because neither the postmaterialism approach nor the NEP were specifically designed to measure climate change beliefs or attitudes toward renewable energy, several specific questions reflecting the cognitive, evaluative, and affective components of citizens' knowledge and understanding of energy policy issues need to be included in this analysis. The *cognitive* component refers to a person's knowledge and awareness of environmental problems. Research has shown that a lack of knowledge and understanding of the causes and consequences related to climate change has contributed to an atmosphere of apathy and disinterestedness in supporting the search for solutions that can help mitigate the problem (Tjernström and Tietenberg, 2008; Yetano Roche et al., 2009). In that respect, people who do not believe that global temperatures are rising or that the rise has been caused by human activities, tend to worry less about the consequences of climate change, are less willing to

support the introduction of government measures to reduce pollution and energy consumption, and are more reluctant to support renewable energy development than those who see climate change as real and caused by human behavior (Devine-Wright, 2007; Leiserowitz, 2007b; Leiserowitz et al., 2009; Rabe and Borick, 2008).

The *affective* component refers to a person's emotional responses to environmental problems. While it is important to cognitively understand the issues surrounding climate change, research points to the need for people to be also emotionally motivated to take action (O'Neill and Hulme, 2009). It has been shown that those concerned about environmental degradation and the consequences of climate change to themselves, their local communities, and future generations, are willing to engage in conservation behavior (Leiserowitz et al., 2009).

The *evaluative* component is defined as "judgments or opinions about problem-solving actions concerning various environmental issues" (Yin, 1999: 63). In examining environmental attitudes, Yin (1999) uses questions regarding performance evaluation of environmental protection actions and support for stricter environmental laws to measure evaluative attitudes. Concerning climate change and renewable energy policy, surveys have asked respondents to evaluate the importance of decreasing dependence on foreign oil and gas for national security and increasing government spending on research and development of alternative fuels (Baldassare et al., 2009; Laver, 2007). Research shows that 68 percent of Americans believe it is important to gain energy independence even if it increases the cost of gas, electricity, and heating fuel (Bittle et al., 2009).

The dimensions of the attitude components reflect the principal analytical concerns explored in this analysis. The first concern relates to the content of the components, defined as the substantive material of individual's values and beliefs (Pierce et al., 2000). As such, content is reflected in the degree to which the questions being asked are able to explain the measured constructs (i.e., are all questions well suited for measuring climate change beliefs and renewable energy attitudes). How well do they measure them (i.e., what is the explanatory ability of the questions)? In other words, what percent of renewable energy attitudes and climate change beliefs is explained by the variables that are used?

The second type of concern relates to the structure of attitudes, with two distinct dimensions of structure being examined, internal and external (Pierce et al., 2000; Pierce and Lovrich, 1980). The internal structure refers to the degree to which certain attitude components, sometimes referred to as psychological (Devine-Wright, 2007) or social psychological (McFarlane and Boxall, 2003), are bound together in the way they are organized in the minds of citizens. For example, when people say that they are concerned about foreign ownership of energy resources, are they also concerned about being personally affected by shortage of electricity? Do certain sets of attitudinal components tend to better explain climate change beliefs, while others renewable energy attitudes?

A characteristic of the attitude structure is that all environmental beliefs are jointly connected (i.e., they are made of tightly covarying domains; Milfont and Duckitt, 2010; Xiao and Dunlap, 2007). In other words, individuals who support

environmental attitudes in a specific domain will tend to support those attitudes in other domains (Pierce and Lovrich, 1980). In that respect, it is not surprising that the structural determinants of environmental attitudes have served as a typical starting point in examining the structure of both climate change and renewable energy attitudes (Dunlap, 2010; Hansla et al., 2008; Schultz et al., 2004; Smith, 2002). Since this study explores the determinants of, and the relationship between, renewable energy attitudes and climate change beliefs, we would expect people who are concerned about the human impact on the environment to believe climate change is happening, and that it is human-caused. Also, we would expect them to be more supportive of mitigation strategies to reduce climate change, including renewable energy development.

The external structure assesses the degree to which the values, beliefs, and attitudes of individuals are connected to their personal characteristics, also referred to as social structural variables (McFarlane and Boxall, 2003) or entry level variables (Cottrell, 2003); in particular, it assesses the relationship of political value orientations to politically relevant personal attributes (Pierce et al., 2000). Political values are important because they have been demonstrated to be linked to one of two environmental policy domains. A policy domain refers to beliefs about issues of public policy, grouped together because they share a similar substantive content; and the content has two core dimensions – preservationist and developmental (Pierce and Lovrich, 1980). At the most general level, individuals who exhibit a desire for environmental protection and preservation of natural resources tend to be attentive to

leaders and policies that embody preservationist preferences. On the other hand, people who place a relatively strong emphasis on a desire for development of natural resources, tend to support policies that stress developmental alternatives.

Regarding beliefs that climate change is real and human-caused, studies show small to moderate differences in terms of age, education, gender, and income; while partisan affiliation is shown to have a substantial impact (Leiserowitz et al., 2007; Rabe and Borick, 2008). Dunlap and McCright (2008: 26) even state, "Nowhere is the partisan gap on environmental issues more apparent than on climate change." They explain that ideological polarization with a widening gap in the views of party leaders and political ideologues, a cleavage that started in the early 1980s with the Reagan administration, which labeled environmental regulations a burden on the economy and stressed market approaches at the expense of environmental degradation (Dunlap and McCright, 2008). These partisan preferences point to the importance of examining climate change beliefs and attitudes by looking at their external structures first, before explaining the way some social structural and social psychological attributes are linked internally.

Examining the external structure has important policy implications. If climate change beliefs are determined mostly by social structural attributes, the prospects of increasing climate change understanding and awareness may be limited because of the static nature of these attributes (i.e., it is difficult to change one's educational attainment, occupation, or socioeconomic status quickly; Steel et al., 2005a). Moreover, if only social structural characteristics account for one's level of climate

understanding, the gaps among citizens with adequate and not so adequate understanding of the climate change and energy policy issues may continue to persist and even to widen, so that the least informed citizens may be less able to protect and promote their interests than those who are already better informed (Delli Carpini and Keeter, 1996). That is why it is important to examine the relative importance of both types of structures – internal and external - when discussing one's climate change beliefs and renewable energy attitudes.

Before we move on to analyzing the results obtained from the Oregon energy policy survey, it is important to review the literature about the impact of some social structural factors – age, gender, level of education, income level – in addition to political orientation on climate change and renewable energy attitudes. Despite the fact, that we would expect both climate change beliefs and renewable energy attitudes to be defined by similarities in their jointly connected internal structure components, research has shown that there are some differences in the characteristics of their external structure components (Dunlap and McCright, 2008; Dunlap, 2010).

Regarding global environmental problems that are not directly observable like ozone depletion and global warming, it has been suggested that citizens detect them through dissemination of scientific findings as well as via direct perception (Dunlap and McCright, 2008; Kempton, 1991). When scientific interpretations are transmitted through the mass media, most often they become value-laden and reach the public in a simple but politicized manner. Because of differences in interpretation, a widening gap between ideological preferences and global warming perceptions has been shown to

exist. While 76 percent of Democrats believe global warming is happening, only 42 percent of Republicans share this view (Dunlap and McCright, 2008). This gap persists in the causes climate change is being attributed to, once again, while 72 percent of Democrats see human activities as the main cause, only 40 percent of Republicans believe in the idea that global climate change is human-induced (Ibid). Such differences have not been shown to exist with regard to renewable energies. For example, one study claims that partisan differences do not influence wind energy attitudes (Michaud et al., 2008).

Structural Components of Climate Change Beliefs and Attitudes

Studies show that certain individuals will be more favorably inclined to environmental protection than others (McFarlane and Boxall, 2003; Milfont and Duckitt, 2010). In that respect, women, the younger individuals, politically liberal, those with higher levels of education and higher incomes, view nature as having an inherent worth regardless of its usefulness to people, and support the principles of sustainable development (McFarlane and Boxall, 2003; Steel et al., 1994). These individuals are also concerned about the global condition of the environment (Franzen, 2003). The way these differences have been reflected in climate change policy beliefs, preferences, and behaviors, has been demonstrated by the Center for Climate Change Communication (Leiserowitz et al., 2007). Based on a segmentation analysis, the Center identified six distinct groups of Americans. These "six Americas," consisting of the *Alarmed* (19% of the population), the *Concerned* (22%), the *Cautious* (20%),

the *Unconcerned* (12%), the *Doubtful* (16%), and the *Dismissive* (11%), not only have a nuanced understanding of global warming and a distinct policy response to it, but also have different geodemographic characteristics. According to the study, the majority of Americans who belong to the first two groups – the *Alarmed* and the *Concerned* tend to be women, have liberal policy preferences, and be mostly middle aged (30 - 64 years of age). They are convinced that global warming is happening and that humans are the primary cause. They also see global warming as a "serious" threat to themselves and their families and favor policies for regulating and reducing harmful gas emissions and increasing energy efficiency.

The *Cautious* are less convinced than the previous two groups that global warming is happening or caused by humans. They believe its effects will be felt between ten and 25 years from now, and perceive global warming as a "somewhat serious" threat to their families, and as a greater threat to "other" people in their communities, the U.S., or other countries. Members of this group also tend to be women (56%), older than the previous two groups (65 years or older; 22%), not well educated (46% of them hold a high school diploma or less), and have lower income (22 percent live in households with income less than $25,000). They tend to be Democrats (44%) and politically moderate (47%).

The majority of the remaining three groups tend to be men and to have conservative policy preferences. The *Unconcerned* and the *Doubtful* are unlikely to believe that global warming is happening, or that it is caused by human activities. They are likely to believe that it will begin to harm people either in 25 to 50, or in 50

to100 years from now; and are less worried about global warming than the other three groups. The members of the last group, the *Dismissive*, are not concerned about global warming because they do not believe it is happening. They tend to be men (62%), early middle-aged (30-49; 46%), and to live in upper-middle income households ($75K- $99,999; 17%; Leiserowitz et al., 2007).

Age, gender, income, race, ethnicity and education, have been shown to yield inconsistent results with regard to climate change beliefs and preferences (Dietz et al., 2007; Dunlap, 2010; Zia and Todd, 2010). Since only the partisan gap shows consistent results across all studies, we would expect it to hold true in our study as well. The influence of the other social structural variables remains to be examined. We now present the possible determinants of the profile of the renewable energy supporter as they are laid out in the literature, and then turn to comparing Oregon and national characteristics of respondents who are most aware of the rising temperatures, and those who attribute the temperature-rise to human activities.

Structural Components of Renewable Energy Attitudes

The relationship between environmental concern and renewable energy development has proven to be somewhat complex (Devine-Wright, 2007). On one hand, support for renewable energy policies is led by a desire for reducing the human impact on the environment by endorsing energy conservation and renewable energy technologies. People concerned about the human impact on the environment also worry about the consequences renewable energy technologies might have on the local flora and fauna.

In a qualitative survey conducted in November 2008, comprised of 47 semi-structured interviews with Oregon coastal residents, Hunter (2009) found that participants made reference to the effects wave energy could have on local marine ecosystems and on global climate patterns. In investigating the underlying factors regarding public opinion on offshore wind power on Cape Cod, Massachusetts, Firestone and Kempton (2007) identified that the top three most important factors influencing support for wind energy development were environmental effects, electricity rates, and foreign oil dependence; while the top three factors, influencing opponents were environmental effects, aesthetics, and fishing/boating interests. Global warming was a factor mentioned by only four percent of the supporters and four percent of the opponents.

