Peak Oil: Knowledge, Attitudes, and Programming Activities in Public Health

Thesis

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By

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Abstract

Peak Oil, or the world reaching the maximum rate of petroleum extraction, poses risks such as depletion of energy resources, amplification of existing threats of climate change, destruction of existing oil reliant transportation and infrastructure, and more. These issues all trace back to the collective carbon footprint of U.S. citizens, as well as much of the rest of the developed and developing world, and are potentially solvable through society-wide behavior change.

There have been connections made between Peak Oil and human health, specifically its negative effects thereof. Even though discussing Peak Oil within the context of human health is relatively novel, public health agencies must become aware of the potential consequences of Peak Oil in order to properly protect their jurisdictions. In order to analyze the underlying factors that influence Peak Oil risk perception and health, as well as determine whether or not public health agencies are addressing or plan to address the health related impacts of Peak Oil, the research presented in this thesis involves a survey of Environmental Health Directors (EHDs) across the United States.

This study was divided into two parts. First, the factors that influence EHDs’ risk perception of Peak Oil were evaluated by assessing four independent variables: beliefs about Peak Oil, environmental attitudes, attitudes towards acting on Peak Oil, and
political ideology. It was found that out of the four independent variables, beliefs about Peak Oil, environmental attitudes, and attitudes towards acting on Peak Oil all made strong, unique contributions in explaining EHDs’ risk perception of Peak Oil. Secondly, the study looked at what factors influence Peak Oil mitigation behavior - termed Peak Oil programming - within public health agencies. Independent variables analyzed were Peak Oil risk perception, perceived responsibility, self efficacy, and response efficacy. Out of the four independent variables analyzed, EHDs’ self efficacy played the largest role in determining whether or not public health agencies had programmatic activities that addressed energy consumption, and therefore Peak Oil mitigation. Resource issues, including funding, staffing, and training, were also significant factors that influenced whether or not a public health agency addressed the health-related impacts of Peak Oil.
Dedication

This is dedicated to my mother who has always supported my dreams.
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I would like to thank my advisor, Dr. J. Mac Crawford, whose advice and guidance has helped further both my research and educational experience. Without his time and effort this project would not have been possible. I would also like to thank my committee members, Dr. Robyn Wilson and Dr. Berry Lyons for their contributions to this thesis.

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Chapter 1: Introduction to Peak Oil

This chapter will discuss Peak Oil as a concept and give a brief background. It will then delve into more specific information about oil such as types of oil, uses for oil, and consumption and import patterns. It will close by examining why oil is not easily replaceable in our society, and finally why Peak Oil will be a grave threat to public health.

1.1 Background

In 1956, Marion King Hubbert - a geoscientist from Shell - forecast the end of an era. Hubbert predicted that the production of conventional crude oil in the United States would peak around 1970, and would enter a terminal decline in production thereafter (Frumkin et al 2007). His prediction was based on the fact that oil is a finite resource, as well as his perception that there is an overconsumption of this valuable resource that outstrips the natural replenishment process. This phenomenon has been termed “Peak Oil” (Frumkin et al 2007). Figure 1.1 depicts this concept by showing past oil discoveries with a solid black line and projected oil discoveries with a solid gray line. While it is not a bell shaped curve with one conventional peak, the highest point on the graph occurs around 1970 and progressively decreases thereafter. The reason that oil production - represented by the dotted black line - has been continually increasing despite such a drastic decrease in discovery is that the previously discovered reserves average about 5 years lag between discovery and production, but often take many more
years still to produce (Höök et al 2009). This is due to time, money, and resource investments that must be made in drilling wells, extraction, and transport/storage of oil.

![Graph showing the growing gap between oil discovery and production](image)

**Figure 1.1** The growing gap between oil discovery and production (Hanlon & McCartney 2008)

1.2 Consumption

World consumption is estimated to be 27 billion barrels annually, while only 7 billion barrels are being discovered annually (Pimentel 2009). Cumulative world oil consumption was just below 1.2 trillion barrels by 2008; this is out of the 2.4 trillion barrels in the estimated world reserve of conventional oil (Strahan 2009). This is another possible way in which Peak Oil can be defined, as we have used over 50% of the estimated world reserve of conventional oil. Furthermore, world oil demand is expected to increase by 50% by 2025 (Hirsch et al 2005).
1.2.1 Population Pressure

The United States uses roughly a quarter of the world’s oil though it houses less than 5% of the global population (Worldwatch Institute 2011). This is more than twelve times the per capita use in China - the next leading per capita user (Pimentel & Pimentel 2008). This consumption pattern is as unsustainable as it is disproportionate, especially considering that the population is projected to continue growing from the world’s current 7 billion people (U.S. Census Bureau 2012b) to upwards of 16 billion people by 2050 (U.N. 2012).

1.2.2 Domestic Oil v. Imports

Some scientists have suggested “that as of 2008 the United States has consumed about 90% of the recoverable oil that was ever in the ground and that we are currently consuming the last 10% of our oil” (Pimentel 2009, 4). As a result, domestic oil production is projected to be substantially less over the next several years than it has ever been in the past (Pimentel 2009). Since, as noted in Section 1.3, the United States consumes so much oil despite the fact that it has so little, much of it must be imported. In fact, the United States imports approximately 60% of its oil, making it the world’s largest importer of oil (Schwartz el al 2011). Figure 1.2 clearly demonstrates some of the disparities between countries who have oil versus countries who use it.
Figure 1.2 Disparities between oil producing countries and oil consuming countries (Energy Information Administration 2004)
1.3 Uses for Oil

1.3.1 Transportation

Transportation is reliant on oil as a primary fuel source for automobiles and planes, as well as trains and ships. In 2008, 70% of the oil used in the United States was consumed by the transportation sector (Energy Information Administration 2009). According to the Natural Resources Defense Council, the United States was dependent on oil for 97% of its transportation energy needs in 2011. Some transportation is quite necessary; this includes logistics such as food, medical supply, and other critical product distribution; trips to and from work and medical appointments; and travel required for emergency responders in urgent situations such as fire, medical crisis, natural disaster, etc. Much of the travel within the United States, however, is discretionary. In 2003, 67% of automobile and 50% of airplane travel was elective (U.S. Department of Transportation). Some product shipment can be superfluous as well. For example, in 2005 the United States imported 16% of its vegetables and 44% of its fruits despite local commodities being readily available (Huang & Huang 2007). In fact, in 2010 the United States exported just under $1.3 billion worth of goods while it imported just over $1.9 billion (U.S. Census Bureau 2012a). It may stand to reason that if $1.3 billion had not been exported, only $600 million would need to be imported, saving on travel costs for nearly $2.6 billion worth of goods.

1.3.2 Agriculture

Oil dependency is no less prevalent in agriculture, where “the energy in the fertilizers, pesticides, machinery, and transportation that underlie food production and
shipment” contribute significant amounts to petroleum reliance (Frumkin et al 2007, 1689). In 2007, 19% of the United States total annual energy was used to fuel the production and distribution of food (U.S. Census Bureau 2007). On average, the generation of 1 calorie of food requires the input of roughly 4 calories of energy (Pimentel & Pimentel 2008). A number of foods - especially meat and dairy products - need as much as 35 calories of energy input to produce a single calorie of food (Horrigan et al 2002). In some cases, crops may be grown in locations that do not have ideal amounts of rainfall, making irrigation necessary for their survival. Irrigation, however, requires vast amounts of energy in order to pump and apply water to crop fields. One study estimated that irrigated corn requires more than 2.5 times the amount of energy input of its rainfed counterpart (Pimentel 2009). Needless to say, there is a great difference between the hefty input of oil and the minuscule output of foodstuff.

1.3.3 Miscellaneous

While transportation and agriculture comprise the largest total use of oil, it serves other functions as well. Numerous products are made from derivatives of oil, rendering it virtually indispensible to our lifestyle. Oil can be found as a raw material in the formation of products such as plastics, solvents, textiles, lubricants, pesticides, and medications (Frumkin et al 2007). While only a small quantity of oil is allocated to the production of pharmaceuticals by comparison to transportation and agriculture - approximately 3% - nearly 99% of pharmaceuticals are derived from oil (Hess et al 2011). Within every barrel of crude oil produced, 14% will be used for plastics production (San Francisco State University 2012). As far as home heating and cooling is
concerned, oil accounts for 3% of electrical energy produced in the United States (Energy Information Administration 2006).

1.4 Implication

Oil is certainly a substance of immense significance, and is in constant and vast demand. It is evident that our culture and society have built an infrastructure that requires oil, and it is a stark reality that there are currently few alternatives available should the oil supply become increasingly scarce. There is currently no obvious substitute for oil as a raw material, and it is indispensable as a cheap, reliable fuel source (Hanlon & McCartney 2008). While the science and technology required for such alternatives does exist in forms such as electric vehicles, solar panels, hydrogen fuel cells, etc., they are not readily available nor are they viable options for oil replacement within the existing infrastructure (Hirsch et al 2005).

1.5 Conflicting Perspectives

Peak Oil is a unique concept in that there is little debate over whether or not it will occur, but rather when it will occur (Wood et al 2004). Ultimately, there is no way to predict exactly when the world will arrive at Peak Oil due to the many factors that influence it—described throughout Chapters 1-2 of this paper. Many believe that the world has already or will soon reach Peak Oil, and that something must be done to transition society away from the use of oil as soon as possible. These people identify with the New Ecological Paradigm worldview. Others claim that Peak Oil is in the distant future, and emphasize technological innovation in order to extend oil production and use further into the future. These people identify with the Human Exemptionalism
Paradigm worldview. These two opposing viewpoints are further defined in the following sections.

1.5.1 Human Exemptionalism Paradigm

The Human Exemptionalism Paradigm (HEP) is an anthropocentric worldview comprised of the following assumptions:

1. Humans are unique by comparison to other species because we have culture.
2. Culture has the ability to change and vary much more than biological traits.
3. Human differences are socially induced and can be altered to eliminate inconvenience.
4. Progress can continue without limits, meaning that all social problems are solvable (Catton & Dunlap 1978, 42-3).

