



## AN ABSTRACT OF THE THESIS OF

Maria Lewis Hunter, for the degree of Master of Science in Water Resources Policy and Management presented on June 3, 2013

Title: WATER, ENERGY, AND ECOSYSTEM SERVICES: A STUDY OF BUSINESSES IN OREGON'S WILLAMETTE VALLEY

Abstract approved:

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Mary V. Santelmann

This study uses interviews with 18 businesses in Oregon's Willamette Valley to explore business investment in the environment, and how this relates to ecosystem services, payment for ecosystem services programs, and the water-energy nexus. Our research led us to outline 5 factors that influence business investment in the environment, those factors being size, the champion effect, organizational culture, industry culture, and the geographic focus of a business. Of these factors, geographic focus is a unique contribution of our study. In addition, our research uses these interviews to explore issues within the water-energy nexus as well as to suggest a new conceptualization of energy as an ecosystem service of watersheds. Our findings suggest that while the size, the champion effect, organizational culture, industry culture, and geographic focus are important differences that distinguish businesses from one another, the water-energy nexus is a concern for many businesses, regardless of type. We anticipate that our results will not only contribute to the body of knowledge on these important issues, but will help guide future research in the areas of ecosystem services, energy, and the private sector.

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WATER, ENERGY, AND ECOSYSTEM SERVICES:  
A STUDY OF BUSINESSES IN OREGON'S WILLAMETTE VALLEY

by  
Maria Lewis Hunter

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

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Maria Lewis Hunter, Author

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## INTRODUCTION

Ecosystems supply a multitude of resources and processes that sustain and support human life. These resources and processes are referred to as ecosystem services, and nearly every product or function of society relies on them in some way. We all require healthy air to breathe, clean water to drink, and healthy soil in which to grow our food. But even the more complex functions of society, such as energy production, manufacturing, and information technology rely on ecosystem services. Without healthy, robust ecosystems, these essential functions would cease to exist (Daily, 1997).

Unfortunately, many of the world's ecosystem services are degraded or overused, with the Millennium Ecosystem Assessment (2005) estimating that over 60% of global ecosystems are in peril. This situation is only likely to worsen, particularly in light of global population growth, developing economies, and climate change. The loss or partial collapse of these ecosystem services will likely result in freshwater scarcity, food insecurity, the increased spread of infectious diseases, increased damage and destruction from natural disasters, political instability, and increased global conflicts – just to name a few (MEA, 2005).

Payment for ecosystem services, or PES, is a market-based mechanism that provides payments to landowners in exchange for managing their lands in ways that protect ecosystem services. This involves both accurately valuing the worth of these services, and arranging payment programs that are effective and successful at protecting ecosystem services without providing perverse incentives. The precise nature and shape of these programs varies depending on the parties involved, the ecosystem service to be protected, and geographical, logistical, and political constraints.

The original purpose of this study was to investigate how the private sector – businesses and corporations – could be engaged in PES programs in Oregon's Willamette Valley. Until recently, interest in PES has primarily been from governmental agencies and non-

profit conservation organizations. However, the private sector holds much potential for investment in ecosystem services, and this study originally sought to understand the motivations, barriers, and incentives businesses face when investing in PES programs. However, the course of our research led us in a different direction, and two areas of inquiry emerged: understanding the meaningful differences among businesses in regards to how and why they invest in the environment, and the significance of the water-energy nexus for the business community.

The two papers presented here summarize the results of our study and propose some promising new areas of inquiry. It is our hope that this study will both advance our understanding of how businesses relate to the environment, as well as provide a means by which the business community can be engaged in PES programs. In addition, our study furthers our understanding of how businesses and corporations approach energy and water use. We anticipate that our results will not only contribute to the body of knowledge on these important issues, but will help guide future research in the areas of ecosystem services, energy, and the private sector.

BUSINESS ENGAGEMENT IN PAYMENT FOR ECOSYSTEM SERVICES:  
A STUDY OF OREGON'S WILLAMETTE VALLEY

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## ABSTRACT

This study explores business investment in payment for ecosystem services (PES) programs, using Oregon's Willamette Valley as a case study. The overall guiding research question was, "What are the meaningful differences between businesses in regards to how and why they invest in the environment, and how can this inform business investment in PES?" Using interviews of business owners and managers within the Willamette Valley, this study sought to discover what motivates businesses to participate in PES programs and if there are meaningful differences among businesses that influence how they invest in the environment. Interviews with 18 participants in the Willamette Valley indicate that a number of factors influence business sustainability activities and interest in PES opportunities. Our study identified five of these factors – size, the champion effect, organizational culture, industry culture, and geographic focus – of which geographic focus is an original and important contribution. In addition, our study proposes a method in which these factors influence each other and contribute to overall business engagement in environmental sustainability.

Keywords: payment for ecosystem services, PES, ecosystem services, business, investment, private sector, Willamette Valley

## INTRODUCTION

Ecosystem services are the benefits to humankind provided through the natural processes of ecosystem functions (Daily, 1997). The Millennium Ecosystem Assessment (MEA, 2005) organized ecosystem services into four categories: *provisioning*, such as the production of food and water; *regulating*, such as the control of climate and disease; *supporting*, such as nutrient cycles and crop pollination; and *cultural*, such as spiritual and recreational benefits (MEA, 2005; Waage et al., 2012). Unfortunately, over 60% of the earth's ecosystems are becoming increasingly degraded and overused, and their ability to deliver ecosystem services has been compromised (MEA, 2005). Payment for ecosystem services, or PES, is a market-based mechanism that attempts to protect and restore these services by assigning a monetary value to the benefits they provide (Gómez-Baggethun et al., 2009; Tallis et al., 2008; Vickerman, 1999).

Much of the attention surrounding PES has focused on the public sector (primarily government agencies) and the voluntary sector (primarily non-governmental organizations, or NGOs); private sector investment in the form of businesses and corporations has received less attention (Waage et al., 2007). Yet many businesses are coming to understand that environmental stewardship may be critical to ensuring their longevity and managing risk over time, particularly in the face of increasing resource scarcity. Other potential benefits to businesses include, but are not limited to, regulatory compliance, cost savings, and creating a favorable relationship with the community (Gutman & Davidson, 2007; Waage et al., 2007; Hanson et al., 2008). Private sector investment in PES is still in embryonic stages (Tallis et al. 2008), yet the private sector represents a crucial opportunity for investment in ecosystem services. The scale of payments available from the private sector is vastly greater than that of the public and voluntary sectors (Mulder, 2006; Waage et al., 2007), and businesses have much to contribute in terms of expertise, networking, and innovation (Perrot-Maitre, 2006; Gutman & Davidson, 2007). Widespread business investment in PES could be transformative; it could effectively shift the discussion of environmental initiatives from isolated, discrete actions to cumulative, system wide approaches (Waage et al., 2012).



The study presented here uses interviews with owners and managers of businesses in the Willamette Valley of Oregon, USA, in an effort to contribute to the body of knowledge on business investment in PES. We begin by identifying important gaps in the literature and critical needs for advancing this research agenda, and propose a number of factors to help guide further inquiry aimed at understanding how and why businesses choose to invest in the environment. We anticipate that our work will both advance understanding of how businesses relate to the environment and the community, as well as help researchers and environmental advocates understand how best to engage different businesses in PES programs.

## BACKGROUND

### PUBLIC SECTOR INVESTMENT

People are most familiar with the concept of PES through actions in the public sector. In the US, the best-known examples of public investment in PES include the Conservation Reserve Program and other programs of the US Department of Agriculture, which have existed for decades (Sullivan et al., 2004). In other countries, long-term public investment has been conducted through programs and policies such as the Quito Water Fund in Ecuador and the Sloping Land Conservation Program in China (Tallis et al., 2008). More recently, the public sector in the US has experienced notable success with PES through partnerships between local utilities and the US Forest Service aimed at preserving water quality (Greenwalt & McGrath, 2009; Ruhl & Salzman, 2007). Water utilities in New York and Denver have successfully implemented programs in which funds from utility ratepayers go towards assisting the USFS in forest and watershed protection (Greenwalt & McGrath, 2009). In the Pacific Northwest of the United States, Clean Water Services, a wastewater utility near Portland, Oregon, has piloted a program in which local landowners are compensated for planting shade trees along the Tualatin River (Abdalla, 2008; Cochran & Logue, 2011).

### VOLUNTARY SECTOR INVESTMENT

Voluntary sector investment in PES has often taken the form of conservation actions undertaken by non-governmental organizations, or NGOs. Preserving ecosystem services has long been a goal for many of these organizations, even before PES was a named concept (Tallis et al., 2008). These organizations have played an essential role in coordinating efforts and brokering arrangements for the preservation of ecosystem services and the advancement of environmental initiatives (Breckenridge, 1999). However, reliance upon the voluntary sector to carry the burden of preserving and restoring ecosystem services means that these services may be under-valued, and may lack sufficient funding to truly maintain their functions (Farley & Costanza, 2010).

## PRIVATE SECTOR INVESTMENT

The private sector is a more recent entrant into the ecosystem services market. Privately backed PES programs have included international buyers of carbon credits, private water utilities, water quality protection, and ecotourism companies (Gutman & Davidson, 2007; Waage et al., 2007; Perrot-Maitre, 2006; Hanson et al., 2008). However, the private sector remains a relatively untapped resource in terms of investment in PES (Mulder, 2006; Perrot-Maitre, 2006; Gutman & Davidson, 2007; Waage et al., 2007), and the programs noted above have largely been exceptions rather than the rule (Gutman & Davidson, 2007).