Studies that examine the values and beliefs that motivate people to learn about energy issues and express support for or opposition to various energy policy initiatives also use questions related to attitudes toward energy and technology (Anderson and Lipsey, 1978; Grankvist and Biel, 2007; Shackley et al., 2009). In examining public attitudes toward the 1973 energy crisis, researchers found a positive correlation between skepticism about the benefits of technology and the reality of the crisis - respondents who characterized technology as both "extremely useful and necessary," seemed to think that the seriousness of the crisis had been exaggerated and indicated it was "an outright hoax" (Anderson and Lipsey, 1978: 27). In addition, respondents' level of enthusiasm for technology determined their type of preferred solution for solving the energy crisis. In that respect, respondents who were not enthusiastic about the ability of technology to solve energy problems tended to be supportive of

'behavioral' solutions (i.e., requiring citizens and industry to use less energy). On the other hand, the high enthusiasts for technology supported 'technical' solutions, those stressing expansion of the search for new energy sources to permit continuation of energy consumption at increasing levels (Anderson and Lipsey, 1978).

Americans seem to be evenly split between these two options – the behavioral and the technical. Asked about the ability of new technologies to solve the global warming problem "without individuals having to make big changes in their lives," 48 percent of Americans agree that it is technologically possible to do so, while 52 percent say that the ultimate solution would require much more than technological innovations, including "significant changes in our lifestyles" (Leiserowitz et al., 2010a: 39).

A recent study explores respondents' knowledge of energy issues and energy policy preferences, and based on cluster analysis, reveals four distinct segments of the U.S. population – the *Disengaged* (19%), the *Climate Change Doubters* (17%), the *Anxious* (40%), and the *Greens* (24%; Bittle et al., 2009). The *Disengaged* don't know much about energy and only 14 percent of them worry "a lot" about global warming. Ninety percent of the *Climate Change Doubters* do not worry about global warming at all and believe that global warming is just a theory or that it exists, but attribute it to natural causes. A large majority of the *Anxious* (69%) and the *Greens* (65%) believe global warming is happening and it is due to human activities. The *Anxious* do not know the correct answers to all the energy-related questions, but they know enough to be worried. They are also the firmest believers that renewable energies can be

developed in the near future. The *Greens* are most knowledgeable about energy and their preferred policy option is energy conservation (Bittle et al., 2009).

These four segments have different social structural characteristics. For example, while the *Disengaged* are predominantly older (over the age of 65), mostly women with lower income, the *Climate Change Doubters* are mostly men, well educated, with conservative policy preferences. The *Anxious* are younger (less than 35 years of age), tend to be less educated than the general public (21 percent did not complete high school), to have low incomes and are less likely to be employed than the other three groups. The *Greens* have moderate policy preferences, high incomes (1/2 of them make $ 75,000 or more), and are well educated (1/4 have post-graduate degrees).

Based on previous research findings, we would expect small to medium differences in the characteristics of respondents who would support renewable energy development, and those who believe climate change is real and it is human-caused. For example, we would expect respondents predominantly from the early to the late middle-age bracket (30-64 years of age) with liberal political orientations, to most strongly believe that climate change is happening and it is human-caused; while those who are less than 35 years of age, and have moderate political preferences, to be likely to support the development of alternative energies.

Methods

The research reported here presents a case study for investigating the substantive and structural components of individual beliefs that climate change is real and that it is human-caused. It compares the climate change beliefs of Oregonians to those of national respondents, and examines the role these beliefs play with regards to renewable energy attitudes by establishing baseline information about the variables that influence attitudes toward wave energy development in Oregon. The public opinion of Oregonians with regard to their beliefs that climate change is happening and it is human caused, in addition to their attitudes toward renewable energy development, is the unit of analysis in this research.

The population for this study was defined as adult (at least 18 years of age) residents of the state of Oregon. The sampling frame consisted of private households with a permanent mailing address in the state. Addresses were obtained from Survey Sampling, Inc. Residents were sampled from randomly selected household samples. The statewide sample consisted of 1,200 households. Data were collected using mail-back surveys, administered during September-October, 2008. The mail survey procedure was designed and implemented following Dillman's (2000) mail survey method, which requires three waves of mailings, including an introductory postcard announcing the survey and two subsequent waves of the survey with a cover letter, sent within two weeks of each other. There were no restrictions on the participant population in terms of gender, race, and ethnicity; the only restriction was on age – only participants 18 years of age and older were included. The following statement

was made part of the survey cover letters: “Only respondents 18 years of age or older are eligible to participate in this survey.”

The survey was pretested with a group of 35 randomly selected Oregon State University students and with 20 random households in an apartment complex in Corvallis, Oregon, in order to ensure that respondents were able to understand the questions and that their responses would produce the desired data, suitable for SPSS.v17 manipulation.

A potential problem associated with mail-back surveys is that the presence of non-responses can lead to sample selection bias. It is reasonable to expect that those with a strong positive or negative opinion about renewable energy development in general, and wave energy in particular, are more likely to answer and return the surveys. Given the heightened interest in wave energy development in Oregon during the time of the survey, the extensive media coverage of some of the wave energy projects, in addition to the spike of oil prices in the summer of 2008, it is not surprising that the response rate was 56 percent (n=674).

To examine the relationship between the determinants of the internal and the external structure of public acceptability with regard to wave energy, and the role these determinants play in defining public support for wave energy development, general awareness of climate change, belief in the impact of human activities on rising global temperatures, and attitude toward wave energy were set as the dependent variables. We present first the results regarding Oregonians’ climate change awareness and beliefs, and compare them to the national tendencies regarding the same beliefs.

Results

Are Temperatures Really Rising and Why: Structural Components of Oregonians' Climate Change Awareness and Beliefs in Comparison to Those of National Respondents

Two questions related to Oregonians' climate change beliefs are explored. The first asks respondents whether they believe in the existence of solid evidence that the average temperature on earth has been getting warmer over the past few decades. The second question inquires about the causes of the earth's warming. The questions are phrased in terms of rising temperatures, rather than climate change or global warming for the following reasons:

- Temperature is the climatic characteristic for which the longest and the most detailed data records are available, and about which the IPCC is "unequivocally" certain (IPCC 2007).
- Temperature is most directly influenced by green house gas emissions and changes in its average are directly felt and acknowledged by the population (Dessler and Parson, 2006).
- Despite the fact that climate change is the more scientifically accurate of the two terms that describe the recent rapid atmospheric changes, people have the tendency to associate it with natural causes and weather variations that have already been observed, while they ascribe more human causes, including pollution, fossil fuel consumption, and overuse of earth's natural resources to the term global warming (Whitmarsh, 2009b). Since we did not want respondents to be prejudiced in their

responses, the question was phrased in terms of rising average temperatures.

- The Pew Research Center (PRC) has been conducting surveys since 2006, using the same wording for the two climate related questions, that are used here, and has collected nationally representative data (Pew Charitable Trust, 2009).

National tendency toward climate change skepticism – where do Oregonians stand?

The findings of the Oregon survey reveal the majority of Oregonians (73%) believe in the existence of solid evidence about the rising average temperature on earth over the past few decades, while 14 percent are skeptical, and 13 percent do not know (Table 4.1, middle column). Of the 73 percent who believe in the sufficiency of warming evidence, 43 percent attribute the temperature rise to human activities and only 18 percent to natural patterns, while 11 percent say that they do not know. The results from Oregon are similar to the nationally obtained ones by PRC earlier the same year (April 2008), but substantially different from the October 2009 ones (Table 4.1, first and third columns). Could these results be a part of a trend, and if so, how can it be explained?

Despite slightly different ways of wording the questions, surveys and polls have consistently shown a gradual increase until 2007- 2008 in the percentage of Americans convinced that global warming is happening and that it is mostly attributed to human-related activities (Nisbet and Myers, 2007; Rabe and Borick, 2008). For example, surveys conducted by Ohio State University and ABC News in 1997, 1998, 2006, and 2007, have recorded correspondingly 76 percent, 80 percent, 85 percent,

and 84 percent of respondents who believe temperatures have been increasing over the past century (Nisbet and Myers, 2007). Another national survey from 2008, finds that 69 percent of Americans believe global warming is happening, and 62 percent of them are convinced climate change is caused mainly by human activities (57%), or caused equally by humans and natural changes (5%, Leiserowitz et al., 2008). In January 2010, the percent of Americans who believe global warming is happening drops to 57 percent, and so does the percent of respondents who attribute it to human causes (Leiserowitz et al., 2010a).

TABLE 4.1. Beliefs in rising global temperatures and possible causes.

	Nationally April 2008[1]	Oregon October 2008	Nationally October 2009[1]
Q: Is there solid evidence the earth is warming?	(%)	(%)	(%)
Yes	71	73	57
Because of human activity	47	43	36
Because of natural patterns	18	18	16
Don't know	6	11	6
No	21	14	33
Mixed/Don't know	8	13	10
	100	100	100

Note: Not all percentages add up to 100% because of rounding.
[1] National data taken from the Pew Research Center surveys (Pew Charitable Trust, 2008, 2009).

The 2009 PRC results show the same percentage of respondents who believe global warming is happening (57%), but an even lower percentage of those who believe climate change can be attributed to human activities (36%; Pew Charitable Trust, 2009). In addition, survey results show that during the last two years (2008-2010) Americans are becoming "much more sure" that global warming is *not*

happening; that those "very worried" about global warming are getting less in number, while the percentage of those "not worried at all" is going up from 13 percent to 23 percent (Leiserowitz et al., 2010a).

Two main explanations appear in the literature about the increased skepticism and reduced concern over the existing evidence of and causes for the rising global temperatures: scientific bickering and mass media attention to the issue of global warming (Dunlap, 2010; Leiserowitz et al., 2010a; Nisbet and Myers, 2007) The first one shows that because of the inability of climate scientists to reach consensus, people have become more skeptical that global warming is happening. For example, when asked in 2008, "What comes closest to your view?" and presented with four answer-choices, 47 percent of Americans replied, "Most scientists think global warming is happening" and 33 percent answered, "There is a lot of disagreement among scientists about whether or not global warming is happening." In 2010, the percent of respondents selecting these two answers is reversed: 34 percent choose the former and 40 percent select the latter as their preferred choice (Leiserowitz et al., 2010a). The other two choices, "Most scientists think global warming is not happening" and "Don't know enough to say" do not exhibit a big percent change: the former gets three percent in 2008 and five percent in 2010, while the latter 18 percent and 22 percent correspondingly (Leiserowitz et al., 2010a).

The percentage of respondents distancing themselves from the harmful effects of global warming on their health, family, or community has also been rising. While 75 percent of Americans were concerned about global warming in 2003 (Leiserowitz,

2003), in 2010 that percent is down to 28 percent (Leiserowitz et al., 2010a). Americans also tend to perceive the consequences of climate change as occurring far off in space and time. For example, only about a third of the American public believe global warming will pose a threat within their lifetime (Nisbet and Myers, 2007), and less than a fifth think global warming will harm people in the U.S. "a great deal" (Leiserowitz et al., 2010a).

Some researchers explain this shift in concern with the decreasing attention given to global warming in the mass media (Nisbet, 2009; Nisbet and Myers, 2007). In an overview of more than 70 surveys administered over the past 20 years, and using historical studies of patterns on news coverage, Nisbet and Myers (2007) show that there is a strong connection between patterns in media attention to global warming and shifts in poll trends. In that respect, the authors show that as media attention to the issues surrounding climate change increases, the number of respondents who have heard about climate change, those who believe it is happening and it is human-caused, also increases, and vice versa. In addition, because climate change decisions at the policy level, reflect ideological values and beliefs, which during President's Bush administration (2001-2009) were characterized by a state of denial that temperatures were rising, and especially due to human activities, there has been a widening partisan gap among people with different political ideologies (Republican, Independent, and Democrat), and corresponding policy preferences (conservative, moderate, and liberal). Studies show that Republicans and people with conservative policy

preferences are most skeptical about temperature rise and its anthropogenic sources (Dunlap and McCright, 2008; Hamilton, 2009).