The above assumptions are the base for the HEP viewpoint which argues that humans are exempt from ecological limitations because of their uniqueness as a species via culture. This western worldview of human dominance and Durkheimian tradition of explaining social phenomena with strictly social facts seems justifiable due to the emergence of technology and innovation in providing solutions to shelter, travel, disease, and other problems that “lesser” species may face within the natural world. Furthermore, such innovations in conjunction with increased urbanization have allowed humans to separate themselves from nature, physically speaking, in many ways, hence reinforcing the HEP mentality (Dunlap & Catton 1994). HEP enables humans to feel empowered and often invincible. This leads to increased consumption of the earth’s resources, especially oil, without thought towards the implications this might have for the future. It functions as a convenient rationalization pardoning irresponsible exploitation.
1.5.2 New Ecological Paradigm

The New Ecological Paradigm (NEP) is the opposing viewpoint to HEP. NEP has some assumptions of its own including:

1. Humans are one species among many. All species are interconnected and dependant on one another in the bigger picture of the biosphere.

2. Human action impacts environmental systems.

3. Limits to growth are inevitable due to finite resources available (Catton & Dunlap 1978, 45).

Contrary to HEP, NEP recognizes and acknowledges that humans are not exempt from ecological limitations and are actually very much ecologically dependent. It preaches that the world is not here to be conquered, but rather to be shared and maintained in a fashion that may be sustainable.

NEP does not dispute that the human culture and innovative capacity by comparison to other species makes humans unique; it does, however, discern that regardless of this matter humans cannot ignore the impacts of their actions when concerning the environment. The laws of science indicate that feedback loops established within ecosystems will generate an effect when catalyzed by a cause, often on necessary ecosystem services. They also note that resources are finite. Thus, human activity is susceptible to constraints placed upon it by the biophysical environment.

1.6 Technology

Science and technology have been instrumental in the growth and development of society and our industrialized world. History has shown clear benefits in increased industrial and agricultural production, improved transportation and communications,
advancements in human health care, and general improvements to many aspects of human life, all as a result of technology and innovation (Pimentel 2009). The same technology, however, has also brought about detriments such as overconsumption, increased financial pressures, and environmental degradation. This section will further discuss the costs and benefits of technological advancement.

1.6.1 Efficiency

Technological advancements may be made by increasing the efficiency of a product or process, and can be an excellent step towards decreased consumption. It is, however, not a silver bullet solution, as psychological and behavioral factors often play a large role in addressing consumption patterns. According to Jevon's Paradox, increased efficiency actually often facilitates increased consumption (Adua 2010). This occurs because increased efficiency typically causes costs to decrease. For example, when buying a hybrid vehicle there will be an initial investment cost, but the cost of gasoline will be much lower for the same distance traveled in a non-hybrid vehicle. Because of the monetary savings in gasoline, however, many individuals may actually be encouraged to drive longer distances more frequently, therefore negating the aforementioned savings. Increased consumption may also occur when individuals who are not in the market for new vehicles initially discard their current functioning vehicle for a new hybrid simply because it is in high demand and therefore desirable. In order to properly address excess consumption, a comprehensive approach must be taken that does not rely upon squeezing the last full measure of efficiency out of resources as an end all be all, because such an effort will inherently yield diminishing returns.
1.6.2 Non-Conventional Sources

As mentioned in Section 1.2, the world has already consumed half of its estimated 2.4 trillion barrels of conventional oil reserves (Strahan 2009). There are, however, two main categories in which oil can be classified: conventional and non-conventional. Conventional oil is light, high quality, and easily recoverable with reasonable costs (Hirsch et al 2005). Conventional reserves, however, pale in comparison to the reserves that exist in the wide variety of non-conventional oil sources: tar sands, oil shale, heavy oil, bitumen, and gas and/or coal based synthetic liquid fuels (Hirsch et al 2005). In fact, the International Energy Agency has stated that these non-conventional sources may expand the total reserves from 2.4 to approximately 9 trillion barrels, with much of it being yet untapped (Strahan 2009). Technology will give us the ability to produce these “newer” reserves, but will do so at a cost.

1.6.2.1 Oil Shale

Oil shale is a sedimentary rock that contains a substance called kerogen - a solid bituminous material (Bureau of Land Management 2012). It can be mined using both underground and surface methods. Once mined, oil shale is transported to a plant where it is heated to extremely high temperatures; this process is called retorting (Bureau of Land Management 2012). When oil shale is heated the liquid oil separates from the solid mineral. The now separated liquid is then collected, and the mineral fraction is disposed of - typically by returning it to the mine. Another process that can be utilized in retrieving oil shale is called in situ retorting (Bureau of Land Management 2012). This process is similar to conventional retorting, but does not involve mining of the oil shale.
as a first step. Instead, the oil shale is heated underground and the resulting liquid is pumped to the surface.

1.6.2.2 Tar Sands

Tar sands are composed of clay, sand, water, and bitumen, and are mined using either a strip or open pit technique (Bureau of Land Management 2012). Once extracted, tar sands must undergo processing with hot water in order to separate the oil rich bitumen from the other components, and the clay and sand are disposed of - typically by returning them to the mine. After this step, the bitumen must then be distilled and diluted to make it less viscous so that it can be transported via pipeline (Bureau of Land Management 2012). Another process that can be utilized in retrieving bitumen from tar sands is called in situ production in which steam or solvents are injected into the mine in order to heat and separate the bitumen in the ground and pump it to the surface, leaving the clay, sand, and excess water in the ground (Bureau of Land Management 2012).

1.6.2.3 Hydraulic Fracturing

Hydraulic fracturing - more commonly known as fracking - is a technique in which a wellbore is drilled into a rock and highly pressurized fracturing fluid is injected in order to fracture the rock further (Ground Water Protection Council & ALL Consulting 2009). Drilling can occur either horizontally or vertically into the rock surface. After this process, most fractures are then propped open by the injection of a porous material such as sand, allowing permeability for oil or natural gas to flow out (Ground Water Protection Council & ALL Consulting 2009).
1.6.2.3 Recovery

Producing non-conventional oil is easier said than done. The estimated reserves of oil shale in the Green River Formation - located in parts of Colorado, Utah, and Wyoming - range from 1.2 to 1.8 trillion barrels (Bureau of Land Management 2012). More than 2 trillion barrels of oil throughout the globe currently exists in the form of tar sands, with an estimated 12-19 billion barrels residing in Utah alone (Bureau of Land Management 2012). Despite large quantities, however, prospects for non-conventional oil look bleak. This is due to the fact that not all reserves are recoverable, meaning that they are not available for production. In order for a reserve to be economically worth producing, the amount of usable energy retrieved from the reserve must be greater than the amount of energy expended to obtain it; this concept is known as energy returned on energy invested (EROEI) (Murphy & Hall 2010). Many reserves are simply cost prohibitive due to the complex nature of the extraction methods necessary in combination with the specific location and geology of any given reserve (Hirsch et al 2005). Strahan notes that in addition to major hurdles practically and financially, there are also challenges imposed by more stringent and widespread environmental - specifically carbon - regulations (2009). Due to the nature of non-conventional oil, the World Energy Council has declared that “unconventional oil is unlikely to fill the gap” associated with conventional oil peaking (2003, 67).

1.6.2.4 Environmental Impacts

Mining, in situ production, processing, and fracking of non-conventional oil all have inherent environmental impacts. Mining will cause a disturbance to the mined land, therefore forcing wildlife out of the area and destroying the natural grade of the soil,
current topography, and native vegetation pattern. In many cases, these operations are exceedingly water intensive as it is required for both pumping in fracking and in situ production and processing of oil shale and tar sands (Bureau of Land Management 2012; Ground Water Protection Council & ALL Consulting 2009). This is ultimately more of a concern in arid regions, but nonetheless, these activities currently necessitate several barrels of water input for each barrel of oil produced (Bureau of Land Management 2012). Groundwater contamination is also of concern as fracking fluids may leak into the water table and in situ methods may heat water tables to unnatural levels (U.S. House of Representatives Committee on Energy and Commerce 2011). Last, air quality will be affected from process emissions of methane (Ground Water Protection Council & ALL Consulting 2009), which as a greenhouse gas will ultimately contribute to global climate change.

1.7 Threats to Public Health

1.7.1 Economics

As oil becomes scarcer, the price will continue to rise. This will cause economic stress for many, and may in turn lead to recession (Schwartz et al 2011). Economic recessions are generally viewed as bad for public health for many reasons (Hanlon & McCartney 2008). First and foremost, Peak Oil and the economic downturn that will ensue will cause lifestyle changes for a great number of people, many of whom may not be able to afford food, gasoline, or medical care. Further, rising oil prices will affect individuals differently, with the most burdens falling upon the poor, minorities, the
elderly, and children (Neff et al 2011). This sort of disruption in one’s life is often the root of many psychological illnesses such as anxiety and depression (Miller 1972).

1.7.2 Transportation

In 2009 there were 3.8 billion trips made by individuals to access health care services of which a mere 0.08% was made utilizing public transit; the average distance traveled for health care was 10.3 miles (Hess et al 2011). As a result of oil scarcity and increased prices at the pump, many individuals will not be able to afford gasoline, and hence will not have accessible and affordable means of travel. One study has shown that when travel costs are high, distance can be a predominant factor in the decision-making process when seeking treatment (Celaya et al 2006). This will ultimately lead to many people going without healthcare, therefore increasing the rate of illness due to treatable and preventable diseases.