## KNOWLEDGE GAPS CONCERNING PRIVATE SECTOR INVESTMENT

Although the private sector holds much promise as a source of funding for investment in PES, the lack of an organizing framework to structure our inquiry has hampered our ability to identify various factors that may influence corporate involvement in market-based programs. For example, much of the literature on business investment in the environment fails to distinguish among different types of corporations and enterprises. Also absent from the discussion are considerations of the geographic or social context in which a business operates. In most analyses to date, the business community is characterized as fairly homogenous, with common motivations, values, and incentives (Jenkins, 2006; Moser, 2001). Yet, preliminary research suggests that this assumption is far too broadly stated (Mulder, 2006; Moser, 2001). For private enterprises, managing ecosystem services is not merely an issue of public image; rather, how a business interacts with the environment impacts the regulatory control to which a business is subject, financial risks as a result of pollution and climate change, and the availability of resources necessary for operations (Gerbens-Leenes & Hoekstra, 2008; Waage et al., 2007).

## CURRENT UNDERSTANDING OF BUSINESS INVESTMENT

Much of the research on corporate environmental stewardship identifies size as a potential determinant regarding business investment in the environment. However, researchers differ in how they divide businesses according to size. Moser (2001) distinguishes private enterprises as being local companies, overseas independent companies, or multinational corporations. Jenkins (2006) makes only two distinctions: that of large corporations and small to medium enterprises (SMEs). Besser and Jarnagin (2010) define large businesses as having over 500 employees and small businesses as having less than this number. Regardless of where the lines of business size are drawn, most literature only discusses the relationship of large corporations to the environment; there is less documentation on the environmental stewardship efforts of smaller businesses (Besser & Jarnagin, 2010). Yet while the individual actions of a small business may be relatively insignificant, the collective actions of small businesses may in fact have a meaningful impact on the environment.

This discussion is also important because smaller businesses may in fact behave differently than larger businesses, particularly with respect to environmental stewardship. Research on smaller businesses has suggested that, although cost and government regulation are issues for all businesses, motivators for small businesses to engage in environmental initiatives may be primarily internal, centering on moral or ethical values, as opposed to external factors such as consumer pressure or public relations (Besser & Jarnagin, 2010, Jenkins, 2006, Gerbens-Leenes & Hoekstra, 2008). Conversely, large, multi-national corporations may experience greater stakeholder pressure and public scrutiny for their actions than smaller businesses, and therefore may put more value on having an environmentally friendly brand (Moser, 2001).

Another potential determinant that has received attention in the literature is what is known as the “champion effect.” The success or failure of environmental initiatives within an organization is often dependent on a “champion” who personally advocates for the cause (Jenkins, 2006; Preston, 2001; Wu & Wirkala, 2009). In the private sector, this

champion is often an owner, CEO, or high-level manager (Hemingway & MacLagan, 2004). These high-ranking executives are often in a position to make broad, company-wide decisions or to otherwise influence the culture of the business itself (Preston, 2001; Hemingway & MacLagan, 2004). While there are certainly instances of “bottom up” effects, in which lower-level employees initiate an environmental ethic, the research thus far seems to suggest that the far more powerful mechanism is a “top down” effect from high-ranking executives (Preston, 2001; Hemingway & MacLagan, 2004; Linnenluecke & Griffiths, 2010; Wu & Wirkala, 2009).

Organizational culture may also be a factor in how and why businesses invest in the environment. Organizational culture, loosely defined, is the set of values, beliefs, and norms inherent to a particular organization (Harris & Crane, 2002; Linnenluecke & Griffiths, 2010). Employees must “buy-in” to environmental values in order to have longevity within the business. If organizational values and norms do not support environmental responsibility, then even a passionate champion may have difficulty implementing environmental programs (Jenkins, 2006).

In contrast to organizational culture, industry culture deals with the values, beliefs, and norms inherent to a particular industry or field, including consumer expectations (Abrahamson & Fombrun, 1994). This has received significantly less discussion in the academic literature, but it may be just as important as organizational culture to understanding how businesses adopt environmental values. The potential for organizations to engage in environmental sustainability may be dependent on an industry culture that supports environmental values (Harris & Crane, 2002; Abrahamson & Fombrun, 1994). Additionally, the expectations of consumers for how an industry should behave toward the environment, such as the beverage industry’s relationship to water and water protection, is an important part of industry culture. It is also possible the businesses within an industry mimic each other in an environment of uncertainty and take cues from each other as to how to proceed in regards to environmental sustainability.

## RESEARCH NEED

Although some research has been done regarding business size, the champion effect, organizational culture, and industry culture, there has not been enough research to frame plausible hypotheses as to how these different factors influence business investment in PES. In addition, a number of gaps in the literature deserve attention. The most notable of these is role of the geographic focus of a business.

In terms of how businesses relate to the environment, the role of geography has received little discussion. Besser and Jarnagin (2010) have researched the influence of small towns on small businesses. Yet this discussion may not be comprehensive enough, as it does not compare businesses of various sizes, nor does it investigate how different locales other than small towns might affect business values. Geographic focus describes the physical scope of a business' reach; it may be local, regional, or multi-national. This has relevance to our research because geographic focus defines the scale at which businesses may perceive their relationship to the environment. A local business may perceive itself as being responsible for the welfare of a community and the local environment, whereas a multi-national business may perceive its social and environmental responsibility on a global scale.

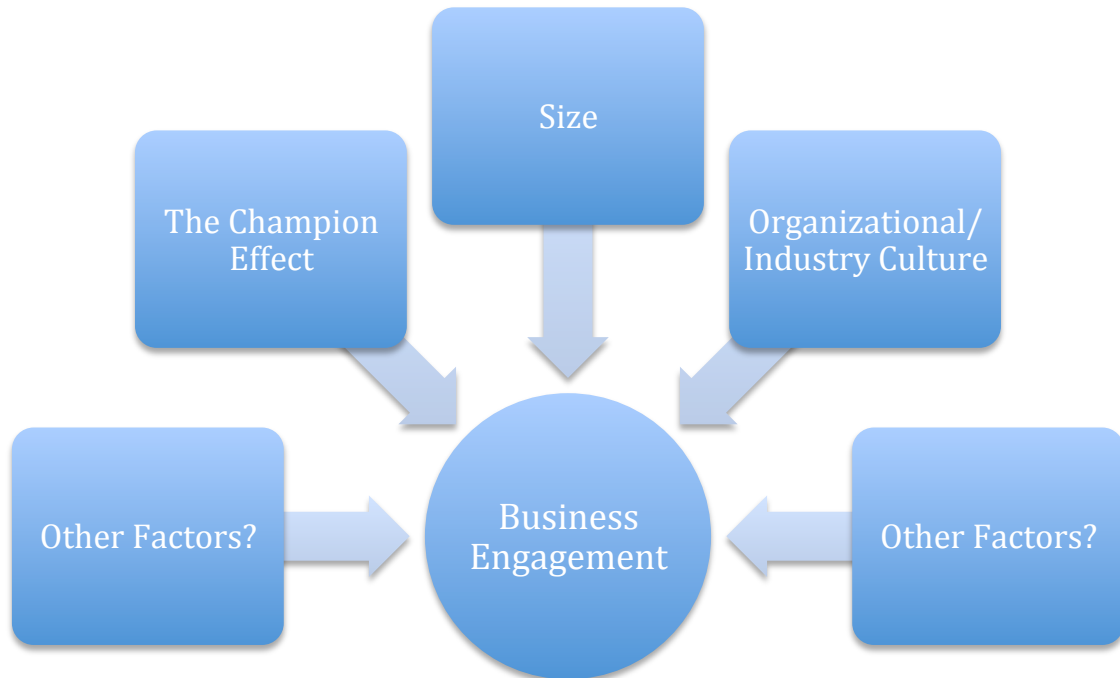


Figure 1.1 Current state of knowledge on factors that influence business engagement in environmental sustainability

Initially, this project sought to identify the motivations, barriers, and incentives that businesses face when investing in the environment. To this end, we interviewed the owners and managers of 18 businesses that had headquarters or principal operations in the Willamette Valley. However, early on in our research, it became clear that our inquiry was premature; in order to understand the motivations, barriers, and incentives that businesses face, we needed to first understand what factors meaningfully distinguish businesses from one another in regards to investing in the environment, and then use this information to build a sampling framework from which future research could build. Our primary research question was therefore adjusted to reflect this change, resulting in the question, “What are the meaningful differences between businesses in regards to how and why they invest in the environment, and how can this inform business investment in PES?”

## METHODS

### STUDY REGION

The Willamette Valley is the geographic region in northwest Oregon that is approximately 5,300 square miles, and is demarcated by the Willamette River drainage basin. It extends from the Cascade Range to the east; to the Oregon Coast Range to the west; on the north it is bounded by the Columbia River and on the south by the Calapooya Mountains near Eugene. Because of the rich sediments deposited in the valley from Ice Age floods, the Willamette Valley is a rich agricultural center. The Willamette Valley is also the population and cultural heart of Oregon, containing 70% of the state's population as well as the major cities of Portland, Salem, Corvallis, and Eugene (ODFW, 2006).