Before examining the relative importance of the social structural and social psychological variables with regard to awareness in the existence of solid evidence for the rising global temperatures, and beliefs about their causes, we turn to analyzing the social structural components of Oregonians who believe there is enough evidence about global warming and those who think it is human caused. At each step, we compare Oregonians' social structural characteristics to the characteristics of the respondents from the national PRC sample for April 2008 and October 2009.

Toward a Profile of Oregonians Who Believe Temperatures Are Rising

Oregonians who believe there is solid evidence about the rising of global temperatures are predominantly middle aged (50-64 years old; 79%), women (76%), who are well educated (college grad +; 81 percent), with medium household incomes ($30K - $74,999; 79%), and liberal policy preferences (97%). This profile is slightly different from the profile of the national PRC respondents, who believe there is solid evidence for rising global temperatures (Table 4.2).

Despite the fact that consistently women and respondents with liberal policy preferences tend to have stronger beliefs about the rising temperatures, respondents from the national sample tend to be younger (18-29 years of age; 74% in 2008 and 64% in 2009) and to come from households with lower incomes (less than $30K; 73% in 2008 and 66% in 2009) than their Oregon counterparts.

TABLE 4.2. Characteristics of respondents, who believe there is solid evidence the earth is warming.

% who believe there is solid evidence the earth is warming	Nationally April 2008[1]	Oregon October 2008	Nationally October 2009[1]
	%	% (Number)	%
Total	71	73 (485)	57
Age			
18-29	74	71 (56)	64
30-49	74	74 (121)	55
50-64	70	79 (167)	59
65+	64	67 (140)	50
Gender			
Men	68	69 (213)	54
Women	74	76 (272)	61
Education[2]			
College Grad+	70	81 (217)	58
Some College	71	71 (173)	57
HS or less	72	61 (92)	56
Income[3]			
$75,000+	70	77 (101)	56
$30,000 - $74,999	70	79 (197)	51
<$30,000	73	65 (173)	66
Party and ideology[4]			
conservative/Republican	43	55 (112)	32
moderate/Independent	75	67 (163)	57
liberal/Democrat	91	97 (196)	83

[1] The national data are taken from the Pew Research Center (Pew Charitable Trust, 2008, 2009).
[2] Pew uses three categories for Education: College grad, Some college, High school (HS) or less. The Oregon survey had seven categories, which were grouped into 3. Vocational school was added to the category Some College.
[3] Pew uses the first cut-off point for income to be <$30,000; while the category for income in the Oregon survey is <$35,000.
[4] Pew uses four categories: conservative/Republican, moderate/liberal Republican, moderate/ conservative Democrat, and liberal Democrat. These four categories were regrouped into the following three: conservative Republican, moderate, and liberal Democrat, in order to be made compatible with the three categories used in the Oregon survey: conservative, moderate, and liberal.

Their level of education is different for the 2008 and the 2009 samples. In the former, respondents tend to be less educated (high school diploma or less; 72% in 2008), while in the latter they are mostly well educated (college grad +; 58% in 2009).

The profile of Oregonians who believe climate change is happening, matches closely the profile of the *Alarmed* group, described by the Center for Climate Change Communication (Leiserowitz et al., 2007). The profile of the 2008 national respondents seems to be closer to the characteristics of the *Cautious* group, while the profile of the 2009 group comes closer to the profile of the *Concerned* group (Leiserowitz et al., 2007). This would lead us to believe that if the Oregon survey were to be conducted now, in 2010, we would most probably see a drop in the percentage of respondents who believe climate change is happening, but the profile of respondents would not have changed much. Finally, bivariate analyses of the social structural and policy preferences of Oregonians confirm the significant role these determinants play in the structure of beliefs regarding the existence of climate change evidence (Appendix 1). The bivariate analyses also show the significance of these determinants in relationship to respondents' awareness that humans are the primary cause for the temperature rise. Income level makes the only exception, which suggests that income may not be as strongly related to beliefs about the anthropogenic sources of the rising temperatures as the other social structural determinants are.

Toward a Profile of Oregonians Who Believe Temperature Rise is Human Caused

We now turn to examining the characteristics of the 43 percent of Oregonians, who attribute the cause for warming mainly to human activities (Table 4.3). Again, predominantly women (50%) with liberal policy preference (75%) tend to be the ones who see climate change as human-caused. These respondents also tend to be young

(18-29 years of age, 52%), well educated (college graduate +; 59%), and to live in high-income households ($75K+; 49%).

TABLE 4.3. Characteristics of respondents, who believe the earth is warming because of human activities.

% who say the earth is warming because of human activity	Nationally April 2008[1]	Oregon October 2008	Nationally October 2009[1]
	%	% (Number)	%
Total	47	43 (289)	36
Age			
18-29	54	52 (41)	47
30-49	50	51 (82)	34
50-64	44	42 (90)	35
65+	37	35 (76)	25
Gender			
Men	45	35 (108)	32
Women	48	50 (183)	39
Education[2]			
College Grad+	51	59 (158)	40
Some College	49	39 (96)	38
HS or less	43	23 (36)	31
Income[3]			
$75,000+	51	49 (64)	38
$30,000 - $74,999	47	48 (121)	33
<$30,000	44	37 (101)	37
Party and ideology[4]			
conservative/Republican	22	13 (27)	16
moderate/Independent	46	41 (101)	33
liberal/Democrat	75	75 (151)	69

[1] The national data are taken from the Pew Research Center (Pew Charitable Trust, 2008, 2009).
[2] Pew uses three categories for Education: College grad, Some college, High school (HS) or less. The Oregon survey had seven categories, which were grouped into 3. Vocational school was added to the category Some College.
[3] Pew uses the first cut-off point for income to be <$30,000; while the category for income in the Oregon survey is <$35,000.
[4] Pew uses four categories: conservative/Republican, moderate/liberal Republican, moderate/ conservative Democrat, and liberal Democrat. These four categories were regrouped into the following three: conservative Republican, moderate, and liberal Democrat, in order to be made compatible with the three categories used in the Oregon survey: conservative, moderate, and liberal.

In the three samples, the profile of respondents who believe in the human-caused climate change is strikingly the same. It comes closer to the profile of the *Concerned* group, rather than the *Alarmed*; both described earlier.

This finding may have important policy implications. Despite the fact that the *Concerned* respondents worry less about the consequences of the human-induced climate change and feel less personally threatened by it than do the members of the *Alarmed* group; they, more than the members of any other group, are likely to believe that the actions of a single person or a single nation, like the U.S., can make a difference in reducing global warming. The members of the *Concerned* group are also strong supporters of policies aimed at reducing greenhouse gas emissions, increasing energy efficiency, and switching to renewable energies (Leiserowitz et al., 2007).

The question now becomes, what is the relative importance of the differences in the profiles of respondents who believe climate change is happening, and those who believe it is human-caused? What kind of policy implications might these differences have?

Putting it All Together: Substantive and Structural Components of Climate Change Beliefs

Until this point, we were building the profiles of respondents who are convinced temperatures are warming, and of those who attribute the warming to human activities. It is now time to assess the relative importance of these respondents' values and characteristics in terms of the structure of climate change beliefs. To examine the level of importance of each of the internal and external social structural and social

psychological components in determining beliefs about the reality of global warming and its causes, two regression analyses are run. The first one explores the relative importance of the variables determining whether respondents believe there is sufficient evidence that proves the existence of global warming, while the second examines these determinants with regard to those who believe human activities are the main cause for warming. The description and summary measures of the independent variables included in the regression analyses are presented in Table 4.4 and discussed below.

The social structural variables used to explain respondents' climate change beliefs are: age in years, gender, formal education with seven categories,[1] and income with ten categories.[2] The social psychological variables used here are postmaterialist values, biocentric/anthropocentric environmental value orientations, subjective policy orientations with five categories,[3] and cognitive, affective, and evaluative attitude components.

The cognitive attitude component is measured with two questions: expressed level of agreement with possibility of increasing energy supplies while protecting the environment, and agreement with the ability of new technologies to provide electricity for all of us in the future. The affective attitude component is measured with three questions: expressing level of concern with foreign ownership of our energy resources; concern that the country does not have enough energy resources, and concern about being personally affected by shortage of electricity in the next five years.

TABLE 4.4. Independent variables

Variable name	Variable description/coding	Mean (S.D.)
Age	Age in years (range=18 to 94 years)	54.65 (17.86) n=672
Gender	Gender dummy variable [1=female; 0=male]	.54 n=674
Education	Formal educational attainment in seven categories: [1=grade school to 7=graduate school]	4.93 (1.45) n=672
Income	Income in ten categories: [1= less than $10,000 to 10=more than $200,000]	4.98 (1.96) n=653
Ideology	Subjective political ideology in five categories: [1= very liberal to 5= very conservative]	2.95 (1.01) n=657
Postmaterialism	Postmaterialism Index in three categories: [0=materialist, 1=mixed, 2=postmaterialist]	1.07 (.70) n= 623
New Ecological Paradigm (NEP)	NEP index: [6=DSP/anthropocentric to 30=NEP/biocentric]	21.01 (6.11) n=662
Evidence	Dummy variable ["The earth is getting warmer"=1, and "No, it is not"=0]	.37 n=580
Cause	Dummy variable ["The earth is getting warmer because of human activities"=1, and "The earth is getting warmer because of natural activities" =0]	.46 n=413
Dependence	Level of agreement with importance of decreasing dependence on foreign oil and gas [1=strongly disagree to 5=strongly agree]	4.39 (0.98) n=673
Foreign ownership	Level of concern about foreign ownership of energy resources [1=strongly disagree to 5=strongly agree]	4.42 (0.88) n=671
Not enough resources	Level of concern about not having enough energy resources [1=strongly disagree to 5=strongly agree]	3.47 (1.37) n=672
Personally affected	Level of concern about being personally affected by shortage of electricity in the next five years [1=strongly disagree to 5=strongly agree]	3.18 (1.18) n=673
R&D	Level of agreement with not enough money spent on research and development of alternative fuels [1=strongly disagree to 5=strongly agree]	4.05 (1.04) n=671
Protect	Level of agreement with possibility of increasing energy supply while protecting environment [1=strongly disagree to 5=strongly agree]	4.28 (0.98) n=670
Technology	Level of agreement with possibility for new technologies to provide enough electricity [1=strongly disagree to 5=strongly agree]	4.03 (0.98) n=673

The evaluative attitude component consists of two questions: evaluating the importance of decreasing dependence on foreign oil and gas to preserve national security, and expressing judgment whether enough money is being spent on research and development of alternative fuels. All attitude components are measured on a five-point scale, ranging from 1="Strongly Disagree" to 5="Strongly Agree."

Individual values are measured following Inglehart's postmaterialism/ materialism index scale, which consists of four statements (Inglehart, 1995). Respondents are asked to define "what our country's goals should be for the next ten to fifteen years" by rank ordering two of the following four statements: "maintaining order in the nation," "giving people more say in important governmental decisions," "fighting rising prices," and "protecting freedom of speech" (Inglehart, 1990, 2008; Welzel and Inglehart, 2001). The rankings are combined to construct a three-point index. Respondents who select the first and the third statements are given a score of zero and are classified as materialist; those who select the second and the fourth are given a score of two and are defined as postmaterialist. Respondents who select one materialist and one postmaterialist goal are given a score of one and are labeled mixed. For greater accuracy, and in order to be consistent with the logistic regression rules for having only dichotomous and continuous variables, the postmaterialism index is recoded into two dichotomous variables. For the first, the postmaterialists are given a value of one, while the materialists and the mixed are given a value of zero. For the second variable, the materialists are given a value of one, and the rest – postmaterialists and mixed - are grouped together and given a value of zero.