Considering the high cost of gasoline, many of these individuals will not be able to get to their places of work, and may lose their jobs and therefore their income. This may lead to being unable to purchase necessary food and healthcare, and exacerbate the mental ailments mentioned previously. This may also be treacherous in that much of the public health workforce may not be able to get to work, leaving hospitals and clinics understaffed, water treatment facilities unmanaged, solid waste uncollected, and so-on. Some individuals may choose to turn in their automobiles for more efficient scooters and motorcycles. This is extremely dangerous, however, as the projected fatalities from motorcycle accidents increase by 1500 every time fuel prices are raised by one dollar (Wilson et al 2009).
1.7.3 Medications and Medical Supplies

Since oil is an integral ingredient in many plastics used for medical supplies and medications, there is no doubt that Peak Oil will have a negative effect on health care. In one study it was found that past oil scarcity led to rising plastic prices which, in turn, increased health care prices, although at a rate that lagged behind by several months (Hess et al 2011). While only a small quantity of oil is allocated to the production of pharmaceuticals by comparison to transportation and agriculture - approximately 3% - roughly half of all Americans use prescription drugs at any given time (Hess et al 2011). As those individuals well know, these medications are already quite costly in many cases, meaning that oil scarcity and rising oil prices are sure to make numerous medications unaffordable to those who need them.

1.7.4 Agriculture

While oil intensive agriculture may increase crop yields, it also contributes to environmental degradation through decreased soil quality, therefore making land less suitable to sustain crop growth in the future (Pimentel 2008). Considering that agriculture is extremely oil intensive, it should come as no surprise that rising oil prices will raise food costs as well. This will make nutritious food unaffordable for some, leading to many becoming malnourished and/or going hungry. With oil scarcity many farmers have already begun to convert cropland into the production of biofuels, decreasing food supply and further inflating the price of food (Neff et al 2011). Food shortages and prices have already increased anywhere from 10-50% (Pimentel 2008).
1.7.5 Non-Conventional Sources

As conventional crude oil becomes scarcer and prices begin to rise, non-conventional oil will likely become more popular. This will bring about many negative environmental impacts as discussed in Section 1.6.2.4, which will in turn affect human health. For instance, the disruption of minelands may alter ecosystem services such as natural water filtration processes. Water may become scarce in some cases due to the large water requirements of extraction and processing non-conventional oil. Groundwater contamination may be the biggest concern since many of the chemicals used in fracking are carcinogenic (U.S. House of Representatives Committee on Energy and Commerce 2011). Last, air quality will be affected from process emissions of methane (Ground Water Protection Council & ALL Consulting 2009), which as a greenhouse gas will ultimately contribute to global climate change - the effects of which are discussed in more detail in Section 1.7.6.

1.7.6 Climate Change

The primary cause of anthropogenic climate change is the accumulation of greenhouse gases - especially carbon dioxide (CO₂) - in the atmosphere caused by the burning of fossil fuels (Kharecha & Hansen 2008). The burning of fossil fuels produces around 21.3 billion tonnes of CO₂/year, a significant portion of which is due to oil (Kanawade et al 2010). In this way oil is already contributing significantly to climate change. However, the depletion of oil as a resource via Peak Oil will also limit societies’ ability to provide resources toward climate change mitigation and adaptation programming. Furthermore, when oil prices skyrocket, governments will likely look into energy options that are less environmentally friendly than conventional crude oil.
Non-conventional oil, discussed in Section 1.7.5, would considerably amplify the threats imposed by climate change. Another such option will be to substitute coal for oil. This will put an estimated 208,000lbs of CO₂/billion BTU into the atmosphere as opposed to oils 164,000lbs of CO₂/billion BTU (Silverman 2012). This is over 25% more CO₂ than is being dispensed currently, significantly accelerating global climate change. Research has shown that climate change can have a considerable effect on human health as described in more detail in the following sections.

1.7.6.1 Heat

As climate change induces temperature increases, the frequency, severity, and duration of heat waves will rise as well (U.S. Climate Change Science Program 2008). Heat related illness ranges from lesser sunburns and heat cramps to heat exhaustion and heat stroke (National Oceanic and Atmospheric Administration 2012). According to the NOAA’s National Weather Service “heat is the number one weather-related killer in the United States, resulting in hundreds of fatalities each year. In fact, on average, excessive heat claims more lives each year than floods, lightning, tornadoes and hurricanes combined.” History has proven this in the heat waves of 1980, 1995, and 2003 wherein 1,250, 700, and 50,000 lives were claimed respectively (National Oceanic and Atmospheric Administration 2012). Heat waves will be distributed disproportionately as cities will receive more heat waves as a result of the urban heat island effect. The elderly and young children will be most vulnerable to heat stress, although those with low socio-economic status will also be at risk due to a lack of conventional air conditioning (U.S. Climate Change Science Program 2008).
Increased levels of heat will affect health in other ways than just heat related illness. In some locations rising temperatures will induce an earlier spring and a prolonged summer, and increasing concentrations of carbon dioxide will stimulate plant production of greater levels of pollen. This will cause a rise in the severity and duration of seasonal allergies (U.S. Climate Change Science Program 2008). In other locations rising temperatures will contribute to the drying of soils and vegetation, resulting in the increased occurrence, severity, and duration of wildfires (U.S. Climate Change Science Program 2008). Effects of wildfires include death, burns, mental illness, and respiratory illnesses from fire-related air pollution, notwithstanding the environmental concerns of more fires occurring than are natural.

1.7.6.2 Extreme Weather

Climate change will also bring about an increase in the frequency, severity, and duration of extreme weather events including hurricanes, floods, tornadoes, heat waves - mentioned in more detail in Section 1.7.6.1 - and more. The IPCC predicts the number of people who suffer from these extreme weather events will increase as a result of climate change (Confalonieri et al 2007). This may include illness, injury, and/or death. Mental health problems caused by extreme weather events will be especially prominent due to emotional trauma and anxiety, and will often lead to disorders such as depression or post-traumatic stress disorder (U.S. Climate Change Science Program 2008).

1.7.6.3 Water

With increases in precipitation and extreme weather events such as hurricanes, probabilities of flooding and sewer overflow will increase dramatically. This may cause
waters to become contaminated with microbial agents and other pathogens that cause waterborne disease (U.S. Climate Change Science Program 2008). Exposure to contaminated waters may occur from ingestion of water for drinking or dermal contact during flooding or recreational activities (U.S. Climate Change Science Program 2008). Past examples of these events have had detrimental effects on those who experienced them. For example, after Hurricanes Katrina and Rita, many cases of diarrhea were documented after drinking water supplies were contaminated with fecal bacteria (Confalonieri et al 2007). Another case appeared in Milwaukee in 1993 when a rise in total precipitation and runoff caused 403,000 illnesses and 54 deaths, making it the largest documented water-borne disease outbreak in the history of the United States (Curriero et al 2001). Research has also contributed to this relationship. One study comparing data on water-borne disease outbreaks to precipitation data between 1948-1994 found that the occurrence of water-borne disease was strongly correlated with extreme precipitation events (Curriero et al 2001).

1.7.6.4 Food

The occurrence of food-borne illness is also expected to increase. This is due to higher temperatures creating more favorable conditions for the replication, survival, and transmission of both parasitic infections and bacterial pathogens (Center for Disease Control and Prevention 2009). Extreme weather events will also affect the food supply. Increased precipitation and flooding may drown many croplands, while increased temperature and heat waves may lead to desertification of many croplands (U.S. Climate Change Science Program 2008). Many crop species will not be productive in a warmer, dryer climate, leading to smaller yields (U.S. Climate Change Science Program 2008).
Prices have already begun, and will continue to rise as a result of this food shortage, affecting poor individuals disproportionately as they will not be able to afford higher charges. Likely health consequences range from poor nutrition - and complications that stem from it - for some, to starvation for others (Frumkin et al 2008).

1.7.6.5 Air Quality

With the presence of oxides of nitrogen (NOx) and volatile organic compounds (VOCs) from motor vehicle exhaust and industrial emissions (Environmental Protection Agency 2012), and as temperatures rise and greenhouse gases accumulate in the atmosphere, tropospheric ozone formation will increase through the combination of warm, polluted air and sunlight (Weare 2002). This will decrease air quality and can damage the lungs and contribute to an increase in cardiovascular and pulmonary disorders such as asthma and chronic obstructive pulmonary disease (U.S. Climate Change Science Program 2008). Children and individuals who work outdoors will be most susceptible to these disorders (U.S. Climate Change Science Program 2008).

1.7.6.6 Vector-borne Diseases

The incidence of vector-borne disease will likely rise with increases in temperature and precipitation by increasing the distribution of breeding grounds, number of suitable habitats, and duration of the reproductive season for many species (Chan 1999). Warm wet conditions are favorable for insect vectors (Hamburg et al 2008), while rodents will prefer the hot dry conditions (Cameron & Scheel 2001). These vectors include mosquitoes, ticks, and rodents that carry diseases such as West Nile virus, Lyme disease, Dengue fever, and more (U.S. Climate Change Science Program 2008). Birds
can also be a major vector, often carrying bacteria, viruses, parasites, and/or other organisms with them over long distances (Reed et al 2003).

1.8 Benefits to Public Health

Not all of the effects of Peak Oil will be dire. Over time the principle of supply and demand may lead to demand destruction, meaning that if prices rise to a point where no one can afford to consume oil, the prices will then fall again with this decreased demand. At this point, however, individuals may not perpetuate the vicious cycle of supply and demand since they may have learned to live adequately without oil after being financially forced to go without. Peak Oil may lead to the proliferation of renewable energy sources and/or decreased energy consumption overall. In some cases individuals may lead healthier lifestyles from walking or biking as their primary means of transportation and buying more locally grown organic foods instead of heavily transported, packaged, and pesticide grown foods. Climate change mitigation may also occur through lessened use of oil - that is if society does not turn to non-conventional oil and other fossil fuels - in transportation and agriculture.

1.9 Role of Public Health

Public health agencies serve their jurisdictions through the promotion of healthy living as well as prevention of disease (Wilson 1920). They are leaders regarding such matters, and are often the sole charge for policy formation and communicating important information to the general public (World Health Organization 2012). The aforementioned findings strongly suggest that Peak Oil will affect human health in the United States. Thus, it would be prudent for public health agencies to establish
programming to deal with the health-related challenges associated with Peak Oil, as well as programming to mitigate Peak Oil through decreased energy consumption. Since many of the expected health impacts of Peak Oil are related to environmental health, the role of the Environmental Health Director (EHD) within a local health department was specifically assessed. For the purposes of this study, EHDs within a local health department were assessed by focusing on individual EHDs’ risk perception of Peak Oil as well as behavior towards Peak Oil. The ultimate goal is to identify why public health agencies do or do not have Peak Oil programming in order to more effectively promote the development of future Peak Oil policies within public health agencies across the United States.
Chapter 2: Theoretical Background on Risk and Behavior

This chapter will discuss some theories about what factors affect individual risk perception and behavior. This is important in determining what characteristics of an individual EHD may enhance or inhibit the likelihood of establishing preparedness plans to help prevent, or at least decrease the chances of, severe health impacts caused by Peak Oil.