We chose the Willamette Valley for our study for a number of reasons. Because it is both an agricultural and population center for the state, it faces considerable development pressure, and this increased development poses a threat to the ecosystem services of the region, many of which have already been compromised or degraded (Vickerman, 2008). In addition, population growth is expected to double the occupancy of the region from approximately 2 million in 1990, to 4 million by 2050 (Baker et al., 2004). Climate change also presents an unknown challenge for the region, which is dependent on seasonal snowpack for its source of water in the summer.

Because of the relative scarcity of research on the factors that influence business investment in the environment, our study was necessarily inductive by nature. Therefore, we did not set out with firm hypotheses regarding business engagement in environmental sustainability. This meant that our study was not guided by a specific theoretical approach, but rather was intended to provide a foundation upon which a sampling framework could be developed.



## SELECTION CRITERIA

For our interviews, we developed a purposive sample of businesses representing different sizes and industries that have headquarters or critical operations located in the Willamette Valley, specifically the cities of Eugene, Corvallis/Salem, and Portland. To do this, we created a list of these businesses by contacting the Chamber of Commerce for each respective city, as well as by conducting a web search. An effort was made to have a representative from the agricultural, forest products, brewing, electronics manufacturing, food and beverage, and apparel industries, as these industries are significant economic drivers in the Willamette Valley.

## INTERVIEW METHODS

Once these businesses had been identified, they were contacted by phone or email to request an interview. Interviews were conducted in person or over the phone, depending on the preference of the interviewee, and each interview lasted approximately one hour. Please see Appendix 1 for a list of the questions that were used to structure each interview. Six businesses were interviewed from each of the Eugene, Corvallis/Salem, and Portland areas, resulting in a total of 18 interviews.

The interviews addressed how each business has addressed the topic of environmental sustainability; the motivations, barriers, and incentives for engaging in sustainability; and how the participants saw themselves fitting into the ecosystem services market. For the purposes of this study, motivations were defined as internal factors – financial, social, or other – that guided businesses towards investing in the environment. Incentives were defined as external factors that guided investment in the environment, such as energy credits, regulatory relief, or various forms of compensation. Barriers were defined broadly as any factor that impeded environmental investment.

Careful notes were taken by hand during each interview, along with direct quotes from the interviewees. Immediately following the interview, these notes were transcribed into

a Word document, which was subsequently uploaded into NVivo software for analysis. Coding of the data was done in two parts. For the first round of coding, the researchers read through each interview and separated out sections that discussed a theme, such as climate, location, or water quality. Once a list of these initial themes had been made, this list was sorted and condensed by the researchers into key concepts. Some of these concepts aligned with topics that had already been discussed in the literature, including size, the champion effect, organizational culture, and industry culture. However, we also discovered a fifth concept – geographic focus – that as of this writing has received little to no research attention. Once these five concepts were identified, the interviews were analyzed again by the researchers and coded according to each concept.

An inter-coder reliability test was also applied to the data to check for reliability and consistency. A single interview was selected at random for comparison, and was subsequently coded by each researcher. This analysis found a 95% consistency rate between coders, based on the criteria outlined in the codebook. Please see Appendix 2 for the codebook used by the researchers to code the interviews.

## RESULTS

Our results identified five factors – size, the champion effect, organizational culture, industry culture, and geographic focus – that influence how and why businesses invest in the environment. We propose that these five factors modify each other in various ways, which culminates in a total measure of business engagement. While our small sample size does not lend itself to tests of statistical significance, our intent here is to communicate the themes we identified and propose possible areas for future inquiry.

### SIZE

For the purposes of our study, we defined small businesses as those having 1-19 employees, mid-sized businesses as those having 20-499 employees, and large businesses as have 500+ employees. These cut-off points are consistent with the way US Census gathers data on business size (US Census Bureau, 2008). A breakdown of business size per location is shown in Table 1.

Table 1.1 Business size per location

|           | Eugene | Corvallis/Salem | Portland |
|-----------|--------|-----------------|----------|
| Small     | 0      | 2               | 0        |
| Mid-sized | 4      | 2               | 2        |
| Large     | 2      | 2               | 4        |

### CHAMPION EFFECT

Of the 18 participants interviewed, 8 cited the presence of an environmental champion as one of the primary reasons for how and why their business invested in the environment. A comparison of the champion effect to business size is shown in Table 2. Though the conclusions we can draw from these data are limited by our small sample size, we found that 100% of our small businesses, 62.5% of our mid-sized businesses, and 12.5% of our

large businesses cited an environmental champion as an important reason their business invested in the environment. Our results are consistent with those reported in previous research (Preston, 2001; Hemingway & Maclagan, 2004; Linnenluecke & Griffiths, 2010; Wu & Wirkala, 2009), which indicate that the champion effect may be more influential in smaller businesses.

Table 1.2 Champion effect per business size

|                                      | Small | Mid-sized | Large |
|--------------------------------------|-------|-----------|-------|
| Mention of Environmental Champion    | 2     | 5         | 1     |
| No Mention of Environmental Champion | 0     | 3         | 7     |

Representative comments for the champion effect: “It’s something the owners instilled in the company”; “Mostly, the owners and management have really educated themselves in these things, and have passed that down to the employees”; “Mainly, it’s my personal preference (as founder)”; “This isn’t an official stance, but I have made a commitment to that personally”; “A lot has come from the top-down, from the owner”

## ORGANIZATIONAL CULTURE

Because of the nature of our interview questions, all of our participants cited some aspect of organizational culture as a reason for investing in the environment or as a reason why their business did *not* engage in environmental programs. In Table 3, the relationship between organizational culture and the champion effect is examined. While the patterns in Table 3 are less clear than the relationship between size and the champion effect, our results suggest that presence of an environmental champion within an organization corresponds with an organizational culture that supports environmental values. Of the 8

businesses that cited the presence of an environmental champion, 100% mentioned an organizational culture that supports environmental values. However, of the 15 participants that cited an organizational culture that supports environmental values, the results are more evenly split, with 8 mentioning an environmental champion and 7 not. In addition, it should be noted that we cannot determine directionality from our data, i.e., whether the champion influences organizational culture, or if organizational culture creates an environment in which a champion can emerge.

Table 1.3 Organizational culture per presence of champion effect

|  | Mention of Environmental<br>Champion | No Mention of Environmental<br>Champion |
|--|--------------------------------------|---|
| Organizational Culture<br>Supports Environmental<br>Values         | 8                                    | 7                                       |
| Organizational Culture<br>Does Not Support<br>Environmental Values | 0                                    | 3                                       |

Representative comments for organizational culture that supports environmental values: “That’s just part of the company culture”; “There is a strong value of sustainability within the company”; “We do it because we know it’s the right thing to do”;

Representative comments for organizational culture that does not support environmental values: “We have a lot of employees that are personally green oriented, but we don’t separately focus on sustainability”; “We haven’t really (addressed sustainability), at least not in a proactive sense”; “It’s not a big issue that we see for us”

## INDUSTRY CULTURE

Because of the nature of our interview questions, all of our participants mentioned some aspect of industry culture as a reason for investing in the environment or as a reason why

their business did *not* engage in environmental programs. Of the 18 businesses interviewed, 13 cited some aspect of industry culture as positively influencing their ability to invest in the environment, while 3 cited industry culture as an impediment to investing in the environment (Table 4). Our findings also indicate that there may be a relationship between industry culture and organizational culture. For businesses that reported an industry culture that supports environmental values, 100% of these businesses also reported an organizational culture that supports environmental values. For businesses that reported an organizational culture that supports environmental values, 81.3% also reported an industry culture that supports environmental values. Again, while we cannot make inferences from our data concerning directionality, our data are consistent with the existence of a relationship between these two factors.

Table 1.4. Industry culture per types of organizational cultures

|  | Organizational Culture Supports Environmental Values | Organizational Culture Does Not Support Environmental Values |
|--|--|--|
| Industry Culture Supports Environmental Values         | 13   | 0  |
| Industry Culture Does Not Support Environmental Values | 2  | 3  |

## GEOGRAPHIC FOCUS

One theme that emerged in our research was the importance of the geographic focus of a business in terms of how a business relates to environmental stewardship. The geographic

focus can be described as the physical scope of a business' operations. For our purposes, we created three categories of geographic focus: local, regional, and multi-national. We defined a business with a local focus as a business that conducts operations and markets its goods and/or services within a single community. A business with a regional focus is defined as a business whose reach extends from multiple communities to a national scale. A business with a multi-national focus is defined as a business whose operations and markets for goods and services extend across national boundaries.

One might expect to find a relationship between geographic focus and business size. In our sample, small businesses tended to be those identified as local or regional in focus, and large businesses tended to be those with a multi-national focus (Table 5). However, there were certainly exceptions to this tendency. For example, one business had 20 employees (mid-sized, by our standard) but operated multi-nationally. In another instance, a business had well over 500 employees, but operated on a regional scale, serving only a few communities in the Pacific Northwest. These exceptions to the trend are worth noting because local, regional, or multi-national businesses may have common characteristics and needs, regardless of size.

Table 1.5 Geographic focus per business size

|                | Small | Medium | Large |
|----------------|-------|--------|-------|
| Local          | 1     | 4      | 0     |
| Regional       | 1     | 3      | 2     |
| Multi-national | 0     | 1      | 6     |

A more relevant comparison may be the comparison between geographic focus and organizational/industry culture, which could help us understand what effect, if any, geographic focus may have on how businesses invest in the environment. As discussed earlier, organizational culture and industry culture appear to be closely related. Table 6 shows the geographic focus identified for the 13 businesses that reported *both* an organizational and industry culture that was supportive of environmental values, and the

3 businesses that reported *both* an organizational and industry culture that was not supportive of environmental values.