Environmental concern is measured with a battery of survey questions to assess a person's level of agreement or disagreement (on a scale from 1 "Strongly disagree" to 5 "Strongly agree") with six statements, proposed by Dunlap and Van Liere (1984). Three of the six questions are worded in a way, in which agreement indicates acceptance of the New Ecological Paradigm (NEP) - "the balance of nature is very delicate and easily upset," "we are approaching the limit of the number of people the earth can support," and "plants and animals have as much right as humans to exist." Agreement with the other three statements shows acceptance of the dominant social paradigm (DSP) - "humans have the right to modify the natural environment to suit their needs," "the so-called 'ecological crisis' has been greatly exaggerated," and "humans were meant to rule over the rest of nature." Statements are grouped into their basic belief domains (biocentric-anthropocentric) with reverse coding applied to the items representing anthropocentric orientation. Respondents, who agree with the anthropocentric statements, are given a score of six; those who select only the biocentric statements are given a score of thirty (6 statements times five points/each). Statements are then tested for internal consistency using Cronbach's alpha, which was found to be sufficiently high (Cronbach's Alpha=.77; Dunlap and Van Liere, 1978) . Frequency analysis and analysis of the means were performed.

The first of the two dependent variables, belief about the rising global temperatures, is measured with the question: "From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades, or not?" Respondents are provided with three answer

choices: “Yes,” “No,” and “Don’t know.” The second dependent variable, regarding the cause of the temperature rise, is measured with the question, “Do you believe that the earth is getting warmer…?” Again, three answer choices are presented: “Mostly because of human activity, such as burning of fossil fuels,” “Mostly because of natural patterns in the earth’s environment,” and “Don’t know.” The answers to the climate change questions are re-coded as dummy variables, with the ones that show expressed agreement with the first question, and those marked “human activity” on the second question, are given a value of one, while all negative answers to the first or marked “natural patterns” on the second question, are given a value of zero. As previously stated, we expect respondents with postmaterialist values and biocentric value orientations to believe that temperatures are rising and that the cause for the rise is attributed to human activities. We also expect those who are more concerned about foreign ownership and availability of energy resources, those who believe that not enough money is spent on research and development of alternative fuels, and those who trust new technologies less, to be aware of the rising temperatures and the human impact on them.

Given the description of the social structural and social psychological variables, and the respondents’ profiles obtained on the basis of the social structural variables only, what is the relative importance of the social structural and social psychological variables in determining whether people believe in climate change and its human causes? Which variables altogether do a better job at that? Are there any major differences and what could they mean for policy making?

Regression estimates for belief the earth is getting warmer and that the warming is caused mostly by human activities, are presented in Table 4.5. Both models are significant ($\chi^2_{awareness}$= 155.571, $p \leq .001$, and χ^2_{belief}= 206.602, $p \leq .001$,) and the cases explained correctly are 86.6 percent for the first, and 84.3 percent for the second regression. The high pseudo R^2s show that the variables used explain 45 percent of respondents' awareness that the earth is getting warmer and 63 percent of respondents' belief that human activity is the major cause. We'll look at each model separately and then comparatively discuss the importance of the most relevant variables in both.

From the variables included in the first regression, only four produce statistically significant results – policy preferences, value orientations, and two attitude components. The negative sign of the coefficient for ideology shows that individuals with liberal policy preferences tend to be more aware of rising global temperatures. As discussed earlier, this finding is consistent with previous findings about political ideology and climate change beliefs (Dunlap and McCright, 2008; Leiserowitz et al., 2007; Rabe and Borick, 2008). Value orientations also tend to be a major predictor of one's awareness about rising global temperatures. This finding is also consistent with previous research, which shows that people who have biocentric value orientations are more concerned about the environment and the human impact on it (Dunlap, 1975; Dunlap and Van Liere, 1980; Fransson and Garling, 1999). The results also show that respondents, who are more concerned about foreign ownership of our energy resources and those who strongly believe that it is possible to increase

energy supplies while protecting the environment at the same time, are more aware of the rising global temperatures. None of the social structural variables has a statistically significant effect on determining awareness of the rising global temperatures. However, all of these variables show consistency with the profile of respondents described previously – younger, women, those with low education and high incomes - tend to be associated with increasing awareness of rising temperatures (Leiserowitz et al., 2010a).

Liberal ideological preferences and biocentric value orientations turn out to be significant predictors of respondents' beliefs that climate change is human-caused as well (Table 4.5, second column). Education and income also tend to play a significant role in explaining beliefs about the anthropocentric nature of climate change. The positive sign for education and the negative sign for income show that beliefs about the anthropogenic sources of rising temperatures get stronger with an increase in the level of education but with a decrease in income level. The former finding is consistent with the profile of the climate change believers described earlier, as well as with the literature on environmental concern and climate change (Dunlap, 1995; Fransson and Garling, 1999; Leiserowitz et al., 2010a), which shows that people with higher level of education tend to be more pro-environmental and more aware of the human impact on the environment.

TABLE 4.5 Logistic regression estimates for a) Awareness that the earth is getting warmer; and b) The reason for warming is human activity.

	Awareness that the earth is getting warmer	Belief that the Earth is getting warmer because of human activity
	Coefficient (SE)	
Age	-.018 (.010)	-.023 (.013)
Gender	.178 (.369)	.274 (.377)
Education	-.252 (.137)	.370* (.149)
Income	.006 (.086)	-.260* (.110)
Ideology	-.648** (.218)	-.500* (.243)
Postmaterialist=1, all else=0	.628 (.429)	.144 (.452)
Materialist =1, all else=0	-.535 (.399)	.586 (.494)
NEP	.192*** (.034)	.221*** (.041)
Dependence	.375 (.222)	-.136 (.285)
Foreign ownership	-.449* (.226)	-.366 (.287)
Not enough resources	.156 (.118)	-.017 (.160)
Personally affected	.160 (.138)	-.323 (.192)
R&D	-.056 (.162)	.723*** (.217)
Protect	.395* (.159)	-.297 (.257)
Technology	-.131 (.158)	.142 (.206)
Constant	.807 (1.722)	-.665 (2.474)
% Cases Predicted	86.6%	84.3%
Chi-Square	155.571***	206.602***
Nagelkerke R2	.447	.625
N=	509	362

Significance level *p≤.05; ** Significance level p≤.01; *** Significance level p≤.001.
Note: The dependent variable in the first logistic regression was coded dichotomously as "The earth is getting warmer" = 1 and "No, it is not"=0. The dichotomous dependent variable in the second logistic regression was coded as "The earth is getting warmer because of human activity" = 1, and "The earth is getting warmer because of natural variations"=0;

Despite the fact that the results on household income are contrary to the ones presented in the profile of respondents who believe in the anthropogenic nature of temperature rise (Leiserowitz, 2007a), they are consistent with the literature, which shows people with lower incomes to be more aware of the negative human impact on

the global climate (Tjernström and Tietenberg, 2008), and to be more sensitive and susceptible to environmental degradation (Brechin and Kempton, 1994). Besides respondents' environmental orientation, only one other social psychological variable has a significant impact - level of agreement that not enough money is spent on research and development (R&D) of alternative fuels. Respondents who agree insufficient resources are spent on R&D tend to believe in the human causes of climate change.

In summary, the high values of the pseudo R^2s in both regressions show that the variables used to explain awareness in rising temperatures and beliefs in the human-caused temperature rise are well suited for that purpose. Structurally, biocentric environmental value orientations and liberal policy preferences are the most central components in the structure of beliefs regarding the rising temperatures. The postmaterialist values, signifying a desire for a safe, clean, and beautiful environment, do not have a significant impact on determining either awareness of the global temperature rise or understanding of the human impact on it. Despite these content similarities between climate change awareness and beliefs, however, there are some striking structural differences - the social psychological determinants turn out to be more central to the structure of respondents' beliefs in the rising temperatures, while the social structural determinants are related more strongly to Oregonians' understanding that human activities are the main cause for warming.

Having investigated the different factors that influence respondents' level of awareness and understanding of global temperature change and its anthropogenic

sources, it is important now to examine the impact of global warming beliefs on public support for wave energy development in Oregon. As noted earlier, one of the major barriers for the adoption of renewable energy alternatives is the disconnect between the human impact on the climate and the environment, and the acknowledgement that renewable energies could serve as viable alternatives for mitigating it.

Awareness of Temperature Rise and Beliefs about its Human Causes as Determinants of Wave Energy Development

To measure the impact of temperature warming awareness and beliefs about its human causes on attitudes toward wave energy development, respondents were asked to directly identify their level of support for wave energy development with the question: "Wave energy refers to the extraction of electricity from the up-and-down motion of ocean waves using buoys or devices in the form of "wave energy farms." What is your general attitude toward the development of wave energy off of the Oregon coast?" Respondents were given six choices: "very positive," "positive," "neutral," "negative," "very negative," and "do not have enough information to form an opinion." The last option was included because of the newness of wave energy as a renewable alternative. Since wave energy has not yet become an agreed-upon policy alternative with measurable targets, and there have not been as many public discussions about its implementation as there have been about oil drilling and nuclear development, it was assumed that the majority of the population would not be familiar with it yet and, therefore, would not be able to express an informed opinion. Specifically, research has

shown that providing respondents with more response categories, especially nonsubstantive (e.g., no opinion, neutral, unsure, don't know), does not force respondents who do not have an attitude toward an issue, or do not have enough knowledge about a topic, to express an opinion (Dillman, 2000; Vaske, 2008).

The findings support our assumption (Table 4.6). On average, four out of ten respondents do not have enough information to form an opinion, or they have a "neutral" attitude toward wave energy development. Since the reason(s) for having a neutral attitude cannot be defined at this point because the survey did not present respondents with specific questions about the reasons for their attitudes, the percentage of respondents not having enough information to form an opinion about wave energy development was grouped together with the percentage of respondents who indicated that they have a "neutral" attitude.

TABLE 4.6. Attitudes toward wave energy development in Oregon.

	Attitudes toward wave energy development in Oregon.
Very Positive	25 %
Positive	27
Neutral/Not enough information	46
Negative	2
Very Negative	1

Note: Response rate =98.7% (n=665).

The results from Table 4.6 indicate that the predominant attitude toward wave energy development in Oregon is positive. In particular, 52 percent of the respondents from Oregon have "very positive" and "positive" attitudes toward the development of wave energy. Only three percent of Oregonians have "negative" and "very negative" attitudes toward wave energy development. In general, the results show that the

majority of Oregon residents support wave energy development, are "neutral," or have not yet formed an opinion.

In order to investigate the impact of awareness about temperature warming and beliefs about the anthropogenic causes of warming on attitudes toward wave energy development in Oregon, attitudes were set as the dependent variable and were coded dichotomously with "very positive" and "positive" =1, and other =0.[4] The regression estimates (Table 4.7) form a significant model for explaining support for wave energy development in Oregon ($\chi^2 = 69.342$, $p \leq .001$). The cases explained correctly are 68.5 percent and the pseudo R^2 is relatively low, 23.7 percent of respondents' level of wave energy support is explained by the variables used in the model.

While the large variance not explained by the 16 variables used in this regression model makes it hard to summarize the key results about the determinants of support for wave energy development, it points to some interesting substantive and structural observations. First, it shows that the variables included in the model do not do a very good job at explaining attitudes toward wave energy development.

Second, it suggests that some of the social structural and social psychological measures, which are typically used to explain environmental attitudes may not be the most accurate predictors of renewable energy attitudes. Finally**,** it underscores the need for adjustments to the traditional relationships between social structural and social psychological variables in the internal and external structures of attitudes to properly reflect the differences in the structures of environmental concerns, and those of renewable energy attitudes. We discuss these three observations now one by one.

TABLE 4.7. Support for wave energy and global warming.