There is no silver bullet solution to the complex problem of reducing energy consumption. In order to properly address excess consumption, a comprehensive approach must be taken that does not rely on a business as usual approach or upon squeezing the last full measure of efficiency out of resources. Without consideration of social and behavioral factors, technology-based efficiency improvements in resource use will only generate minimal environmental benefits (Adua 2010). Lessening consumption is a must if any technological advances are to work and if we are to become sustainable in our energy usage.

2.1 Influences of Risk Perception

Risk is generally defined as the “things, forces, or circumstances that pose danger to people or to what they value” (Stern & Fineberg 1996, 215). Risk perception is defined as the personal assessment of the probability or likelihood of a specific event occurring, and how concerned the individual is with the consequences associated with the
risk (Sjöberg et al 2004). The factors described in this section all help to explain what
directly influences an individual’s risk perception towards Peak Oil, and what indirectly
influences behavior through risk perception. They include beliefs, attitudes, and political
ideology.

2.1.1 Attitudes and Beliefs

Affect is the characteristic goodness or badness unconsciously associated with a
stimulus; it relies heavily on imagery and association, often drawing on past experiences
as sources of information (Slovic et al 2004). Attitude is commonly defined as the
evaluation of an object or entity based on the affect one associates with it (Jaccard &
Blanton 2007). Attitudes generally predispose individuals towards behavior with positive
affect (Jaccard & Blanton 2007). A belief is a mental state of being in which an
individual accepts a premise as the truth (Schwitzgebel 2011). Beliefs are generally
driven by values and social norms (Sjöberg 2000). Attitudes and beliefs are highly
correlated and interdependent, and play a key role in an individual’s perception of risk
(Sjöberg 2000).

Research has shown that attitudes and beliefs toward the environment can be
influential to behavior regarding the environment (Dunlap et al 2000). The NEP scale is
a tool by Riley Dunlap and Kent Van Liere designed to assess individual concern for the
environment. A high NEP score means that an individual will have a more pro-
environmental attitude (Dunlap et al 2000). One study found that belief in the NEP
worldview - discussed in Section 1.5.2 - has a positive influence on perceived risk
(Slimak & Dietz 2006). Another study found that individuals with pro-environmental
attitudes were extremely likely to have engaged in pro-environmental behavior (Hines et al 1987).

2.1.2 Political Ideology

Individuals holding politically liberal views are often more pro-environmental in their attitudes and beliefs than their conservative counterparts, scoring higher on Dunlap’s NEP scale (Slimak & Dietz 2006). Since attitudes and beliefs are involved in the influence of risk perception and behavior, it is not a stretch to believe that political ideology will play a role as well. White men tend to be more politically conservative and also have generally low perception of risk; this is often referred to as the white male effect (Slovic 1999). Interestingly, a recent study has shown that individuals who are politically conservative are the most concerned about the health risks associated with Peak Oil (Nisbet et al 2011).

2.2 Influences of Behavior

There are many behaviors that are unsustainable in the face of Peak Oil: excessive automobile ownership and use, unwarranted expenditure of energy in the form of electricity or home heating and cooling, etc. In order to change these behaviors, there must first be an enhanced understanding of human behavior and - more specifically - how behavior can be modified to make it more sustainable. The factors described in this section directly influence whether or not an individual EHD has addressed or plans to address Peak Oil within their department. They include risk perception, perceived responsibility, and efficacy. Outside barriers to behavior change will also be discussed.
2.2.1 Risk Perception

Individual risk perception is integral to determining how individuals view and address the concept of Peak Oil and extremely helpful in predicting why people behave the way that they do (O’Connor et al 1999). Individuals tend to vary in their perception or interpretation of the same risk (Plous 1993), meaning that some EHDs may perceive Peak Oil as riskier than others. Those who perceive risks as high are more likely to engage in behavior to mitigate that risk than those who perceive risks as low. EHDs whom are more knowledgeable and/or aware of the risks posed by Peak Oil are also more likely to engage in behavior to mitigate risks thereof (Rimal & Real 2003).

An EHD may perceive the risks associated with Peak Oil as low for many reasons. If an EHD has a high internal locus of control (Plous 1993), they may choose to accept the risks posed by Peak Oil because they believe that Peak Oil is controllable - whether via new technological advances, further exploration for reserves, etc. - thus preventing any negative consequence from occurring. Prospect theory states that individuals are loss-averse, meaning that they focus more on losses than gains (Plous 1993). In this case, EHDs may frame funds spent on Peak Oil programming as a loss, but fail to recognize the gains being made in human health and safety by putting the programs in place. Because individuals are prone to think in terms of immediate satisfaction, they are likely to avoid an immediate loss, however small, instead of receiving a large future gain (Plous 1993). While there may be concrete short-term benefits to funding other programs, there will also be abstract long-term costs to human health and safety from Peak Oil if it is neglected (Trope & Liberman 2010). Peak Oil is discounted since the risk is viewed as something that may affect the distant future, but in
doing so the risk is amplified by continued inaction. Regardless of the reasoning for perceiving risks posed by Peak Oil as low, EHDs who do are unlikely to engage in behavioral change.

2.2.2 Perceived Responsibility

An individual’s perceived responsibility to act is directly related to their behavior, and is dependent on many factors. Research has shown that an individual will feel more responsible to act if they have had an extremely positive experience or an extremely negative one associated with the specific entity or event (Kahneman & Tversky 1982). One study states that when individuals feel an obligation towards the environment they will be more likely to act in an environmentally responsible fashion (Kellstedt et al 2008).

Some individuals may not feel responsible for acting to mitigate Peak Oil. This may be because to the untrained eye, many of the effects of Peak Oil can appear to be imperceptible. It is the cumulative effect of all of these things that poses an undeniable threat to future global security. While Peak Oil has countless harmful effects, many of them are not yet observable, making present generations skeptical and/or apathetic, and therefore inadequate in their actions. Oil scarcity is also psychologically distant since its consequences are often abstract and seen as something from the far off future that can be addressed at a later point in time (Trope & Liberman 2010). If an EHD feels this way, chances are that he or she will not feel responsible for acting to mitigate Peak Oil.
2.2.3 Efficacy

Efficacy is the perception that an individual can make a difference, and is another important variable that influences behavior. There are two main types of efficacy: self efficacy refers to the degree to which an individual feels capable of acting to mitigate a risk (Ajzen 2004), and response efficacy refers to the degree to which their action will be effective in reducing the risk (Martin et al 2007). Whether individuals act upon a certain risk or not is dependent on their perceived efficacy. The greater efficacy an individual has, the more likely they will be to act (Witte 1994). The more aware an individual is of what can be done to combat a problem, the more likely he or she will be to engage in behavior to do so (Rimal & Real 2003). Research shows that individuals tend to avoid situations where they feel helpless or that they cannot make a difference (Kaplan 2000). These individuals are said to have a low locus of control (Plous 1993); they are aware of the risks that Peak Oil imposes, yet do not believe that they can do much about them since the problems are so colossal in scale and scope.

2.2.4 Outside Barriers to Behavior

Creating Peak Oil programs within public health agencies is challenging to achieve, because data on how Peak Oil can affect health are new and the exact extent of its impact continues to be explored. However, this does not mean that public health agencies should take the issue lightly. Leiserowitz (2007) says it best when he makes the statement about climate change that "...scientific uncertainty alone is not an adequate justification for inaction or business-as-usual. Rather, it suggests that, at a minimum, it would be prudent to [...] adopt adaptive management strategies" (56-57). The public health community should be aware of this growing issue in order to effectively establish
preparedness plans to help prevent, or at least decrease the chances of, severe health impacts caused by Peak Oil.

In addition to the factors mentioned above that will influence EHDs behaviors, there will also inevitably be outside barriers to behavior. Oftentimes there are constraints present within a health department that will be outside the scope and control of an EHD. These constraints often present themselves in forms such as funding and staffing. For example, a 2010 study found that roughly half of the local health departments surveyed expected budget cuts within the following year (Barnett et al 2011). The study also revealed that within a 2 year time frame, the participating departments lost a collective 15% of their staff due to budgeting cutbacks (Barnett et al 2011). These barriers may mean that regardless of an EHD’s view of Peak Oil, they may be prohibited from action. However, the identification and understanding of these barriers is important nonetheless, as it will help to identify ways in which Peak Oil programming can be increased in the future.
Chapter 3: Methods

This chapter will discuss the present study and its research objectives, as well as the sampling frame, survey measures, analytic methods and hypotheses.

3.1 Purpose of the Study

The present study came about as part of a larger set of initiatives at The Ohio State University called Targeted Investment in Excellence (TIE). One TIE funding initiative is Carbon, Water, and Climate-Public Health Preparedness and Infectious Disease (CWC/PHPID). This study was a pilot project entitled “Engaging the Public Health System in Reducing the Societal Carbon Footprint.” The study was run through the College of Public Health at The Ohio State University with the goal of enhancing public cooperation in reducing the collective carbon footprint. Specifically, the study sought to identify the most effective ways to move the public health system to adopt strategies aimed at reducing the carbon footprint on a population scale.