Table 1.6 Geographic focus per types of organizational/industry cultures

|                | Organizational/Industry<br>Culture Supports<br>Environmental Values | Organizational/Industry<br>Culture Does Not<br>Support Environmental<br>Values |
|----------------|---|--|
| Local          | 4   | 1  |
| Regional       | 5   | 1  |
| Multi-national | 4   | 1  |

From our small sample, we cannot make inferences concerning the relationship, if any, between geographic focus and organizational/industry culture. A larger sample size, particularly of businesses that report an organizational/industry culture that does not support environmental values, may shed light on what, if any, relationship exists between geographic focus and organizational/industry culture.



## DISCUSSION

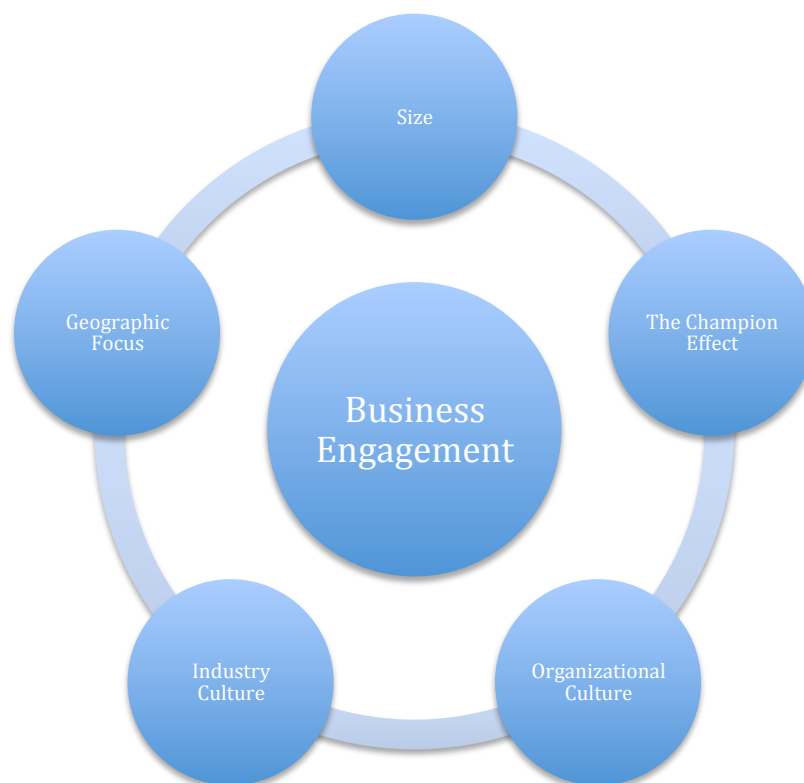


Figure 1.2 Business engagement in environmental sustainability

Our study was initially designed to investigate the motivations, barriers, and incentives that businesses face when investing in the environment. Although it quickly became clear that in order to understand these issues, we needed to understand what factors meaningfully distinguish businesses from one another in regards to investing in the environment, some common motivations, barriers, and incentives did emerge. Principally, cost and financial savings were concerns for all businesses involved. In addition, government intervention – both positively in the form of rebates and tax credits, and negatively in the form of regulations – was a common theme among many businesses. However, a more sophisticated analysis of motivations, barriers, and incentives was not possible without a sampling framework to structure our inquiry; therefore, our research led us instead to investigate what factors might meaningfully distinguish businesses from each other in regards to investing in the environment.

The data from our interviews led us to identify 5 factors that we believe have meaning for understanding business engagement in environmental programs. These factors were size, the champion effect, organizational culture, industry culture, and geographic focus. Four of these factors – size, the champion effect, organizational culture, and industry culture – have received at least some attention in the literature. Geographic focus, particularly as it relates to investment in PES, has not been the subject of substantial research and is a unique contribution of our study. These five factors appear to be relevant to business investment in the environment. Our data also suggest that, rather than operating independently of each other, these factors may modify, influence, and shape each other to produce an interactive sphere of influence on business engagement.

“There are just a lot of resources available, and we can do a lot of things.”

– Large, multi-national apparel manufacturing

It was apparent from our interviews that the size had relevance to how and why a business invested in the environment. However, rarely was size mentioned explicitly; rather, it was more frequently mentioned implicitly or in tandem with other factors. Yet it was clear that size had meaning. The size of a business modified the scope and scale of that business; it affected the quantity of resources a business had to devote to the environment, the visibility it had to the public, and the global reach of its environmental footprint. Yet size alone did not tell the whole story. Among all the businesses we interviewed, regardless of size, there was remarkable diversity in how they approached their responsibility to the environment. In searching for commonalities between businesses of similar size, we found few; yet we were reluctant to dismiss size entirely. Rather, it became clear that size was only part of a much larger story.

“Well, mostly, I have to live here. This is a nice place to live, and I want to keep it that way.” – Small, regional craft brewery

One of the first comparisons that became apparent was the relationship between size and the champion effect. When interviewing small and mid-sized businesses, we were often able to speak with the founder or owner personally, whereas with large businesses we were usually directed to a department head or manager. While this difference may seem obvious, it underscores an important truth – size affects who within a business manages environmental issues. In large businesses, there was often a department or task force that managed environmental stewardship; but with small and many mid-sized businesses, this responsibility lay with the founder or owner. Additionally, although our results are far from conclusive, it should be noted that 100% of our small businesses, 62.5% of our mid-sized businesses, and 12.5% of our large businesses cited an environmental champion as an important reason for why their business invested in the environment. This suggests that the champion effect may be a more powerful driver of business behavior for small to mid-sized businesses than it is for large businesses.

This finding is important for facilitating investment in PES programs because it suggests that, particularly for small to mid-size businesses, appealing to the founder or owner may be the most productive way to engage a business in PES. In addition, the nature of this appeal may be fundamentally different than with large businesses. When we asked the owners and founders of small to mid-sized businesses why they chose to invest in the environment, the responses were primarily based on a personal ethic or a sense of it being “the right thing to do” – a notion which is supported by the literature. This means that while cost savings, risk management, and public relations may also be concerns for small to mid-sized businesses, an important motivator may also be the values and beliefs of the owner or founder.

“This started something of a chain reaction culturally within the company – what else can we do?” – Mid-sized, regional food and beverage distributor

It also appears that both size and the champion effect impact the organizational culture of a business. When asked what the motivations were for addressing environmental sustainability, the first response was often, “It’s just part of the culture here,” both for

businesses that did invest in the environment and for businesses that did not. As our results suggest, an environmental champion may have a meaningful effect on the culture of a business. In addition, it may be possible for the culture of a business to create an environment in which a champion can emerge; our study did not address the possible directionality of this relationship. However, even for a sample size as small as ours, this is compelling evidence that the culture of a business – whether it is shaped by size, the champion effect, or other factors – plays a strong role in how businesses approach the environment.

“Sustainability hasn’t really reached this industry.” – Large, regional retailer

Like organizational culture, industry culture can have either a positive or a negative effect on how and why a business invests in the environment. Of the 18 businesses interviewed, 13 mentioned industry culture as supporting environmental stewardship, which 5 mentioned industry culture as failing to support or discouraging environmental stewardship. Not surprisingly, it appears that industry culture and organizational culture may be related. For businesses that reported an industry culture that supports environmental values, 100% of these businesses also reported an organizational culture that supports environmental values. For those businesses that reported an industry culture that did not support environmental values, 81.3% of these businesses reported an organizational culture that was not supportive of these values.

The craft brewing industry in particular reported a strong industry culture of positive environmental stewardship; of the three craft breweries that we interviewed, all three cited industry culture as a reason for investing in the environment. Conversely, we found that the culture of other industries may be exerting negative influences on businesses; in our sample, it was primarily the retail and manufacturing industries, although this may not universally be the case. Consumer expectations specific to an industry, such as the craft brewing industry, appear to be meaningful drivers of environmental sustainability; industries that do not interface with the public but instead market their goods and services to other businesses may not experience this pressure. What our data suggest is that

particular industries may be more or less predisposed to engaging in environmental stewardship and likewise PES programs.

“If people want to know what we do, they can come by and we’d be happy to talk to them. If a certification program was locally based, that might be better, but the problem with these national certifications is that they have no relevance for our community and what we are doing here. So someone from Ohio says our compost is ok – what does that even mean?” – Mid-sized, local forest products

Finally, geographic focus emerged as a new and promising area of inquiry. Much like size, geographic focus was rarely mentioned explicitly, yet our interviews often pointed to geographic extent of operations or markets as having an influence on how a business behaves toward the environment. Multi-national corporations often perceived their environmental footprint on a global scale. As a general rule, they were less interested in investing locally, and more interested in protecting resources overseas – often in critical manufacturing or production areas. Similarly, local businesses often perceived themselves as members of the community and therefore responsible for the environment on a local scale.