	Support for wave energy[1]
	Coefficient (SE)
Age	.011 (.008)
Gender	-.645* (.273)
Education	-.041 (.111)
Income	.143* (.070)
Ideology	.210 (.161)
Postmaterialist=1, all else=0	-.392 (.270)
Materialist =1, all else=0	-.207 (.369)
NEP	-.041 (.031)
Evidence	2.302 (1.278)
Cause	-.148 (.386)
Dependence	-.074 (.151)
Foreign ownership	.404* (.182)
Not enough resources	-.028 (.102)
Personally affected	.130 (.121)
R&D	.680***(.174)
Protect	.531* (.156)
Technology	-.339* (.151)
Constant	-7.751*** (2.064)
% Cases Predicted	68.5%
Chi-Square	69.342***
Nagelkerke R2	.237
N=	356

Significance level *p≤.05; ** Significance level p≤.01; *** Significance level p≤.001.
[1] The dichotomous dependent variable is coded "very positive" and "positive" = 1 and else = 0.

The first observation becomes clear from the low pseudo R^2 for the model. To investigate the explanatory capacities of the variables used in the model, multiple regressions were run while different variables – both social structural and social psychological - were being removed from the model, in order of least significance. There was no increase in the pseudo R^2 for any of the regression models. To further

investigate the influence of just the social structural and just the social psychological variables on attitudes, two separate regressions were performed (Appendix 2). The pseudo R^2 for the social structural variables regression showed they explain 13.5 percent of wave energy support - a finding consistent with the literature on environmental attitudes, which attests to the ability of social structural variable to explain between six percent (Diamantopoulos et al., 2003) and 15 percent (Greenbaum 1995, cited in Xiao and Dunlap, 2007). However, when the model is run without the social structural variables (Appendix 2, middle column), the social psychological variables explain only 18.8 percent - not a huge improvement from the 13.5 percent explained by the social structural variables.

The second observation is based on notable inconsistencies in the explanatory capacity of some of the social structural and social psychological measures used in the literature about environmental attitudes to explain renewable energy attitudes. To begin with, the literature regarding the social structural variables shows that young, the well educated, and women exhibit higher levels of environmental concern (Diamantopoulos et al., 2003; Fransson and Garling, 1999; McFarlane and Boxall, 2003). Our results suggest that the older, the less educated, and the men, tend to be more supportive of renewable energy development. In addition, only gender and income turn out to have significant explanatory power of wave energy attitudes, but the findings for income are consistent with the literature on both environmental concern (Dunlap and Van Liere, 1978) and renewable energy attitudes (Devine-Wright, 2007; Smith, 2002), which show that higher-income respondents tend to

exhibit higher level of concern for the environment, and also to support more renewable developments.

There are some surprising results regarding the explanatory capacity of the values, value orientations, and attitude component variables used in the model, as well. None of the postmaterialist/materialist values, the biocentric/anthropocentric value orientations, or even the conservative/liberal policy preferences have a significant impact on determining support for wave energy development. Despite their general insignificant explanatory power, however, the signs of their coefficients show that respondents with mixed values, anthropocentric value orientations, and conservative policy preferences are more likely to support wave energy development than their counterparts. In addition, wave energy supporters may be found mostly among people who are likely to be more aware of the temperature warming, but who also attribute the warming to natural variability rather than human activities. This suggests that renewable energy developments are viewed differently from the way solutions to environmental problems are often viewed, "as threatening to the existing social order, possibly requiring substantial changes in traditional values, habitual behaviors, and existing institutions" (Dunlap and Van Liere, 1980: 183).

The fact that renewable energies may be viewed from a different, even opposing perspective – as non-threatening to the existing social order and not requiring substantial changes in values and behaviors – is supported by the explanatory direction change of some of the cognitive, affective, and evaluative attitude components. The results show that respondents who are less concerned about the adequate supply of

national energy resources, and those who agree that it is possible to increase energy supplies while protecting the environment, are more likely to support wave energy development than their counterparts. The attitude components that serve as significant predictors for wave energy support, besides the increased concern about foreign ownership of energy resources and the stronger level of agreement about the possibility for increasing energy supplies while protecting the environment, however, are a high level of agreement that not enough money is spent on research and development of alternative fuels, and the strong disagreement with the possibility for new technologies to provide enough electricity for all in the future.

Concerning the third point – about the need for rethinking and retooling the traditional structural components of environmental attitudes to fit the renewable energy attitudes structure - it seems appropriate to examine the internal and external structural components that serve as significant predictors of support for wave energy development. While we expected a strong and positive relationship between renewable energy attitudes and postmaterialist values, biocentric value orientations, and liberal policy preferences, as is the case with most environmental concerns, we found the opposite relationship –wave energy supporters most likely have mixed values, anthropocentric value orientations, and conservative policy preferences. Concerning the external structure of attitudes, regarding the influence of social structural components on policy preferences, again, we found that although some social structural factors do play a role, they are significantly different from the ones established in the literature regarding environmental concerns. Explaining these

differences will most probably require a thorough review of the building blocks of renewable energy attitudes, in addition to the way information about these attitudes is obtained.

Summary and Conclusions

Most scholars and policy makers recognize the need for changes in human attitudes, values, and behaviors for achieving a successful transition to a more sustainable natural resource use while maintaining and improving the quality of life. Because citizens are directly or indirectly involved in shaping their energy future, it is important to assess the level of their knowledge about global energy problems, in addition to getting an understanding of their perceptions about the causes of and solutions to these problems. Specifying the link between individuals' climate change beliefs and their motivations to support renewable energy development could aid policy makers in the development of a comprehensive renewable energy policy. Ultimately, the questions this study answers are: 1) what are the similarities and differences between the profiles of respondents who are aware of the rising global temperatures, and those who attribute the temperature rise to human activities both at the state and the national levels; 2) what is the impact of the social structural and the social psychological components on determining climate change beliefs and wave energy attitudes (i.e., do certain sets of attitudinal components tend to explain climate change beliefs better, while others - renewable energy attitudes); and 3) how well are the determinants of environmental attitudes able to explain renewable energy attitudes.

The findings reveal that Oregonians who are aware of the rising global temperatures constitute a substantial percentage of the population. However, based on indications from national surveys, conducted a year or more after the Oregon survey, this percent is probably going down. The same trend could be attributed to the group of respondents who believe human activity is the main cause for temperature warming. Besides the conventional explanations provided in the literature – lack of scientific consensus and media (in)attention to the issues of temperature rise - other possible explanations deserve attention as well. For example, studies show that when policy measures to halt global warming are discussed, the American public strongly favors policies that encourage industry to increase energy efficiency, but opposes increased taxes on gasoline or electricity that are intended to alter their consumption behaviors (Nisbet and Myers, 2007). That tendency is confirmed by many other studies (Leiserowitz, 2007b; Rabe and Borick, 2008), and has even led some authors to conclude, "Americans are hesitant to dig into their pockets to address global warming" (Rabe and Borick, 2008: 2). This suggests that an examination of the motivations to adopt renewables is urgently needed, in addition to the social structural and social psychological determinants that may contribute to attitude and behavioral changes.

Since research has shown that a lack of knowledge and understanding of the causes and consequences related to climate change contributes to an atmosphere of apathy and disinterestedness in supporting the search for solutions that can help mitigate the problem (Tjernström and Tietenberg, 2008; Yetano Roche et al., 2009), it is important to reach out to people who do not believe that global temperatures are

rising, or that the rise has been caused by human activities. In this paper, we analyze the relative importance of the social structural and the social psychological determinants of respondents' awareness about the rising temperatures and beliefs in the anthropogenic causes of warming. The results show that the social psychological determinants are more central to the structure of respondents' awareness about the rising temperatures, while the social structural determinants relate more strongly to Oregonians' beliefs that human activities are the main cause for warming. Both the social structural and the social psychological determinants influence wave energy attitudes. These findings have important policy applications.

First, they show that concerns about foreign ownership of energy resources, and beliefs in the possibility of increasing energy supplies while protecting the environment at the same time are the most significant correlates of one's awareness that the earth is getting warmer. This, however, does not mean that people who are more knowledgeable about the factors that cause temperature rise, are also more familiar with the energy situation, or are better educated. On the contrary, the results show that their level of awareness is inversely related to their level of education. So if policy makers would like to convey the message about the reality of rising temperatures, they should not leave that to the general school system. Instead, they should appeal to people's value orientations, preservationist policy preferences, and basic security needs because these respondents are also very concerned that the country does not have enough energy resources and that they will personally be affected by a shortage of electricity. The fact that respondents also tend to disagree

with the ability of new technologies to make it possible for all to have enough electricity in the future, could be interpreted to mean that they most probably prefer the option of making behavioral changes, rather than adopting 'technical' solutions, which would endorse energy consumption at increased levels.

On the other hand, respondents who disagree that it is possible to increase energy supplies while protecting the environment at the same time, are not so concerned whether the country has enough energy resources or not, or that they will personally be affected by a shortage of electricity, are the ones who believe in the anthropogenic impact on climate. Despite the fact that these respondents also have biocentric value orientations and liberal policy preferences, they also tend to believe more in the power of new technologies and do not think that decreasing our dependence on foreign oil and gas should be a priority. More importantly, it is easy to recognize and reach these people on the basis of their social structural characteristics, rather than their social psychological ones. Since education level is an important predictor of their beliefs in the anthropogenic sources of warming, educational materials that could be included as part of the school program may be the most efficient approach about increasing understanding of the human contribution to warming.

The results suggesting both the social structural and the social psychological variables contribute to explaining respondents' level of support for wave energy development, has important policy implications as well because it indicates that citizen attitudes toward renewable energies are shaped not only by who they are but by

what they know and what they believe in. However, because general wave energy knowledge is low or even lacking, educational campaigns about its existence and its socioeconomic and environmental impacts, will need to be undertaken to increase the overall awareness of wave energy development as a renewable energy option.

Educating the public about the benefits of wave energy development will most probably not be a sufficient policy response by itself because it has been shown that simply providing factual information does not elicit attitude change (Bittle et al., 2009; Whitmarsh, 2009b), and also because our findings reveal that one's level of education does not seem to influence attitudes toward wave energy development. Other social structural and social psychological determinants of the wave energy supporters' profile need to be acknowledged.

The characteristics of the wave energy supporters show similarities between their profiles and the profiles of the *Climate Change Doubters* (Bittle et al., 2009), who are most likely men with conservative policy preferences, who do not worry about global warming, and believe that it is just a theory or if it exists is attributed to natural causes. This finding once again underscores the importance of educating the public about the causes and consequences of the rising global temperatures and the human impact on them. The importance of educating the public about the effects of climate change has been discussed in many articles (Bostrom et al., 1994; Kempton, 1991; Sterman and Sweeney, 2007). For example, perceptions of carbon sequestration are shown to be influenced by knowledge of the technology, and beliefs that climate change is happening and that it is human caused (Lorenzoni and Pidgeon, 2006).

However, it has also been shown that just providing factual information about the causes and consequences of climate change is a good starting point, but it not enough (Bittle et al., 2009). Overcoming denial and making changes in habits and lifestyles will need to be the second, and more difficult step, which would also take the longest time. However, only after that second step is made, would people start looking for solutions and support immediate action.

Perhaps, the most important findings of this paper are 1) that the traditional environmental attitude determinants do not add to our understanding of renewable energy attitudes, and 2) that climate change beliefs and awareness do not contribute to public support for wave energy development. Both structurally and content-wise, the determinants used for explaining environmental concern, do not do a good job in explaining renewable energy attitudes. Most probably, because wave energy is a new issue about which people do not know much, the specific attitude components, rather than the most deeply held values, appear to take central place in the structure of wave energy attitudes – four of the seven cognitive, evaluative, and affective components appear to be the strongest predictors of wave energy attitudes. This is consistent with the literature, which suggests that although all values are important, they are ordered in a system of value priorities (Schwartz 1992), and when different competing values are activated in a certain situation, choices are based on the values that are considered most important to act upon in a specific situation (de Groot and Steg, 2009). In a situation that involves decisions to be made regarding renewable energies, questions concerning adequate energy supply seem most pertinent. Concerns about climate

change evidence and awareness of its causes do not seem to take a central position in respondents' minds. However, disagreement with the possibility for new technologies to provide enough electricity for all of us in the future indicates a strong belief in the behavioral solutions to our energy problems. Once people make the connection between the magnitude of their personal contribution to the rising global temperatures, and start seeing renewable energies as a possible solution, backed up by government measures for reducing pollution and energy consumption, we may expect behavioral change and adoption of renewables to take off.