The study looked at two groups of public health workers - EHDs and Nursing Directors - as well as two carbon intensive issues that threaten the public health system: Peak Oil and climate change. For the purpose of this paper, the focus will remain on EHDs and Peak Oil.
3.2 Research Objectives

The primary research objectives for the study are as follows:

1. Assessment of EHD’s baseline understanding of the general concept of carbon footprint and its attendant problems
2. Assessment of EHD’s knowledge, attitudes, and beliefs about Peak Oil
3. Assessment of EHD’s perception of the risks posed by Peak Oil
4. Assessment of the degree to which EHD’s take the issue of Peak Oil into account when engaging in preparedness programming, planning, and training

3.3 Sampling Frame

The sampling frame is composed of EHDs from across the United States. It was developed by using an internet search to locate all public health agencies with an appointed EHD listed on their webpage. Each EHD’s address, phone number, and email address was subsequently documented. Emails containing a pre-notice letter informing about the survey were sent to each EHD on March 15, 2010. The descriptive survey used was disseminated via email on March 17, 2010. There were also 2 reminder emails sent, the first on March 24 and the second on March 31. The closing date on the survey was April 13, 2010. After the survey’s closing date, the responses were collected and exported into Microsoft Excel. Once the variables were labeled correctly, the Excel spreadsheet was transferred to SPSS 17.0. Out of 823 total emails sent, a total of 194 full responses were received at a 23.6% response rate. There were also 225 partial responses, received at a 27.3% response rate. Due to the low response rate, a shorter follow-up survey was sent to non-responders. This survey also suffered from a low response rate. Out of 404 emails sent, 64 responses were received at a 15.8% response rate.
3.4 Survey Development

Many questions from the first draft of the project’s survey were adapted from the 2008 survey by the National Association of Country and City Health Officials (NACCHO), the Environmental Defense Fund, and George Mason University entitled “Are We Ready?” (Balbus et al 2008). In order to test this draft, two focus groups were conducted: one consisting of eight Ohio Public Health Nursing Directors, and the other composed of two Ohio EHDs and one Public Health Administrator. After feedback was given, the survey was modified by eliminating some of the NACCHO questions in favor of the addition of other questions modified from different sources. After several revisions the survey was tested on faculty and graduate students at The Ohio State University. Again, feedback was given and the survey was modified accordingly. The survey went through approximately eight drafts before the final version - located in the Appendix of this paper - was implemented in an online survey system called Checkbox.

3.5 Measures

3.5.1 Socio-Demographics

Several questions that ask about specific socio-demographics were asked at the end of the survey. EHDs were asked to identify their location (state and zip code), age, level of education, gender, and political ideology in order to evaluate differences across these categories. Most of the socio-demographic questions came from the NACCHO survey, however, the political ideology question was taken directly from Kellstedt et al (2008). Political ideology was of specific interest, and was ultimately measured on a 7-
point Likert scale, where -3 = extremely conservative and 3 = extremely liberal.

3.5.2 Peak Oil Beliefs

In addressing beliefs about Peak Oil, EHDs were asked whether or not they agreed or disagreed with the statement “Global oil resources will eventually plateau and decline.” Beliefs were measured on a 7-point Likert scale, where -3 = strongly disagree and 3 = strongly agree.

3.5.3 Peak Oil Attitudes

The questions assessing EHDs’ attitudes towards behavior, specifically the act of addressing Peak Oil within their department were addressed by asking respondents to indicate their position on two attitudinal items - modified from Kahlor & Rosenthal (2009) - on a 7-point Likert scale. The first statement asked respondents to “Please indicate to what extent you feel addressing energy consumption through the public health system is bad or good” where -3 = bad and 3 = good. The second statement asked respondents to “Please indicate to what extent you feel addressing energy consumption through the public health system is worthless or valuable” where -3 = worthless and 3 = valuable. Responses were averaged to obtain an overall score. For these measures Cronbach’s α = 0.949.

3.5.4 Environmental Attitudes

The statements in the survey that assess EHDs attitudes towards the environment were taken from the NEP scale discussed in Section 2.1.1. Although the original NEP scale contains 15 statements, 8 were used in the survey since; in order to diversify the responses, 4 NEP statements were worded positively towards the environment and 4 NEP
statements were worded negatively towards the environment. This was done because the additional 7 statements were not found to be necessary, as Cronbach’s $\alpha = 0.783$ for the 8 statements used. Respondents were asked to indicate to what extent they agreed or disagreed with each statement on a 7-point Likert scale, where -3 = strongly disagree, and 3 = strongly agree. Responses were averaged to obtain an overall score. The statements were as follows:

1. We are approaching the limit of the number of people the earth can support.
2. Humans have the right to modify the natural environment to suit their needs.
3. When humans interfere with nature it often produces disastrous consequences.
4. The earth has plenty of natural resources if we just learn how to develop them.
5. Plants and animals have as much right as humans to exist.
6. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
7. Humans are severely abusing the environment.
8. Humans will eventually learn enough about how nature works to be able to control it.

3.5.5 Peak Oil Risk Perception

Whether or not EHDs perceive Peak Oil as a risk was measured by several items relating to concern and expected scale of the impacts that were modified from Leiserowitz (2006). Respondents were asked to indicate to what extent they agreed or disagreed with each statement on a 7-point Likert scale, where -3 = strongly disagree, and 3 = strongly agree. Responses were averaged to obtain an overall score. For these measures Cronbach’s $\alpha = 0.938$. The statements were as follows:
1. I am concerned about the impacts of Peak Oil in my jurisdiction.

2. The impact of Peak Oil will be serious in the United States.

3. The impact of Peak Oil will be serious in my jurisdiction.

4. The impact of Peak Oil will be serious around the world.

3.5.6 Perceived Responsibility

EHDs’ perception of responsibility towards addressing Peak Oil was uniquely developed and measured by asking respondents to indicate to what extent they agreed or disagreed with the statement “My environmental health department has a responsibility to address energy consumption in my jurisdiction” on a 7-point Likert scale, where -3 = strongly disagree, and 3 = strongly agree.

3.5.7 Response Efficacy

EHDs’ response efficacy towards addressing Peak Oil was modified from Kellstedt et al (2008) by asking respondents to indicate to what extent they agreed or disagreed with the statement “My environmental health department’s actions can decrease energy consumption in my jurisdiction” on a 7-point Likert scale, where -3 = strongly disagree, and 3 = strongly agree.

3.5.8 Self Efficacy

The questions assessing EHDs’ self efficacy towards addressing Peak Oil were uniquely developed, and were measured by asking respondents to indicate their position on two items on a 7-point Likert scale, where -3 = strongly disagree, and 3 = strongly agree. Responses were averaged to obtain an overall score. For these measures Cronbach’s α = 0.837. The statements were as follows:
1. My environmental health department has the ability to address energy consumption in my jurisdiction.

2. My environmental health department is prepared to address energy consumption in my jurisdiction.

3.5.9 Peak Oil Programming

In order to assess public health departments’ current activity or inactivity in addressing Peak Oil, a matrix of 8 different Peak Oil programs asked respondents whether or not a specific activity is a current area of programmatic activity within their health department, or if it would be an area of programmatic activity in the near future. The responses were then scored ranging from 0 = no programmatic activity, to 8 = complete programmatic activity. For these measures Cronbach’s α = 0.851. This measure is illustrated in Figure 3.1.

3.5.10 Outside Barriers to Behavior

In order to further understand factors influencing current Peak Oil programming activities within a public health department, an open-ended question was added at the end of the survey to assess potential barriers. The question asks respondents to list up to three resources that their department would need in order to improve their ability to encourage the reduction of energy consumption; some suggestions stated within the question included funding, staff, and training.
The following are programmatic activities aimed at reducing energy consumption, and as a result reducing risk from Peak Oil. Please think about whether your environmental health department currently includes this activity in their programming for the public, and/or plans to include this activity in their programming soon.

Now, please check the box that most appropriately represents your understanding of the status of these activities within your department. Please check yes, no, or don't know (DK).

<table>
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<tr>
<th>Activity</th>
<th>Yes</th>
<th>No</th>
<th>DK</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Encouraging people to use active transport (walk, ride bikes)</td>
<td></td>
<td></td>
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<tr>
<td>Encouraging people to use mass transportation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouraging people to buy locally-grown food</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Encouraging people to save electricity by turning off the lights, turning the computer off, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educating people about climate change and health related impacts</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Encouraging people to recycle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other energy consumption reduction activities in your department</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3.1 Measure of Peak Oil Programmatic Activity
3.6 Hypotheses

The first set of hypotheses - depicted in Figure 3.2 - focuses on 4 predictor variables (i.e., Peak Oil beliefs, political ideology, Peak Oil attitudes, and environmental attitudes), and how they relate to one dependent variable (Peak Oil risk perception).

They are as follows:

H1. The more positive an EHDs’ Peak Oil Beliefs, the greater their Peak Oil Risk Perception will be.

H2. The more liberal an EHD’s Political Views are, the greater their Peak Oil Risk Perception will be.

H3. The more positive an EHD’s Environmental Attitude is, the greater their Peak Oil Risk Perception will be.

H4. The greater an EHD’s Peak Oil Attitude is, the greater their Peak Oil Risk Perception will be.

The second set of hypotheses - depicted in Figure 3.3 - focuses on 4 different predictor variables (i.e. Peak Oil risk perception, self efficacy, response efficacy, and perceived responsibility), and how they relate to one dependent variable (i.e. current and/or future Peak Oil programmatic activity within public health agencies).

H5. The greater an EHD’s Peak Oil Risk Perception is, the more Peak Oil Programming they will have.

H6. The greater an EHD’s Perceived Responsibility is, the more Peak Oil Programming they will have.

H7. The greater an EHD’s Self Efficacy is, the more Peak Oil Programming they will have.

H8. The greater an EHD’s Response Efficacy is, the more Peak Oil Programming they will have.

When combined, both sets of hypotheses form a path model, shown in Figure 3.4.
Figure 3.2 Hypothesized correlations and independent variables expected to influence Peak Oil Risk Perception
Figure 3.3 Hypothesized correlations and independent variables expected to influence Peak Oil Programming
Figure 3.4 Hypothesized correlations of all independent and dependent variables
3.7 Analyses

All analyses were conducted using SPSS 17.0. Analysis of the data began by conducting reliability tests using Cronbach’s alpha for each of the combined measures used, as alluded to in Section 3.5. Other preliminary analyses included descriptive statistics and Pearson’s product moment correlations in order to observe hypothesized relationships between variables. Linear regressions were then performed on each of the dependent variables. A logistic regression was also performed on the Peak Oil programming variable.
Chapter 4: Results

This chapter will discuss the descriptive results, correlations, and regression analyses associated with the aforementioned variables within the data set.