Our finding that businesses of different geographic focus may behave differently does not mean that different types of businesses would necessarily be more or less likely to invest in PES; rather, it indicates that the type of program these businesses would be interested in may vary depending on their geographic focus. Local businesses may be more interested in investing locally, both because they perceive themselves as members of the community and because their own stewardship can impact their resource availability. Multi-national businesses may also be interested in PES programs, but on a multi-national scale. Protecting water quality in China, investing in sustainably grown cotton, and mitigating the effects of climate change all emerged as concerns among multi-national businesses, whereas local businesses were more likely to be concerned about regulations and policies that they lack the power to influence as individual business, such as municipal regulations for composting and Federal regulations that require them to use

imported materials or ingredients. Understanding the linkages between business size and geographic focus and how geographic focus may interact with industry and organizational culture could help tailor development of PES programs to better meet the needs and interests of specific businesses, and increase the likelihood of success in fostering engagement in stewardship activities that the businesses find appropriate.

## CONCLUSION

This study sought to answer the question, “What are the meaningful differences among businesses with respect to how and why they invest in the environment, and how can this inform business investment in PES?” Our study identified five factors that appear to shape businesses investment in the environment: size, the champion effect, organizational culture, industry culture, and geographic focus. Of these factors, geographic focus is a unique and important contribution of this study.

While our small sample size must be taken into account when attempting to make inferences from these results, our findings do suggest that these factors are influential in business decision making, and must be further investigated in order to inform our understanding of the engagement of the business community in PES programs. Size may impact investment by dictating the scope and scale of resources a business has available to dedicate to these programs. The presence of a champion appears to be a powerful determinant in business investment, particularly for small to mid-sized businesses. An organizational culture that is receptive to environmental values may also play a key role, as well as an industry culture that supports – or may even demand – environmental stewardship. Finally, the geographic focus of a business – whether they operate locally, regionally, or multi-nationally – may impact how businesses choose to invest in the environment.

In addition to identifying and describing these five factors, our study proposes some promising areas for further inquiry. It was beyond the scope and size of our study to examine each of the five factors individually while controlling for the other four; however, our work indicates that a large-scale study that examines the individual effects of size, the champion effect, organizational culture, industry culture, and geographic focus would greatly contribute to the body of knowledge on this topic. In addition, a study that further examines the impact and directionality of these relationships – for example, whether a champion shapes organization culture, or whether organizational culture creates a champion – would be highly useful.

The information gathered in this study is meant to both advance our understanding of how businesses relate to the environment and the community, and help researchers and environmental advocates understand how best to engage businesses in PES programs. Widespread business investment in PES not only holds the potential for greater funding and increased longevity for these programs, it also may help transform how we as a society view, value, and relate to the environment.



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## APPENDIX 1: INTERVIEW QUESTIONS

1. How has your business addressed the topic of sustainability?
2. What are the motivators for engaging in these programs?
3. What are the barriers and incentives for engaging in these programs?
4. Would a certification or third party auditing program be of interest? What characteristics would be useful?
5. What ecosystem services are most essential to your business? Would payment for ecosystem services be of interest?

## APPENDIX 2: CODEBOOK

| PRIMARY CODE           | EXPLANATION  | SECONDARY CODES   |
|------------------------|--|---|
| Size                   | Comments that mention size of a business specifically. Examples might include a discussion of the challenges of being a small business, how that business has managed growth, or the challenges of being a very large business.  | <ul style="list-style-type: none"> <li>- Motivations pertaining to size</li> <li>- Barriers pertaining to size</li> <li>- Incentives pertaining to size</li> <li>- Characteristics relating to size</li> <li>- Government regulations pertaining to size</li> <li>- Public perceptions pertaining to size</li> </ul>  |
| Champion Effect        | Comments that mention a leader that has in some way promoted an environmental program, disseminated environmental values within a business, or otherwise influenced the way a business interacts with the environment. Examples might include a CEO discussing how his personal environmental ethic has motivated environmental policy within the business, an individual taking a special interest in sustainability, or a leader that has been responsible for promoting environmental values. | <ul style="list-style-type: none"> <li>- Motivations pertaining to champion effect</li> <li>- Barriers pertaining to champion effect</li> <li>- Incentives pertaining to champion effect</li> <li>- Ideology/worldview of champion</li> </ul>   |
| Organizational Culture | Comments that describe how the culture of the business itself has influenced the environmental policies of that business. Examples might include a general interest in wanting to be good members of the community, a discussion of values that characterize the business, and comments that discuss how environmental sustainability aligns with long-term business plans.  | <ul style="list-style-type: none"> <li>- Motivations for organization</li> <li>- Barriers for organization</li> <li>- Incentives for organization</li> <li>- Risk management for organization</li> <li>- Ideology/worldview of organization</li> <li>- Financial bottom line for organization</li> <li>- Government regulations pertaining to organization</li> </ul> |

|                    |   |  |
|--------------------|---|--|
|                    |   |  |
| Industry Culture   | Comments that mention the culture, norms, or expectations of an industry or the customer base specific to that industry. Examples might include consumer pressure and expectations (or lack thereof), norms for certification or auditing within an industry, an industry culture that does not support environmental values, and coalitions or groups within an industry that work towards environmental programs (such as an association of craft brewers). | <ul style="list-style-type: none"> <li>- Motivations for industry</li> <li>- Barriers for industry</li> <li>- Incentives for industry</li> <li>- Customer expectations</li> <li>- Public perceptions relating to industry</li> <li>- Risk management for industry</li> <li>- Characteristics of industry</li> <li>- Government regulations pertaining to industry</li> </ul>               |
| Geographical Focus | Comments that mention the geographic scale of a business, such as whether it is local or multi-national.  | <ul style="list-style-type: none"> <li>- Motivations for being in a region/locale</li> <li>- Barriers for being in a region/locale</li> <li>- Incentives for being in a region/locale</li> <li>- Characteristics of region/locale</li> <li>- References to locations for materials/resources</li> <li>- References to being local/regional/multi-national (different from size)</li> </ul> |

ECOSYSTEM SERVICES AND THE WATER-ENERGY NEXUS:  
PROMISING AREAS OF INQUIRY

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## ABSTRACT

This study explores how water, energy, and ecosystem services relate to businesses and corporations in Oregon's Willamette Valley. Using interviews of business owners and managers within the Willamette Valley, this study investigates how the business community views the water-energy nexus and what this might mean in the context of population growth, climate change, and alternative fuel use. This research was part of a larger study that investigated meaningful differences between businesses in terms of how and why they invest in the environment; however, in the process of investigating these differences, we discovered an important commonality: that many businesses, regardless of size, type, or attitude toward environmental sustainability, are very much concerned about water and energy. We also propose the idea that energy can be viewed as an ecosystem service of watersheds, a notion that is unique within the body of research on ecosystem services. In addition, implications for water and energy utilities and payment for ecosystem services programs are discussed.

Keywords: payment for ecosystem services, PES, ecosystem services, business, water resources, energy, utilities, resource policy management, water-energy nexus, WEN, Willamette Valley, Oregon



## INTRODUCTION

The multiple, complex interactions between the water and energy sectors, often termed the water-energy nexus, is receiving increasing attention. Energy production, whether it is from fossil fuels, thermoelectric power, hydropower, solar, biofuels, or other sources, requires water; often, it requires vast amounts of water. Likewise, developing, treating, and transporting water supplies requires large amounts of energy (AGU, 2012; Odom, 2010; CERES, 2007; USDOE, 2006).

In the past, water and energy issues have primarily been addressed independently (Dennen et al., 2007). However, this paradigm is changing as policy makers and resource managers have come to understand the complex interactions between water and energy, the efficiencies that can be realized by addressing energy and water needs together, as well as the potential impacts of water and energy scarcity in the future (AGU, 2012). Both the water and energy sectors depend on a stable supply of each resource to function; developing greater energy resources at the expense of water resources, or vice versa, is no longer a sustainable solution to our water and energy needs (Odom, 2010; AGU, 2012). In addition, a number of factors are likely to strongly influence the water-energy nexus in the future. Among them are population growth, climate change, and increasing development of alternative energy technologies.

The needs of aquatic ecosystems are also increasingly influencing the water-energy nexus. In the Pacific Northwest, for example, the requirement for specific levels of instream flows for endangered and threatened salmon species is competing with the use of water for residential, agricultural, and industrial use, a conflict that may increase if climate change alters stream flow or seasonal water availability (Barnett et al., 2004). In addition to providing habitat for native species, healthy streams and watersheds also provide a host of ecosystem services that are socially and economically valuable (Postel & Thompson, 2005). Sacrificing healthy watersheds for energy production does not simply reduce water availability; it also creates a cascade of profound and far-reaching effects.

The study presented here was part of a larger project that sought to answer the question, “What are the meaningful differences between businesses in regards to how and why they invest in the environment, and how can this inform business investment in payment for ecosystem services?” However, in the course of interviewing business owners and managers, our interviewees consistently voiced concern over the water-energy nexus and how it relates to ecosystem services. That feedback prompted us to investigate how water, energy, and ecosystem services are related, and how they might affect each other in the future. The purpose of this paper is to explore the water-energy nexus as it was manifested in the context of our interviews with owners and managers of corporations and businesses in the Willamette Valley region.

While substantial research has been conducted on the water-energy nexus on a conceptual level, there is still a need for research on how these factors influence each other in real-world contexts. To this end, this research provides an important and meaningful contribution to the body of knowledge on the water-energy nexus. Understanding how the business community approaches water and energy use, as well as how businesses view themselves in relation to ecosystems and the environment, is an essential component to understanding how decisions and policies made today will effect water and energy availability in the future. We begin by presenting a brief review of the literature, and follow with a discussion of our interview results and how these results can inform the water-energy nexus discourse.