In building support for renewable energy policy, understanding the public's motivations is critical. Information alone is unlikely to be effective "if it runs counter to other powerful influences, such as social norms and prices" (Owens and Driffill, 2008: 4414). Changing both attitudes and behaviors requires more than just encouraging messages by politicians and the media for people to conserve and be more energy efficient. Policy decisions need to take into account that changes in attitudes and behavior will come slowly when there is coherence and consistency in the policy instruments and when different strategies combine towards reaching the same goal – sustainability - achieved through conservation, reduced consumption, and switch to renewable energy alternatives.

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Notes

[1] The indicator and response categories used are: What level of education have you completed? (1) Grade School, (2) Middle or junior high school, (3) High school, (4) Vocational school, (5) Some college, (6) College graduate, and (7) Graduate school.

[2] The question and response categories used are: Which category best describes your household income (before taxes) in 2007? (1) Less than $10,000, (2) $10,000-$14,999, (3) $15,000-$24,999, (4) $25,000-$34,999, (5) $35,000-$49,999, (6) $50,000-$74,999, (7) $75,000-$99,999, (8) $100,000-$149,999, (9) $150,000-$199,999, and (10) $200,000 or more.

[3] The indicator for measuring subjective political ideology is: On domestic policy issues, would you consider yourself to be? The response categories used are: (1) Very Liberal, (2) Liberal, (3) Moderate, (4) Conservative, and (5) Very Conservative.

[4] Attitude toward wave energy is a categorical variable since it contains the option: "do not have enough information to form an opinion." When set as a dependent categorical variable, it requires the use of a Discriminant Function Analysis. All attempts at performing a Discriminant Function Analysis yielded meaningless results, which entailed the recoding of the variable as a dichotomous and thus, allowed for the use of a logistic regression, the results of which are presented here.

Appendix 1

Bivariate analysis of respondents' characteristics and their beliefs about the existence of solid evidence the earth is warming and that it is human caused.

TABLE 4.8. Age and views about rising temperatures.

There is solid evidence for rising temperatures	Age (%)				χ^2	p-value	Effect size (*V*)
	18-29	30-49	50-64	65+			
Evidence of warming					24.19	<.001	.14
Yes	71	74	79	67			
No	5	15	15	17			
DK	24	12	7	16			
Earth getting warmer…					20.68	<.01	.15
Human activity	77	71	53	54			
Natural pattern	13	19	34	27			
DK	9	11	14	20			

N (Evidence for warming) = 665; N (Earth getting warmer) = 483.

TABLE 4.9. Gender and views about rising temperatures.

There is solid evidence for rising average temperatures	Gender (%)		χ^2	p-value	Effect size ϕ
	Male	Female			
Evidence of warming			20.49	<.001	.18
Yes	69	76			
No	21	9			
DK	11	15			
Earth getting warmer…			41.47	<.001	.29
Human activity	51	67			
Natural pattern	39	14			
DK	10	19			

N (Evidence for warming) = 667; N (Earth getting warmer) = 484.

TABLE 4.10. Education level and views about rising temperatures.

There is solid evidence for rising average temperatures	Education (%)			χ^2	p-value	Effect size *V*
	College Grad+	Some college	HS or less			
Evidence of warming				39.26	<.001	.17
Yes	81	71	61			
No	12	18	13			
DK	7	11	27			
Cause of earth getting warmer				33.28	<.001	.19
Human activity	72	57	39			
Natural pattern	16	29	40			
DK	12	14	22			

N (Evidence for warming) = 663; N (Earth getting warmer) = 482.

TABLE 4.11. Income and views about rising temperatures.

There is solid evidence for rising average temperatures	Income (%)			χ^2	p-value	Effect size *V*
	$75,000+	$35,000 - $74,999	<$35,000			
Evidence of warming				49.61	<.001	.20
Yes	77	79	65			
No	17	16	11			
DK	7	4	24			
Cause of earth getting warmer				6.76	.150	.09
Human activity	62	60	62			
Natural pattern	27	28	20			
DK	11	12	19			

N (Evidence for warming) = 647; N (Earth getting warmer) = 469.

TABLE 4.12. Policy preferences and views about rising temperatures.

There is solid evidence for rising average temperatures	Policy references (%)			χ^2	p-value	Effect size *V*
	Liberal	Moderate	Conservative			
Evidence of warming				156.26	<.001	.35
Yes	97	67	55			
No	2	8	34			
DK	2	25	11			
Cause of earth getting warmer				132.47	<.001	.38
Human activity	79	62	24			
Natural pattern	8	19	65			
DK	13	19	11			

N (Evidence for warming) = 650; N (Earth getting warmer) = 483.

Appendix 2

TABLE 4.13. Support for wave energy and global warming: three regressions.

	Support for wave energy[1]		
	Coefficient (SE)		
	Social structural characteristics model	Social psychological characteristics model	Full model
Age	.020*** (.005)		.011 (.008)
Gender	-.906*** (.175)		-.645* (.273)
Education	.157* (.066)		-.041 (.111)
Income	.144** (.050)		.143* (.070)
Ideology		.224 (.149)	.210 (.161)
Postmaterialist=1, all else=0		-.300 (.260)	-.392 (.270)
Materialist =1, all else=0		-.300 (343)	-.207 (.369)
NEP		-.052 (.029)	-.041 (.031)
Evidence		2.268 (1.257)	2.302 (1.278)
Cause		-.272 (.361)	-.148 (.386)
Dependence		.017 (.144)	-.074 (.151)
Foreign ownership		.304 (173)	.404* (.182)
Not enough resources		-.084 (.097)	-.028 (.102)
Personally affected		.123 (.117)	.130 (.121)
R&D		.618*** (.166)	.680*** (.174)
Protect		.505*** (.151)	.531* (.156)
Technology		-.401** (.146)	-.339* (.151)
Constant	-1.988*** (.442)	-5.783*** (1.717)	-7.751*** (2.064)
% Cases Predicted	65.3%	67.2%	68.5%
Chi-Square	68.485***	54.879***	69.342***
Nagelkerke R2	.135	.188	.237
N=	643	363	356

Significance level *p≤.05; ** Significance level p≤.01; *** Significance level p≤.001.

[1] The dichotomous dependent variable is coded “very positive” and “positive” = 1 and else = 0. The variable “Evidence” is coded, “The earth is getting warmer” = 1 and “No, it is not”=0. The variable “Cause” is coded, “The earth is getting warmer because of human activity” = 1, and “The earth is getting warmer because of natural variations”=0.

CONCLUSION

The purpose of this dissertation was to provide some insight and understanding about the determinants of public opinion with regards to renewable energy, the role these determinants play in public opinion formulation, and their relative importance in citizen support of or opposition toward wave energy development in Oregon. Based on the theoretical approaches and conceptual frameworks about the determinants of public opinion identified in the literature, several factors were singled out: environmental values and value orientations, ideology preferences, climate change awareness and energy policy beliefs, familiarity with the technology, energy knowledge, and sociodemographic variables.

The first Chapter examined the relationship between environmental values and value orientations, and attitudes toward wave energy development. In addition, because attitudes toward renewable energy projects have been shown to differ between the general and the local populations, differences between attitudes of coastal and statewide respondents were examined. The results showed that the majority of both the statewide (52%) and the coastal (59%) respondents have positive attitudes toward wave energy development but that a large percentage (35% in the state and 23% on the coast) does not have enough information to form an opinion. Coastal Oregonians seem to be slightly more informed about wave energy development and to have better defined opinions than respondents coming from elsewhere in the state. The literature often ascribes local negativity to the NIMBY (Not In My Back Yard) syndrome, according to which local opposition arises from the perceived negative consequences regarding noise and visual impact, despite strong support for renewable energy

developments at the national/statewide level (Devine-Wright, 2005b; Krohn and Damborg, 1999). Our results imply that local negativity could be attributed to differences in values and value orientations between the local and the statewide populations. This finding has important policy implications. It suggests that although the general opinion toward renewable energy developments may be predominantly positive, policy makers need to examine in detail the attitude determinants of the local to the proposed project populations. Typically, renewable energy projects are proposed for development in rural areas; in the U.S., the best places for wind energy development are the windy planes of the rural Midwest, the best physical resource for wave energy development is off the rural Pacific coast, and the best locations for biofuel plants are near wooded or agricultural rural areas.

The findings here show that the coastal rural communities in Oregon, because of their reliance on natural resource extraction – fishing, logging, and agriculture – have built a different relationship with nature, and therefore, have a different view of it than do the majority of statewide respondents. Fifty-nine percent of the coastal, as opposed to only 42 percent of the statewide respondents, have anthropocentric value orientations. Anthropocentric value orientations define the basic goals for humanity as ever-increasing economic development and material well being through technological advances (Dunlap and Van Liere, 1978). Agreement with statements designed to measure one's anthropocentric value orientations, including "humans were meant to rule over nature" and "humans have the right to modify the natural environment to suit their needs," comes predominantly from rural residents, who are used to relying on

nature's "fruits" to sustain their livelihoods. And although these rural respondents may not understand how the new renewable technologies work, what they do understand is that these technologies involve some form of human intervention and an extraction process; and that in order to "harness" the power of wind or waves, humans need to be able to "rule over nature."

This perception of renewables, however, should not leave one with the impression that rural communities are only interested in techno-economic advancement. On the contrary, because of their strong ties to nature, rural communities have learned how to care about the biosphere and the species they depend on. Some wave energy developers even compare fishermen to farmers, saying they all deeply care about nature and natural resource conservation (Gardner, 2009). Our results support that observation because they show that respondents with both biocentric and anthropocentric value orientations have predominantly positive attitudes toward wave energy development. However, one-fifth of the coastal respondents with biocentric value orientations have negative attitudes towards wave energy development, compared to only two percent of the statewide sample with biocentric value orientations. This finding suggests that rural, coastal residents with biocentric value orientations are especially worried about the possible negative impacts of any energy extraction devices on the biosphere and the species in their proximity. Designing policies that would lead to the faster acceptability of renewables, therefore, would need to start with providing information about the possible environmental impacts and socioeconomic costs and benefits of renewable energy

developments at the local level, and then become more inclusive and target the national/statewide population, which although not well informed about the technologies, is more supportive of renewable energy developments in principle.

The findings also suggest that alternative theoretical measures of renewable energy attitudes would need to be sought that capture better the nature of renewables as a sustainable type of energy extraction. Neither the six-item NEP scale, nor the postmaterialism approach reflects the ideas behind the nature of renewables. Designed to capture values and value orientations, which were developed as a result of socioeconomic transformations in the 60s and 70s, these two approaches do not capture the complexity of issues embedded in the perceptions and values of renewables. While the postmaterialism approach links support for environmental protection to prosperity and security (Inglehart, 1995), the New Ecological Paradigm explains the rise of environmental concerns with increased awareness about air and water pollution, species extinction, and environmental degradation. In addition, the NEP tends to be critical of new technologies and embodies the view that scientific progress has come at a great cost to the environment.