4.1 Descriptive Results

The average age of respondents was 49.7 years. The vast majority of respondents identified as white and non-Hispanic - 94.2% and 95.7% respectively. Regarding education, 96.2% of all EHDs had obtained a bachelor’s degree or higher, with 37.6% having obtained a master’s degree or above. Political views of the sample were split relatively evenly with a slight skew towards conservative. EHDs self identified as 39% conservative, 31.6% moderate, and the remainder of 29.4% liberal. All descriptive socio-demographic results can be found in Table 4.1.
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<td>177</td>
<td>---</td>
<td>100</td>
<td>---</td>
</tr>
<tr>
<td>Conservative</td>
<td>69</td>
<td>---</td>
<td>39</td>
<td>---</td>
</tr>
<tr>
<td>Moderate</td>
<td>56</td>
<td>---</td>
<td>31.6</td>
<td>---</td>
</tr>
<tr>
<td>Liberal</td>
<td>52</td>
<td>---</td>
<td>29.4</td>
<td>---</td>
</tr>
</tbody>
</table>

Table 4.1 Socio-Demographic Descriptive Results

This sample of EHDs had a slightly positive environmental attitude, as well as positive beliefs about Peak Oil and risk perception of Peak Oil. They were neutral in their attitudes towards acting on Peak Oil as well as their response efficacy regarding Peak Oil. EHDs were negative, and therefore low in their perceived responsibility towards Peak Oil and their self efficacy. All descriptive results for dependent and independent variables - save political ideology which is found in Table 4.1 - can be found in Table 4.2. Regarding Peak Oil programming, there were 110 out of 262 public health agencies with no programmatic activity, meaning that this data is not distributed normally. Of the 152 departments with Peak Oil programming, the average department
had less than two of the eight programs necessary for complete Peak Oil programmatic activity. This is illustrated in Figure 4.1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>M</th>
<th>St Dev</th>
<th>% Low</th>
<th>% Neutral</th>
<th>% High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Attitude*</td>
<td>220</td>
<td>0.5807</td>
<td>1.15509</td>
<td>9.3</td>
<td>53.2</td>
<td>37.5</td>
</tr>
<tr>
<td>Peak Oil Beliefs*</td>
<td>194</td>
<td>1.9329</td>
<td>1.60976</td>
<td>5.1</td>
<td>21.5</td>
<td>73.3</td>
</tr>
<tr>
<td>Peak Oil Attitudes*</td>
<td>195</td>
<td>0.0615</td>
<td>1.76121</td>
<td>28.7</td>
<td>32.8</td>
<td>38.5</td>
</tr>
<tr>
<td>Peak Oil Risk Perception*</td>
<td>191</td>
<td>1.1754</td>
<td>1.65434</td>
<td>10.9</td>
<td>29.3</td>
<td>59.8</td>
</tr>
<tr>
<td>Perceived Responsibility*</td>
<td>195</td>
<td>-1.0205</td>
<td>1.92904</td>
<td>50.8</td>
<td>38.4</td>
<td>10.8</td>
</tr>
<tr>
<td>Response Efficacy*</td>
<td>196</td>
<td>-0.07500</td>
<td>1.80987</td>
<td>39.8</td>
<td>50.5</td>
<td>9.7</td>
</tr>
<tr>
<td>Self Efficacy*</td>
<td>196</td>
<td>-1.5740</td>
<td>1.47053</td>
<td>66.3</td>
<td>33.2</td>
<td>3.5</td>
</tr>
<tr>
<td>Peak Oil Programming**</td>
<td>262</td>
<td>1.9924</td>
<td>2.27765</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
</tbody>
</table>

*Measured on a scale of -3 to 3
**Measured on a scale of 0 to 8

% Neutral was measured from -1 to 1, % Low and % High were measured up to +/-3

Table 4.2 Descriptive Results for Independent and Dependent Variables
Outside barriers to behavior were also analyzed via the open-ended question that asked EHDs to list three resources needed in order to address energy consumption. Out of 121 responses, 76 respondents (62.8%) indicated that they would need more funding, especially for additional staff, training, equipment, and resources. Fifty respondents (41.3%) indicated that they would need additional training, while 49 respondents (40.4%) expressed a need for additional staff members. Other responses included 22 respondents (18.1%) desiring more political and administrative support, as well as regulatory authority, 16 respondents (13.2%) wanting more information and education, 12 respondents (9.9%) needing more resources and equipment, and 9 respondents (7.4%) who desired more community support, participation, and involvement. Twelve
respondents did indicate for “other” various needs in order to properly address energy consumption within their jurisdiction, and 11 EHDs - citing indifference to the issue itself - stated that no resources were needed. These statistics are represented in Figure 4.2.

Figure 4.2 Resources Needed to Combat Outside Barriers to Behavior
4.2 Correlations

As an initial test of the project’s hypotheses, and as justification for testing the combined and relative strength of the independent variables for predicting Peak Oil risk perception and Peak Oil programming, correlations between all of the independent and dependent variables were run. The correlations between the independent variables and their predicted relationships to other independent variables, and/or to Peak Oil risk perception are shown in Table 4.3. Table 4.4 shows the correlations between the independent variables and their predicted relationships to other independent variables and/or to Peak Oil programmatic activity.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Peak Oil Beliefs</th>
<th>Political Ideology</th>
<th>Environmental Attitudes</th>
<th>Peak Oil Attitudes</th>
<th>Peak Oil Risk Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Oil Beliefs</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Political Ideology</td>
<td>0.429**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environmental Attitudes</td>
<td>0.458**</td>
<td>0.571**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Oil Attitudes</td>
<td>0.321**</td>
<td>0.466**</td>
<td>0.502**</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Peak Oil Risk Perception</td>
<td>0.474**</td>
<td>0.470**</td>
<td>0.600**</td>
<td>0.481**</td>
<td>1</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed)

Table 4.3 Pearson’s correlations for the hypothesized relationships regarding Peak Oil Risk Perception
Table 4.4 Pearson’s correlations for the hypothesized relationships regarding Peak Oil Programmatic Activity

This initial correlation analysis provides support for all of the hypotheses. However, Peak Oil risk perception - although significant at the 0.01 level - was weakly correlated with Peak Oil programming, since the correlation value is less than 0.3 (Cohen 1988). Figure 4.3 depicts each correlation within the path model.

4.3 Regression Analysis

4.3.1 Linear Regressions

The first regression analysis found that the independent variables - Peak Oil beliefs, political ideology, Peak Oil attitudes, and environmental attitudes - explained 45.1% of the variance in Peak Oil risk perception. This percentage is the adjusted R² value, which is used in this study to provide the most realistic estimate of variance for the
dependent variable that can be accounted for by the independent variables. When looking at the independent variables, Peak Oil beliefs, Peak Oil attitudes, and environmental attitudes were found to be significant predictors in explaining the variance in Peak Oil risk perception. Political ideology, however, was not significant. These relationships can be viewed in more detail in Table 4.5.

<table>
<thead>
<tr>
<th>Variable</th>
<th>$R^2$</th>
<th>B</th>
<th>Sig</th>
<th>95% CI for B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Oil Beliefs</td>
<td>0.451</td>
<td>0.220</td>
<td>0.001</td>
<td>[0.096, 0.376]</td>
</tr>
<tr>
<td>Political Ideology</td>
<td></td>
<td>0.076</td>
<td>0.312</td>
<td>[-0.085, 0.264]</td>
</tr>
<tr>
<td>Environmental Attitude</td>
<td></td>
<td>0.317</td>
<td>0.00006</td>
<td>[0.232, 0.666]</td>
</tr>
<tr>
<td>Peak Oil Attitudes</td>
<td></td>
<td>0.256</td>
<td>0.0003</td>
<td>[0.114, 0.337]</td>
</tr>
</tbody>
</table>

Table 4.5 Linear Multiple Regression Results for Peak Oil Risk Perception

The second regression analysis found that the independent variables - Peak Oil risk perception, perceived responsibility, response efficacy, and self efficacy - explained 22.2% of the variance in Peak Oil programming. This percentage is also the adjusted $R^2$ value. When looking at the independent variables, Peak Oil risk perception and self efficacy were found to be significant predictors in explaining the variance in Peak Oil programming. Perceived responsibility and response efficacy, however, were not significant. These relationships can be viewed in more detail in Table 4.6.
### Table 4.6 Linear Multiple Regression Results for Peak Oil Programming

<table>
<thead>
<tr>
<th>Variable</th>
<th>R²</th>
<th>B</th>
<th>Sig</th>
<th>95 % CI for B Lower Bound</th>
<th>95 % CI for B Upper Bound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak Oil Risk Perception</td>
<td>0.222</td>
<td>0.173</td>
<td>0.020</td>
<td>0.038</td>
<td>0.434</td>
</tr>
<tr>
<td>Perceived Responsibility</td>
<td></td>
<td>0.015</td>
<td>0.858</td>
<td>-0.117</td>
<td>0.212</td>
</tr>
<tr>
<td>Response Efficacy</td>
<td></td>
<td>0.079</td>
<td>0.418</td>
<td>-0.142</td>
<td>0.342</td>
</tr>
<tr>
<td>Self Efficacy</td>
<td></td>
<td>0.368</td>
<td>0.00004</td>
<td>0.295</td>
<td>0.828</td>
</tr>
</tbody>
</table>

4.3.2 Logistic Regression

As mentioned in Section 4.1, the data on Peak Oil programming was significantly skewed to the left, with the majority of respondents doing nothing to address Peak Oil. For this reason it was necessary and appropriate to use logistic regression to analyze Peak Oil programming. The original dependent variable, which ranged from 0-8, was converted into a dichotomous dependent variable. The public health agencies that had done nothing to address energy consumption within their jurisdiction were given a 0, and those that had at least one Peak Oil program within their department were given a 1.