## BACKGROUND

### THE WATER-ENERGY NEXUS

The water-energy nexus, or WEN, describes the complex relationships between water, energy, and our society. Some of these relationships are easy to see: for example, the association between water and energy in the case of a large, hydroelectric dam may be easily intuited (AGU, 2012). However, the WEN also extends to areas that might not be readily apparent. Many types of energy production, not just hydroelectric power, require vast amounts of water; likewise, it takes vast amounts of energy to develop and deliver water (Odom, 2010; AGU, 2012). In addition, the very steel and concrete used to create our water and energy infrastructure requires considerable amounts of water and energy in the manufacturing process (AGU, 2012). From a life-cycle perspective, water and energy are intimately linked (CERES, 2007; AGU, 2012).

The ways in which our energy needs will impact water resources depends greatly on the type of energy being used, the number of new plants being built, the rate of old plants being retired, and the environmental regulations applied to these energy sources (Sandia, 2007). Future water scarcity could greatly shape the availability and affordability of future energy sources. In addition, an overall shift from one energy source to another, such as from fossil fuels to biofuels, could also greatly impact water availability (Sandia, 2007; GAO, 2012; Tilman et al., 2009). Declining groundwater tables, few new sources of surface water, competing demands from the energy, domestic, agricultural, and industrial sectors, as well as population growth and climate change could bring these issues into sharp relief sooner rather than later (Sandia, 2007; USDOE, 2006).

Despite these potential conflicts, water resources planning and energy planning are often done separately, with poor or inconsistent communication between water and energy managers (Dennen et al., 2007; USDOE, 2006; AGU, 2012). Bureaucratic silos, incomplete data, and poor data sharing are among the many impediments to integrated resource management (GAO, 2012; USDOE, 2006). This lack of integration has led to development of energy sources without consideration for how the water needs will be

met, as well as planning for future water supplies with the assumption that the energy needed to develop those supplies will be available and affordable (Dennen et al., 2007).

## ECOSYSTEM SERVICES

In addition to the competing needs of the water and energy sectors, the importance of the ecosystem services provided by watersheds should not be underestimated. Watersheds provide water filtration, flow and flood regulation, erosion and sediment control, biodiversity protection, habitat preservation, tourism, and recreational benefits, among others (Postel & Thompson, 2005). Far from taking away from areas such as agriculture and industry, ecosystem services provide essential functions that enable these sectors to thrive (Guo et al., 2000).

Ecosystem services also have tremendous ecological value. In the case of water, many aquatic species require specific water temperatures, minimum flows, and seasonal flooding events to survive. However, the water and energy needs of a growing population may increasingly come into conflict with the needs of these species; in fact, in many areas this conflict is already occurring (Barnett et al., 2004).

Properly valuing these ecosystem services, as well as water and energy, will be an important component to ensuring that each receives proper consideration (Postel & Thompson, 2005). However, valuation of ecosystem services is a complicated issue, both logistically and politically. While energy may be priced competitively, water generally is not. Water is typically subsidized to keep prices low. While this provides an advantage for water users, it skews the balance of the WEN to discourage water conservation (AGU, 2012). In addition, the ecosystem services that watersheds provide are typically undervalued, or not valued at all (Odom, 2010; Guo et al., 2000).

The relationship between water, energy, and ecosystem services is also an area that deserves further attention. Logic suggests that if ecosystem services are the benefits to humankind provided through the natural processes of ecosystem functions (Daily, 1997),

then energy can be viewed as an ecosystem service provided by watersheds in much the same way that healthy, breathable air is an ecosystem service of forests. Viewed in this way, the WEN takes on critical importance both in the valuation of ecosystem services and the implementation of programs aimed at protecting these services.

## UTILITIES

Water and energy utilities are uniquely poised to bridge the gap between ecosystem services and the WEN (Sovacool, 2009). Utilities can be diverse in nature, varying in size and service area and ranging from privately to publicly owned. While utilities may also manage water and energy separately, there are also many instances in which water and energy are managed under the same authority (AGU, 2012). In this regard, utilities may be bellwethers for water and energy crises, and may be able to provide useful insight into how to address the WEN on a broad, system-wide scale (Sovacool, 2009).

Water scarcity has already had an impact on the U.S. electric utility industry. Drought and water shortages have caused lawmakers to deny water rights to power plants, implement mandatory plant shutdowns, or deny applications for new facilities (Sovacool, 2009). With state water managers in over half of U.S. states anticipating shortages of water in the coming decade (Sovacool, 2009; GAO, 2012), this trend is likely to continue.

The Energy Information Administration (EIA) anticipates that electricity generation in the U.S. will increase by nearly 25% in the next 25 years, and about 80-90% of this energy will come from thermoelectric power (EIA, 2011). Thermoelectric power plants consume vast amounts of water for cooling purposes (AGU, 2012). When saline water withdrawals are included, thermoelectric plants use more water than agriculture in the U.S. Even without saline withdrawals, the freshwater use by these plants is considerable (Sovacool, 2009; AGU, 2012). If the projections from the EIA are accurate, increasing thermoelectric power could also result in a significant increase in water consumption, perhaps nearly doubling current use (USDOE, 2006). Considering that many states are already facing water shortages, and that unconstrained thermoelectric power development

is not a sustainable option, utilities and state regulators may be in an important position to advocate for less water-consumptive energy sources (Sovacool, 2009).

In addition, many utilities are increasingly being called upon to manage ecosystem services through payment for ecosystem services programs. Payment for ecosystem services, or PES, is a market-based mechanism that seeks to protect and restore ecosystem services by assigning a monetary value to the benefits they provide (Gómez-Baggethun et al., 2009; Tallis et al., 2008; Vickerman, 1999). Utilities are increasingly in a position to broker, manage, or develop PES programs because they not only have a vested interest in protecting ecosystem services, but also often have a long history of presence within a community and are generally regarded as trustworthy agents for such programs (INR, 2012).

## POPULATION GROWTH

Population growth will also play an important role in determining how and where water and energy crises occur. Increases in population and a growing economy may increase electricity demand in the U.S. by nearly 50% from 2005 levels to 2030 (Sandia, 2007; Odom, 2010). In addition, location greatly influences the WEN. Not all states are equal when it comes to water withdrawals for electricity generation (GAO, 2012; AGU, 2012). For thermoelectric power, Texas withdraws the greatest amount of water, with Illinois, Tennessee, California, and Florida also being heavy water users. Population growth in these regions, particularly in large metropolitan areas, will likely stress water and energy supplies and create scenarios in which tradeoffs between water and energy will occur (Sovacool, 2009). Particularly in regions already experiencing drought and water scarcity, this may evolve into a critical situation.

## CLIMATE CHANGE

Climate change also promises to exacerbate water and energy crises, particularly in the Western U.S. Changes in temperature, precipitation, patterns of drought, and increases in storm strength and severity all may affect water resources in profound and unpredictable ways (Odom, 2010). In addition, much of the West relies on mountain snowpack for its water supply, and a warming of just one or two degrees could significantly impact the timing, delivery, and capacity of mountain snowpack to provide water throughout the year. Many simulations predict that a warming of 1-2°C will occur by mid-century, and that this will create widespread conditions of water scarcity – even without population growth and a larger economy (Barnett et al., 2004).

## FUELS

Replacing imported energy sources, such as fossil fuels from overseas, with alternative domestic sources has the potential to greatly impact demand and availability of water (USDOE, 2006; Sandia, 2007). For example, biofuels have been proposed as a domestic alternative to fossil fuels; yet the water needed to process biofuels is similar to that of fossil fuels, and the production of biofuels generally requires additional water for the irrigation of raw materials. If crops used for biofuels are grown in arid or semiarid regions, the water cost for developing biofuels can be up to 1000 times greater than the water cost of traditional fuels (Hussey & Pittock, 2012; AGU, 2012). In addition, any significant change from one fuel source to another has the potential to impact a host of other issues, from land use to energy costs.

## RESEARCH NEED

The vast potential for conflict and scarcity inherent to the WEN has meant that it has received considerable attention and study in recent years. However, much is still to be learned if we are to effectively manage both our water and energy resources. Among

these concerns is how the business community relates to the WEN. Businesses and corporations are important drivers of the economy, of population growth or migration, and technological innovation, as well as being influential in land use and urban planning decisions. Understanding how businesses are managing water and energy may help to inform policy decisions aimed at addressing the WEN.

While our study did not initially set out to investigate the WEN, it quickly became apparent that an inquiry into how water, energy, and ecosystem services are related was needed. The WEN was a theme that emerged, unprompted, in the course of interviewing business owners and managers throughout the Willamette Valley on how and why they invest in the environment. We believe that the water-energy nexus theme merits a separate discussion, and it is our hope that this paper will provide insight into the relationship between water, energy, and ecosystem services.



## METHODS

### STUDY REGION

The Willamette Valley, in northwest Oregon, is uniquely suited for studying the WEN. The Willamette Valley is the geographical region that drains the Willamette River and its tributaries. Bounded to the north by the Columbia River, to the east by the Cascade Range, to the west by the Coast Range, and to the south by the Calapooya Mountains, the Willamette Valley is both a rich agricultural center and the population heart of Oregon. It encompasses the cities of Portland, Salem, Corvallis, and Eugene, with over 70% of the state's population residing within the valley. In addition to housing most of the state's population and a strong agricultural base, the Willamette Valley has increasingly attracted large manufacturing industries, such as silicon chip and high-technology metals manufacturing, in part because of its abundance of water (Grossman, 2002).