The issues surrounding renewable energy development and climate change, however, go beyond the problems prevalent in the 60s and 70s. First, it has become clear that there are numerous uncertainties and gaps in our knowledge about nature as "a system with countless embedded and networked subsystems" (Steel et al., 2003: 14). Often, policy decisions need to be made in the presence of conflicting knowledge claims and uncertainty of consequences. Second, while until recently economic

models did not include the cost of natural resources and accounted for pollution and resource degradation as externalities; the realization about the finite nature of natural resources is transforming those models. Third, the ideals and values that made people participate in the environmental movement and request environmental protection from economic development, are changing. Rather than being motivated by environmental concerns about their immediate environment or because of a desire for a clean, safe and beautiful environment today, people have come to the realization that natural disasters in one place affect human health and well being almost anywhere else. Renewable energy values are not just environmental types of values, but are much more complex because they transcend human knowledge and ideas about "today," "here," and "now." They capture not only human perceptions of the interaction between nature, science, and technology but also human responses to risk, which has been shown to "be less than fully rational" (Steel et al., 2003:14). As the results presented here show, more specific beliefs related to energy policy and energy use, tend to be indicative of attitudes toward renewable energy developments. However, better measures that embody the nature of renewable energy as a sustainable resource are needed. New theoretical approaches that account for the changes in human environmental values and understanding that not only do we have a stewardship responsibility to earth's resources but we are "a part of and totally dependent on nature," and that our success depends not only on how well we manage the earth's systems for our benefit and the rest of nature, but on learning "how nature sustains

itself and integrating such lessons from nature into the ways we think and act" (Miller and Spoolman, 2009: 662).

Another assumption that may require theoretical revision is related to the structure of attitudes. Research maintains that individuals who support environmental attitudes in a specific domain will tend to support those attitudes in other domains (Pierce and Lovrich, 1980). Based on this assumption, we expected respondents with pro-environmental attitudes (i.e., those who are more concerned about the human impact on the environment) to be aware of rising global temperatures, to believe in the anthropogenic causes of the temperature rise, and also to be supportive of renewable energy developments. The results did not match our expectations. Quite surprisingly, we found more differences than similarities in the profiles of respondents who believe global warming is happening and it is human caused, and those who support renewable energy developments. These are two most likely explanations. First, it is quite possible that the nature of the two attitudes really differs. However, it is also possible that these differences stem from the lack of mental connections between global warming and renewable energy development.

Based on the multiple regression analyses, we constructed a table that presents more clearly the differences in sociodemographic characteristics, values, value orientations, ideological preferences, knowledge, and beliefs between respondents who are aware of global warming and believe it is human caused, and those who have positive attitudes toward wave energy development. As Table 5.1 shows while mostly the young respondents, the women, the well educated, and those with low household

incomes, are more convinced that humans are the main cause of warming; it is the old respondents, the men, the less educated, and respondents with high household incomes who are more supportive of wave energy development. These two segments also differ regarding their values and value orientations.

TABLE 5.1. Differences in determining factors between climate change awareness, beliefs, and renewable energy attitudes.

Attitude determinants:	Climate change awareness of the evidence and beliefs it is human caused:	Positive attitudes toward wave energy development:
Sociodemographic variables:		
Age	Younger	Older
Gender	Women	Men
Education	More	Less
Income	Less	More
Ideology:	Liberal	Conservative
Values and value orientations:		
Postmaterialism	Postmaterialist	Mixed/Materialist
NEP/DSP	NEP	DSP
Specific beliefs:		
Concerned about foreign ownership of our energy resources	Less concerned	More concerned
Not enough money is spent on R&D of alternative fuels	Agree more	Agree more
It is possible to increase energy supplies while protecting the environment	Agree more	Agree more
Evidence of warming	N/A	More agree
Technological familiarity with wave energy	N/A	More familiar

Note: A table with the regression estimates for each variable and their level of significance is provided in Appendix 3

People who have postmaterialist values and biocentric value orientations tend to be more aware about rising temperatures and to believe more strongly that humans are the main cause for temperature rise than those with more mixed/material values and anthropocentric value orientations, who are more supportive of wave energy development. Moreover, while one's biocentric value orientations explain better climate change beliefs, materialist/mixed values seem to be a better correlate of renewable energy attitudes. Still, as we saw in Chapter 1, the majority of respondents with materialist values claim they do not have enough information to form an opinion about wave energy development yet or have 'neutral' attitudes.

A key difference between the climate change believers and renewable energy supporters was found in the influence of political ideology on attitudes. While ideology is the major determinant of one's awareness about the existence of and beliefs in the human causes of climate change, political ideology is not a significant predictor of support for renewable energy developments. As some researchers explain, the polarization of the global warming debate is reflected in issues typically divisive for Americans (Hamilton, 2010).

The profiles of the *Alarmed* and the *Dismissive* Americans, described in studies conducted by researchers at the Yale Center for Climate Change Communication, are at two opposite extremes regarding agreement that climate change is happening, that it is human caused, and ideological preferences (Maibach et al., 2009). As we saw in Chapter 3, while the *Alarmed* have mostly liberal policy preferences, an overwhelming percentage of the *Dismissive* have conservative policy

preferences (81%). Such differences reflect ideological preferences on most U.S. policy issues. For example, people who believe climate change is happening and it is human caused, are much more likely to believe in equal wealth distribution, to support welfare programs and to be in favor of government regulation of business and protection of the environment over economic growth than those who don't believe in climate change (Leiserowitz et al., 2010b). Therefore, research concludes, opinions on global warming instead of being based on facts and scientific evidence about the existence and the causes of global warming, are "filtered through an opaque ideological lens" (Hamilton, 2010: 111).

Because accurate understanding of climate science has been found as the main criterion for acceptance of climate policy, and because citizen familiarity with and knowledge of the energy and environmental issues have been singled out as the main motivating factors for acceptance of renewable energy developments and conservation behavior, it has been suggested that the ideological filtering of the climate change debate needs to be reframed in a way that it captures better the polarization of the climate issue (Zia and Todd, 2010). Based on longitudinal studies that show that individuals with liberal policy preferences tend to favor government policies on the so-called "butter" issues – education, health care, and social welfare; and that citizens with conservative preferences tend to support more "guns" issues, including defense and security (Wood and Vedlitz, 2007), it has been suggested that perhaps, reframing the climate issue to better match one's conservative policy preferences as an issue that is of direct threat to national security or as "a stabilizing response to economic

uncertainty" (Zia and Todd, 2010: 16) may serve as a strong motivator to people inclined to support "guns" issues in general.

Perhaps, one of the reasons for having a strong support for renewable energy development from people with conservative policy preferences could be attributed to the way renewable energy issues have been framed as being directly related to U.S. energy security. The findings of this research support that assumption. More specifically, our results show that people who are concerned about foreign ownership of energy resources tend to be supportive of wave energy development; while those who are less concerned, tend to be more aware that global warming is happening. In the words of President G.W. Bush, foreign ownership of U.S. energy resources and dependence on foreign oil present "a problem from a national security perspective" (White House News Release, 2008). Therefore, increasing awareness of and concern about global warming may be achieved by showing the climate change problem as a threat to one's health and economic security, rather than presenting it only in terms of affecting human health and environment in general. In that way, the attested perception of climate change as being removed in space and time (i.e., that it will affect people in faraway places and future generations) maybe brought closer to home, and motivation to act maybe increased (Lorenzoni and Pidgeon, 2006).

Eliciting citizen understanding of the climate change evidence is extremely important for policies designed for the adoption of renewable energies, especially in light of the findings that awareness of global warming and level of familiarity with the technology are statistically significant determinants of support for wave energy (Table

5.1). As research presented in Chapter 2 has acknowledged, the biggest challenge for wave energy adoption is “low public knowledge” (Hansen et al., 2003: 5). Renewable energies could be adopted faster if citizen understanding of the way the technologies work is increased. As research on public opinion of new carbon technologies has shown, perceptions of carbon sequestration are influenced by knowledge of the technology, and beliefs that climate change is happening and that it is human caused (Lorenzoni and Pidgeon, 2006).

Providing factual information and educating the public about the technologies, however, is not enough. As the literature on climate change has acknowledged, although providing factual information about the causes and consequences of climate change is a good starting point it would not lead to the desired attitude change (Bittle et al., 2009). Overcoming denial and making changes in habits and lifestyles will need to be the second, and most difficult, step; which would also take the longest time. However, only after that second step is made, would people start looking for solutions and support immediate action.

Mallon (2006) describes the renewable energy policy development process as the convergence of three paths that industry, government, and [civil] society need to travel in order for the renewable energy sector to start taking significant market share. The civil society path starts from the premise that citizens are unaware of climate change issues but aware of the existence of renewable energy as a possibility. Citizens then become aware of climate impacts and the causes (fossil fuels) and solutions (renewable energies), and start questioning the cost of the human impact for the

present and future generations. At that point, people start seeking action on carbon reduction or compensation and become stakeholders in major renewable energy developments. Subsequently, renewables take off (Mallon, 2006). In this description of the renewables adoption process, two points deserve attention. First, the presumption that citizens are unaware of climate change at the beginning of the process, and second, that policy action is to be expected only after people become aware of alternative to fossil fuel solutions and realize the cost of their impact.

The first point raises questions about the ways in which knowledge is acquired and acted upon – "[r]ather than starting with any expectations about the knowledge that the public should possess, it [i.e. the discussion on global warming] takes ignorance as the starting point and the norm" (Ungar, 2000: 298). The lack of knowledge of the causes and consequences of climate change has been identified as one of the main barriers that currently prevent Americans from saving more energy (Leiserowitz, 2007b). The need for citizen knowledge and understanding is part of the civil society model, in which democratic governance is achieved through informed citizen participation in policy decisions. As stated, "Only a participatory approach to policy making can incorporate the needs of all segments of society, future generations, and other species"(Paehlke, 1996: 19). Despite the importance of an informed citizenry for effective governance, there has been a substantial decline in knowledge at the individual level (Delli Carpini and Keeter, 1991). In addition, the growth of specialized knowledge in some areas has led to a complete disregard of information in others, leading to the so-called "knowledge-ignorance paradox" (Ungar, 2000).

These cognitive differences once again underscore the importance of taking into account personal values and preferences, embedded in the context, in which climate change decisions are made. Traditional ways of science and policy-making that do not capture the complexity of our understanding of the ecological functioning of the natural systems and the human role within those systems have been proven unable to come up with effective solutions (Whitmarsh, 2009a). This necessitates a thorough examination of our human ecological values and beliefs in relationship to our understanding of the problems and solutions to climate change. Achieving policy action, as defined by Mallon's (2006) second point, is to be expected only after people become aware of alternative solutions and realize the cost of fossil fuel impacts. In other words, knowledge of existing options and motivation to act, go together. This proposition implies that people need to acknowledge the cost of both short and long-term solutions, in addition to the cost of inaction. To do that, they need to understand not only the short and long-term consequences of increased energy consumption, but also they need to be aware of conservation and renewable energy options. That is why, when seeking energy policy solutions, people's level of climate knowledge needs to be assessed, in addition to the motivations that determine their attitudes and possibly their actions. As this research shows, citizens are mostly well aware of the existence and the causes of climate change, however, they are not motivated to take action because some of these reasons seem distant or not acceptable to them.

Admitting that intense consumption of natural resources leads to increased CO_2 emissions and climate change, is equal to public recognition of one's personal fault,

and requires policy and personal action. That is why educating the public about how their personal energy consumption patterns affect the environment is an important first step. Reiterating that even individual actions of reduced consumption contribute to decreasing harmful emissions and slowing temperature rise, is the next significant step. The third, and most significant step is increasing motivations to act and empowering people to make behavioral changes. This third step may start with providing more information and educating the public to reframe the issues along ideological lines (Hamilton, 2010; Lorenzoni and Hulme, 2009). In addition, it will also require giving them the tools by showing them the concrete steps they can take on a daily basis. Energy use and personal consumption footprint calculators, taught in sustainability courses at some schools and universities are excellent starting points, which would only have long-term effect if they become embedded in our understanding of how we affect the environment, and also become part of our personal consumption behavior.