The regression analysis indicated that the independent variables - Peak Oil risk perception, perceived responsibility, self efficacy, and response efficacy - explained 9.2%-14.2% of the variance in Peak Oil programming (Cox & Snell $R^2 = 0.092$ and Nagelkerke $R^2 = 0.142$). The only variable that was found to be significant in predicting Peak Oil programming was self efficacy. The Exp(B) value of 1.510 indicates that the odds of a public health agency addressing energy consumption is 1.5 times higher for every additional unit of increase in self efficacy by the EHD. The 95% confidence
interval department efficacy was 1.015-2.246, indicating a statistically significant result at p < 0.05 since the confidence interval does not contain the value of 1.

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>Sig</th>
<th>B(exp)</th>
<th>95 % CI for B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak Oil Risk Perception</td>
<td>0.173</td>
<td>0.116</td>
<td>0.135</td>
<td>1.189</td>
<td>0.947-1.492</td>
</tr>
<tr>
<td>Perceived Responsibility</td>
<td>0.066</td>
<td>0.138</td>
<td>0.630</td>
<td>1.068</td>
<td>0.816-1.399</td>
</tr>
<tr>
<td>Response Efficacy</td>
<td>0.050</td>
<td>0.157</td>
<td>0.750</td>
<td>1.051</td>
<td>0.773-1.431</td>
</tr>
<tr>
<td>Self Efficacy</td>
<td>0.412</td>
<td>0.203</td>
<td>0.042</td>
<td>1.510</td>
<td>1.015-2.246</td>
</tr>
</tbody>
</table>

Table 4.7 Logistic Regression Results for Peak Oil Programming
Figure 4.3 Path Model with all relevant correlations and variances (in red)
Chapter 5: Discussion

The descriptive results show that the average EHD within the sample had a slightly positive environmental attitude, as well as positive beliefs about Peak Oil and positive risk perception of Peak Oil. EHDs were neutral in their attitudes towards acting on Peak Oil as well as their response efficacy regarding Peak Oil. EHDs were distributed roughly equally across political lines, with a slight skew towards the conservative. They were also negative, and therefore low in their perceived responsibility towards Peak Oil and their self efficacy. These results indicate that EHDs do care about the environment, believe that Peak Oil will occur, and perceive Peak Oil as a risk to human health. They are, however, apathetic to whether or not Peak Oil is addressed within their jurisdiction and do not know that if they did act that it would be effective. As well, many EHDs do not see it as part of their job description to be addressing Peak Oil, nor do they feel that they are capable of doing so. There are many possible reasons that EHDs have reacted to Peak Oil in this way. EHDs may not care about acting to mitigate Peak Oil in their jurisdictions because they may not perceive it as a risk to their jurisdiction. This is consistent with research that states that individuals frequently perceive larger, more abstract risks as being greater or more threatening in other parts of the world, but not necessarily within their jurisdiction (Trope & Liberman 2010). Low perceived responsibility and apathy towards response efficacy may be functions of their indifferent attitudes towards Peak Oil action. Furthermore, low self efficacy may result from outside
barriers to behavior such as lack of funding, staff, community involvement, and political support, meaning that regardless of environmental concern and perception of the risks to human health posed by Peak Oil there may be nothing that the EHD is capable of doing.

After running a multiple linear regression, Peak Oil beliefs, Peak Oil attitudes, and environmental attitudes were shown to be significant predictors in explaining the variance (45.1%) in Peak Oil Risk Perception in EHDs, and thus indirectly affect the number of Peak Oil programs within a given public health department. These results parallel other research that indicates attitudes and beliefs as predictors of risk perception (Sjöberg 2000). A preliminary multiple linear regression indicated that Peak Oil risk perception and self efficacy were significant predictors in explaining the variance in Peak Oil programming in EHDs (22.2%). These results parallel other research that indicates risk perception and efficacy as predictors for behavior (O’Connor et al 1999; Witte 1994). However, subsequent to the necessary logistic regression, only self efficacy was found to be significant in explaining the variance in Peak Oil programming (9.2-14.2%). This low variance and loss of significance for Peak Oil risk perception may have occurred because the measure of Peak Oil risk perception used was a combined measure in which EHDs were asked about the risks of Peak Oil both globally and locally. As previously mentioned, if the EHD does not perceive Peak Oil to be a risk for his or her jurisdiction, the result of this measure may be flawed. The fact that Peak Oil risk perception was significant in the first place, however, does indicate that while it may not make an EHD act to decrease energy consumption within their jurisdiction, it may mean that they are at least thinking about the consequences associated with Peak Oil - an important first step towards action (Cone 2008). The low variance may also be due to
outside barriers to behavior having more influence over EHDs Peak Oil programming than the variables assessed directly in this study.

The identification of barriers to behavior is important when addressing how Peak Oil mitigation behavior can be better encouraged in the future. Maibach et al states that when encouraging behavioral change, those in the center of the spectrum of concern should be targeted (2009). This means that EHDs on the extreme of either end of the spectrum - those who are highly concerned and have complete Peak Oil programming and those who perceive risks as non-existent and have no Peak Oil programming - are so set in their ways that there is little probability that they can be convinced to change. EHDs who are concerned about the risks posed by Peak Oil and/or have some Peak Oil programming, however, could likely be persuaded to do more with increased efficacy. Low efficacy could be addressed through education and funding given to those who will use it - EHDs in the middle of the spectrum.

It is clear that more research is necessary. It would be helpful to discover more exact timing when Peak Oil will begin to affect human health, as well as the extent to which EHDs should be taking precautions. Increasing efficacy and EHD perception of Peak Oil health risks close to home will be necessary and can be accomplished, but at what cost? Funding will be integral to this mission in order to provide for various staffing, training, and other resource needs throughout public health agencies. Only then will EHDs be able to properly address energy consumption and the expected health impacts of Peak Oil within their jurisdictions.
References


Appendix: Full Survey
Thank you for agreeing to take part in this study. Your input is crucial to the success of this project, and we appreciate the time you are taking. Your responses will be completely anonymous, but by viewing public reports and publications describing this research, people in the United States and elsewhere will have access to our findings. Your answers therefore are important and should be truthful and accurate. Keep in mind that there are no right or wrong answers to any of the questions; we are only interested in your opinions.

The survey consists of three parts, and will take approximately 20 minutes to complete. In Part I, we will ask you to state your opinions about the relationship between humans and the environment, climate change, the health-related impacts of climate change, and the role that Public Health may play in addressing climate change issues. In Part II, you will be asked a series of questions about oil and energy consumption, the concept of "Peak Oil", and the role of Public Health in energy consumption reduction activities. In Part III, you will be asked to respond to several questions that will help us learn more about you and your job responsibilities. Please be sure you complete all three parts so that we may include your results, grouped with others, in our analyses and reports.

Thank you again for your time and participation!

Page 2 of 15

*Listed below are statements about the relationship between humans and the environment.*

Please indicate to what extent you agree or disagree with each statement (where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)).

<table>
<thead>
<tr>
<th>SD</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- We are approaching the limit of the number of people the earth can support.
- Humans have the right to modify the natural environment to suit their needs.
- When humans interfere with nature it often produces disastrous consequences.
- The earth has plenty of natural resources if we just learn how to develop them.
- Plants and animals have as much right as humans to exist.
- The balance of nature is strong enough to cope with the impacts of modern industrial nations.
- Humans are severely abusing the environment.
- Humans will eventually learn enough about how nature works to be able to control it.

Page 3 of 15

*This next set of questions has to do with your opinions about climate change. Please read each question carefully and check the appropriate response that best represents your opinion.*
To begin, people sometimes disagree about how the climate system works. The five pictures below illustrate five different perspectives, using the analogy of a ball balanced on a line, to represent the climate system. Each picture depicts different perspectives about the ability of the climate system to withstand disturbances. Which one of the five statements and corresponding images below best represents your understanding of how the climate system works?

- A) Climate is stable within certain limits. If the changes are small, climate will return to equilibrium. If they are large, there will be abrupt and catastrophic impacts.
- B) Climate is random. We do not know what will happen.
- C) Climate is slow to change. Climate change will gradually lead to dangerous impacts.
- D) Climate shows a delicate balance. Small changes will have abrupt and catastrophic impacts.
- E) Climate is very stable. Climate change will have little to no impact.

Please indicate to what extent you agree or disagree (where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)) that your jurisdiction:

<table>
<thead>
<tr>
<th>SD</th>
<th>-3</th>
<th>-2</th>
<th>-1</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Has experienced climate change in the past 20 years.
- Will experience climate change in the next 20 years.

Scientific consensus indicates that climate is changing. Please indicate the number that best represents where your opinion of the cause of climate change falls on this scale from completely natural to completely human.

<table>
<thead>
<tr>
<th>Completely natural and human</th>
<th>Balance of natural and human</th>
<th>Completely human</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>

Please indicate to what extent you feel climate change is bad or good.
### Climate Change Controllability

<table>
<thead>
<tr>
<th>Bad</th>
<th>Neither bad nor good</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /></td>
<td><img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /></td>
<td><img src="image.png" alt="textBox" /></td>
</tr>
</tbody>
</table>

Please indicate to what extent you feel climate change is controllable or uncontrollable.

<table>
<thead>
<tr>
<th>Controllable</th>
<th>Neither controllable nor uncontrollable</th>
<th>Uncontrollable</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /></td>
<td><img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /></td>
<td><img src="image.png" alt="textBox" /></td>
</tr>
</tbody>
</table>

This next set of questions has to do with your opinions about the health-related impacts of climate change. Please read each question carefully and respond by either selecting or typing in the response that best represents your opinion.

### Health-Related Impact on Health System

Please indicate to what extent you feel addressing the potential health-related impacts of climate change through the public health system is bad or good.

<table>
<thead>
<tr>
<th>Bad</th>
<th>Neither bad nor good</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /></td>
<td><img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /></td>
<td><img src="image.png" alt="textBox" /></td>
</tr>
</tbody>
</table>

Please indicate to what extent you feel addressing the potential health-related impacts of climate change through the public health system is worthless or valuable.