The Willamette Valley relies primarily on surface water in rivers, streams, and reservoirs for its water needs. While the valley receives abundant rainfall, it generally occurs from October through March, and is out of phase with the summer growing season when water demand is highest. Because of this, the valley relies on snowpack stored in the Cascade Range to provide water to rivers, streams, and reservoirs during the summer months (Brooks et al., 2012). In addition, this seasonal snowpack is needed to generate power from the eight hydropower dams functioning within the valley (USACE, 2013).

However, this reliance on seasonal snowpack makes the Willamette Valley particularly vulnerable to climate change (Brooks et al., 2012). Seasonal snowpack in the Pacific Northwest accumulates in storm events that involve both rain and snow. A slight warming could raise the snow level to a higher elevation, which would result in a vast decrease in the overall snow cover. Alternately, even slight changes in weather patterns and storm events, such as an increase in warm, wet storms from the tropics or rain-on-snow events, could drastically alter the volume and timing of seasonal snowmelt (Barnett et al., 2004). In a region that relies so heavily on abundant surface water supplies, even slight changes to snowpack could have far-reaching consequences.

Population in the Willamette Valley is also expected to increase in the coming years, potentially exceeding four million. This represents a doubling of 1990 population levels (Baker et al., 2004; ODFW, 2006), and would mean a significant increase in the valley's water and energy needs. The unique mix of agricultural, urban, and industrial sectors located within the Willamette Valley suggests that the effects of this population growth, and corresponding economic growth, would be complex.

An additional factor to consider is that 96 percent of the land in the Willamette Valley is privately owned. This suggests that voluntary, incentive-based approaches to conservation and ecosystem services management, such as PES programs, may be more effective than regulatory approaches (ODFW, 2006). Some PES programs have already been piloted in the region, including a program with Clean Water Services, a wastewater utility near Portland, Oregon, that has initiated a program that compensates landowners for planting shade trees and vegetation along the Tualatin River (Abdalla, 2008; Cochran & Logue, 2011). However, developing a richer understanding of how the WEN relates to ecosystem services and PES will be useful if voluntary, incentive-based programs are to become more common practice.

Because of the relative scarcity of research on the factors that influence business investment in the environment, our study was necessarily inductive by nature. Therefore, we did not set out with firm hypotheses regarding business engagement in environmental sustainability, nor about how these businesses might relate to the water-energy nexus. This meant that our study was not guided by a specific theoretical approach, but rather was intended to provide a foundation upon which further research could be developed.

## SELECTION CRITERIA

Our study was originally designed to investigate the differences between businesses in regards to how and why they invest in the environment. To this end, we interviewed 18 businesses that had headquarters or critical operations in the Willamette Valley,

specifically the cities of Eugene, Corvallis/Salem, and Portland. Our sample was developed by contacting the Chamber of Commerce for each respective city, as well as conducting a web search. An effort was made to include a diversity of sizes and industries, including representatives from the agricultural, forest products, brewing, electronics manufacturing, food and beverage, and apparel industries, as these are significant economic drivers in the Willamette Valley. Our sample was not developed with the WEN in mind; rather, the purpose of our study was to use these interviews to develop a sampling framework from which further research on business engagement in PES programs could be done. Therefore, our sample is not meant to be representative of the businesses and industries most impacted by the WEN. Instead, we hope that this provides useful information from which a more targeted sample can be derived.

## INTERVIEW METHODS

Businesses were contacted by phone or email to request an interview, and each interview lasted approximately one hour. Six participants were interviewed from each of the Eugene, Corvallis/Salem, and Portland areas, resulting in a total of 18 interviews. The interviews addressed how each business has addressed the topic of environmental sustainability; the motivations, barriers, and incentives for engaging in sustainability; and how the participants saw themselves fitting into the ecosystem services market. Please see Appendix 1 for the questions that were used to structure each interview.

Careful notes were taken by hand during each interview, along with direct quotes from the interviewees. Immediately following the interview, these notes were transcribed into a Word document, which was subsequently uploaded into NVivo software for analysis. To code the data, the researchers read through each interview and separated out sections that discussed energy, water, or ecosystem services.

An inter-coder reliability test was also applied to the data to check for reliability and consistency. A single interview was selected at random for comparison, and was subsequently coded by each researcher. This analysis found a 95% consistency rate

between coders, based on the criteria outlined in the codebook. Please see Appendix 2 for the codebook used by the researchers to code the interviews.

## RESULTS

Although our interview questions did not ask respondents to discuss the WEN directly, issues surrounding sustainability of energy and water resources and the interconnection between energy and water emerged unprompted in many of the interviews. Frequently, water and energy were mentioned in the same sentence; often, ecosystem services were also referenced in tandem with the WEN. The interconnectedness of these issues in the interviews was what initially led us to identify the WEN as a theme that deserved special attention. Because our study was not specifically designed to investigate the confluence of water, energy, and ecosystem services, the results are primarily useful for identifying areas and concepts that are potentially rich for future research. It is beyond the scope of our data to attempt to quantify these relationships for businesses and industry in general. However, the information presented here provides an initial sample of the issues and concerns facing corporate users of water and energy in the Willamette Valley, Oregon and is a useful starting point for further inquiry.

Table 2.1 Occurrence of Water and Energy as Themes in Interviews

|              | Water Only | Energy Only | Water and Energy | Neither Water nor Energy |
|--------------|------------|-------------|------------------|--------------------------|
| Interview    | 1          | 4           | 12               | 1                        |
| Participants |            |             |                  |                          |

Energy was the most frequently cited topic, with 16 of the 18 participants mentioning energy and energy use as a concern for their business. Energy was most frequently brought up in the context of discussing how each business had addressed environmental sustainability. Participants were concerned not only about the financial cost of their business's energy use, but also their environmental impact in regards to energy. Some representative comments include:

“Heating and cooling are also major costs for us – we use a lot of energy.”

“Cooling and energy use are also huge issues for our business.”

“New equipment is key – we are constantly updating our equipment, looking for better and more efficient ways, and this results in an almost automatic increase in our sustainability.”

“Energy is also huge, both in terms of access and efficiency. We are really interested in investing in energy efficiency.”

“We are a very energy intensive operation.”

Water and water use were also cited as a concern for many business owners and managers, with 13 of the 18 interviews mentioning water specifically. Similar to energy, many participants saw water conservation both as a way to save costs and also as part of their environmental stewardship strategy. Clean water and healthy watersheds were also mentioned as essential ecosystem services that many businesses relied on. Some representative comments include:

“We are definitely interested in conserving water. We are a water heavy industry, so that is important to us.”

“Water is the most essential component of our products. Water goes into everything we do. It goes into our beverages, into the agricultural products that we need, it’s part of our manufacturing processes.”

“What strategies should there be, what options do we have in the community to increase water availability? What other things can we do on site to reclaim water, and can we make this cost effective?”

“Our watershed is definitely important to us.”

“Water use is huge – we are always trying minimize our water use and the wastewater that we generate.”

“Water is a big resource to us, through and through – we need it from the fields all the way through to our manufacturing.”

Water and energy were also frequently discussed together. As shown in Table 1, of the 18 participants interviewed, only 1 brought up the topic of water without discussing energy, and 4 discussed energy without mentioning water. Two-thirds of the participants, 12 in

total, mentioned both energy and water in the interviews. Only 1 participant out of the 18 brought up neither water nor energy. In discussing water and energy together, some representative comments include:

“One of the things we have done has been to dedicate funding to energy reduction and utility reduction, including water conservation. This is perceived as something that is important that can save us money in the long run.”

“We use a lot of energy and a lot of water, but in the company we tend to focus on energy usage more than water. Nobody is wondering whether we might run out of water.”

“Every one of our plants has an energy and water team.”

“We are also starting to look at our operations... at reducing our water and energy use.”

“We also try and do a lot with water reclamation and energy recovery.”

Finally, three comments related ecosystem services directly to the WEN. While this represents only 1/6 of the interview population, it should be noted that these are instances where the interviewees made explicit and unprompted connections between ecosystem services and the WEN:

“I don’t really see how we fit into the ecosystem services market, except that we are a significant electricity consumer. So we hope that our utilities are making the right choices. We definitely support sustainability at the utility level.”

“If I had to name the two ecosystem services that are most important to our business, they would be energy and water.”

“We don’t really use a lot of ecosystem services in our business – our products are made of aluminum and fabric, and we source those from overseas. But we do use a lot of gas – it’s very energy intensive to ship our products – might there be a way to mitigate that?”