In creating strategies for the adoption of renewables, policy makers should first bridge the gap between citizen motivations to act on climate change and understanding of the need for renewable energy developments. Despite the major differences in values, value orientations, ideological, and sociodemographic characteristics between respondents who are aware of the existence and the causes of climate change, and those who support renewable energy developments, there are a couple of specific beliefs that are shared between these two segments: 1) agreement with the possibility of increasing energy supplies while protecting the environment, and 2) agreement that

not enough money is spent on research and development of alternative fuels. In crafting policies for the adoption of renewables, policy makers would perhaps be more effective if they stressed these two consensual issues at the beginning, and then framed the debate so as to provide understanding in terms of the differences. Despite the fact that debates about energy policy issues will continue for years to come (Smith, 2002), climate mitigation strategies require not only policy makers, but also citizens to act fast, and to act now. Climate change is not the typical policy issue, requiring three things to become prominent on most agendas: 1) *scope* – it affects a lot of people; 2) *intensity* – its impact is sharp, and 3) *a triggering mechanism* – an accident or a dramatic event to spark action (Baker, 2002). It should be clear that if we don't take action before going over the tipping point where too many people are dramatically affected by accidents and natural disasters – flooding, hurricanes, droughts – it may be too late for us to come up with solutions.

This dissertation provided a description and a ranking of the relative importance of the major determinants of public opinion with regard to renewable energy development. One of the major difficulties encountered relates to the multidisciplinary nature of the concepts and the lack of consensus on a single definition and method for their measurement. Tracking the origins and understanding the changes in meaning of the term public opinion has been defined as "one of the most frustrating of all projects in intellectual history" (Herbst, 1995: 90). Researchers assure us that regardless of how hard we look for a clear definition of public opinion, our efforts will "prove fruitless" (Price, 1992: 4). The lack of a definition is not due to the lack of effort,

however. For example, as early as 1965, Childs, one of the early researchers of public opinion, had collected more than 50 different accounts of the meaning of public opinion, making it clear that the literature in the field is indeed "strewn with zealous attempts" at definitions (Childs, 1965: 14). The same lack of unified concepts and clear variable specifications relates pretty much to all of the terms and concepts used in this dissertation.

Renewable energy itself, as a relatively new multidisciplinary concept, creates confusion as well – not only in respondents' minds (as we saw, people with biocentric value orientations are still unsure about their attitudes toward renewable energy development), but in the ways it is measured. The exciting part is that although research on renewable energy attitudes is a relatively new scientific domain, it is full of both theoretical and policy-relevant ideas. However, the sad part is that most of those ideas serve as interesting discussion points in the circles of academia, but do not reach the eyes and the ears of either the general public or of the policy makers. Our goal as researchers, therefore, should not be to just clearly define ideas on paper, but also to make those ideas publicly available and widely debated. If only citizens spent a minute a day thinking about their contribution to global warming, and if only policy makers spent an hour a day devising and implementing strategies for climate change mitigation…we might have a greener planet… some day.

Appendix 3

TABLE 5.2. Regression estimates for determining the differences in factors between climate change awareness, beliefs, and renewable energy attitudes.

	Awareness that the earth is getting warmer	Belief that the Earth is getting warmer because of human activity	Support for wave energy development
	Coefficient (SE)		
Age	-.018 (.010)	-.023 (.013)	.014 (.008)
Gender	.178 (.369)	.274 (.377)	-.458 (.290)
Education	-.252 (.137)	.370* (.149)	-.149 (.120)
Income	.006 (.086)	-.260* (.110)	.196* (.077)
Ideology	-.648** (.218)	-.500* (.243)	.191 (.168)
Postmaterialist=1, all else=0	.628 (.429)	.144 (.452)	-.970**(.313)
Materialist =1, all else=0	-.535 (.399)	.586 (.494)	-.137 (.389)
NEP	.192*** (.034)	.221*** (.041)	-.025 (.034)
Dependence	.375 (.222)	-.136 (.285)	-.095 (.153)
Foreign ownership	-.449* (.226)	-.366 (.287)	.473* (.189)
Not enough resources	.156 (.118)	-.017 (.160)	-.003 (.108)
Personally affected	.160 (.138)	-.323 (.192)	.022 (.130)
R&D	-.056 (.162)	.723*** (.217)	.704*** (.187)
Protect	.395* (.159)	-.297 (.257)	.492** (.162)
Technology	-.131 (.158)	.142 (.206)	-.297 (160)
Evidence[1]			3.150* (1.370)
Cause[1]			-.275 (.408)
Knowledge[2]			.099 (.173)
Familiarity[2]			.758*** (.191)
Constant	.807 (1.722)	-.665 (2.474)	-10.199***(2.304)
% Cases Predicted	86.6%	84.3%	68%
Chi-Square	155.571***	206.602***	87.023***
Nagelkerke R2	.447	.625	.300
N=	509	362	344

[1]The coding for these two variables: evidence and cause is described in Article 3, Table 4.4.
[2]The coding for these two variables: knowledge and familiarity is described in Article 2, Table 3.4.
Significance level *p≤.05; ** Significance level p≤.01; *** Significance level p≤.001.

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APPENDIX 4: OREGON ENERGY POLICY SURVEY

Oregon Energy Policy Survey

Please return surveys to:

Oregon Energy Policy Survey

Master of Public Policy Program
311 Gilkey Hall
Oregon State University
Corvallis, Oregon 97331-6206
541-737-2811

ID # _____
[for mailing purposes only]

SECTION 1

In this first section of the survey we would like to ask you some general questions about your interest, activities, and knowledge about energy and environmental policy issues. Please circle the number that most closely represents your view.

Q-1 In general, how well informed would you consider yourself to be concerning renewable energy policy issues in Oregon—such as wind, solar, wave, and biomass energy?

1. Not informed
2. Somewhat informed
3. Informed
4. Very well informed

Q-2 How often do you talk about issues related to renewable energy with your family, friends, or other acquaintances?

1. Never
2. Hardly ever
3. Sometimes
4. Often

Q-3 Overall, how much impact do you think PEOPLE LIKE YOU can have in making Oregon's energy policy?

1. No impact at all
2. A small impact
3. A moderate impact
4. A big impact

Q-4 How familiar are you with specific renewable energy technologies including biofuel, wind, solar, geothermal and wave energy? Please circle the number of your response.

		Not Familiar	**Somewhat Familiar**	**Familiar**	**Very Familiar**
a.	Biofuels (e.g. ethanol, etc.)	1	2	3	4
b.	Wind energy	1	2	3	4
c.	Geothermal energy	1	2	3	4
d.	Solar energy	1	2	3	4
e.	Wave energy	1	2	3	4

Q-5 How much do you agree or disagree with the following statements concerning energy policy?

		Strongly Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Strongly Agree
a.	Decreasing our dependence on foreign oil and gas is important to our national security.	1	2	3	4	5
b.	I am concerned about foreign ownership of our energy resources.	1	2	3	4	5
c.	I am concerned that our country doesn't have enough energy resources.	1	2	3	4	5
d.	I am concerned about being personally affected by shortage of electricity in the next five years.	1	2	3	4	5
e.	Not enough money is being spent on research and development of alternative fuels.	1	2	3	4	5
f.	It is possible to increase energy supplies while protecting the environment at the same time.	1	2	3	4	5
g.	New technologies will make it possible to have enough electricity for all of us in the future.	1	2	3	4	5

Q-6 Here are a few specific questions about energy. Many people don't know the answers to these questions, so if there are some you don't know just leave them blank and continue.

a. The largest source of energy for electricity in Oregon is:

1. Coal
2. Hydroelectric
3. Natural Gas
4. Nuclear

b. Most electricity in Oregon is used by the:

1. Residential Sector (e.g., households)
2. Commercial Sector (e.g., retail stores)
3. Industrial Sector (e.g., factories and mills)
4. Transportation Sector

c. Being “off-grid” means:

1. Producing one’s own electricity
2. Getting electricity from another state
3. Having no electricity
4. Being energy efficient

Q-7 Wave energy refers to the extraction of electricity from the up-and-down motion of ocean waves using buoys or devices in the form of “wave energy farms.” What is your general attitude toward the development of wave energy off of the Oregon coast?

1. Very positive
2. Positive
3. Neutral
4. Negative
5. Very negative
6. Do not have enough information to form an opinion.

Q-8 We would like to know which of the following information sources you currently use or would use to learn more about Oregon's energy situation and policy. Please circle the number of the frequency of your use.

		Never	Infrequently	Frequently	Very Frequently
a.	Television news programs and specials	1	2	3	4
b.	Oregon Public Broadcasting	1	2	3	4
c.	Radio programs	1	2	3	4
d.	The *Oregonian* newspaper	1	2	3	4
e.	Other local newspapers	1	2	3	4
f.	Local community leaders	1	2	3	4
g.	State elected officials	1	2	3	4
h.	Oregon Department of Energy	1	2	3	4
i.	Universities and colleges	1	2	3	4
j.	Utilities	1	2	3	4
k.	Environmental groups	1	2	3	4
l.	Information available on the Internet	1	2	3	4
m.	Other? _____ (please list)	1	3	3	4

SECTION 2

This section of the survey concerns your attitudes toward the environment and politics. Please circle the number that most closely represents your view.

Q-9 Listed below are statements about the relationship between humans and the environment. For each, please indicate your level of agreement.

		Strongly Disagree	Mildly Disagree	Neutral	Mildly Agree	Strongly Agree
a.	The balance of nature is very delicate and easily upset by human activities.	**1**	**2**	**3**	**4**	**5**
b.	Humans have the right to modify the natural environment to suit their needs.	**1**	**2**	**3**	**4**	**5**
c.	We are approaching the limit of people the earth can support.	**1**	**2**	**3**	**4**	**5**
d.	The so-called "ecological crisis" facing humankind has been greatly exaggerated.	**1**	**2**	**3**	**4**	**5**
e.	Plants and animals have as much right as humans to exist.	**1**	**2**	**3**	**4**	**5**
f.	Humans were meant to rule over the rest of nature	**1**	**2**	**3**	**4**	**5**

Q-10 From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades, or not?

1. Yes (go to Q-11)
2. No (go to Q-12)
3. Don't know (go to Q-12)

Q-11 Do you believe that the earth is getting warmer…?

1. Mostly because of human activity such as burning fossil fuels.
2. Mostly because of natural patterns in the earth's environment.
3. Don't know

Q-12 On domestic policy issues, would you consider yourself to be?

1. Very Liberal 2. Liberal 3. Moderate 4. Conservative 5. Very Conservative

Q-13 There is a lot of talk these days about what our country's goals should be for the next ten or fifteen years. Listed below are some goals that different people say should be given top priority. Please mark the one you consider the most important in the long run. What would be your second choice? Please mark that second choice as well.

		1st Choice (circle one)	**2nd Choice** (circle one)
a.	Maintaining order in the nation.	1	1
b.	Giving people more say in important governmental decisions.	2	2
c.	Fighting rising prices.	3	3
d.	Protecting freedom of speech.	4	4

SECTION 3

We now have a few concluding questions to check if our survey is representative of all types of people. Please remember that all answers are completely confidential to the extent permitted by law.

Q-14 What is your current age in years _____ ?

Q-15 Please indicate your gender? 1. Female 2. Male

Q-16 What level of education have you completed?

1. Grade School
2. Middle or junior high school
3. High school
4. Vocational school
5. Some college
6. College graduate
7. Graduate school
8. Other _____ ?

Q-17 How long have you lived in Oregon? _____(in years)

Q-18 Which of the following best describes your current work situation?

1. Employed full time
2. Employed part time
3. Not employed outside the home
4. Unemployed
5. Retired
6. Other _____ ?

Q-19 Which category best describes your household income (before taxes) in 2007?

1. Less than $10,000
2. $10,000 - $ 14,999
3. $15,000 - $24,999
4. $25,000 - $34,999
5. $35,000 - $49,999
6. $50,000 - $74,999
7. $75,000 – $99,999
8. $100,000 – $149,999
9. $150,000 – $199,999
10. $200,000 or more

Those are all the questions we have. If you have any additional comments, please include those on a separate piece of paper. Thank you for your precious time.

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