<table>
<thead>
<tr>
<th>Worthless</th>
<th>Neither worthless nor valuable</th>
<th>Valuable</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /></td>
<td><img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /> <img src="image.png" alt="textBox" /></td>
<td><img src="image.png" alt="textBox" /></td>
</tr>
</tbody>
</table>

On a scale of 0-10, 0 being no knowledge at all, and 10 being knowing everything there is to know, what would you say is your level of knowledge about the potential health-related impacts of climate change in your jurisdiction?
Using the same scale of 0-10, where do you think your knowledge should be about the potential health-related impacts of climate change in your jurisdiction in order to plan appropriately?

For the remaining questions in this section, please indicate to what extent you agree or disagree with each statement (where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)).

<table>
<thead>
<tr>
<th>SD</th>
<th>N</th>
<th>1</th>
<th>2</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

I am concerned about the health-related impacts of climate change in my jurisdiction. [ ] [ ] [ ] [ ] [ ]

In the next 20 years, the health-related impacts of climate change will be serious in my jurisdiction. [ ] [ ] [ ] [ ] [ ]

In the next 20 years, the health-related impacts of climate change will be serious in the United States. [ ] [ ] [ ] [ ] [ ]

In the next 20 years, the health-related impacts of climate change will be serious around the world. [ ] [ ] [ ] [ ] [ ]

In my position, it is expected that I seek information about the potential health-related impacts of climate change. [ ] [ ] [ ] [ ] [ ]

I am easily able to locate information on the potential health-related impacts of climate change. [ ] [ ] [ ] [ ] [ ]

The following set of questions asks your opinions on the role of environmental health departments in addressing the health-related impacts of climate change.

Please read each question carefully and respond by indicating to what extent you agree or disagree with each statement (where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)). Keep in mind that when we refer to your department, we mean your environmental health department.

<table>
<thead>
<tr>
<th>SD</th>
<th>N</th>
<th>1</th>
<th>2</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
<td>-1</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

My environmental health department has a responsibility to address the health-related impacts of climate change. [ ] [ ] [ ] [ ] [ ]

My environmental health department has the ability to address the health-related impacts of climate change. [ ] [ ] [ ] [ ] [ ]

My environmental health department's actions can decrease the health-related impacts of climate change in my jurisdiction. [ ] [ ] [ ] [ ] [ ]

My environmental health department is prepared to address the health-related impacts of climate change. [ ] [ ] [ ] [ ] [ ]
Addressing the public health consequences of climate change is a priority in my environmental health department.

Page 6 of 15

The following are a list of health-related impacts that may increase as a result of climate change. Please think about whether each of these issues:

A. has already increased or will increase within the next 20 years as a result of climate change, and
B. is currently, or soon will be, an area of programmatic activity in your EH department.

Now, please select the choice that most appropriately represents your understanding of the following health-related impacts across the previously mentioned categories. Please check yes, no, or don't know (DK) for each of columns A and B.

<table>
<thead>
<tr>
<th>Heat-related illness</th>
<th>Yes</th>
<th>No</th>
<th>DK</th>
<th>A. Has already increased or will increase within the next 20 years as a result of climate change.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flooding-related displacement of residents</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Vectorborne infectious disease</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Waterborne disease</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Foodborne disease</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Water availability related illness</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Air quality related illness</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Malnutrition</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Disruption of health care services during extreme weather events</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Anxiety, depression or other mental health conditions</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Cold-related illness</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
<tr>
<td>Other climate change-related health impacts in your jurisdiction</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

If you checked yes for "Other climate change-related health impacts...” please list those issues below.

[Space for listing issues]

[Space for listing issues]
Please list the three most important resources that your department needs in order to improve your ability to address the health-related impacts of climate change. These resources could be, but are not limited to: staff, staff training, equipment, funding. Please provide as much detail as possible (e.g., What type of staff? How much money? What type of training?)

Page 7 of 15
This concludes the first part of the survey on climate change and related health impacts. Is there anything else that would help us understand how your department is currently engaged in addressing the health-related impacts of climate change, or what your department might need in the future to engage in these activities?

Page 8 of 15
The next two sections ask your opinions about oil and energy consumption. Please remember that there are no wrong or right answers, we are only interested in your opinions.

Please indicate to what extent you agree or disagree with each statement (where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)).

<table>
<thead>
<tr>
<th>SD</th>
<th>N</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Global oil resources are unlimited. □ □ □ □ □ □ □

Global oil resources will eventually plateau and decline. □ □ □ □ □ □ □

Page 9 of 15
The term “peak oil” refers to the idea that the world will reach a maximum rate of oil extraction, and that rate will be unable to sustain energy use in modern industrial civilizations. Keeping this definition of peak oil in mind, please respond to the remaining questions.

Please indicate to what extent you agree or disagree with each statement (where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)).

<table>
<thead>
<tr>
<th>SD</th>
<th>N</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Peak Oil has occurred in the past 5 years. □ □ □ □ □ □ □
Peak Oil will occur in the next 20 years.  

For the remaining questions in this section, please indicate to what extent you agree or disagree with each statement (where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)).

<table>
<thead>
<tr>
<th></th>
<th>SD</th>
<th>N</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
</tr>
</tbody>
</table>

I am concerned about the impacts of Peak Oil in my jurisdiction.

The impact of Peak Oil will be serious in the United States.

The impact of Peak Oil will be serious in my jurisdiction.

The impact of Peak Oil will be serious in the United States.

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*This section has to do with the role of public health in addressing energy consumption as a means to addressing Peak Oil.*

To begin, please indicate to what extent you feel addressing energy consumption through the public health system is bad or good.

<table>
<thead>
<tr>
<th></th>
<th>Bad</th>
<th>Neither bad nor good</th>
<th>Good</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Now please indicate to what extent you feel addressing energy consumption through the public health system is worthless or valuable.

<table>
<thead>
<tr>
<th></th>
<th>Worthless</th>
<th>Neither worthless nor valuable</th>
<th>Valuable</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Now indicate to what extent you agree or disagree with each of the following statements regarding energy consumption in your jurisdiction, and the specific role of your environmental health department (where -3 = strongly disagree (SD), -2 = somewhat disagree, -1 = mildly disagree, 0 = neither agree nor disagree (N), 1 = mildly agree, 2 = somewhat agree, and 3 = strongly agree (SA)).

<table>
<thead>
<tr>
<th></th>
<th>SD</th>
<th>N</th>
<th>SA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
</tr>
</tbody>
</table>

My environmental health department has a responsibility to address energy consumption in my jurisdiction.

My environmental health department has the ability to address energy consumption in my jurisdiction.
My environmental health department’s actions can decrease energy consumption in my jurisdiction.

My environmental health department is prepared to address energy consumption in my jurisdiction.

Helping my jurisdiction reduce energy consumption is a priority in my environmental health department.

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The following are programmatic activities aimed at reducing energy consumption, and as a result reducing risk from Peak Oil. Please think about whether your environmental health department currently includes this activity in their programming for the public, and/or plans to include this activity in their programming soon.

Now, please check the box that most appropriately represents your understanding of the status of these activities within your department. Please check yes, no, or don't know (DK).

<table>
<thead>
<tr>
<th>Activity</th>
<th>Yes</th>
<th>No</th>
<th>DK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encouraging people to carpool</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouraging people to use active transport (walk, ride bikes)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouraging people to use mass transportation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouraging people to buy locally-grown food</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouraging people to save electricity by turning off the lights, turning the computer off, etc.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Educating people about climate change and health related impacts</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouraging people to recycle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other energy consumption reduction activities in your department</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If you checked yes for “Other energy consumption reduction activities in your department...” please list those issues you had in mind below.

<table>
<thead>
<tr>
<th>Issues</th>
</tr>
</thead>
</table>

Please list the three most important resources that your department needs in order to improve your ability to reduce energy consumption in your jurisdiction. These resources could be, but are not limited to: staff, staff training, equipment, funding. Please provide as much detail as possible (e.g., What type of staff? How much money? What type of training?)
This concludes the second part of the survey on peak oil and energy consumption. Is there anything else that would help us understand how your department is currently engaged in reducing energy consumption within your jurisdiction, or what your department might need in the future to engage in these activities?

In this final section, we want to know more about you. Please remember that your responses are completely anonymous and this information will only be used to better understand how environmental health directors may differ across the United States.

Do you collaborate with your colleagues in Public Health Nursing?

- Always
- Frequently
- Occasionally
- Rarely
- Never

Please indicate to what degree any of those collaborative efforts address climate-related health impacts:

- Always
- Frequently
- Occasionally
- Rarely
- Never

Please indicate to what degree any of those collaborative efforts address reducing carbon footprint:

- Always
Frequently
Occasionally
Rarely
Never

What is the zip code of your health department?

Is your health department a municipal (city), county, district, or state agency?

What is your position at your health department?

How many years have you been at your current position?

How many years have you worked in the field of public health?

What is the approximate annual budget for your environmental health department?

What is your age?

What is your highest level of education?

- High school diploma
- Technical/Trade school
- Associate's degree
- Bachelor's degree
- Master's degree
- Doctoral/Professional degree (PhD, MD, DDS, DVM, etc.)

What is your educational background (e.g., public health, nursing, biology, economics, etc.)?

What is your gender?

- Female
- Male

What is your race?
☐ While
☐ Black / African American
☐ American Indian / Alaska Native
☐ Asian
☐ Hawaiian Native / Other Pacific Islander
☐ Other (please list)
What is your ethnicity?
☐ Hispanic origin
☐ Not of Hispanic origin

In politics today, do you consider your political views to be conservative, moderate, or liberal?
☐ Extremely liberal
☐ Liberal
☐ Slightly Liberal
☐ Moderate
☐ Slightly Conservative
☐ Conservative
☐ Extremely Conservative

Please select the political party with which you most identify:
☐ Republican
☐ Democrat
☐ Independent
☐ None

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This completes the survey. Thank you again for taking the time to provide us with your insight on these issues! If you have any remaining questions, or would like to see the results of this research, please contact Mac Crawford at jocrawford@cpb.osu.edu or 614.293.8804.