## DISCUSSION

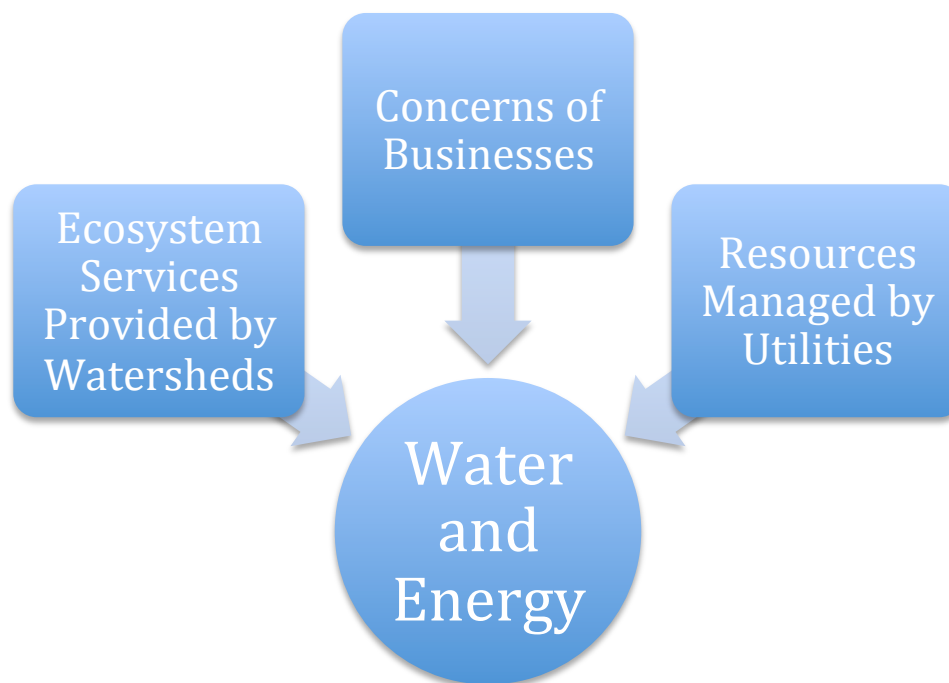


Figure 2.1 The convergence of water and energy with businesses, ecosystem services, and utilities

Our research suggests that businesses are already considering water and energy on a meaningful level. Even though we did not set out to investigate the WEN specifically, interviews with business owners and managers in the Willamette Valley nonetheless revealed that concerns over water and energy were uppermost in the minds of our study participants. While the connection to ecosystem services was less clear for our participants, even businesses that did not see themselves as fitting into this discourse were able to make the connection to water and energy. When asked what ecosystem service they most rely on, a number of our participants stated that they did not rely on any ecosystem service in particular – except for energy. While the WEN teaches us that that these businesses, regardless of their outlook on this issue, most likely rely a great deal on water or other ecosystem services, these interview results highlight an important truth: businesses that do not see themselves as part of the discussion on environmental stewardship and sustainability can nonetheless be brought to the table on the issue of



energy. Along with the financial bottom line, energy appears to be a common denominator that many businesses are concerned with, regardless of size, type, or culture regarding the environment.

This also suggests that role of utilities is likely to be of increasing importance in regards to how the WEN relates to ecosystem services. Utilities are not only suppliers of both energy and water, but are increasingly being called upon to broker PES exchanges and programs. Given that integrated resource management has been hampered by inconsistent and incomplete data sharing and a lack of an umbrella organization from which to coordinate both water and energy planning, utilities may be increasingly called upon to fill this need.

In addition, the landscape of the Willamette Valley and areas like it might meaningfully be impacted by how businesses, industries, and utilities incorporate – or fail to incorporate – ecosystem services into their consideration of the WEN. Decisions about land use, alternative energy sources, water conservation, and urban planning have the potential to impact ecosystem services and the WEN in significant ways. Increased population, the uncertainty of a changing climate, and alternative fuels such as biofuels will also contribute to the WEN both on a local and global scale. Decisions made today on how to manage both energy and water will likely effect generations to come.

Our research, therefore, has led us to propose a number of areas that hold promise for future research:

- 1.) Research into which industries are already aware of the close connection between water and energy use, with the goal of learning how businesses in this industry set up teams to study this topic, how the findings of those teams influence business decision-making, and how this approach might be adopted by other industries.
- 2.) Research into locations where power and water utilities are avoiding a siloed approach to planning and are already collaborating – either through private initiatives or under government mandates – to plan for future needs. The goal of

this research would be to learn how these partnerships operate and what best practices might be adopted in other areas.

- 3.) Research into public misperceptions about the actual costs of various forms of energy production, especially in terms of water use. The goal of this research would be to see where the greatest gap exists between fact and awareness, so that strategies could be developed to influence more informed decision-making at the local, regional and state level.

## CONCLUSION

This study initially sought to discover the meaningful differences between businesses in regards to how and why they invest in the environment. However, in the process of investigating these differences, we discovered an important commonality – that many businesses, regardless of size, type, or attitude toward environmental sustainability, are concerned about water and energy. The WEN appears to be a common denominator from which businesses can begin to discuss issues such as environmental stewardship and sustainability. This is an important finding because it offers researchers and environmental advocates an avenue from which to bring businesses to the table regarding environmental sustainability – even if these businesses might not otherwise concern themselves with this issue.

In addition, we discovered that ecosystem services are more intimately linked to the WEN than might initially appear. A number of our study participants made unprompted connections between ecosystem services and the WEN, identifying energy as an ecosystem service even though this has not traditionally been the view among researchers. This finding is meaningful in that it proposes an entirely new understanding of ecosystem services and their relationship to the WEN.

While our small sample size, and the fact that our study was not initially designed to investigate the WEN, must be taken into account when attempting to make inferences from our results, this research does suggest that the business community may have an important role to play in regards to water and energy planning. In addition, utilities may increasingly become agents for addressing the WEN and managing water and energy scarcity. Population growth, climate change, and alternative fuels such as biofuels also promise to impact water and energy resources in profound and unpredictable ways.

In addition to identifying common concerns over the WEN among the businesses we interviewed, our study proposes some promising areas of future inquiry. Research into which industries are already aware of the close connection between water and energy use,

locations where power and water utilities are avoiding a siloed approach to planning and are collaborating, as well as public misperceptions about the actual costs of various forms of energy production would greatly contribute to the body of knowledge on the WEN. While it was beyond the scope of our study to investigate these topics at this time, our study highlights the importance of this knowledge.

The information gathered in this study is meant to advance our understanding of how businesses, corporations, and utilities fit into the discussion on water and energy, to propose the idea of energy as an ecosystem service, as well as to provide meaningful areas of future inquiry. The water-energy nexus promises to be of increasing importance in the future. Understanding how it relates to real-world contexts will be essential for shaping policy and planning decisions as well as for ensuring the continued availability of these essential resources.

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## APPENDIX 1: INTERVIEW QUESTIONS

1. How has your business addressed the topic of sustainability?
2. What are the motivators for engaging in these programs?
3. What are the barriers and incentives for engaging in these programs?
4. Would a certification or third party auditing program be of interest? What characteristics would be useful?
5. What ecosystem services are most essential to your business? Would payment for ecosystem services be of interest?



## APPENDIX 2: CODEBOOK

| PRIMARY CODE       | EXPLANATION   |
|--------------------|---|
| Water              | Comments that mention water, water use, watersheds, wastewater, or water conservation.  |
|                    |   |
| Energy             | Comments that mention energy, energy costs, energy conservation, fuel, fuel cost, efficiency in the context of energy use, waste in the context of energy use, and technological advances or upgrades in the context of energy use. |
|                    |   |
| Ecosystem Services | Comments that refer to ecosystem services specifically; may include comments regarding soil, water, forests, clean air, and in some cases energy where energy is explicitly referred to as an ecosystem service.                    |

## CONCLUSION

This study sought to answer the question, “What are the meaningful differences among businesses with respect to how and why they invest in the environment, and how can this inform business investment in PES?” The original purpose of the study was to discover the motivations, barriers, and incentives businesses face when investing in the environment. However, it quickly became apparent that before we could understand this, we needed to understand more about the businesses themselves, about what factors distinguished them from each other in regards to investing in the environment. This seemingly simple inquiry led us to some unexpected and intriguing results.

Our study identified five factors that appear to shape business investment in the environment, these factors being size, the champion effect, organizational culture, industry culture, and the geographic focus of a business. Of these factors, geographic focus appears to be unique to our study. Previous analyses have characterized the business community as fairly homogenous, yet our study suggests that these factors may influence business investment in the environment in meaningful ways. While our small sample size must be taken into account when considering our results, our study suggests that this is a valuable area worthy of investigation.

In addition, the emergence of the water-energy nexus theme was an unexpected result of our research. Although our study did not intend to investigate this issue, it nonetheless emerged unprompted in many of our interviews. Our sample of businesses was selected to represent a diverse array of industries, sizes, and approaches to environmental sustainability, yet nearly all of them expressed a concern over water and energy issues. In addition, the responses from our interviewees led us to propose a new understanding of energy as an ecosystem service of watersheds.

The Willamette Valley is facing increasing pressure from development, population growth, and climate change, and many of the ecosystem services in the region are already stressed or degraded. Understanding how the private sector might contribute to the

protection and maintenance of the ecosystem services is one piece in the puzzle of how to maintain healthy and sustainable natural resources. The results described in our study hold the potential to facilitate greater investment in PES by the business community. In addition, it is our hope that by contributing to the body of knowledge on ecosystem services, energy, and the private sector, we have furthered our collective understanding of these important issues and laid the groundwork for future research.

Ecosystem services are essential to the health, welfare, and survival of all human societies. The time has passed when we can simply take these services for granted without thought to the cost and consequence of their exploitation. Understanding how human actions can both degrade and protect these services will be essential to maintaining them for generations to come. Widespread investment in ecosystem services holds the potential to protect and restore these services as well as transform how we as a society view, value, and relate to the environment.

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